

Acoustic data logging protocols and procedures for commercial fishing vessels

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Final Draft 12/30/05

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Acoustic data logging protocols are proposed to address

- 1) fishing vessels conducting echo integration-trawl (EIT) surveys (e.g. Aleutian Islands walleye pollock surveys)
- 2) fishing vessels under charter for bottom trawl surveys (e.g., groundfish surveys) and
- 3) opportunistic data collection during commercial fishing operations.

Survey priorities

Echosounding system requirements

Echosounding system calibration

Acoustic data

Biological and environmental data

Other considerations

1) Collection of acoustic data from fishing vessels for echo integration-trawl survey (e.g., Aleutian Islands pollock echo integration-trawl survey)

Survey priorities

Priority is to conduct an echo integration-trawl (EIT) survey of Aleutian Island pollock aggregations, using a 38 kHz Simrad ES60 (or EK60) echosounding system on a mothership vessel during a fishery. An AFSC operator would be on board the mothership vessel to supervise this data set. "EIT survey" of pollock is a survey conducted to estimate the biomass of walleye pollock following established echo integration methods (NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling 2003, MacLennan and Simmonds 1992). A number of options are being considered for contractual arrangements under which this cooperative work between NOAA and industry would be carried out.

Details:

-Catcher boat(s) will provide biological samples while the mothership runs acoustic transects.

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- Timing should be if possible optimized to when fish are aggregated for spawning.
- A series of snapshot surveys may be needed to assess timing issues.
- Ideally would use methods similar to Midwater Assessment and Conservation Engineering (MACE) EIT surveys: parallel transects, systematic spacing, periodic trawls to ID species composition, etc. Surveys may be timed to breaks in commercial fishing operations.

Echosounding system requirements

1. Vessel(s) must have a split beam **Simrad ES60 or EK60 system** on board connected to a GPS system, and method for logging the **.raw** and **.out** (acoustic bottom) data. Standard installations of ES/EK60s may require hardware or software upgrades to be suitable for EIT surveys. If using vessel ES60, contract must require the vessel to have the latest ES60 software version (v1.5.2.76, no cost from Simrad). Potential contract vessels must supply an ES60 data sample to AFSC. A 24 hr. sample would be optimal.
2. Prior to and after data collection the vessel's acoustic system must be sphere calibrated (see below). The vessel owner/skipper should provide transducer specifications to AFSC as well as a hull diagram of exact locations of all transducers and other protrusions on the bottom of the vessel.
3. ES60 settings that are controllable (**pulse length, ping repetition rate, power, range settings, storage options, etc.**) should be set according to recommendations (see Appendix 4). All system settings should be written down prior to the survey and only changed by AFSC survey technicians. The technicians should ensure that the transducer specs match the .ini file selection, and that **Power** setting is appropriate for the combination of transducer and GPT. (See Appendix 2, Figs 1-4 for screen grabs of the ES60 software interface for reviewing settings and other details.)
4. Sources of noise and interference should be eliminated as much as possible. (For examples, see Appendix 2, Screen shots Figs. 5-8). **Conventional fisheries sounders** of the same or close frequencies to the ES60 38 kHz system must either be **synchronized** or **turned off** during data collection. A marine electronics specialist may be needed to synchronize sounders.
5. AFSC survey technicians should monitor the ES60 screen and data collection at all times to identify obvious problems. Potential problems (such as the sounder off, lack of GPS signal, bad or no picture, noisy data, data not being recorded to disk, data not being transferred to external drive, disk drive full) should be discussed ahead of time, and solutions determined for correcting them in the field. A checklist will be provided for routine error checking while underway.
6. Data should be backed up to CD, DVD or IOMEGA drive daily. A spare IOMEGA drive should be on board in case of failure.
7. AFSC survey technicians should work through these matters with the vessel owners/skipper before the survey. System requirements should be part of any contract

or agreement as part of vessel selection for the survey. Any changes necessary to satisfy system requirements or complete upgrades should be completed well before the survey. Any background reading that the vessel officers are willing to do on EIT methods is encouraged.

Echosounding system calibration

Ideally, the ES60 38 kHz echosounding system should be calibrated before and after the survey using standard sphere methods (Foote et al. 1987, MacLennan and Simmonds 1992). Calibration should be carried out at anchor in calm conditions in deep water (>40 m). The location of the vessel's transducer should be known ahead of time. If possible, double anchoring is preferable, e.g., by dropping a trawl door off the stern. Once the vessel is anchored, calibration normally takes 4-6 hrs. Elliot Bay, Seattle, has been used for commercial vessel(s) (see [www.afsc.noaa.gov/refm/...](http://www.afsc.noaa.gov/refm/)). Port Susan is also suitable. Captains Bay and Makushin Bay (Unalaska Island, Alaska) are good calibration locations in the Eastern Bering Sea (EBS). See MACE calibration locations (Appendix 4).

Acoustic sampling

AFSC survey technicians will direct the vessel to conduct acoustic transects while the vessel is processing or otherwise not occupied with fishing or taking deliveries from catcher vessels. The exact locations of transects will be determined by the location of the vessel when fishing or deliveries have been completed and the time available before resuming fishing or receiving deliveries once again. Transects may be conducted during day or night. If feasible, transects will be in parallel, spaced 5 to 10 nautical miles apart, and oriented perpendicular to the bathymetry. Transects will be conducted inside and outside of Steller sea lion critical habitat. An acoustic logbook should be maintained with daily entries of events, transect start and stop times, problems/solutions, etc. (Example in Appendix 4.)

Biological sampling

If feasible, the vessel will conduct net tows to verify the species and size composition of the acoustic sign observed during transects. The tows will be of minimal size (1 to 5 t) and will not be retained for commercial purposes. The vessel will equip the codend of their net with catch sensors, or the bidder must propose alternative means of limiting each catch to 1-5 t. Ideally, tows will be conducted as soon as possible after completion of a transect. A means of keeping the scientific catch separate from the commercial catch (such as a separate bin) must be provided. Catcher boats with observers or NOAA technicians will collect biological data following MACE trawl sampling procedures. If observers or NOAA technicians are not available on the catcher vessels then unsorted codends will be delivered to the mothership and processed following MACE trawl sampling procedures. Biological data will be recorded on standard observer forms. Commercial catch data will be processed as per observer protocols, and scientific tows will be entered into an access database mirroring the MACEBASE biological records tables.

Environmental measurements

Sound speed/Seawater absorption loss

Ideally, and only if time allows, one or two conductivity-temperature-depth (CTD) probe casts down to fishing depths should be made to allow calculation of sound speed and

seawater absorption loss in situ. (*Feasibility of collecting CTD casts vs. resulting errors if unable to collect CTD data will be evaluated.*)

Depth/temperature profiles for water column characterization

Attaching Sea-Bird SBE39s to the headrope of the trawls on the catcher boat(s) would be optimal.

Other considerations

-First time FV ES60 EIT surveys may be exploratory.

-Results will depend on fish availability to acoustics, taking into account migratory behavior, variable vessel speeds, potential signal loss due to adverse weather effects, potential vessel noise interference problems causing poor system performance, and vessel-avoidance effects. (Presumed worse for commercial vessels...) During a survey, poor weather could necessitate running transects in one favorable direction.

-Demonstrate the difference between raw data collected at Max ping rate vs. that collected at 1 ping per second to any vessels that express concerns.

2) Collection of acoustic data from groundfish charter vessels during routine bottom trawl surveys (Eastern Bering Sea Shelf Bottom Trawl Survey, Gulf of Alaska Bottom Trawl Survey, Aleutian Islands Bottom Trawl Survey, Eastern Bering Sea Upper Continental Slope Bottom Trawl Survey)

Survey priorities

Priority is to collect usable 120 or 38 kHz ES60 echo integration data from chartered groundfish survey vessels while they are conducting routine bottom trawl surveys. “Echo integration data” are acoustic backscatter data that could be used to estimate the biomass of walleye pollock following established echo integration methods (NOAA Protocols for Fisheries Acoustics Surveys and Related Sampling 2003, MacLennan and Simmonds 1992). Results from analysis of these data could be used 1) as an index of pollock abundance to compare with biennial MACE EIT surveys (Fig. 1), 2) to compare the echosign characteristics to trawl catches at survey stations, and 3) to guide the development of survey designs that combine echosign and trawl information. Currently, the feasibility of incorporating the acoustic data directly with trawl survey data, effectively increasing the trawl survey sample size by including information collected between stations, is being investigated. This will result in large volumes of backscatter data being collected and stored on the vessel. (*Effort is also being made to automate a process for large volume acoustic data analysis.*)

Details:

-Biological samples will be provided from the bottom trawl station data.

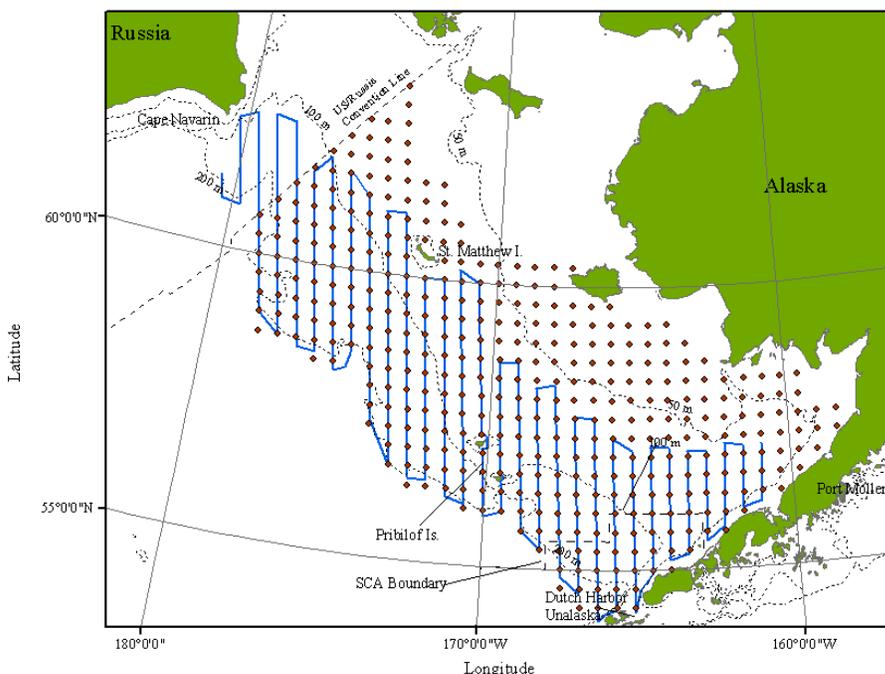


Figure 1.--Transect lines from the summer 2004 echo integration-trawl survey of pollock (blue lines), and stations from the annual groundfish/invertebrate bottom trawl survey (red diamonds) on the Bering Sea shelf.

-Timing is the same as the bottom trawl survey, and not intended to interfere with that survey's data collection.

-Where possible, this can result in methods similar to MACE EIT surveys: parallel transects with systematic spacing, with regular bottom trawl hauls for biological specimens and species ID.

Echosounding system requirements (for details, see Appendix 1)

1. Vessel(s) must have a Simrad ES60 system on board, preferably with a split beam 38 kHz transducer, connected to a GPS system, and method for logging the ES60 **.raw** and **.out** data. Optimally, standard installations of ES60s may be improved with hardware or software upgrades. In future, contracts should require vessels to have the latest ES60 software version (at present, v1.5.2.76).

2. Prior to data collection the vessel's acoustic system should be sphere calibrated if possible (see below, and Appendix 1, Calibration). If not, the vessel and AFSC should have a contingency plan². The vessel owner/skipper should provide transducer specifications to AFSC as well as a hull diagram showing exact locations of transducers and other protrusions.

3. Prior to the cruise, ES60 settings that the vessel normally uses should be recorded in order that the system can be returned to the original settings after data collection if there are any changes (Appendix 1, Recording ES60 parameter settings). ES60 settings that are controllable (**pulse length, ping repetition rate, power, range settings, storage options, etc.**) should be set according to recommendations (Appendix 4). If a copy of the transducer specs exists, ensure that they match the .ini file settings. Any settings that were changed for the survey should be reset to the vessel's preferred settings at the end of data collection. (See Appendix 2, Figs. 1-4 for screen grabs of ES60 software interface for reviewing settings and other details.)

4. Sources of noise and interference should be eliminated. **Conventional fisheries sounders** of the same or close frequencies to either the ES60 38 or 120 kHz systems **must either be synchronized or turned off during data collection**. A marine electronics specialist is needed to synchronize sounders.

5. Of top priority: The designated person in charge of the acoustic data collection (or someone in the wheelhouse) should periodically monitor the ES60 screen to identify obvious problems with data collection (Appendix 1, Throughout the day, Verifying that quality data... and Appendix 2, Figs. 5-8). Potential problems (such as the sounder off, lack of GPS signal, bad or no picture, noisy data, data not being recorded to disk, data not being transferred to external drive, disk drive full) should be discussed ahead of time, and

² For the summer 2005 Bering Sea bottom trawl survey, calibration will occur in 2 stages. First, calibration set up will be worked out in Seattle for the *Arcturus* in Seattle, and in Dutch Harbor for the *Aldebaran*. Second, both vessels will attempt to calibrate on the Bering Sea shelf at night when they are inactive. This will be done by centering a calibration sphere under the transducer and collecting data overnight. Calm sea conditions and relatively few fish in the water column would be required for successful calibration.

solutions determined for correcting them in the field. Problems (and solutions) should be noted on log form with date, time, etc. (See Appendices 3, 4).

6. At first arrival at a trawl station just before starting the trawl, and again after the trawl is complete as the vessel leaves the trawl station, technicians in the wheelhouse should increment the ES60 data file (Appendix 1, Creating separate on-station and between-station files). A log form should be kept associating the L0001, L0002, etc, numbers with haul numbers. This will greatly assist the data analyst in separating trawl data from transect data.

7. As soon as possible, data should be backed up from the IOMEGA to CD, DVD or another IOMEGA drive daily. A spare IOMEGA drive should be on board in case of failure.

8. AFSC scientists should work through these matters with the vessel owners/skippers before the surveys. System requirements should be checked as soon as possible after the vessels are selected for charter to ensure enough time to satisfy system requirements or complete upgrades if necessary.

Echosounding system calibration

Ideally, the ES60 38 kHz echosounding system should be calibrated prior to the survey using standard sphere techniques (MacLennan and Simmonds 1992, Foote et al. 1987). Ideally calibration should be carried out at anchor in calm conditions in deep water (>40 m). Two-point anchoring is preferred, e.g., by dropping a trawl door to serve as the stern anchor. The location of the vessel's transducer should be known ahead of time. Calibration normally takes 4-6 hrs. (plus steaming time to the calibration site if any). Elliot Bay, Seattle, as well as Port Susan are suitable in the Puget Sound area. Captains Bay and Makushin Bay (Unalaska Island, Alaska) are reasonable calibration locations in the Eastern Bering Sea (EBS). Malina Bay and Three Saints Bay are good locations for the Gulf of Alaska (GOA)(see Appendix 4). (Appendix 1, Calibration).

Biological sampling

Groundfish station samples should be sufficient to obtain biological data. Routine collection of biological data (haul, catch, and lengths, specimens, e.g., lengths, weights, age structures, etc.) should be available at AFSC after the survey.

Environmental measurements

Sound speed/Seawater absorption loss

Ideally, conductivity-temperature-depth probes (CTD) casts should be made at calibration and other field locations to allow calculation of sound speed and seawater absorption loss in situ. Sea-Bird SBE/MBT casts of temperature-depth profiles could be substituted with conductivity estimated from other sources.

Depth/temperature profiles for water column characterization

Attaching Sea-Bird SBE39s to the headrope of the bottom trawls, as usual, is optimal.

Other considerations

- Try to standardize power settings
- Should noise data be collected while trawling (or at all?)
- Disadvantages to using Surface – Auto range setting
- What about bottom detection threshold? Why is bottom offset -0.5 m?
- What about collecting data for habitat classification?
- Feasibility study of temperature-conductivity and sound speed/absorption needs

3) Collection of acoustic data from pollock fishing vessels during the commercial fishing seasons

Survey priorities

Priority is to collect quality 38 kHz ES60 echo integration data on pollock aggregations from commercial fishing vessels while they are fishing. “Echo integration data” are acoustic backscatter data that could potentially be used to estimate distribution and/or abundance of walleye pollock (MacLennan and Simmonds 1992). This will result in large volumes of relatively unsupervised backscatter data being collected and stored on the vessel. (*Effort is also being made to automate a process for large volume acoustic data analysis.*)

Details

- Timing is during the fishery, and data collection is not intended to interfere with fishing operations.
- Biological data can be obtained from the NOAA domestic observer program database.
- This is a collaborative arrangement. AFSC scientists should nurture good relationships with the vessel(s). They should communicate clearly the value of following a few key acoustic system setup guidelines towards use of their vessel’s data in improved fisheries science and management.

Echosounding system requirements

1. Vessel(s) must have a Simrad ES60 system on board connected to a GPS system, a NOAA supplied 120 or 20 GB IOMEGA external drive. A cruise data **folder** needs to be created on the IOMEGA drive and the ES60 needs to be directed to **Store** the raw and out data there. If disk space is insufficient for the duration of data collection, the opportunistic acoustics data collection and monitoring software (OAD) should be installed on the ES60 for logging the ES60 .raw and .out data. (The OAD, a WinBatch executable program which monitors the IOMEGA drive, sends periodic messages informing operators how much memory remains unused. Once the drive is 99% full, the OAD informs users to replace the external drive.) It is desirable and recommended that vessels update their ES60 software to the latest version (currently v1.5.2.76, free from Simrad) prior to data collection.
2. The vessel’s acoustic system should be sphere calibrated prior to data collection if possible (see below). If not, the vessel and AFSC should have a contingency plan. The vessel owner/skipper should provide transducer specifications to AFSC as well as a hull diagram of the exact locations of transducers and other protrusions.
3. All of the vessel’s preferred or usual ES60 settings should be recorded so that they can be re-established after data collection. To do this click on the **frequency** displayed in the upper left corner of the ES60 screen (e.g., **38kHz**). Record pulse length and power. Then click on Advanced and record all additional settings. ES60 settings that are controllable should be agreed upon (**pulse length, ping repetition rate, power, range**

settings, storage options, etc.) See recommended settings (Appendix 4). Any new settings should then be recorded prior to the survey. Ensure that the transducer specs match the .ini file settings, and that **Power** settings are appropriate for the combination of GPT and transducer. (See Appendix 2, Figs. 1-4 for screen grabs of the ES60 software interface for reviewing settings and other details.)

4. Sources of noise and interference should be eliminated as much as possible. Conventional fisheries sounders of the same or close frequencies to the ES60 38 kHz systems must either be synchronized or turned off during data collection. A marine electronics specialist is needed to synchronize sounders.

5. Troubleshooting: A person overseeing data collection in the wheelhouse should be able to recognize from the appearance of the ES60 screen whether there are obvious problems with data collection (Appendix 2 Figs. 5-8). Potential problems (such as the sounder off, lack of GPS signal, bad or no picture, noisy data, data not being recorded to disk, data not being transferred to external drive, disk drive full) should be discussed ahead of time, and solutions determined for correcting them in the field.

- 1) GPS data being recorded: Look in lower right of ES60 screen on tool bar for positions.
- 2) Data being recorded: In lower right screen, **L0001** etc. should be **red** (data logging to file) rather than black (e.g. L0001, data not logging to file). In **Store** menu, make sure “Save raw data” (echogram recorded in .raw files) and “Save output data” (bottom information recorded in .out files) are both checked.
- 3) Noisy data: shut down other sounders that interfere (Ping Filter should be off)
- 4) Double check that .raw and .out files being written to disk. Windows Explorer, navigate to data storage drive, check raw files are being recorded sequentially, and check date-time in filename to make sure they are current.

It is recommended that the skipper keep a checklist with dates, times and listing problems/solutions. (see Appendix 1, Verifying that quality data are being recorded..., Troubleshooting; see Appendix 2)

6. AFSC scientists should work through these matters with the vessel owners/skippers before data collection begins. System requirements should be checked as soon as possible after the vessels are selected.

7. Data will be backed up when they reach the lab at AFSC.

Echosounding system calibration

Ideally, the ES60 38 kHz echosounding system should be calibrated using standard sphere techniques. Calibration should be carried out at anchor in calm conditions in deep water (>40 m). Double anchoring is preferred; this can be achieved by dropping a trawl door off the stern. The location of the vessel’s transducer should be known ahead of time. Once the vessel is anchored, calibration normally takes 4-6 hrs. Elliot Bay, Seattle, (see www.afsc.noaa.gov/refm/...) or Port Susan would be suitable locations. Captains Bay and Makushin Bay (Unalaska Island, Alaska) are reasonable calibration locations in

the Eastern Bering Sea (EBS). Malina Bay and Three Saints Bay are good locations in the Gulf of Alaska (GOA). See Appendix 4, MACE calibration site positions.

Biological sampling

Observer-collected pollock biological data (haul, catch, and lengths, specimens, e.g., lengths, weights, age structures, etc.) will be available at AFSC after the fishing season is completed and observers have been debriefed.

Environmental measurements

Sound speed/Seawater absorption loss

Ideally, conductivity-temperature-depth (CTD) probe casts would be made to allow calculation of sound speed and seawater absorption loss in situ. It is understood that this is not possible in most situations. The AFSC will work to find alternative ways to obtain environmental conditions during the fishery.

Depth/temperature profiles for water column characterization

If at all possible the AFSC should work with the fishing industry to attach a Sea-Bird SBE39, CTD, or similar device to the headrope of the trawls to obtain depth and temperature profiles.

Other Considerations

-In protocol situations 2) and 3) (above)

-Species ID may be problematic, e.g., in summer Bering Sea (*see Honkalehto et al. 2002*). *Retrospective analysis is currently investigating areas that are reliably pollock.*

-Can we purchase a robust CTD for use on fishing vessels? –V. Wespestad has used small CTD devices attached to headropes (SeaStar, made in Iceland).

- 38 kHz split beam system is optimal for situations 2) and 3)

--Past EBS BT survey vessels have split beams but different frequencies:

Arcturus (38 kHz), *Aldebaran* (120 kHz).

--Past GOA BT survey vessels are single beam:

Sea Storm (38 and 200 kHz), and *Gladiator* (38 kHz).

NW Explorer currently has no ES60 but will (?) install one in March 2006.

--*Gladiator* (and sister vessel *Dominator*) acoustic data are noisy, due to sponsored hull design.

Sea Storm data are relatively noise-free except for other sounder interference.

Acknowledgements

The authors would like to thank T. Ryan, CSIRO, Hobart, TAS, Australia, for sharing his unpublished document “Procedures and protocols for orange roughy surveys”. It was helpful in preparing this document.

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Appendix 1. ES60 instructions for the 2006 EBS and GOA groundfish surveys

The purpose of this document is to provide the designated ES60 data-logging operator with a detailed set of instructions to ensure that ES60 acoustic data are properly recorded and stored. Once familiar with this document, refer also to the abbreviated Check List (Appendix 3).

ES60 instructions

Before survey begins:

Hardware Requirements and Setup of Portable Hard Drives

To archive data SIMRAD ES60 echosounders require a USB port, an operating system that recognizes the USB port (typically Windows 2000), and a GPS unit connected to the echosounder. A keyboard attached to the echosounder is desirable. Data will be archived on Iomega 250 GB external hard drives. Some operations below require basic file management operations using the ES60 computer – see “Troubleshooting and Helpful Keystrokes” at the end of the document.

Connecting the IOMEGA hard drive

The IOMEGA drive has two outlets: a **power outlet** (round, next to the “Power” button), and a **USB port**. Connect the USB cable from the IOMEGA drive to the **ES60**. Connect the power cord to the IOMEGA power outlet and to the power strip, which is connected to a UPS (and to the vessel’s power supply). If the power is on and everything is working properly, the IOMEGA drive should be making a humming sound and the blue LED should be lit up.

Synchronize the clocks on the ES60 computer with other data collection computers on the vessel. **Secure (turn off) unneeded sounders** other than ES60, unless they are synchronized to the ES60 system. They cause interference with the ES60 raw data.

Destination folder on IOMEGA drive

A destination folder for the **ES60** data should be created on the IOMEGA hard drive. Two file types generated by the ES60 will be stored here: ***.RAW** and ***.OUT** files. Verify that a destination folder exists and create it if needed. In Windows explorer, double-click on the IOMEGA drive icon (IOMEGA_HDD (x:)) to create a new folder (e.g., use descriptive folder names: ‘EBS_06_vessel’ or ‘GOA2006vessel’.). If using a folder already present, verify that it is empty at the beginning of the survey. **NOTE:** on the ES60 computer the IOMEGA drive may be any letter, such as E, F, G.

Creating a file path for ES60 data storage and ES60 settings

In the ES60 software, in order for **ES60** data to be transferred to and stored on the IOMEGA drive, a destination file path must be specified.

- 1) Select: **FILE → STORE**. (see screen grabs in Appendix 2, Fig. 4, and also Figs. 1-3, for assistance with this and the following sections).
- 2) Check the **“Save Raw Data”** box (raw data from the transducer saved as *.raw files)
- 3) Check the **“Save Output Data”** box (bottom data saved as *.out files)
- 4) Set **“Line Number”** to zero (only at the beginning of the survey)-this controls the serial/file numbers of the raw data files.
- 5) Check the **“Local Time”** box (affects the time stamp in the file).
- 6) Set **“Maximum file size”** to **50 MB**.
- 7) Finally, under “Survey” specify the file path corresponding to the destination folder that was created on the IOMEGA drive. The path reflects the appropriate drive letter, and the folder reflects area, year, and vessel (e.g, **G:\EBS_2006_vessel_rawfiles.**)

Other settings

Set the ping rate for data collection

- 1) Set the ping rate to 1 per second: **FILE → Operation → Ping rate**

Set the bottom detection parameters

- 2) **Right-click** on the **depth display** at the top of the echogram window.
 - a. Set the **“maximum depth”** to **1500 m**.
 - b. Set **“back step min. level”** to **-36 dB** (default is -50 dB)
 - c. Check the **“bottom smoothing”** box
 - d. **Do NOT** check the **“alternative bottom detector”** box.

Set gains

- 1) Right-click on the Color Display Bar
- 2) Set Schools gain to -70 dB
- 3) Set Fish gain to -70 dB

Set viewing preferences for the echogram, and raw data file range.

- 1) Right-click anywhere inside the echogram window.
 - a. Check **Surface – Manual** (ES60 will use the range setting in the BI500 Surface range menu as long as they are deeper than the Display range)
 - b. Check **“Event”**
 - c. Gain should be set to **“school”**
 - d. Select **“variable depth”**
 - e. Set **“Bottom”** to **“on”**
 - f. Uncheck **Ping Filter** (turn it off)
- 2) Set .raw data file Range:
On upper menu bar, click on Install → BI500.
Under Datagram check Echogram.
Click Surface Range
Set Start relative surface to 0,
Set range to 500 m (EBS) or 700 m (GOA). Click OK.

Set environmental parameters:

- 1) In Alaska: Install → Environment, check Salt Water,
- 2) set sound speed to 1470 m/s).

Set single target viewing parameters (split beam transducers, check for your vessel):

- 1) Right-click anywhere inside the single target window (the circle and crosshairs)
- 2) Set presentation to “Echo trace”
- 3) Set scale to “TS”

Recording ES60 parameter settings

All ES60 settings should be recorded at the beginning of the survey.

1. Right-click on the frequency (e.g., 38 kHz, 120 kHz, 200 kHz) near the top and left of the screen.
2. In the Transceiver Settings dialog box, make sure the Power setting is appropriate for your combination of GPT and transducer (e.g. typically 1000 W to 2000 W for 38 kHz),
3. Set Pulse length 1.024 ms,
4. click on the “ADVANCED” button to display the ES60 settings.
5. Record all settings (e.g., frequency, beam type, gain, Sa correction etc.) on the log form.
6. Make a screen shot of the settings window: Click Ctrl+Alt+Prnt_Scrn, open a program such as Paint or Word and Paste. Save the file on the on the IOMEGA drive raw file folder. Record date/file name on log form.

Verifying version of ES60 software

Record the version of the ES60 software on the log form. To do this, go to **HELP → about this echosounder**.

Verifying that a GPS unit is connected to the ES60

In order to verify that a GPS unit is hooked up to the **ES60** and functioning properly, check for latitude and longitude data at the bottom of the screen in the **ES60** software (Appendix 2, Fig. 1). Contact the skipper if no lat/lon data present, and ask if the GPS is hooked up properly.

At start of survey or at beginning/end of day:

Acoustic data logging

As you leave port to begin the survey begin logging acoustic data.

1. Assuming transducers are fully under water, right click on the frequency, and verify Mode is Active (unless collecting Noise files). This needs to be done separately for each frequency.

2. Click on the file serial number (the **LXXXX** number at the bottom of the screen). If data logging starts correctly, **LXXXX** will turn from **black** to **red**.
3. If data are already being logged, the **LXXXX** will already be **red**.
4. File breaks (while already logging) may be inserted by clicking **LXXXX** once to **stop** logging (turns it from **red** to black), and click again to **start** logging (return the color to **red**). The file number will advance by 1. Record each new file entry in the log form.
5. Once a file break has been made, subsequent files (50 MB each) will continue to log automatically with the same file number and different date-time stamps.
6. Continue to log data day and night. Manually end the day file and start a night file by inserting a file break (see above). Log file name.

Throughout the day:

Verifying that quality data are being recorded and stored on the IOMEGA drive

Check the following periodically to ensure that quality acoustic data are logged and saved on the IOMEGA drive (Appendix 3 has brief version of all instructions):

- 1) Lat/Lon data appear at the bottom right side of the screen.
- 2) The file serial number (**LXXXX**) at the bottom of the screen is **red**, indicating data are being logged. If **black**, logging process is stopped. Click to **start (red)** and record time on log form.
- 3) Ensure that acoustic files generated by the ES60 (extensions **.raw** and **.out**) are being stored on the IOMEGA drive. To do this, go into Windows Explorer and click on the **IOMEGA drive icon**. In the destination folder look for stored *.raw and *.out files. Check dates and times to ensure data storage is current and on going.
- 4) Look for signs of noise (e.g., interference from another transducer with similar frequency) on the echogram (Appendix 2, Figs. 5-8). Make sure Ping Filter is off (unchecked). Noise from another transducer usually look like “rain” or “drizzle” on the echogram (i.e., numerous regularly spaced thin vertical bars). If present, ask the skipper to turn off the “offending” transducer.
- 5) Although there should be plenty of storage with the 250 GB Iomega drive, it may be necessary from time to time to **check the disk space**. To do this, use Windows Explorer to select the directory in which the data are being stored, right-click with the mouse and select properties.
- 6) Record problems/solutions in the log form.

Creating separate “on-station” and “between- station” files

1. Upon arrival at a trawl station--as soon as the skipper slows the vessel down to reposition it for a haul--insert a File Break, incrementing the **LXXXX (toggle twice, from red to black to red)**, as described above, creating an “on-station” file.

2. When departing the trawl station insert another File Break, to create a “between-station” file. The first file created should contain all trawl station data, and the next file contains between-station data, etc.
3. NOTE: Separating files this way is helpful, not critical. And it is only helpful if the “on-station” file is started just before the trawl setting procedure begins, and ended (and the “between station” file started) after the trawl has been retrieved.

During the survey (minimum, once per leg):

Calibration Procedures

Calibration should be attempted as soon as convenient during each leg of the cruise, but only under relatively calm sea state, when the vessel is not moving (some drift is OK), and where there is little, if anything (i.e., fish) in the water column, contributing acoustic backscatter. An ideal time to do calibration work is after the last haul of the day.

Calibration data can then be collected overnight.

Preparing the ES60 for calibration

1. Right click on the Echogram window.
2. Switch the Gains to “Fish”
3. Enlarge the Single Target window (circle with cross-hairs) by dragging its edge.
4. Right click inside the Single Target window and ensure that “Presentation is set to “Echo Trace” and “Scale” is set to “TS”.
5. Right click on Color Display Bar and set “Fish” gains to –55 dB.

Three point calibration

- 1) Attach 3 downriggers at pre-specified locations (centered around transducer), e.g., on *Aldebaran* and *Arcturus*,
1 starboard downrigger even with transducer
1 port downrigger ahead of the transducer(s)
1 port downrigger behind the transducer(s)
- 2) Tie 2 large shackles evenly spaced about 10 m apart to a rope.
- 3) Using one person on port and one on starboard, drop rope over bow, allowing enough slack to clear bow and any other protuberances between bow and transducer;
- 4) Walk rope along each side until rope is even with single (e.g. starboard) downrigger.
- 5) Tie starboard downrigger line to rope and while feeding out starboard downrigger line with slack, pull rope up portside at forward port downrigger
- 6) Remove rope and attach all 3 downrigger lines together using swivel at forward port downrigger
- 7) Douse the clean, dry, calibration sphere with dish soap (e.g., Joy)
- 8) Attach sphere to middle loop of separate, pre-made calibration line; attach stabilizing weight ~ 5 m below calibration sphere, attach top loop to swivel junction of 3 downrigger lines.

- 9) Carefully lower sphere and weight over side –do not touch side of vessel with sphere.
- 10) Reel out same amount of line, e.g., 50 turns, on all 3 downriggers. Look for sphere on echogram. Keeping track of how much line you are letting out on each downrigger, incrementally let out line on downriggers until sphere is visible on ES60 screen (but do not let out so much line that weight/sphere hits bottom).
NOTE: Do not confuse the calibration sphere with a swivel.

When the sphere is positioned approximately 15 –20 m below the transducer of interest:

- 1) Create separate ES-60 data file(s) for each calibration event using by clicking on LXXXX to change it to **red** to start logging a new file, or a toggling twice to insert a File Break.
 - a. Record file number(s) of calibration file(s) on log form
 - b. Record date and time of calibration file(s) on log form
 - c. Record **file type code** “C” (calibration) on log form
 - d. **NOTE:** when calibration data are collected overnight (ideal case), several calibration files will automatically be created since file sizes will be limited to 50 MB. Note all file names & date-times associated with a particular calibration episode.
- 2) Right click in the Range area window (white strip on right of screen, see Appendix 2, Fig. 1, and Appendix 2, Fig 4d).).
- 3) Enter a start relative surface value that is 2-3 m above your sphere. This will reduce the number of unwanted fish targets from above the calibration sphere that you see on the display.
- 4) Enter a Range value of 5-6 m. This will limit the number of unwanted fish targets from below your calibration sphere.
- 5) Enlarge the calibration window (the window containing a circle with crosshairs, Appendix 2, Fig. 1), by clicking and dragging the lower right-hand corner of the window, when logging calibration data. This makes it easier to determine if the calibration sphere is located near the acoustic axis (i.e., on the cross hairs).
- 6) Collect at least 20 min of on-axis calibration data, preferably more, or collect overnight.
- 7) The sphere will tend to wiggle around in the calibration window. This is OK as long as the motion is not too erratic, and as long as the back and forth motion is centered on the cross hairs. Check screen regularly, and if the sphere appears centered off the cross hairs, adjust the amount of line out on the three downriggers to re-center it.
- 8) End calibration data collection by toggling to a new file. Record time in log book.
- 9) Retrieve sphere without touching the side of the boat, and Dismantle calibration equipment
 - a. Release tension on 2 downriggers and reel in sphere assembly on the 3rd downrigger. Do not allow sphere to touch side of vessel.
 - b. Carefully remove sphere from assembly; remove weight from assembly.
 - c. Rinse sphere in fresh warm water and then handling carefully,
 - d. **Dry thoroughly**, w/ many clean paper towels.
 - e. Store sphere dry in clean paper towels, in container provided with rest of calibration equipment.

- f. Unclip 3 lines and reel to downriggers. Dismantle downriggers, rinse with fresh water, let dry, and then store together with cal equipment.
- g. Right click on echogram. Reset Fish Gain to -70 dB, and switch Gain from “Fish” to “School”
- h. Start logging acoustic data (if necessary).

Bring the calibration .raw and .out files to Seattle at the end of the first leg (and after each leg).

Creating “noise files”

Collecting measures of the **vessel-generated background noise** may facilitate the processing of the acoustic data after the survey.

Collect noise files in 2 locations:

- 1) when the vessel is over deep water (e.g., >500 m bottom depth) and
 - 2) when the vessel near or on-station.
- In **each location**, create a noise file for 3 conditions; when the vessel is
- a. sitting still or drifting
 - b. running at cruising speed
 - c. trawling (on-station location only).
- 3) Record file information in log form.

To create noise files:

- 1) **Right-click** on “38 kHz” or “120 kHz”, etc. in upper left corner of the screen.
- 2) Check “**PASSIVE**” in the dialog box. This puts the transducer in a passive “listening” mode (no pings generated).
- 3) Assuming data are already logging, toggle the **LXXXX** twice (**stop** logging, then **start** logging new file) to create a file break w/file number incremented by 1.
- 4) Record file number and time in log form, along with the **vessel speed** as a noise file on log form (use file type “N”).
- 5) Log data for approx. 10 minutes.
- 6) Close the file (click on LXXXX). Note the end time in your log form.
- 7) For another noise file, toggle the LXXXX to **start (red)** and repeat steps 4)-6). **Stop** logging when finished (toggle to black).
- 8) Return to normal data collection by right-clicking “38 kHz, etc.” and changing Mode back to Active (check “**ACTIVE**”).
- 9) Resume normal data logging operations by clicking on LXXXX again so that it turns **red**. Record propeller speed and RPM, and weather conditions on log form.

At the End of each leg

When you are tied up and finished data logging for the leg or for the survey,

- 1) **Stop** data logging by clicking LXXXX before disconnecting the Iomega drive (!)
- 2) Record ending time and file number.
- 3) Back up all data onto spare Iomega drive.

Raw data CD to bring back to Seattle

At end of each leg, if a CD writing drive is available, cut a CD with an example raw and out file. Include a file from 1) the beginning (when arrive at survey grounds), 2) middle, and 3) end (before leaving the survey grounds). If calibration was done, include the calibration files on the CD. If noise files were collected, include noise files.

Troubleshooting and Helpful keystrokes

Closing ES60 software w/o shutting down the ES60 computer

To avoid shutting down the ES60 computer every time you shut down the ES60 software, execute the following keystroke combination:

Hit **SHIFT+ALT** keys, and then go to **FILE→Shutdown**.

If the sounder does not have a keyboard, it is also possible to shutdown the sounder software by:

File menu, press right mouse button, then press left mouse button and scroll to 'shutdown' holding both mouse buttons, then release left button before right button.

Toggling between Windows Explorer and ES60 screen

If you have applications running in the background, you can toggle between ES60 and the desired programs by:

- 1) Hold "Alt" key down and strike the Tab key.
- 2) Toggle between programs, e.g., hit Windows Explorer icon to bring up this program.
- 3) If the Windows Explorer icon is not present, it may be necessary to shutdown the echosounder without shutting down the processor (see above), open Windows Explorer, then later restart the ES60 software from the icon on the desktop.

Problems with recognizing IOMEGA drive when booting up ES60 software

If the **ES60** does not recognize the USB port (where the IOMEGA drive is plugged in):

- 1) Press **F2**, which takes you into the **BIOS**.
- 2) Choose **ADVANCED** and **enable USB Host controller** and **USB Bios Legacy support**.
- 3) Next, hit **F10**, which saves the settings you just made and exits BIOS.

Good Luck. Contact details are below if you have any questions. Thanks.

Paul von Szalay (EBS)
Ph: (206) 526-4153
email: paul.von.szalay@noaa.gov

Paul Spencer (GOA)
Ph. (206) 526-4248
email: paul.spencer@noaa.gov

Appendix 2. Sample ES60 screenshots, Figs. 1- 8

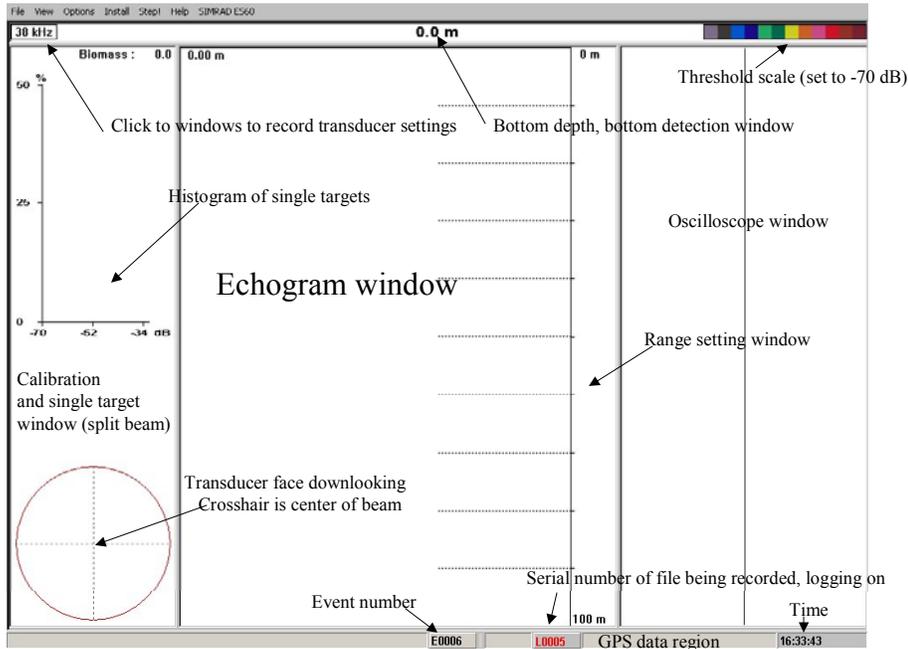
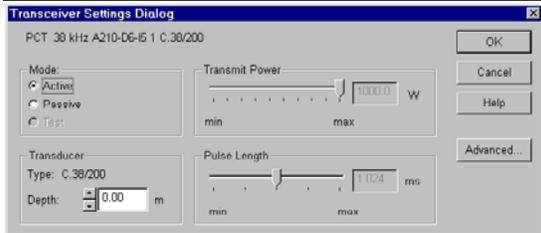
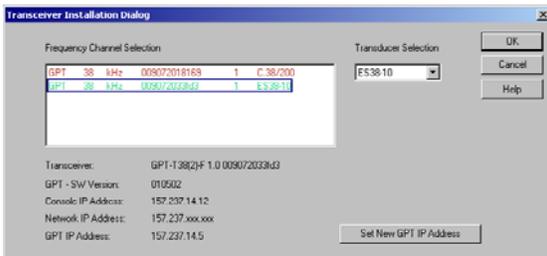


Fig. 1 ES60 software entire screen (in Passive Mode).



a. Fig. 2 ES60 software windows
 a) Install → Transceiver window showing GPT type and transducer types. Click on “38 kHz” in upper left corner of screen to obtain b) Transceiver settings menu and c) Advanced transceiver menu.

b.

c.

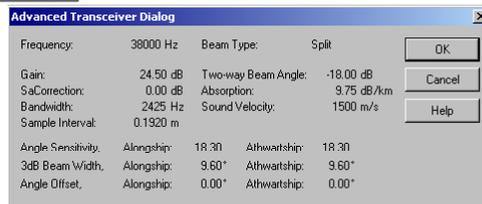


Fig 3. ES60 software. a) Color scale dialog showing threshold settings, and b) Click inside the echogram window to obtain Echogram dialog for setting range and grid lines on the echogram, etc.

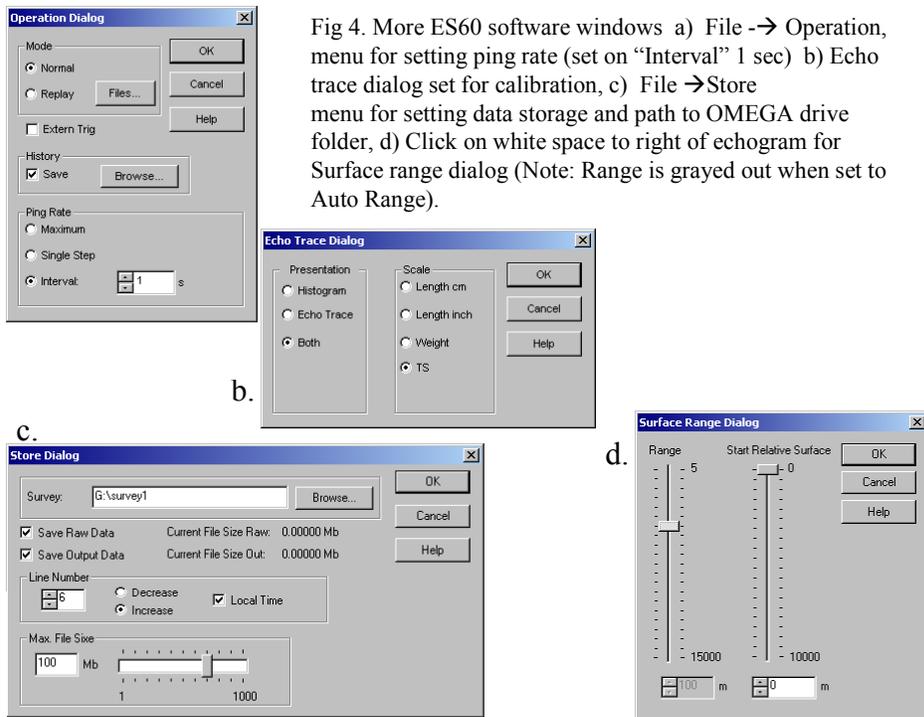
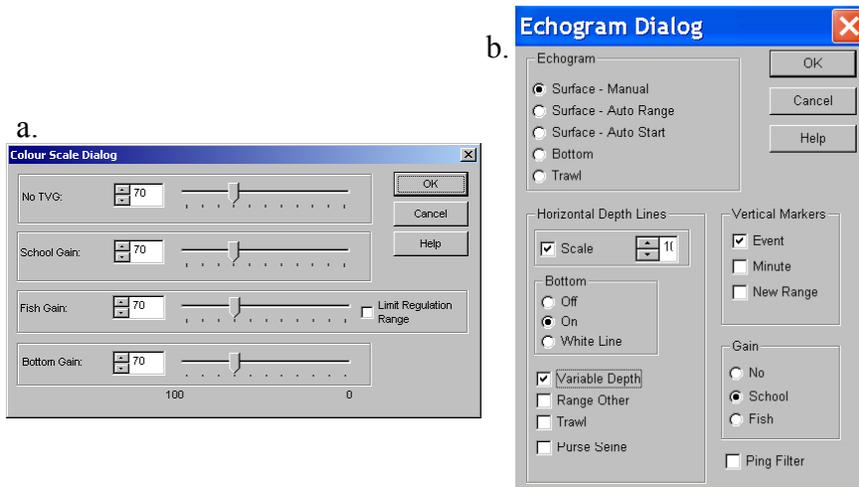


Fig 4. More ES60 software windows a) File -> Operation, menu for setting ping rate (set on "Interval" 1 sec) b) Echo trace dialog set for calibration, c) File ->Store menu for setting data storage and path to OMEGA drive folder, d) Click on white space to right of echogram for Surface range dialog (Note: Range is grayed out when set to Auto Range).

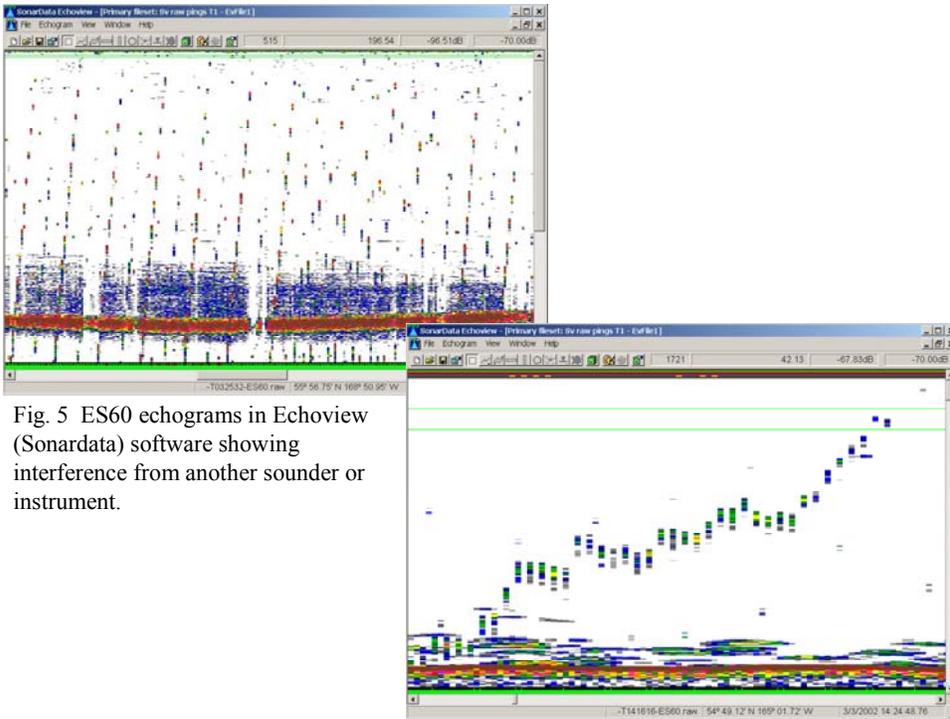


Fig. 5 ES60 echograms in Echoview (Sonardata) software showing interference from another sounder or instrument.

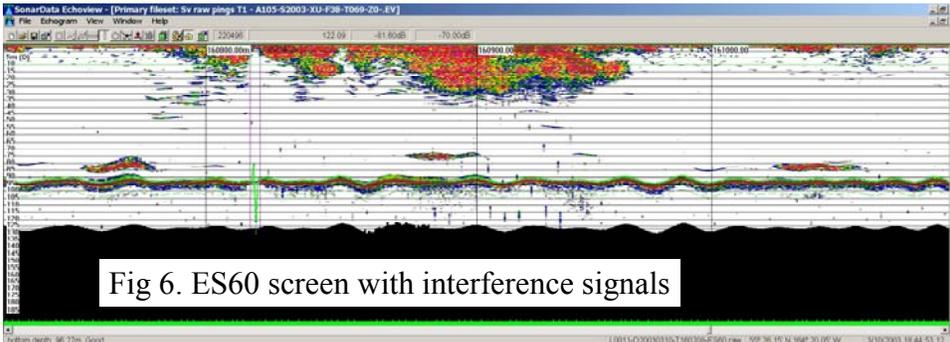
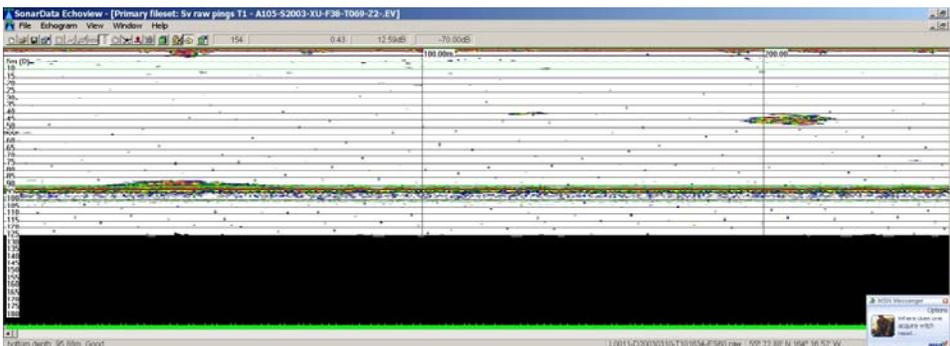


Fig 6. ES60 screen with interference signals



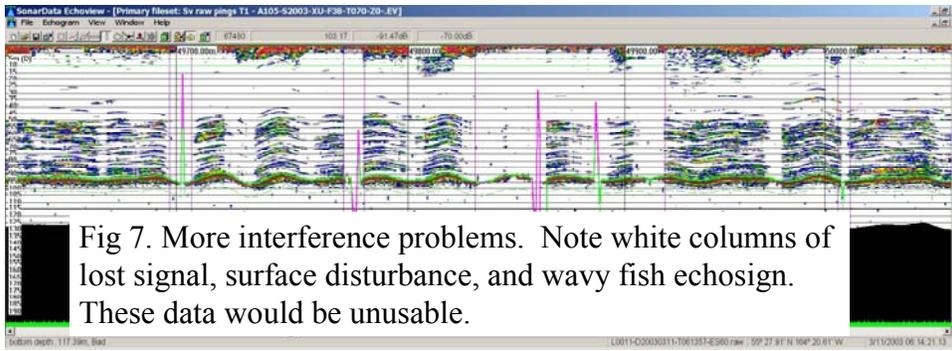


Fig 7. More interference problems. Note white columns of lost signal, surface disturbance, and wavy fish echosign. These data would be unusable.

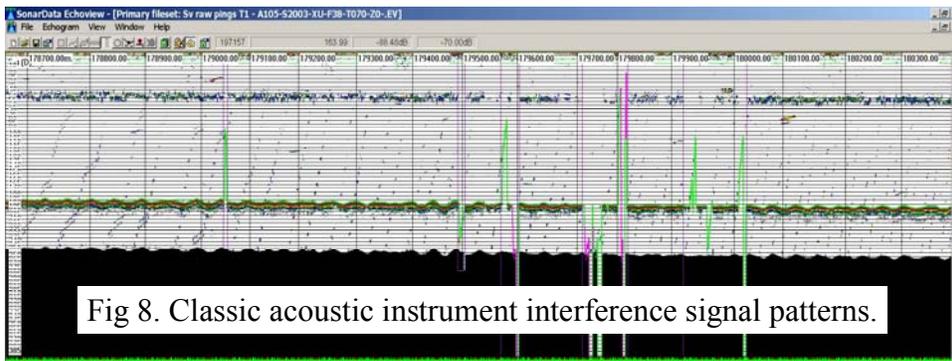
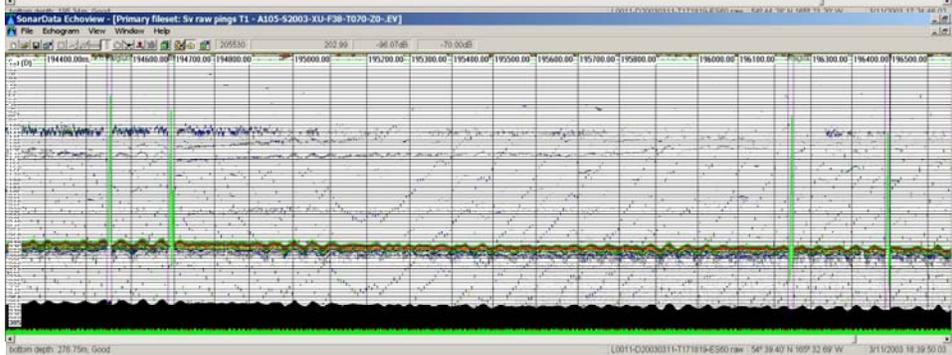


Fig 8. Classic acoustic instrument interference signal patterns.



Appendix 3. ES-60 Operations Check List

Before survey begins:

Set up the echosounder to log acoustic data

- 1) Connect IOMEGA drive to ES-60 computer
- 2) Verify existence of destination folder for *.raw and *.out files on IOMEGA drive (e.g. EBS_2006_vesselname_rawfiles)
- 3) Verify that a GPS unit is connected to the ES-60
- 4) Create a file path for ES-60 data storage and ES-60 settings
 - a. **FILE→STORE**
 - b. Check the “**Save Raw Data**” box
 - c. Check the “**Save Output Data**” box
 - d. Set “**Line Number**” to zero
 - e. Check the “**Local Time**” box
 - f. Set “**Maximum File Size**” to **50 MB**
 - g. Under “**Survey**” specify file path corresponding to the destination folder created on the IOMEGA drive

Other settings

- 5) Set “**Ping Rate**” to **1 per second (FILE→Operation→Ping rate)**
- 6) Right-click on Depth display and check the following:
 - a. Set “**Maximum Depth**” to 1500 m
 - b. Set “**Back Step Min. Level**” to -36 dB (default is -50 dB)
 - c. Check the “**Bottom Smoothing**” box
 - d. Verify that the “**Alternative Bottom Detector**” box is *unchecked*
- 7) **Right-click inside echogram window and check the following:**
 - a. Check Surface-Manual
 - a. Check “**Event**”
 - b. Set “**Gain**” to “**school**”
 - c. Select “**Variable Depth**”
 - d. Set “**Bottom**” to “**on**”
 - e. Set **Ping Filter** off (unchecked)
- 8) Set BI500 surface range echogram to 500 m (EBS) or 700 m (GOA).
(Install, BI500, Datagram → check Echogram,
Surface Range → start relative surface 0, range = 500 (or 700), OK.)
- 9) Record version of ES-60 software (HELP→ ABOUT THIS ECHOSOUNDER)
- 10) Set sound speed to 1470 m/s (in Alaska). (Install → Environment, check Salt Water, enter 1470)
- 11) Record ES-60 parameter settings (Right-click on the frequency)
 - a. Verify that power setting is appropriate (1000W- 2000W for 38 kHz, 500 W for 120 kHz)
 - b. Verify that **Pulse length** is set to **1.024 ms**
 - c. “**Mode**” should be set to “**Active**”
 - d. Click on “**ADVANCED**” button to display and record ES-60 settings
- 12) Start data logging (click on file serial number, LXXXX, turning it red)

At beginning/end of each day:

At day beginning: Start logging a new data file. (Assuming you are already logging, Toggle **LXXXX** twice, **red-black-red**. If not logging, toggle LXXXX once **black-red**.)

At day end: After the last haul of the day is complete, start a new file. (Log data 24 hrs.)

At survey end when approaching port: Stop logging data (toggle **LXXXX** to LXXXX).

Throughout the day:

Check the following periodically to ensure that quality data are logged and saved on the IOMEGA drive:

- 1) Lat/Lon data appear at the bottom right side of the screen
- 2) The file serial number (LXXXX) at the bottom of the screen is appropriate color (**red** = data are logged, **black** = logging process is off)
- 3) Ensure that acoustic files generated by the ES60 are stored on the IOMEGA drive
- 4) Look for signs of noise and correct problems if any.
- 5) Check the IOMEGA drive for available disk space

Create separate files for different activities

- 15) Upon arrival at trawl station (prior to setting trawl !)
 - a. Close current file (click on file serial no.; color changes from **red** to **black**)
 - b. Click on the serial number again (color changes back to **red**)
 - c. Record **serial no.**, **file type** (“**S**” for Station), **date**, and **time** on log form
- 16) When departing trawl station, just after doors are up:
 - a. Close file created at trawl station (click on file serial number)
 - b. Click on the serial number again toggling a new log file (**red**).
 - c. Fill out log form again (using the file type code “**T**” for Transit/Transect)

Sometime during the survey:

CALIBRATION

Once vessel has stopped moving and/or is anchored:

- 1) Attach 3 downriggers at pre-specified locations
- 2) Tie 2 large shackles evenly spaced about 10 m apart to rope and drop over bow with plenty of slack to clear obstacles.
- 3) Have 2 people walk rope along both sides until even with starboard downrigger
- 4) Tie starboard downrigger line to rope and reel in on port forward downrigger
- 5) Remove rope and attach all 3 downrigger lines together at forward port
- 6) Douse the clean, dry calibration sphere with dish soap (e.g., Joy)
- 7) Attach sphere to middle loop of separate, pre-made calibration line; attach stabilizing weight ~ 5 m below calibration sphere, attach top loop to junction of 3 downrigger lines.
- 8) Carefully lower sphere and weight over side –do not touch side of vessel with sphere.

- 9) Reel out same amount of line, e.g., 50 turns on all 3 downriggers. Continue to let out same amount of line on all downriggers slowly, keeping track, until sphere is visible on ES60 screen (but do not hit bottom).
- 10) Using downriggers, position sphere about 15-20 m below transducer.
- 11) Create separate ES-60 data file(s) for each calibration event
- 12) Record file number(s) of calibration file(s) on log form
- 13) Record date and time of calibration file(s) on log form
- 14) Record file type on log form: Use **file type code “C”** (calibration)
- 15) Enlarge calibration window
- 16) Right-click inside calibration window. In calibration dialog box:
 - i. Set **presentation** to **“Echo trace”**
 - j. Set **scale** to **“TS”**
 - k. In **Echogram** window set to **“fish”** (reset to **“school”** when done)
- 16) Zoom in on calibration sphere
 - l. **Right-click** on white strip (**“range area”**) to right of echogram
 - m. Set **“Start relative surface”** to 2-3 m above calibration sphere depth
 - n. Set **“Range”** to 5-6 m
 - o. Verify that only the calibration sphere is displayed in echogram, if not:
 - p. Play around with **“Start relative surface”** and **“Range”** settings until only the calibration sphere (**not** the weight) is displayed
- 17) Ensure that any back and forth motion of calibration sphere in calibration window is centered on the cross hairs. If not:
 - q. Adjust the amount of wire out on the three downriggers
- 18) End data collection, Retrieve spheres and Dismantle calibration equipment
 - r. End/start new file. Record calibration end time in log form.
 - s. Release tension on 2 downriggers and reel in sphere assembly on the 3rd downrigger. **Keep sphere away from side of vessel**—do not allow sphere to touch at all.
 - t. Carefully remove sphere from assembly; remove weight from assembly.
 - u. Rinse sphere in fresh warm water and then handling carefully,
 - v. **Dry thoroughly**, w/ many clean paper towels, hang to dry if possible, then
 - w. Store sphere **dry** in clean paper towels, in container provided, in safe place with rest of calibration equipment.
 - x. Unclip 3 lines and reel to downriggers. Dismantle downriggers, rinse with fresh water, let dry, and then store together in safe place.
 - y. Reset Gain to School
 - z. End of calibration: Start logging acoustic data if necessary

CREATING “NOISE FILES”

- 1) Right-click on **“38 kHz”** (*Arcturus*, *Sea Storm*, *Gladiator*) or **“120 kHz”** (*Aldebaran*), or **“200 kHz”** (*Sea Storm*)
- 2) Check **“Passive”** in the Transceiver settings dialog box
- 3) If data are being logged, close the current file by clicking on the file number
- 4) Click on file number again to start a new **“noise file”**

- 5) Record file information on log form.
- 6) End noise file (stop logging data to that file)
- 7) Transceiver settings dialog box -→ Check “Active”
- 8) Start data logger again with a new serial number.

Appendix 4. Recommended ES60 Settings, Calibration sites, Logbook examples

ES60 System settings

- 1. pulse length** 1.024 ms
- 2. ping repetition rate** Interval, 1 (1 ping per second)
- 3. power** Max power (that is, the lower of the 2 power ratings between the GPT and transducer. This should show up as the Maximum in the Power window if both the transducer and GPT transceiver are specified correctly) (1000-2000 W for a 38 kHz system, and 400-500 W for a 120 kHz system)
- 4. range settings:** Echogram, Range = Manual
- 5. Maximum bottom detection:** Max range 1500 m, Max threshold -36 dB
6. Install **BI500**, Datagram, check Echogram; Surface echogram range = 500 m (EBS) or 700 m (GOA). (**Note** this is a “work-around” to control the raw file range setting—BI500 data are not being collected).
- 7. storage** 50 MB files
- 8. gain** -70 dB “school” (20 Log r) for survey/fishing data collection
-70 dB “fish” (40 Log r) during calibration
- 9. Ping Filter off (unchecked)**
- 10. Set sound speed to 1470 m/s (in Alaska). (Install → Environment, check Salt Water, enter 1470)**

Calibration sites

Puget Sound

Port Susan 48° 08.80 N, 122° 24.80 W
Elliot Bay 47° 37.63 N, 122° 24.31 W

Bering Sea

Captains Bay 53° 51.52 N, 166° 34.64 W
Makushin Bay 53° 44.70 N, 166° 53.50 W

Gulf of Alaska

3 Saints Bay 57° 10.59 N, 153° 30.27 W
Malina Bay 58° 13.06 N, 153° 02.11 W

Groundfish survey Acoustic data Log form

The following is a template for the log book/log form for keeping track of acoustic data collected during the summer 2005 groundfish bottom trawl surveys. It is also available in an excel file. Please log all system settings, file information, troubleshooting and notes. This is just one way to log information. The user is free to modify or adapt this form as needed and encouraged to make suggestions on its usefulness.

