County: Island
Grant No: SEANWS-2014-IsCoPH-00002

PROJECT TITLE: Island County Marine Resource Committee

TASK NUMBER: 2.5 – Monitor eelgrass for changes, disease, and destruction

DELIVERABLE: 2.2 – QAPP for each monitoring project

PERIOD COVERED: October 2014-September 2015

DATE SUBMITTED: 3/12/2015

PUGET SOUND PARTNERSHIP

This project has been funded wholly or in part by the United States Environmental Protection Agency. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

QUALITY ASSURANCE PROJECT PLAN: Island County Marine Resources Committee Eelgrass Monitoring Program

Prepared by: Anna Toledo

Prepared for:

Washington Department of Ecology

March 2015

Based on EPA guidance CIO 2106-G-05 (2012)

Publication Information

This study has been funded in part by the United States Environmental Protection Agency (EPA) through its Puget Sound Action Agenda Technical Investigations and Implementation Assistance Program to the Puget Sound Partnership, via Interagency Agreement Number 2015-32 with the Department of Ecology/Northwest Straits Commission, of which the Island County Marine Resources Committee is a member. The Northwest Straits Commission is comprised of 7 Marine Resources Committees in Northwest Washington. The Island County Marine Resources Committee was established in 1999 under the federal Northwest Straits Initiative, as an advisory body to county government.

Each study conducted for the EPA or Ecology must have an approved Quality Assurance Project Plan (QAPP) describing the objectives of the study and the procedures to be followed to achieve those objectives. This generic QAPP serves as an umbrella under which multiple data collection, production and use activities will be conducted over an extended period of time at several different project sites. The plan and final reports for this program will be available on Island County Marine Resources Committee's website at www.islandcountymrc.org. Neither document necessarily reflects the views and policies of the EPA, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Data for this project will be available on the Island County Marine Resources Committee's website at www.islandcountymrc.org

Author and Contact Information

Anna Toledo
P.O. Box 5000
Island County Department of Natural Resources
Coupeville, WA 98239-5000
For more information contact: Island County Department of Natural Resources – www.islandcountyeh.com

Quality Assurance Project Plan
Island County Marine Resources Committee
Eelgrass Monitoring Program

March 2015

Approved by

Signature: ____ Date: __________________

Sasha Horst, Project Officer, Washington State Department of Ecology

Signature: ____ Date: __________________

Frances Wood, Chair, Island County Marine Resources Committee

Signature: ____ Date: __________________

Lenny Corin, Island County MRC Representative, Northwest Straits Commission

Signature: ____ Date: __________________

Keith Higman, Health Services Director, Island County Public Health

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Acronyms

GPS – Global Positioning Satellites

HDOP – Horizontal Dilution Of Precision

IC DNR – Island County Department of Natural Resources

MRC – Island Marine Resources Committee

MRC PM – Marine Resources Committee Project Manager

NOAA – National Oceanic and Atmospheric Administration

QAPP – Quality Assurance Protection Plan

SVMP – Submerged Vegetation Monitoring Project

WADNR – Washington State Department of Natural Resources

WDFW – Washington Department of Fish and Wildlife

Project Management

Project Organization

Position/Role	Who is Responsible	As of 1/1/2015
Program Manager	MRC PM	Anna Toledo
Project Manager	MRC Liaison	Ken Urstad
Lead Scientist	MRC PM or designee	Gregg Ridder
Researchers	Island Co. volunteers	MRC volunteers
Data Manager	PM or designee	Gregg Ridder, Neal Clark
Report Producer	PM or designee	Gregg Ridder
Permit Holder	PM or designee	
Boat Captain	MRC PM or designee	Ken Urstad
Equipment Team	MRC PM or designee	Gregg Ridder, Neal Clark, Tom Vos, Mark Kennedy, Bob Gentz
Video Analysts	MRC PM or designee	Gregg Ridder, Neal Clark, Mark Kennedy, Bob Gentz

Project Schedule

Date	Event
Jan-Mar	Calculate bed area results; Present to MRC; Choose sites for next year
Apr-May	Prepare transects; test equipment; schedule crews
Jun-Aug	Collect underwater video at 10 sites; Collect aerial photos for IC
Sep-Dec	Prepare spreadsheets/DVDs; analyze video; create GIS maps

Project Background

Eelgrass (*Zostera marina*) is an essential element of our nearshore that provides food and habitat for an array of organisms and is an indicator species of environmental threat from disease, pollution and environmental stress. The Puget Sound Action Agenda identifies eelgrass protection and recovery as a 2020 Recovery Target. An element of Strategy B6.1, Improve data and information to protect eelgrass in sensitive areas, includes the estimation of total area of eelgrass beds in the Puget Sound annually in sensitive areas.

The objective of the eelgrass project is to monitor the health of eelgrass beds in Island County. We use aerial photography and underwater videography to visualize and measure eelgrass bed areas in regions sensitive to damage from human or environmental threat. The primary regions of interest include Holmes Harbor, Penn Cove and Cornet Bay with a variety of secondary sites around the county. Our measures of success for this project are the completion of data collection, analysis and reporting such that we communicate eelgrass bed areas and appearance relevant to the health of eelgrass beds for each site we sample. We will use these data as a basis of comparison for sites we have previously reported in our own program and from reports of others (i.e. DNR). To date we have collected underwater video data from 27 different sites in Island County and completed 50 bed area estimates in the last 5 years. Aerial photographs have been collected for hundreds of different sites during the same period allowing visual assessments of eelgrass bed appearance.

Project/Task Descriptions

Two complementary techniques are used to assess eelgrass beds within selected 1000 meter-long sites defined by WADNR in the nearshore of Island County. Underwater video recorded along approximately ten 1 meter wide transects perpendicular to the shoreline allows for an estimate of eelgrass bed area by measuring the presence/absence of *Zostera marina* plants by visual inspection of the recorded video. Aerial photography allows a more complete visualization of vegetative growth for the entire site, but lacks the specificity of plant identification. When results of the two techniques are superimposed in GIS maps, a more complete picture of eelgrass bed areas and appearance is obtained.

Data Quality Objectives

Bias:

Our sample site selection process is somewhat arbitrary based on a variety of factors such as expected presence of eelgrass, human activity at or around the site, ability to access and navigate the site by small boat and coordination with WADNR sampling. Therefore, our sampling may not represent Island County as a whole. Our analysis then is mainly focused on comparing sites from one year to another or among sites within a smaller region of interest.

There is a small controversy within WADNR around random or regular spacing of transect lines within a site, but we have chosen a more regular spacing with random start to assure transects represent the site as a whole for each year.

Differentiating eelgrass species (*Zostera marina* vs *Zostera japonica*) from underwater video alone is at times impossible and a possible a bias to classify unidentified eelgrass as *Zostera marina* can skew the results slightly. Differences among video analysts are mostly limited to this issue. Fortunately, unidentified eelgrass usually represents only very small percentage of all the eelgrass.

Precision:

In calculating eelgrass bed area for any site from underwater videography data, the 95% confidence interval is improved by the square root of the number of transects sampled. Our goal is to collect video from at least ten transects for each site, but we are ultimately limited by time and tide constraints.

GPS measurement of our position could be a factor in precision, but to date only once in five years has the GPS signal been seriously degraded to where the data were compromised for a very short period. Usually the GPS' horizontal dilution of precision (hdop) is less than 1.0 (ideal).

Changes in airplane altitude and attitude (angle of attack and roll) from being perpendicular to the ground can result in distortions in geometry of the aerial photograph. Our goal is to limit the altitude changes within regions to ±100' and attitude changes to less than 5°. The plane is flown at 100 knots IAS at 2500' along the shoreline while taking photographs every 4 seconds to provide overlap. Altitude may vary due to ceiling limitations.

Subsequent image processing including rubber-sheet warping using fiduciary landmarks (houses, road crossings and identifiable landmarks) greatly reduces the positional variations when comparing aerial photos taken at different days or years.

Accuracy:

Any deviation in navigating the boat used for underwater videography along the straight transect lines will result in line lengths longer than the transect line. Since there should be no correlation between navigation errors and the presence/absence of eelgrass or transect line position, the unavoidable errors should be random and have small effect

Several factors contribute to the ability to accurately assess the presence or absence within a 1 square meter of seafloor area when analyzing each frame of underwater video. These factors include the variations in camera height above the seafloor, blockage of the camera by debris (entangled kelp or eelgrass usually), the turbidity of the water, excess speed of the boat or becoming entangled in mooring lines. The result represents a short, infrequent loss of data. If the loss is significant the transect will be rerun.

To accurately determine eelgrass bed positions and appearance using aerial photography, the photographs need to be taken with consistent, diffuse sunlight (thin overcast above 3000' is ideal), lack of motion or focus blur, high water clarity and inclusion of enough landmarks to accurately register images with a base map. Color differences associated with sunlight intensity and cloud contrast are difficult to correct and are tolerated at this time. Positional inaccuracies due to camera lens, GPS data and airplane attitude/altitude are corrected as part of the image/GIS processing.

Completeness

Within each site we can sample typically 10 transects representing about 1% of the total area. This under-sampling contributes to an uncertainty of up to 20% for within site comparisons. We have the capacity to perform underwater videography at only 10 of approximately 250 sites within Island County each year. For this reason we must only speculate on the overall gain or loss of eelgrass bed area for the entire county.

Aerial photography can be performed for all of Island County sites except for those near NAS Whidbey when Air Traffic Control prohibits access due to military operations. Typically, however, only sites along Saratoga Passage are photographed since the west coast of Whidbey Island has much less eelgrass than surfgrass due to higher wave action outside Saratoga Passage.

Special Training

Our boat captain (and owner) is trained in boating safety, computer navigation and use of a remote-controlled electric trolling motor. Two of our equipment team, who participated in the design and construction of the electronics, are designated to maintain, modify and repair the equipment. Our equipment other team members are trained by them to set-up, validate and capture video, depth and GPS data using our specialized electronics hardware. Our volunteer camera operators are trained by the equipment team members to monitor the underwater camera and keep it approximately one meter from the seafloor.

Our video analysts were originally trained by WADNR and have subsequently trained additional analysts. The calculations of eelgrass bed area from underwater video analysis data are ultimately done by the WADNR Eelgrass Monitoring Program.

Our aerial photographer (and airplane owner) is a licensed pilot (current medical and biennial flight review) using a remotely triggered wing camera to capture orthogonal photographs of the shoreline at very low tides in May through August. Our lead scientist is skilled in the use of spreadsheet software, programming and ArcGIS to map GPS tracklogs, underwater video analysis results and aerial onto maps of Island County.

Documentation and Records Requirements

All project documents are maintained by the Data Manager. The documents include the QAPP, GPS tracklogs for both boat and airplane movement, a list of boat crews and schedules, underwater video files and geo-tagged aerial photographs, a videolog spreadsheet to record any video editing required to prepare DVDs that are sent to video analysts, spreadsheets derived from the boat GPS tracklogs that contain video analysis results, aerial photograph composites that have been geo-referenced onto base maps, tables of bed area calculation results. A "Quick Report" is produced by the Data Manager shortly after each data collection outing to record events and conditions of the day and to communicate the day's progress to crews by mapping the tracklog. Quarterly reports for the project are produced by the Program Manager and a final report is produced by the Lead Scientist at the end of the year.

Data Acquisition

Detailed descriptions of data acquisition procedures are described in the attached documents: (1) Videography Manual v1_4 and (2) Aerial Photography Manual v1_1.

Sample collection

No physical samples are collected for this project. Only underwater video and aerial photograph are produced.

Analysis

Analysis of the underwater videography data and image processing techniques are described in data acquisition documents.

Quality Control Requirements

Our ultimate numerical result is an eelgrass bed area estimate for each site. Our only reference points are results from WADNR for the same site and year. Data from 2013 provided our first opportunity to make such a direct comparison. However, our year-to-year results for sites we have sampled every year show values and confidence intervals similar to WADNR year-to-year comparison for other sites.

Instrument/Equipment Testing, Inspection and Maintenance Requirements

GPS positioning

One of the parameters recorded in the boat GPS tracklog is the horizontal dilution of precision (hdop). A score of 1 or less indicates ideal precision for our device tracking multiple satellites. Also, at the beginning of each outing, data are collected while the boat is stationary at the dock giving us another check on GPS accuracy and precision. Thirdly, the noise of the tracklog trace provides another check on the functioning of the GPS receiver. For aerial photography, the photographs are geo-tagged after the flight based on synchronization of the time recorded by the GPS and by the camera. To aid this synchronization, several 90° turns are executed with a single photograph taken during the turn to allow the difference in time between the two devices to be established. The geo-tagged photographs don't need exact GPS precision since they will later be geo-referenced to base maps with exact coordinates.

Underwater Video Electronics

Our set-up procedure for the underwater video electronics contains parameters and expected responses that allow for equipment validation (see Appendix A: Videography Manual v1_4). If working properly, the onboard navigation will agree with the transect maps and recording of GPS data and underwater video will be evident from: (1) files being written to the onboard computer and (2) overlayed information on the camera monitor. All 12-volt car batteries to run the trolling motor and electronics are recharged after each outing.

Aerial Photography

The airplane used to acquire aerial photographs is maintained according to FAA standards for private aircraft. All flights are conducted in VFR conditions and under supervision of the appropriate Air Traffic Control facilities. Proper set-up and functioning of the camera is detailed in our written procedure (see Appendix B: Aerial Photography Manual v1_1). Batteries for the camera hardware are replaced each year.

Data Acquisition Requirements

The only data supplied to the project are coordinates of site boundaries by WADNR.

Data Management

Before each underwater video outing, maps of transect lines for the site of interest are loaded onto the navigation computer by the Data Manager. After each outing, the recorded computer and video data are off-loaded to a dedicated data storage disk drive and backed-up on a personal RAID1 NAS disk drive. The GPS tracklog data file is transformed into a spreadsheet using a program written by the Lead Scientist. This file is imported into an ArcGIS map to display the path of the boat along the transect lines. The spreadsheet and underwater video recordings are processed into individual files and written onto DVDs. The DVDs are used by video analysts to record their assessment for each second of video as to the presence or absence of eelgrass. Coded spreadsheets are returned to the Lead Scientist and displayed as categorical data on GIS maps. The coded spreadsheets are transformed to a format compatible with WADNR's programs by the Data Manager and sent to WADNR to calculate the eelgrass bed area estimates for all sites. The results are returned to the Lead Scientist as a spreadsheet. The eelgrass bed area estimates and 95% confidence intervals are added to a table of final results for comparison. (see Appendix A: Videography Manual v1_4)

Aerial photographs are downloaded from the camera SD chips onto a dedicated data storage disk drive and backed-up on a personal RAID1 NAS disk drive. The GPS tracklog for the flight (.GPX format) is downloaded from the on-board GPS system. All of the aerial photos are geo-tagged using a commercial program (Geotagalog) and loaded into iPhoto. iPhoto maps are used to select images for each site and combined to make panorama images that cover the entire site (Photoshop). The site images are geo-registered in ArcGIS using landmark for alignment. These mapped images are displayed as a layer underneath the underwater video assessment data to provide the finished map of results.

The Lead Scientist will summarize the data and the Report Producer will produce the final report, which will be proofed by the Lead Scientist and 2 other peer reviewers.

Assessments

Assessments and Response Actions

The Project Manager or Lead Scientist will accompany researchers in the field to review field practices.

Reports to Management

Bimonthly report will be produced by the Project Manager and will contain a summary derived by the Lead Scientist. The Report Producer will write the annual final report. After the report has been reviewed by 2 other peer reviewers, the Report Producer will send it to the Program Manager who will distribute it to the Island County Marine Resources Committee and the Northwest Straits Commission, Island County Lead Entity and other interested parties.

Review, Evaluation of Usability, and Reporting Requirements

Data Review, Validation and Verification

The video analysts provide a continuity check on the data integrity and give feedback to the Data Manager who prepared the files. The prepared spreadsheets and overlay of the video must have identical GPS, time and date information for analysis to be performed.

Validation and Verification Methods

Since our project was modeled after the WADNR Submerged Vegetation Monitoring Project (SVMP), our goal is reproduce their results using our equipment and techniques. Direct comparison requires that we and WADNR sample the same site within the same summer sampling period. We achieved this only in 2013 (WADNR results are not available yet).

Reconciliation with Data Quality Objectives

The project results and associated variability and accuracy will be compared with project objectives. If results do not meet criteria, then they will be explicitly stated in the final report. Based upon data accuracy, some data may be discarded and the reasons will be reported. If project criteria need to be modified, then details of and justification for the modification will be reported.

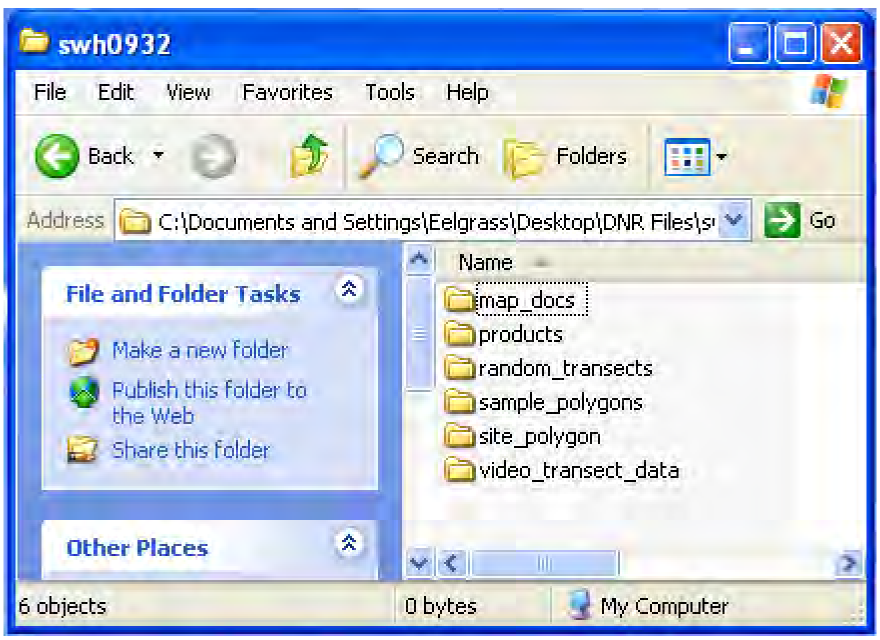
Underwater Videography Tasks

(Gregg Ridder 6/2/13)

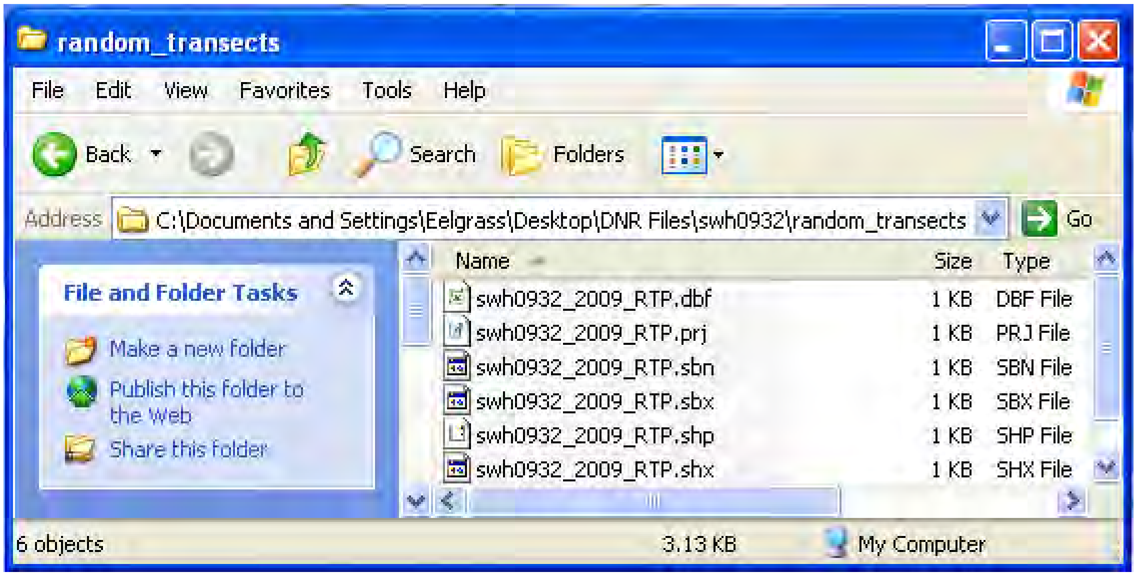
V1. Importing DNR Transect Points and sampling polygons

The goal of this task is to take random transect points defined by DNR and import them to Mediamapper so we can plan our transect tracts and provide live GPS guidance to the boat captain using the laptop as a moving map. The problem is that DNR supplies the data as an ArcMap projected coordinate system (NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet; Projection: Lambert_Conformal_Conic) and Mediamapper is set to a geographic projection. This transformation can be done in ArcMap by changing the coordinate system to geographic, exporting the data and opening the file in Mediamapper. The instructions below will accomplish this task.

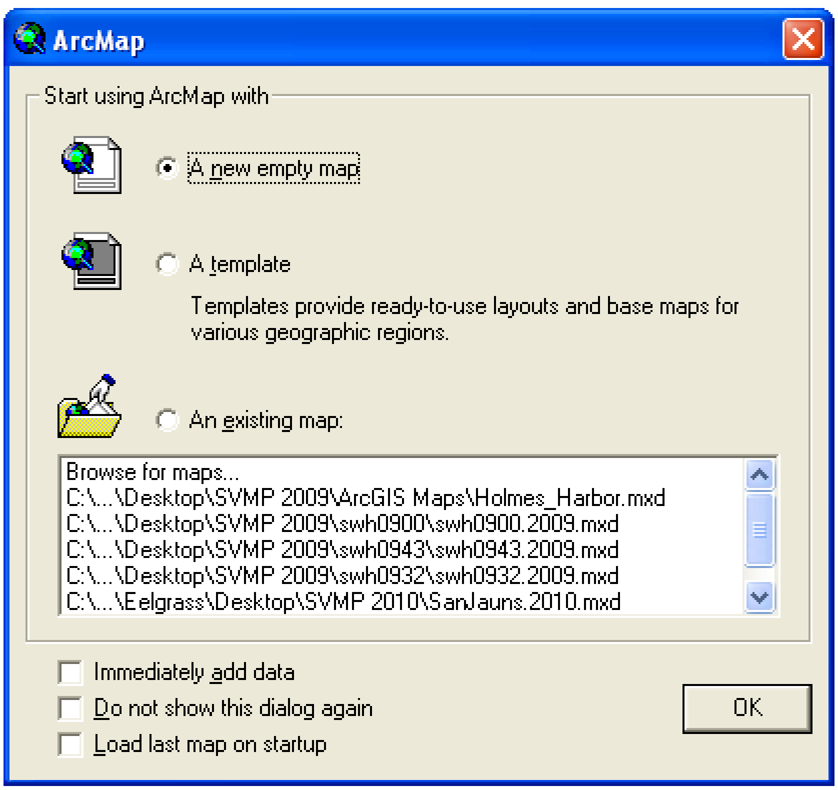
Our transect points have been defined and prepared by Jeff Gaeckle and Dolores Sare at DNR. Dolores put the files up on the DNR server and we download them as the following files for each site:



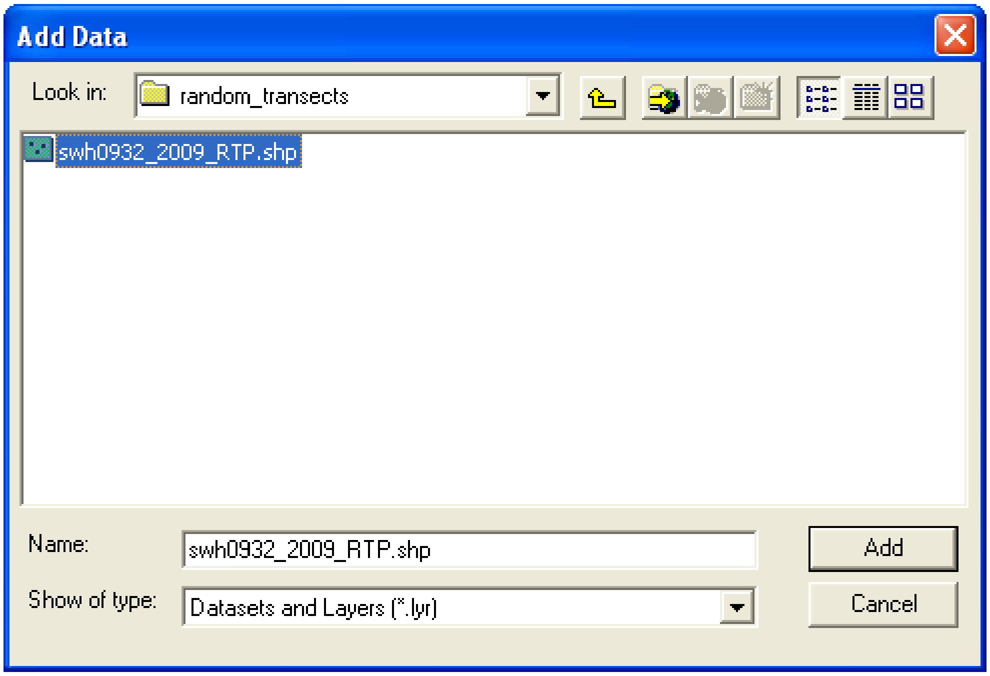
The data we need is in the folder we want are in the "random_transects" and "site polygon" folders.



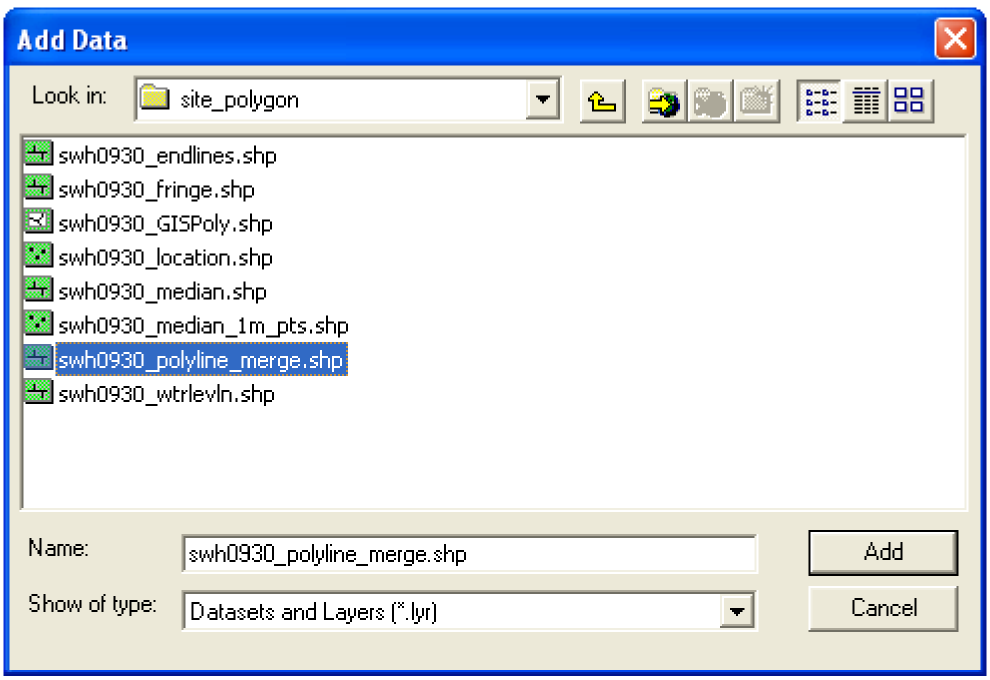
The particular file of interest is ".shp" (shape). Open ArcMap and choose to create a new map.



Once the new blank map is open, use the "Add Data" button -  - and select the shape file in the random_transect folder and click "Add".

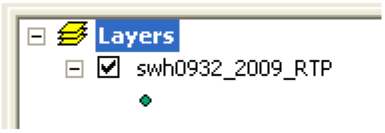


The transect points will appear. Repeat the "Add Data" step for the sampling polygon

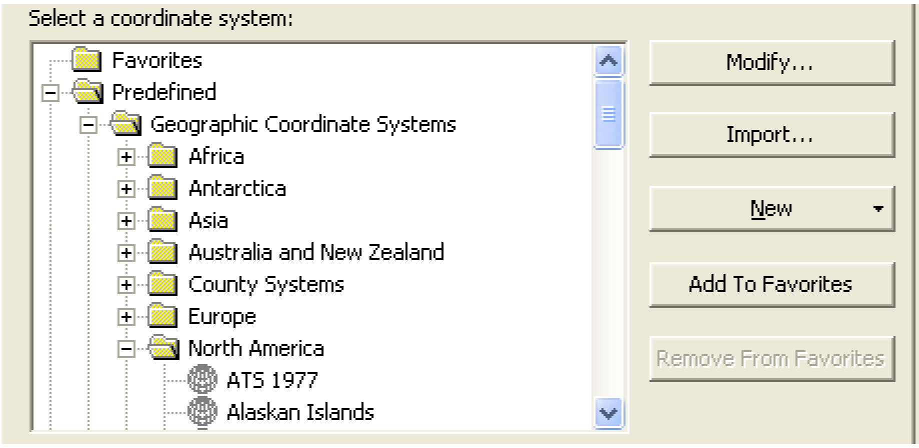


Repeat adding transect points and sampling polygons for all sites. Now it's time to convert them from a projection coordinate system to an geographic coordinate system.

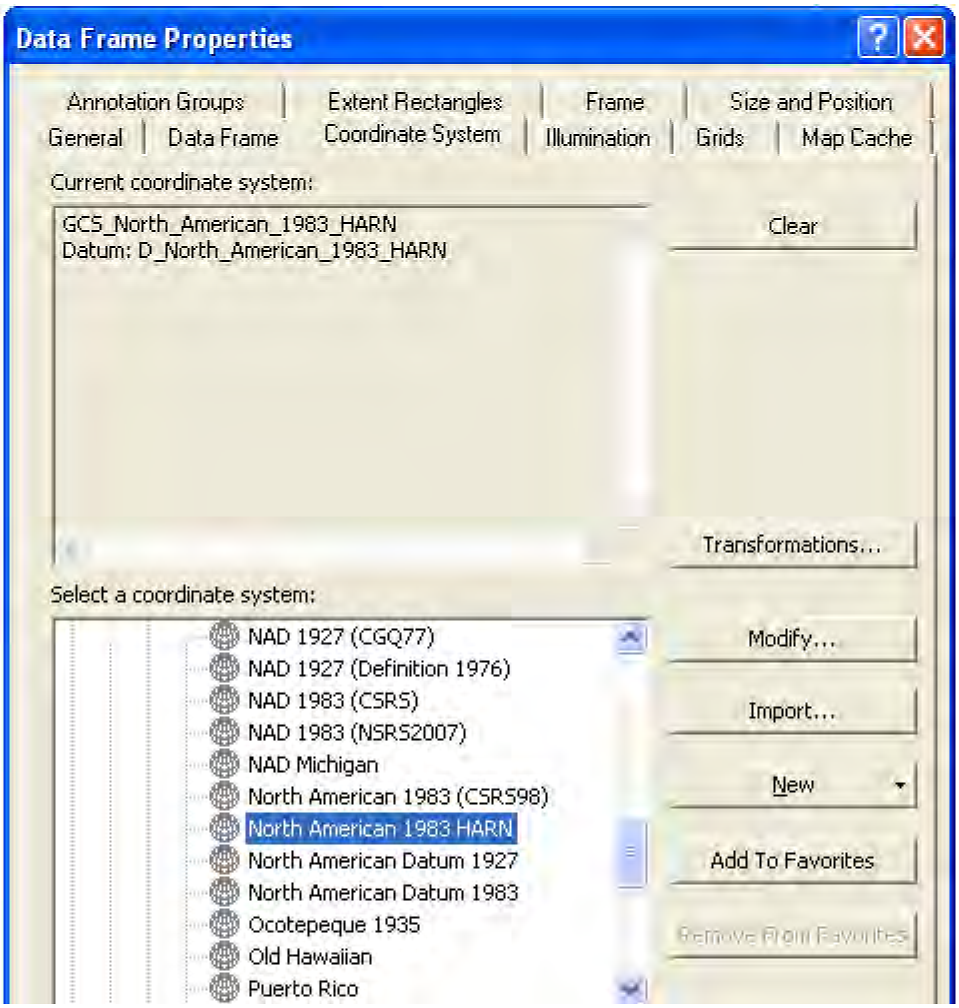
To do this, click on the word "Layer" in the upper left corner.



Then right click and select "Properties". Choose the "Coordinate System " tab. Select the folder: Predefined>North America

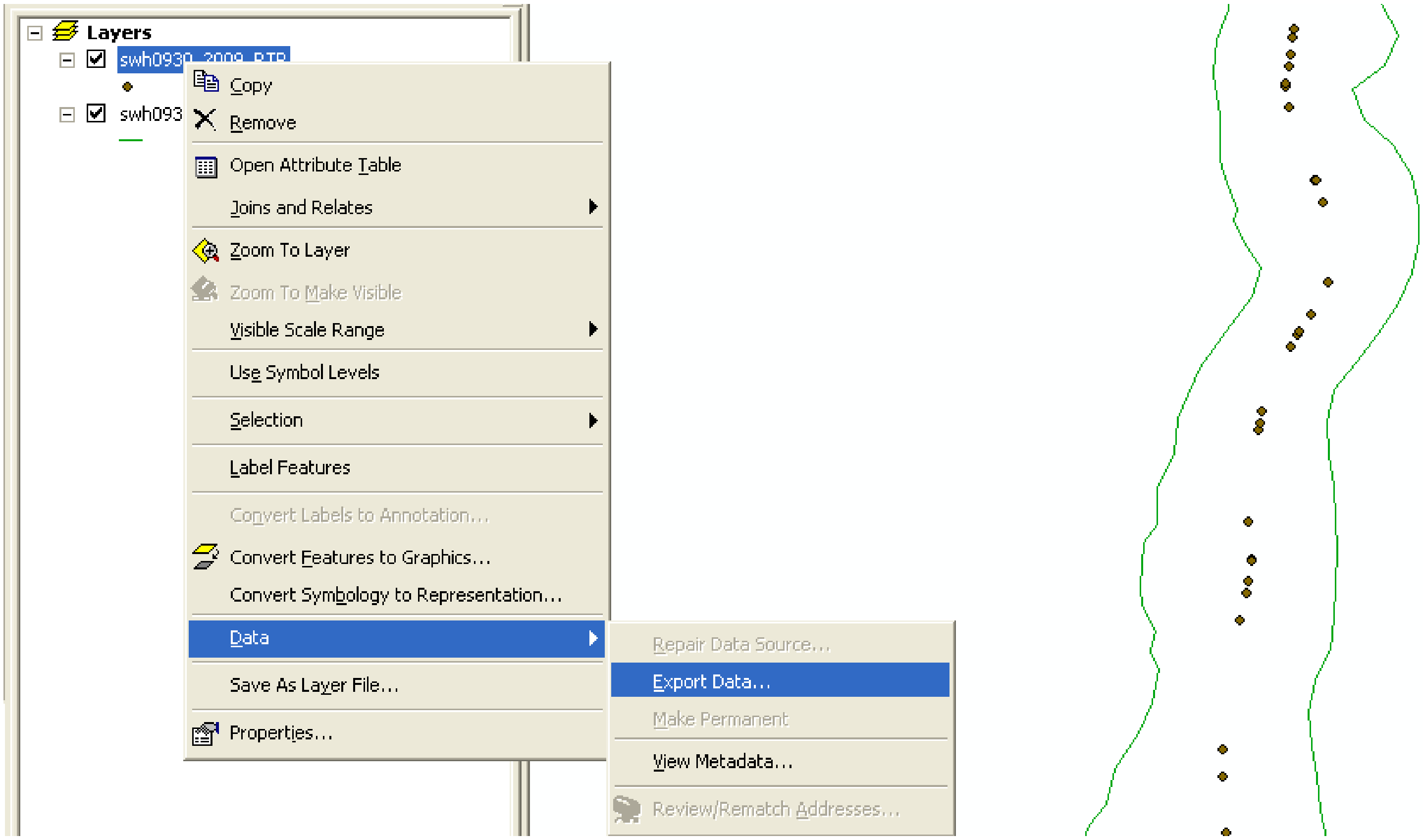


Scroll to "North American 1983 HARN" and click "Apply"

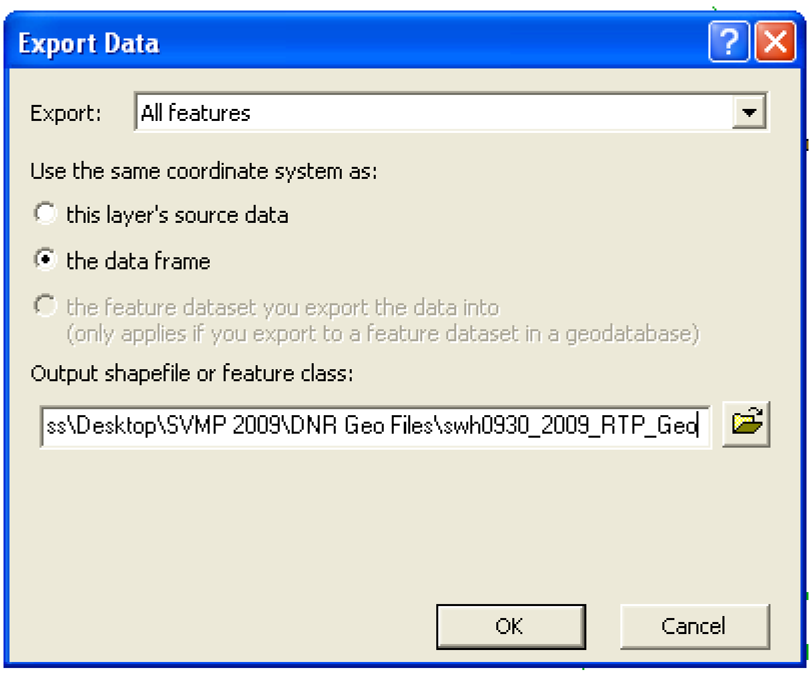


Answer "Yes" to the warning screen about transforming to a geographic. Create a new folder in the SVMP folder to hold the DNR Geo Files.

Now we want to export the data for each layer, adding "_Geo" to the file name, to the new folder you named "DNR Geo Files". To do this right click on the layer you want to export and choose "Export Data".



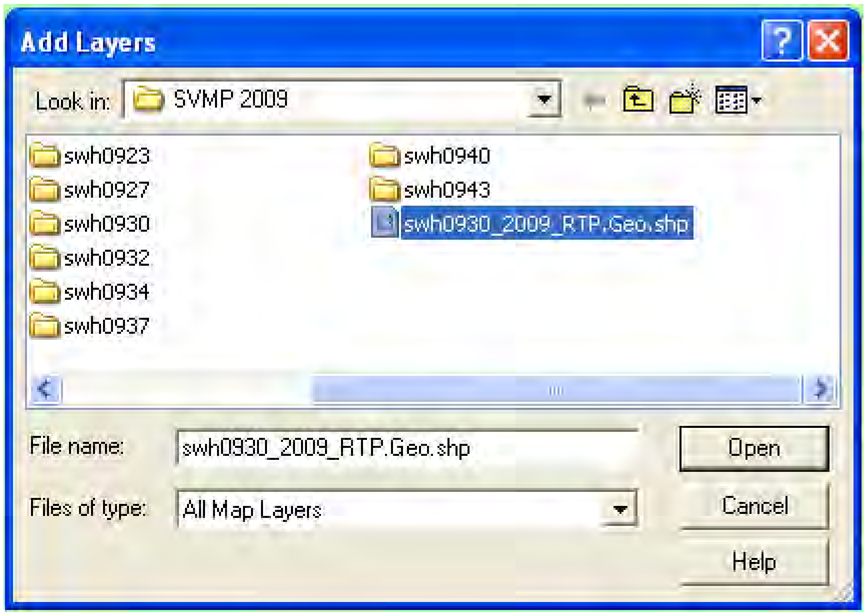
Make sure to select "the data frame" button, add" DNR Geo Files" to the path and rename the file by adding a "_Geo" to it.



Repeat this for all the transect point and sample polygon layers you loaded in ArcMap. After this is done, close ArcMap without saving anything – we shouldn't need this anymore.

Start Mediamapper. Either Create and new map or open an existing one if that is desirable.

Use the "Add Layers" button -  - to import the new geographic transect points into Mediamapper.



Select the transect point and sampling polygon files for one site and click "Open". Right click on the new layer (imported to Other Layers) to scale the map to the layer ("View Extents of…") or use "Layer Manager" to raise the layer to a higher plane (may be under other layers) or change the symbol or labels for the points.

If you chose to create a new map, you can now populate it with background maps, draw transect lines or import other data. To import background aerial maps, set the map width to between 2.5km and 5.0km, click on Map>TerraServer Maps… and choose "Aerial Photo" map type and 1 meter/pixel resolution, then click "download". This can take 15 minutes to download.

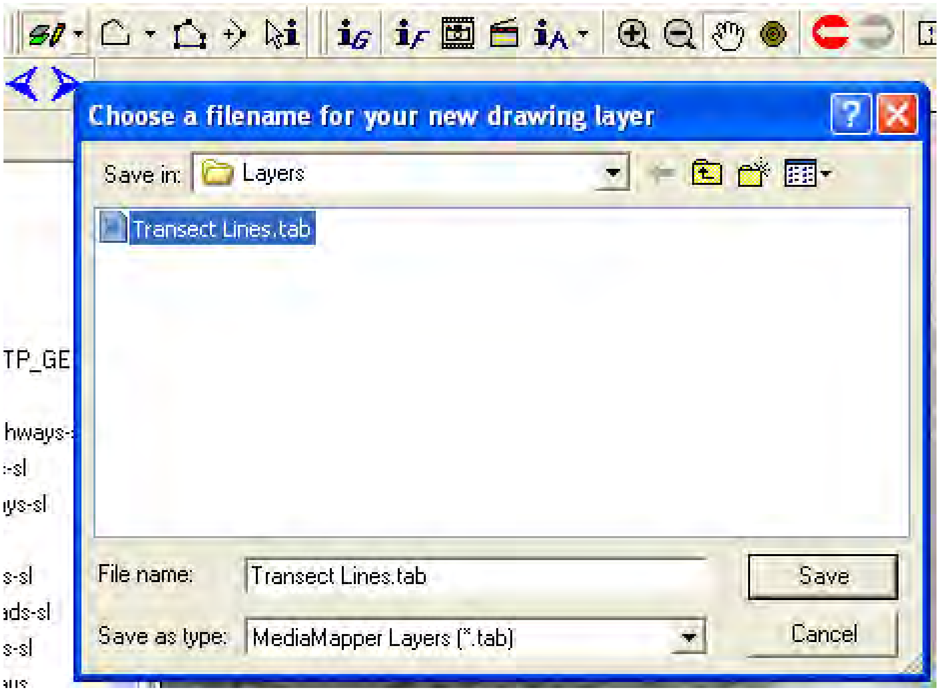
Save your new map named for the site (e.g. swh0930).

V2. Drawing Transect Lines for Navigation

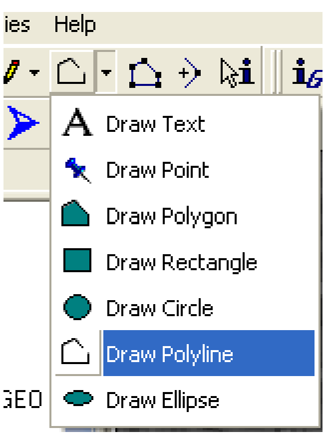
The goal of this task is to create lines on a Mediamapper map for the boat captain to navigate using the live GPS navigation capabilities of the RedHen VMS300 box.

Open the appropriate Mediamapper map which has DNR transect points and sampling polygon imported (see V1) at the site of interest.

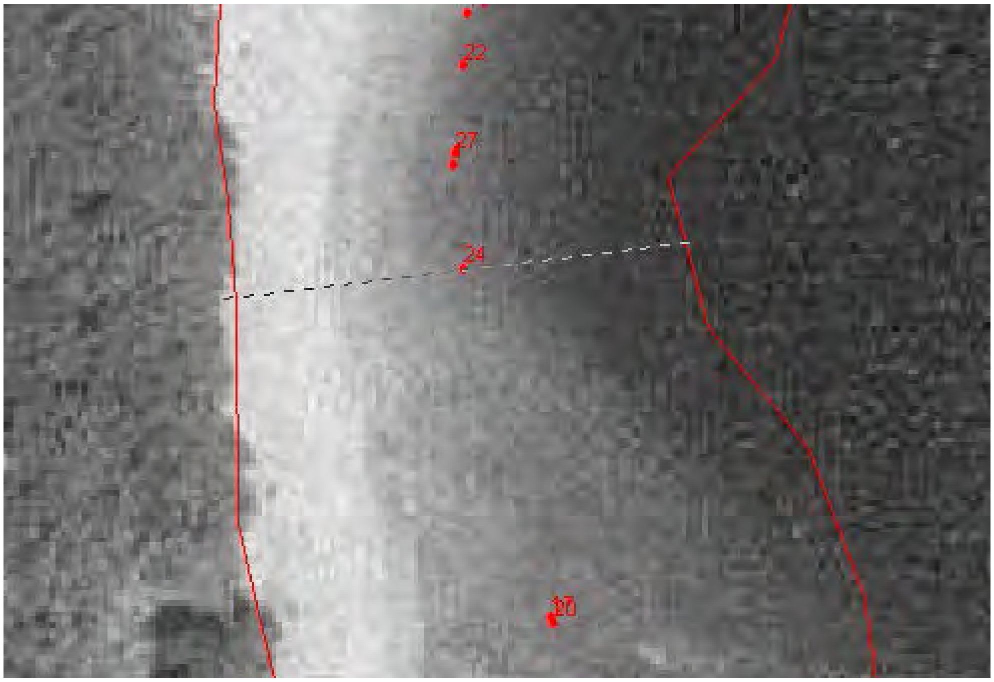
Use the "Create Drawing Layer" tool to create a layer called "Transect Lines"



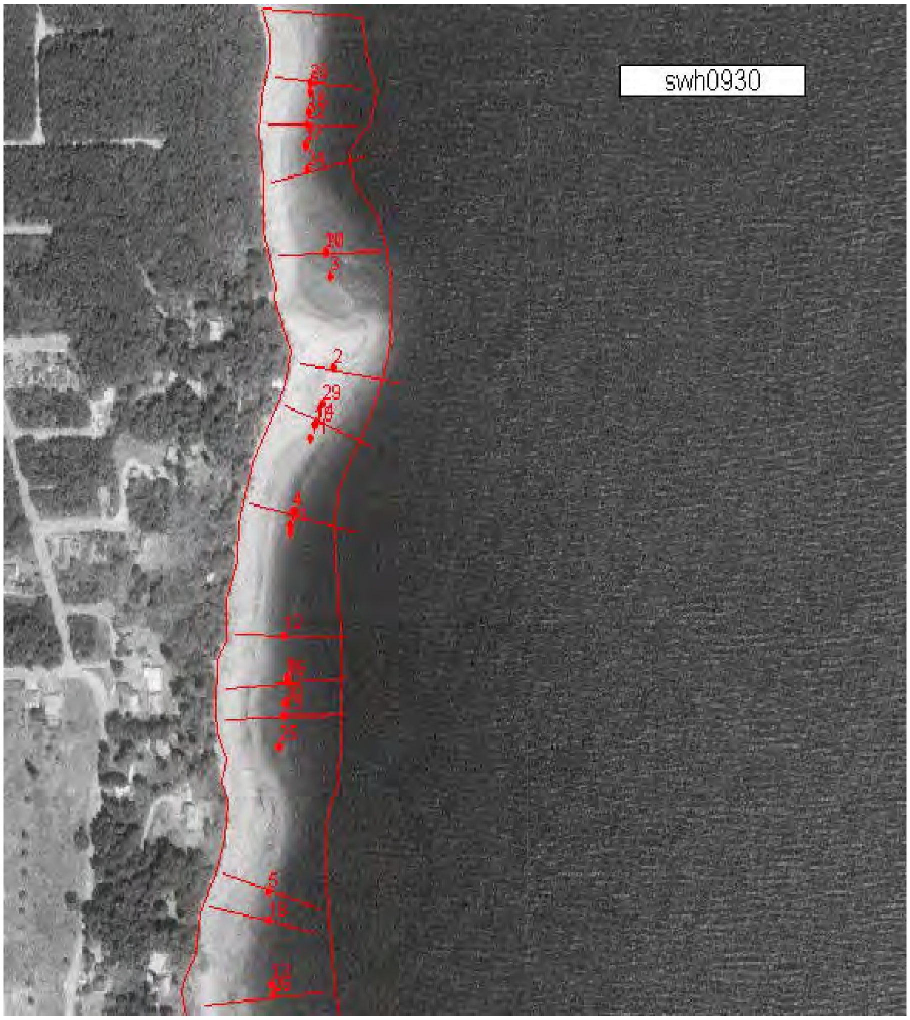
Then select "Draw Polyline" from the drawing mode choices and select the drawing tool.



The goal is to draw lines completely across the sampling polygon that are approximately perpendicular to the line running through all the transect points. Pick the transect points by labeling with them with “SEL_ORDER” (use layer manager to do this) and take 12 consecutive numbers (i.e. if there are 35 points take points 1 though 12) for which to draw transect lines.

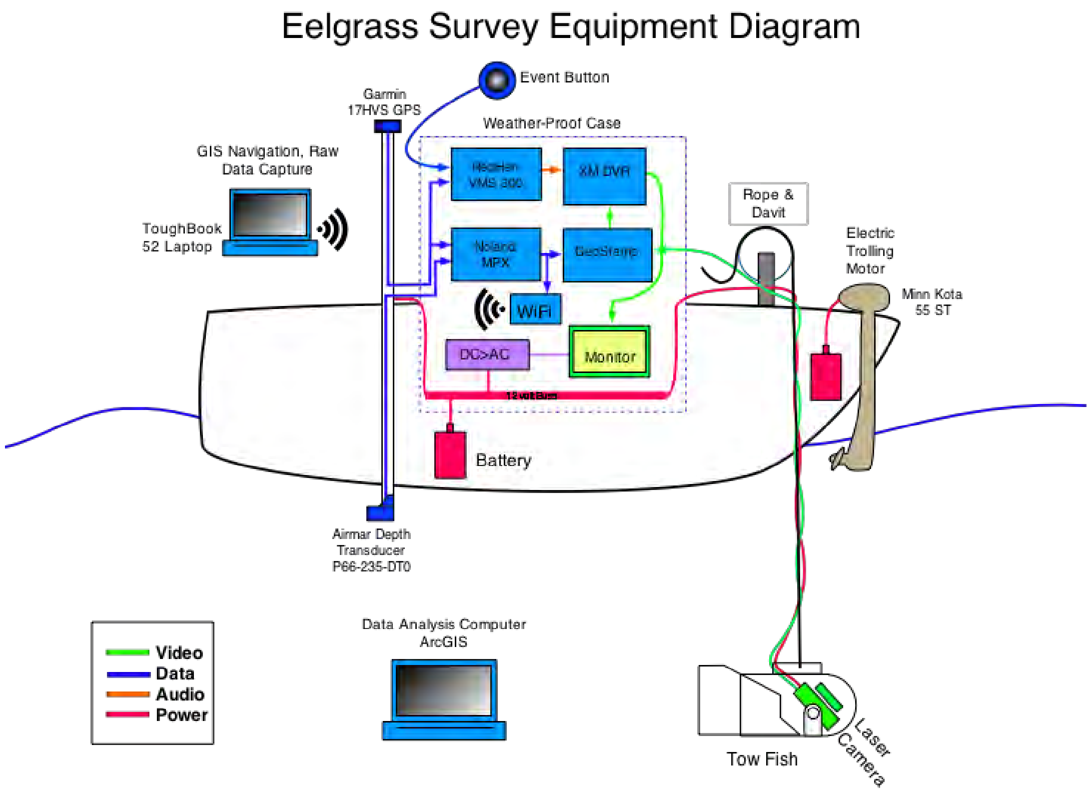


Again, you can use the layer manager to change the color and style of the lines you draw. When you are done it will look like this:

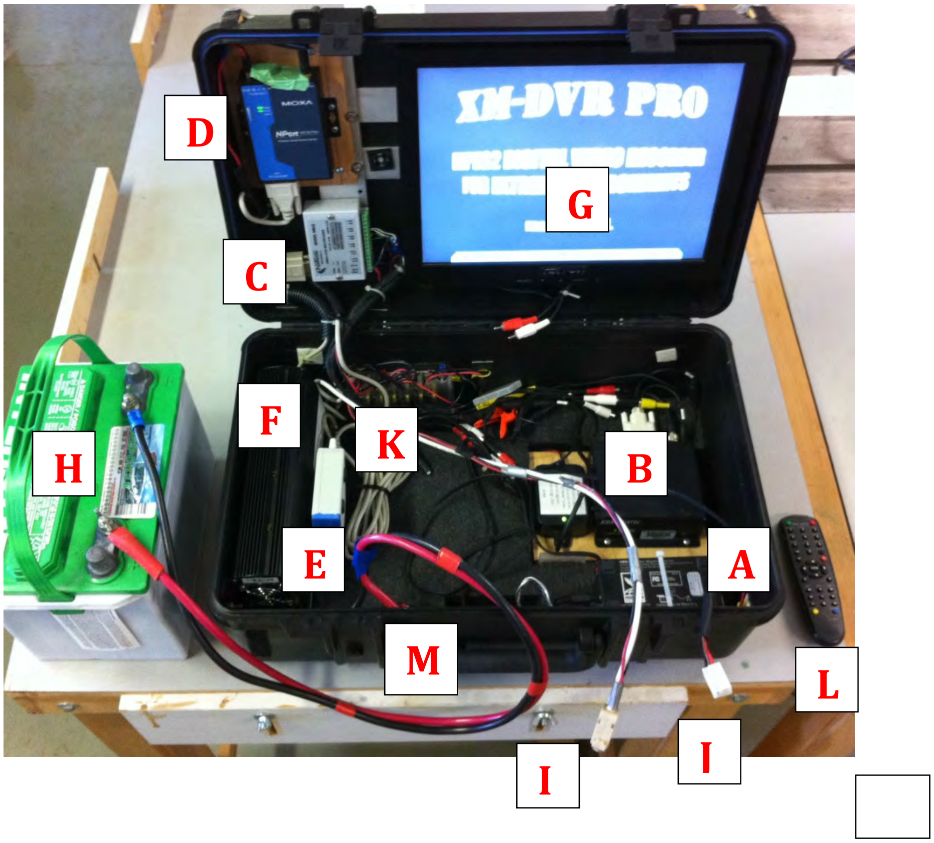

swh0930

V3. Collecting geotagged underwater video.

The hardware our group uses to simultaneously collect underwater video, GPS data and depth sounder data is show in the diagram below:



The weather-proof case contains all the electronics to record data from all the sensors (camera, gps, depth transducer):



A. RedHen VMS300

B. XM Digital Video Recorder

C. Noland Multiplexer

D. WiFi Unit

E. GeoStamp Text Overlay

F. DC> 60Hz AC Converter
AC is not used at this time

G. Monitor

H. Battery/Cable

I. GPS/Depth Transducer –In Cable

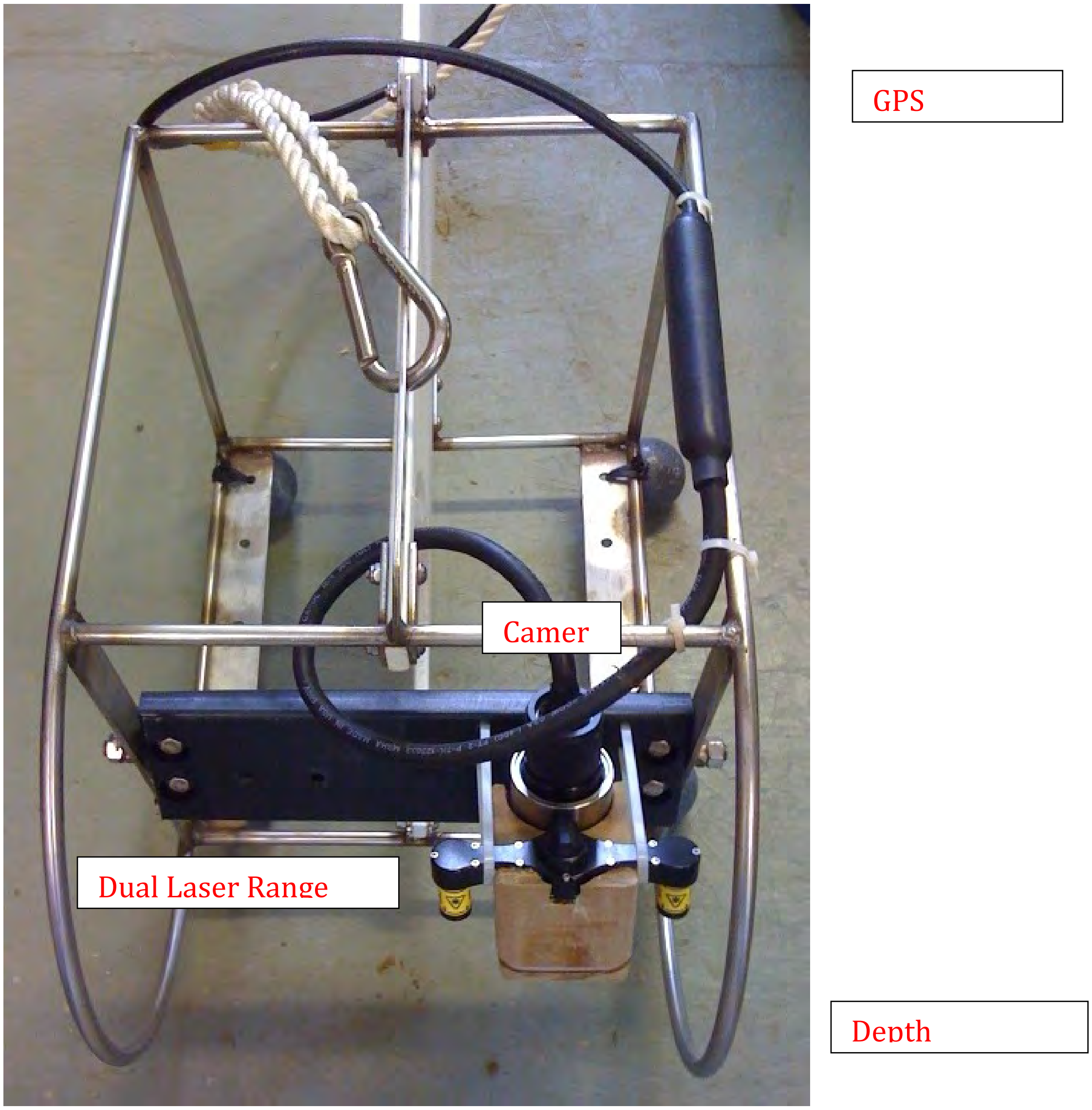
J Camera Power

K. Video-In Cable

L. XM DVR Remote Control

M. Circuit Breaker

Signals come from the camera on the tow fish and the Gps and Depth transducer mounted on a pole.


GPS
Camer
Dual Laser Range
Depth

Set-Up Procedure for Underwater Video Data Collection

DON'T FORGET TO RECHARGE THE BATTERY AND LAPTOP BEFORE GOING OUT ON THE BOAT!!!

1. Mount the GPS/Depth Transducer pole and measure the distance from the bottom of the depth transducer to the water level. (Ken's boat is approximately 20")

2. Position the tow fish rope bucket is near the electronics box; hang the tow fish on the davit.

3. Make connections:

a. Confirm the circuit breaker off by pushing the red button (Figure # - Component N)

b. Connect the battery cable to the battery (Red first then black)

c. Check that the video monitor power is on (switch on bottom right/ green power light in on)

d. Connect the GPS/Depth Transducer 9-pin connector

- note flashing green light on Noland Multiplexer

- wait for solid red NAV light on VMS300

- within a minute the VMS300 red NAV light blinks once per second indicating data processing

- should see Time/Date/Depth/GPS data on monitor

e. Turn on dual laser range finder if desired

f. Connect camera power cable to electronics box

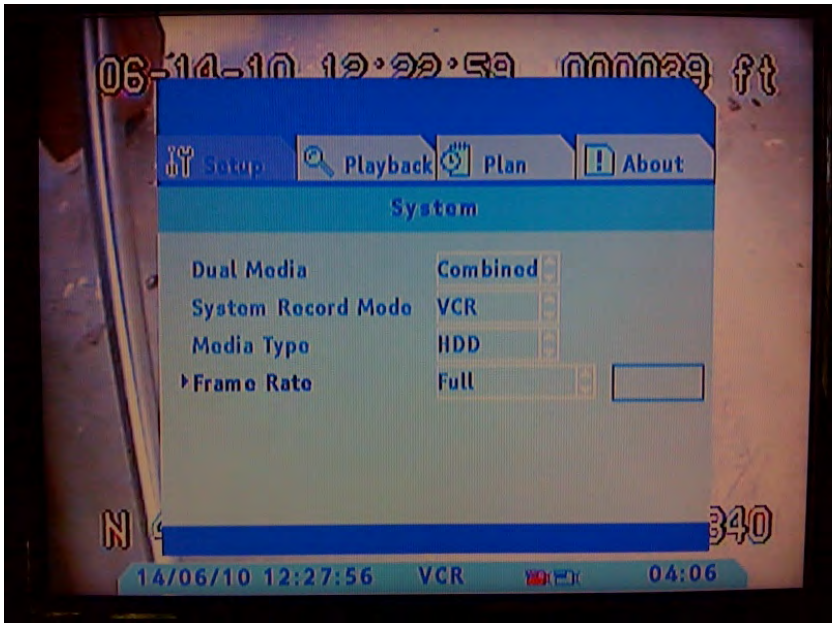
g. Connect video cable to GeoStamp box (top-most RCA connector); image should appear on-screen

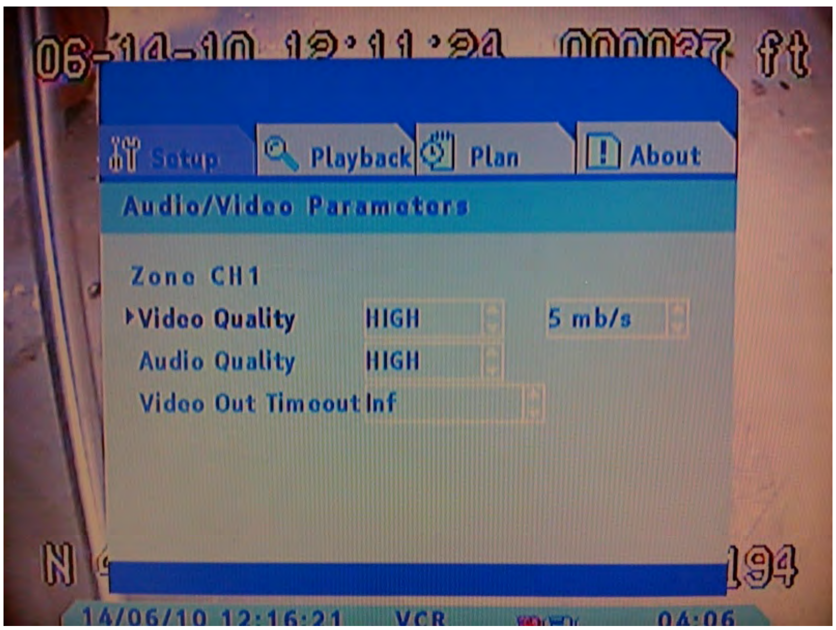

06-14-10 12:11:54 000025 ft
N 47 57.4388 W122 26.5198
14/06/10 12:16:51 VCR 04:06

If the video is frozen or absent – bypass the Geostamp box by disconnecting the video-in cable from the GeoStamp box and connecting it to the cable labeled "to monitor".

h. Check the XM DVR green light (left) is on and amber light (right) is blinking.

i. Only if necessary, check the DVR parameters using the "menu" button on the remote.

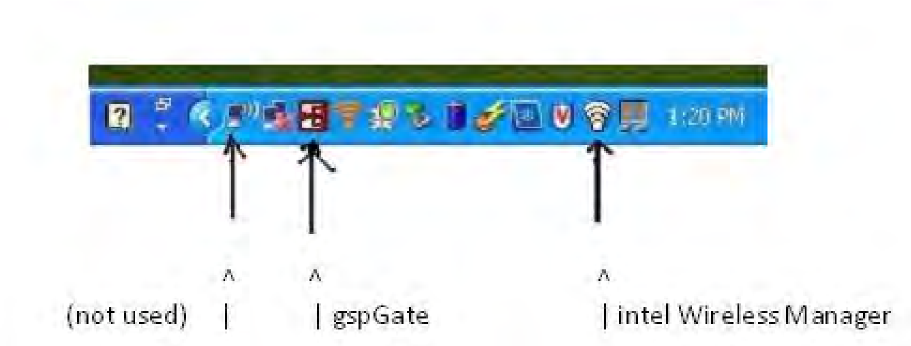




4. Navigation/Data logging --Computer Startup

a. Power-up and Log-on (ID: Eelgrass PW: bluesky##
- ## changes every month or so – usually between 01-12)

b. Wait for the following icons to appear in the desktop tray



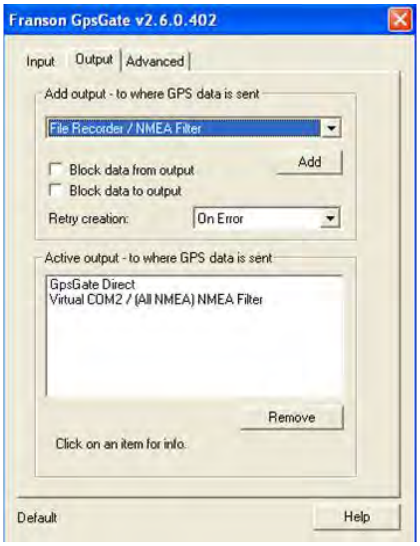
The red color on gpsGate indicates it is not connected. It will change to green when connected.

c. Select the Intel Wireless Manager (Icon) and verify connection to WS4000

d. Wait for the WiFi Network Connection (Icon) and the GPSGate Icon to show connection (green)

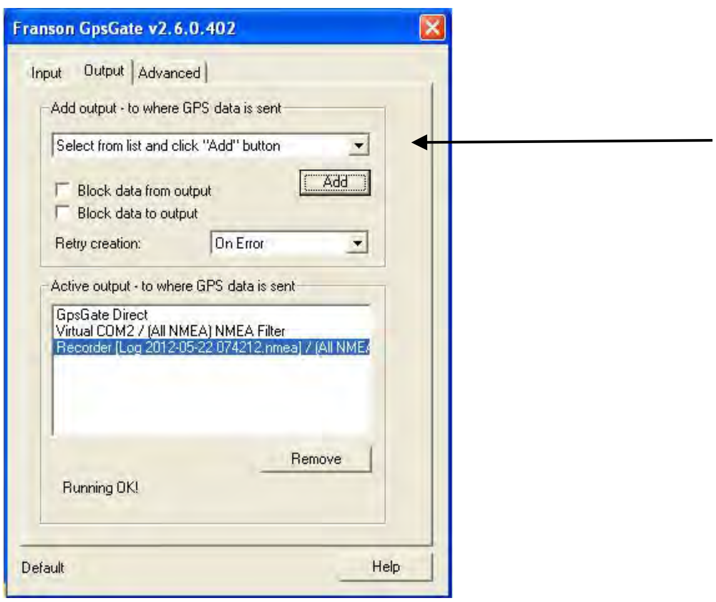
e. Click on the GPSGate icon and select “Settings”.

f. Select the Output Tab



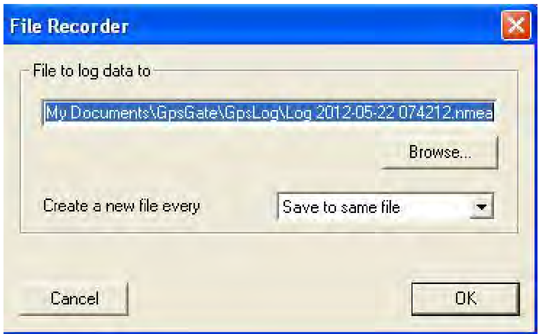
Remove all open files except GpsGate Direct and Virtual COM2/ (all NMEA) NMEA Filter

g. Select the "File Recorder / NMEA Filter" Type from the pull-down menu



and Click on "Add" button

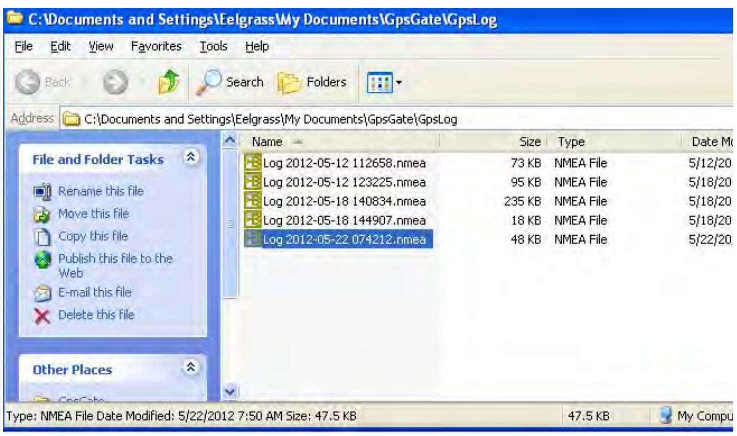
h. Use pop-up window file name that is displayed ;



i. Click OK to enter file data, OK to allow all NMEA and close the "Settings" window.

j. Double click the Logfile link (upper right corner) to display the "GPS Log" icon in upper right and

verify that the file is gathering data.



File size of selected Logfile should be increasing

If problems: review setup configuration --TBD

5. Establish live GPS tracking.

a. Double Click on the SVMP2014 icon in top right corner of home screen. 

Map of Whidbey with site transect lines should appear. If the desired site is not being displayed, select the layer tab at lower left, and select the proper site layer (e.g. swh0932_TL).

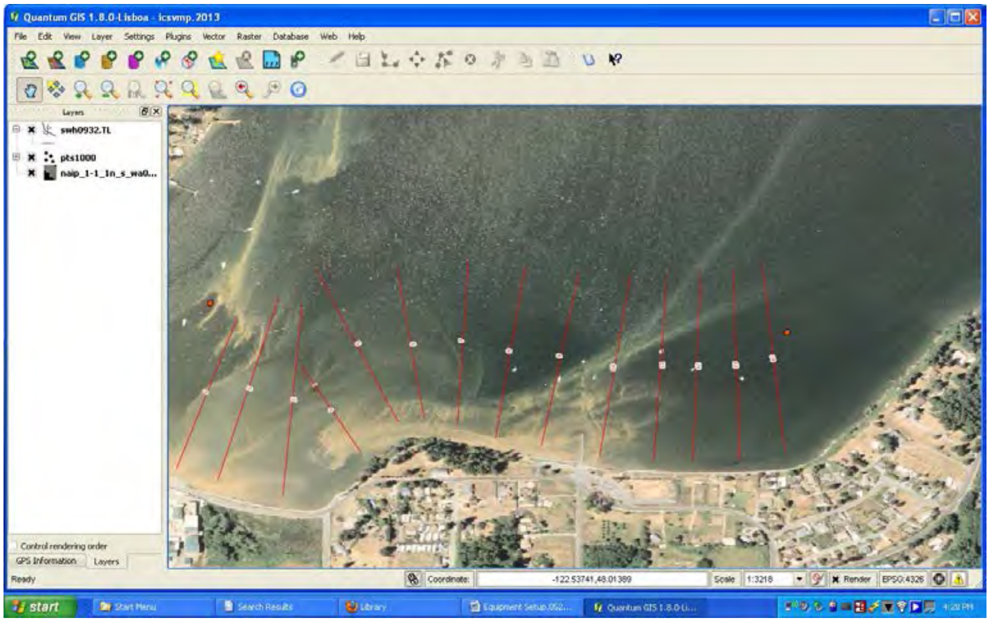
Then use the Zoom to layer tool icon

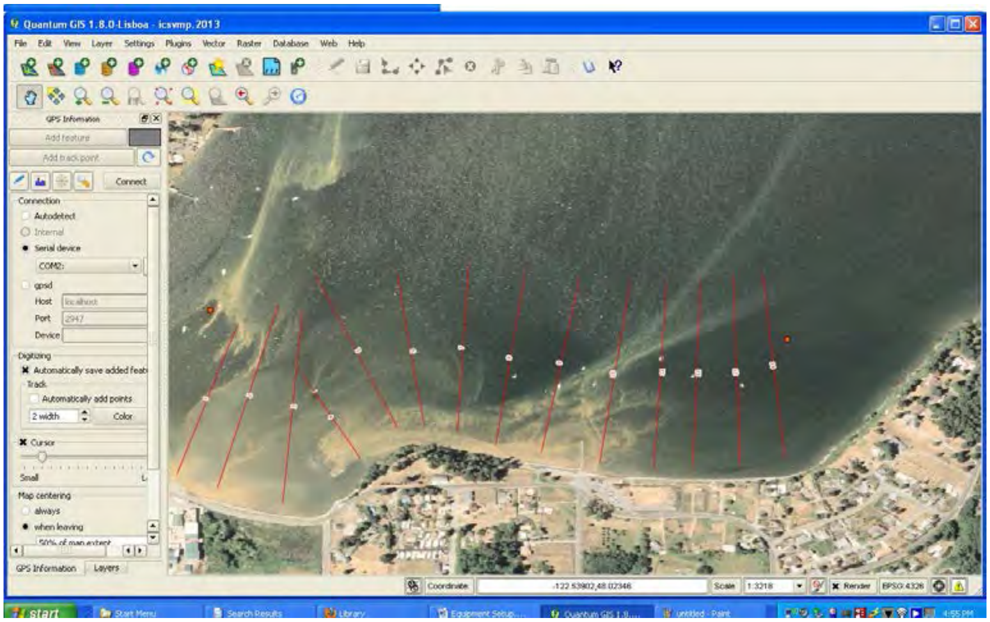
to display the transect layer and associated map.

b. Select the GPS information panel using the tab on the bottom left.

Make sure serial device COM2: is selected, then click Connect on the subpanel.

The current position should be displayed on the map.





6. Use XM DVR to record video

a. toggle the remote red “ON/STBY” button until the Sharp Monitor shows “RDY”

b. Press the remote red “REC” to start and stop video recording

b. Video is recording when red “REC” in overlay is flashing and XM-DVR amber light flashes at 2x speed

c. Time displayed on bottom right is time remaining to record.

V4. Collect Data

Once the equipment is up and running, the tasks are to:

1. Navigate to and follow the transect lines at 0.5 mph as accurately as possible using the remote and trolling motor.

2. Start the video recorder (record button) before reaching the beginning of a transect line and use the even marker at the start of the transect line run to indicate the beginning.

3. During the run, control the height of the towfish/camera to be about 1 meter above the eelgrass tops or floor of the sea so that something is always in focus. If nothing is in focus, it may be scored as unusable video during video analysis. The depth display and rope markings can help anticipate changes needed, but watching the monitor is central in keeping the height above features of interest.

4. Occasionally eelgrass gets caught on the tow fish and must be cleared. If it is possible to complete the run, keep going. If not, raise the tow fish and clear the debris, then navigate to before where you raised the tow fish and continue the run. There is no reason to stop the video collection for the run; the gap in video quality can be removed by video editing guided by GPS data.

5. At the end of the transect run, use the event button to indicate the end. It is helpful for data processing if you also stop the recording shortly after using the event button and start again shortly before the beginning of the next transect line run. However, if you forget, this can again be handled by video-editing – the reason we record in MPEG-2 format.

6. After all transect line runs are complete, the electronics can be shut down. To do this:

a. make sure video recording is stopped (use the remote).

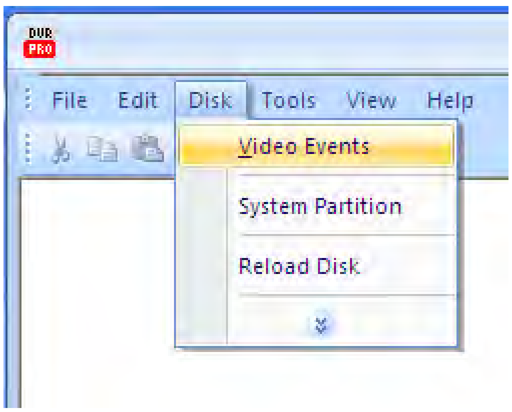
b. For the laptop, just shutdown: from startup icon (bottom left corner) select "Turn off Computer" the select shutdown. Wait for Windows XP to complete shutdown and power off, before closing lid.

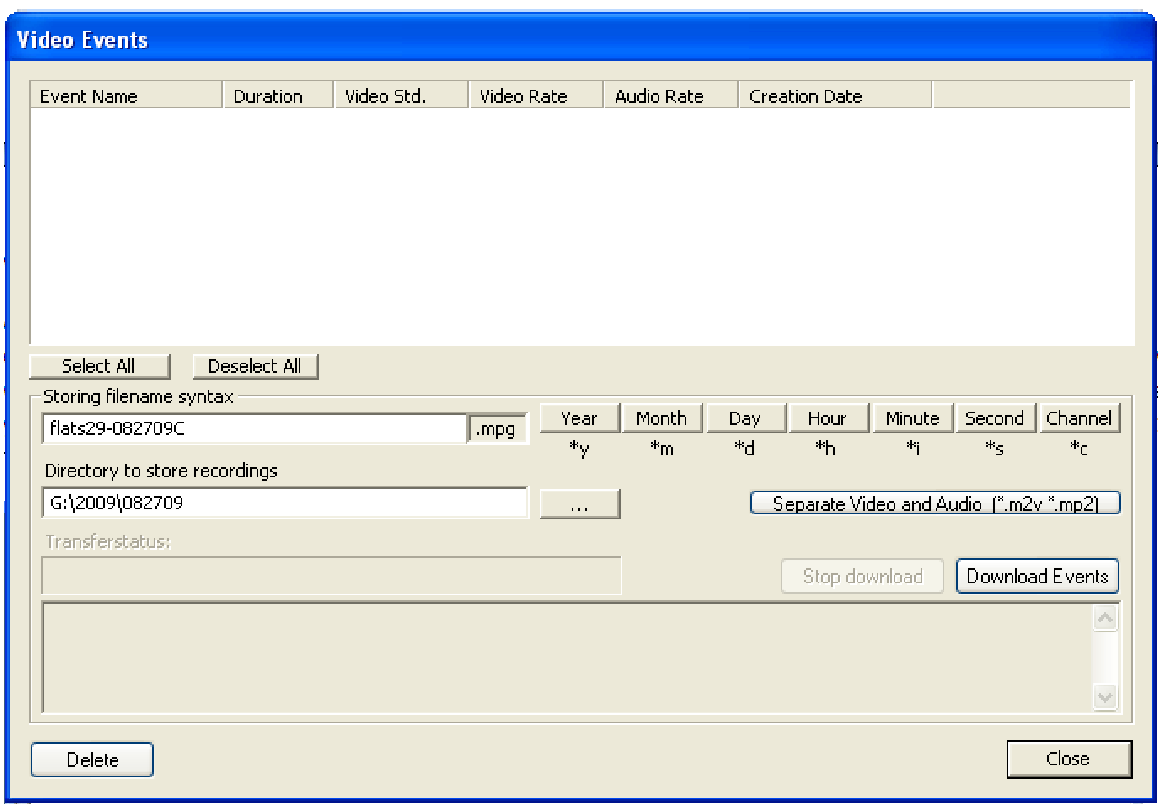
c. For the electronics box, just unhook the battery.

d. pull the towfish into the boat and disconnect all the cables to the electronics box; close the lid.

V5. Store Data.

After a hard day of collecting data on the water, we need to store the data on a computer and remove it from the compact flash cards in the XM-DVR to be ready for the next outing. XM-DVR provides a program, "DVR2PC", to do what we need. To do this you'll need to plug in the transformer to power the XM-DVR and connect the USB cable between the XM DVR and the laptop which is also connected to the external data storage drive (Iomega 1Tb drive). Once you have powered up and logged on to the laptop, find the shortcut to it on the laptop screen and double click. When the DVR2PC screen comes up, it will ask to which drive you want to use since the XM-DVR holds two compact flash cards and sees them as different drives. Select Drive 1. Then select the Disk tab and Video Events to view the files on the disk:





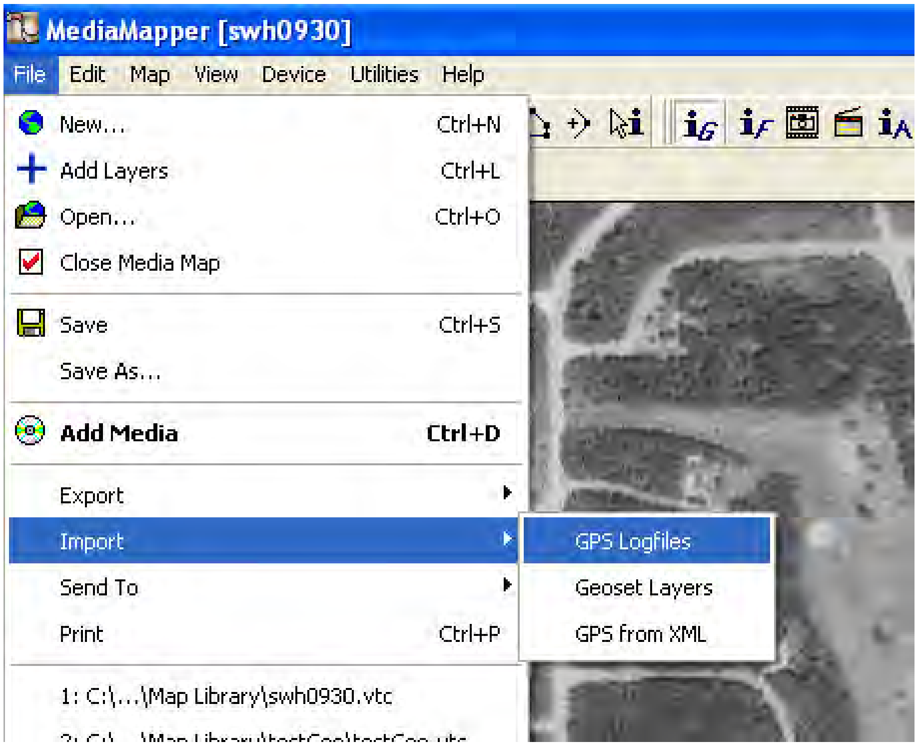
Unlike the screen above, you will see all the MPEG-2 video files you captured in the boat – one file for each time you started and stopped the XM-DVR recorder. You notice they were automatically named based on date, time and channels being stored. You can now set the directory in which you want the files stored by browsing or typing it in (in this case it is the Iomega 1Tb drive (G:) in the 082709 folder inside the 2009 folder). There is not enough space to keep all the raw data on the laptop, so we use an external drive for this. You can also define the filename for storing the data (eg flats29-082709C). Renaming the file will not lose any information. Then click on "Download Events" and, after the files are transferred, click on "Delete" to clear the CompactFlash card. If data is also stored on the second CompactFlash card, repeat the process for it. You have now saved the video recordings.

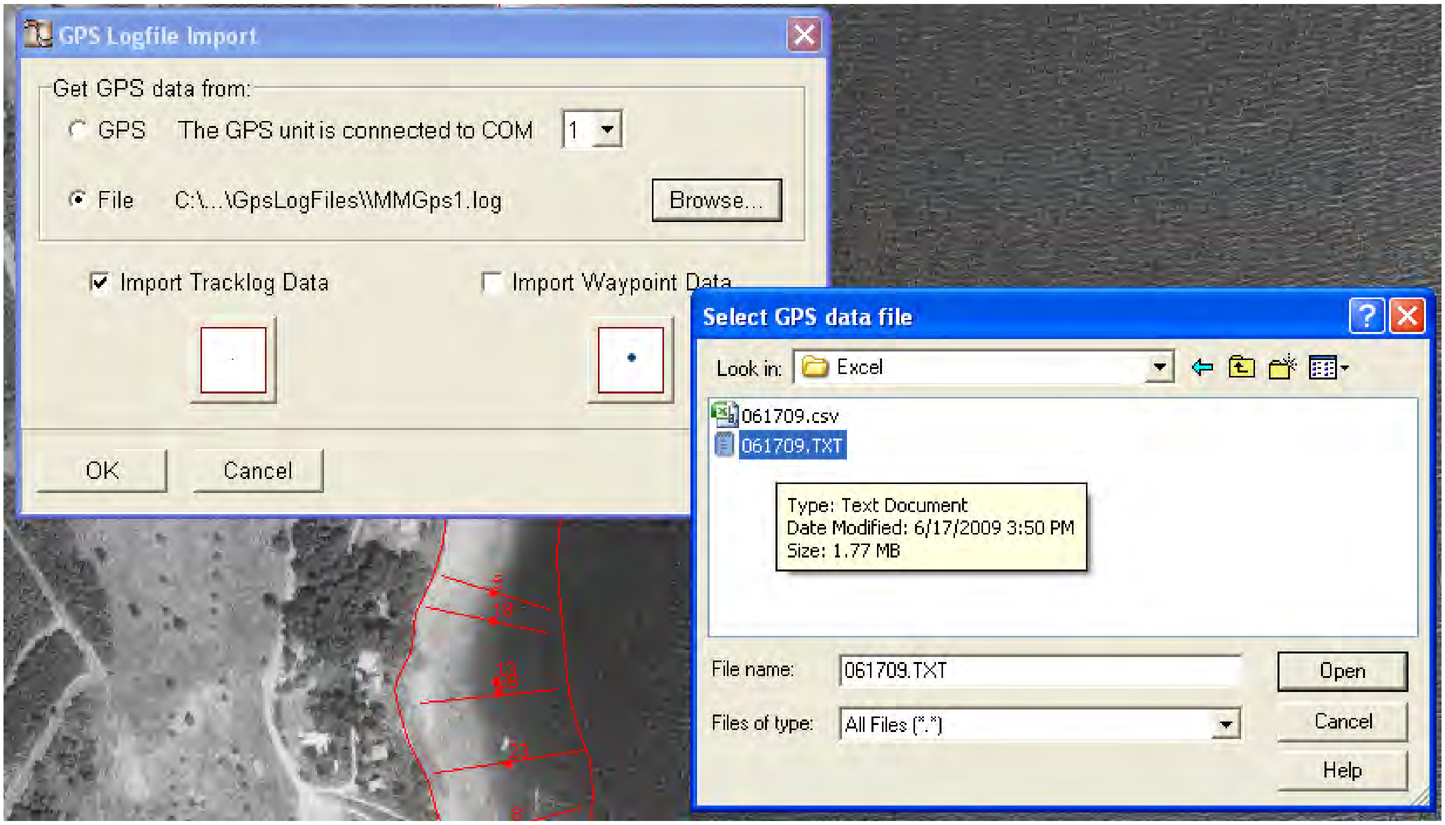
V6. Save the Tracklog data

Copy the tracklog file (mmddyy.txt you saved using Hyperterminal to the laptop on the boat) to the same folder you just saved the corresponding raw video (see V5). Locate the original tracklog on the laptop (e.g. SVMP2009\082709\082709.txt)and copy it to the same external data storage disk (e.g. G:\082709\ on the Iomega 1Tb drive). These are fairly small files so no need to delete them from the laptop. If these files are lost, we have another chance to reclaim the GPS (but not depth) information from the video's encoded audio channel at a later time using Mediamapper.

V7. Import Tracklog and Video data into Mediamapper.

We now want to display all the information we collected on the map we prepared for navigation. The first piece is the tracklog which shows the track of the boat through the water. It also contains our depth information, but that will not be imported to the map at this time. To show the tracklog, open the Mediamapper file for this site and import GPS Logfiles.

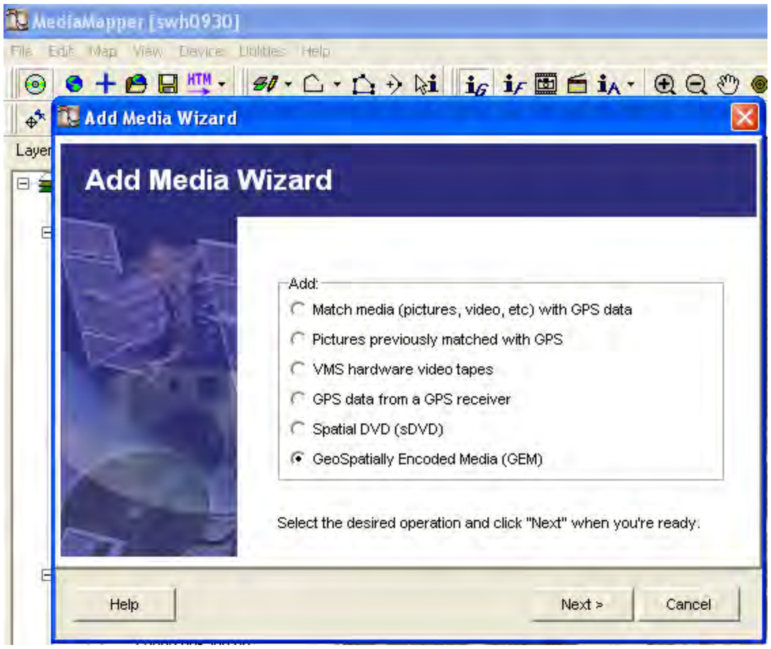




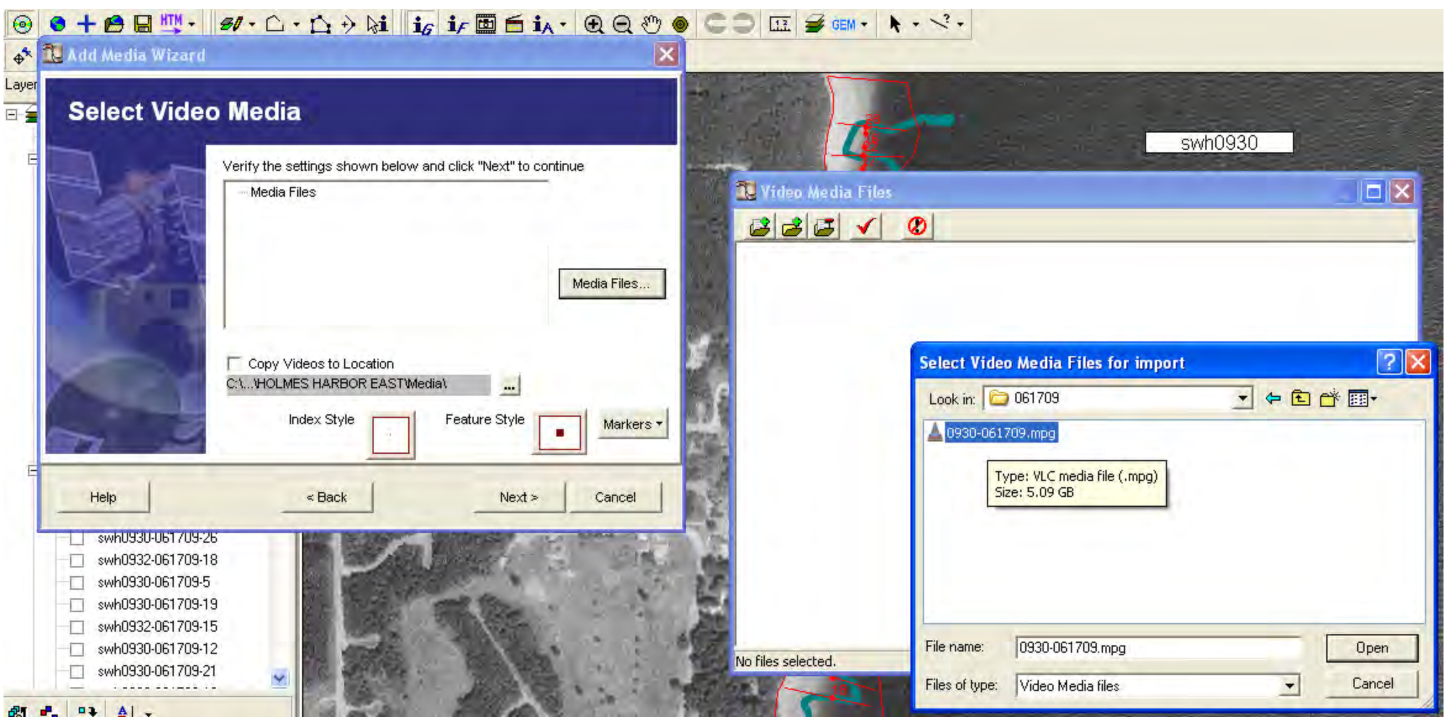
Browse to the tracklog file (e.g.G:\2009\swh0930\Excel\061709.txt) and open it.

The tracklog will import quickly and show the continuous GPS track that was recorded on the laptop.

Next bring in the video (.mpg) files. This will take a lot longer since the GPS information is stored in the audio channel and needs to be decoded. Also, the video files are very large. To do this click on the Add Media button and choose the GeoSpatially Encoded Media (GEM) button and click on "Next".



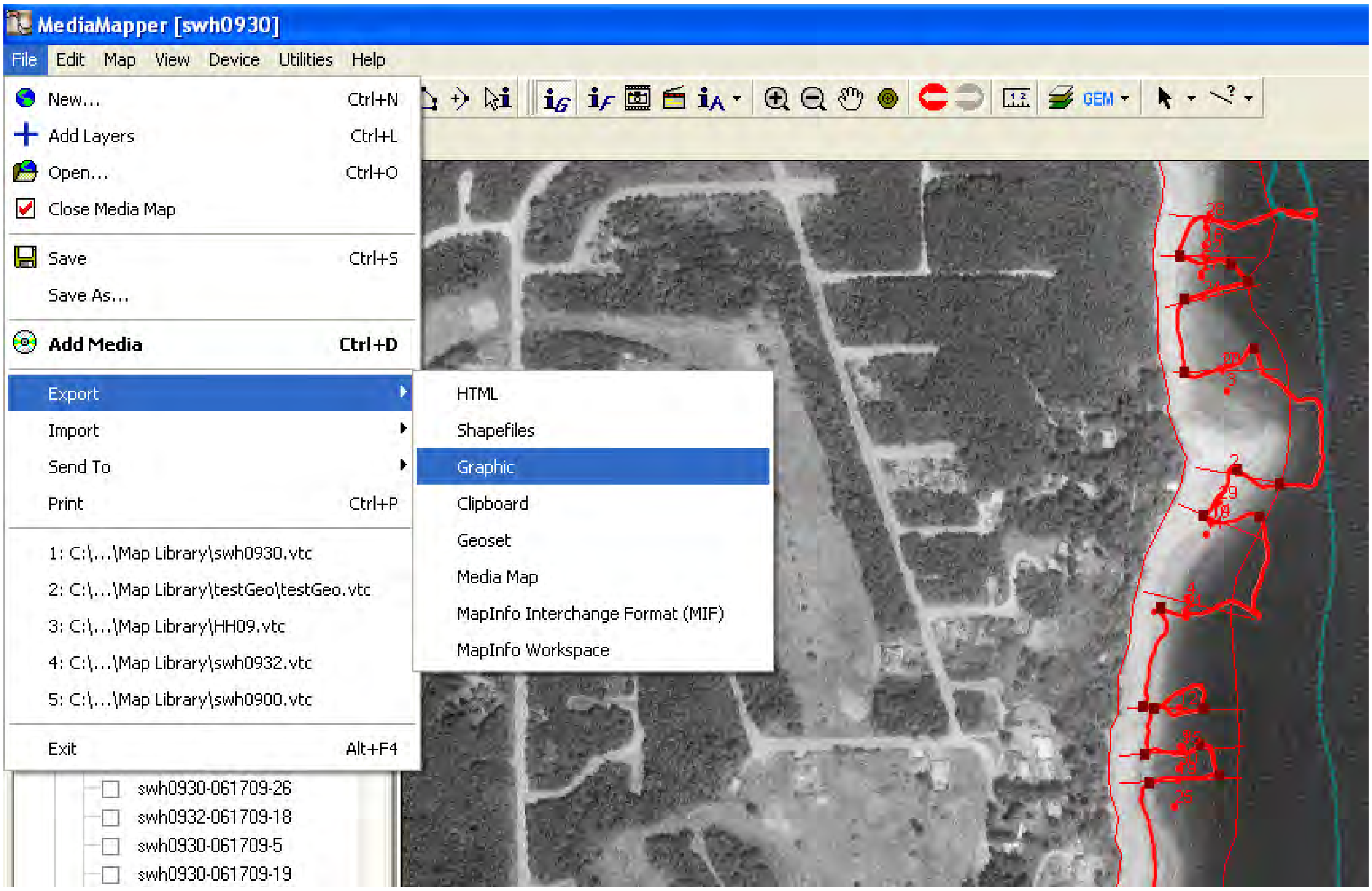
Browse your way to the stored video files, select all that apply and click "Open".



The video file(s)and event marks will open and can be drawn on top of the tracklog trace, but only in places where the XM-DVR was recording. As always, use the layer manager to adjust the display (color, style and layer position) of each component.

V8. Record Notes in interim Report

For 2009, I put together a quick report after each outing from brief notes of the data collection process (who was on board, which site, weather and equipment issues,....) and a map of the tracklog. This was sent to volunteers for their feedback. Included here are the cumulative notes from 2009. (Use Export Graphic to create JPEG Pictures)



V9. Make Transect Clips

Our goal is to make individual video files for each transect to make analysis possible without the use of Mediamapper. To do this we will use the capability of Mediamapper to playback the video and allow us to clip the continuous video into separate files. This is only possible if we recorded the files in MPEG-2 format and is one of the primary reasons we switched from DVD recording to DVR recording. To do this:

1. click on the "search and pause" button on the lower left of the main Mediamapper screen (blue pause sign in oval)

2. click the video map trace where the clip should begin (start of transect run – you can check direction by using play)

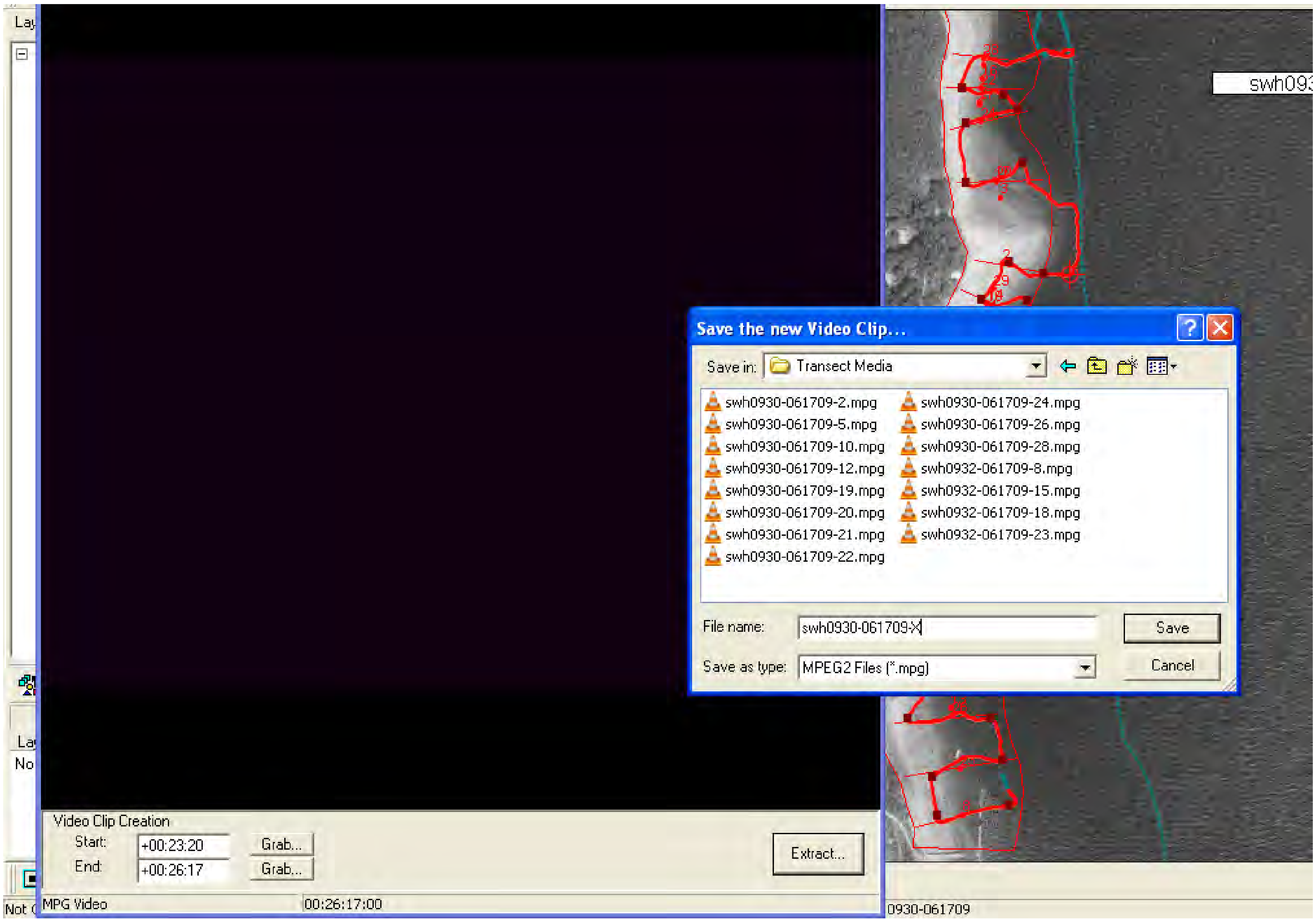
3. a frame from the video will show up in a video player window (black here due to copy screen limitation)

3. At the bottom of the video player screen you will see "Start:" has been filled in with the time.

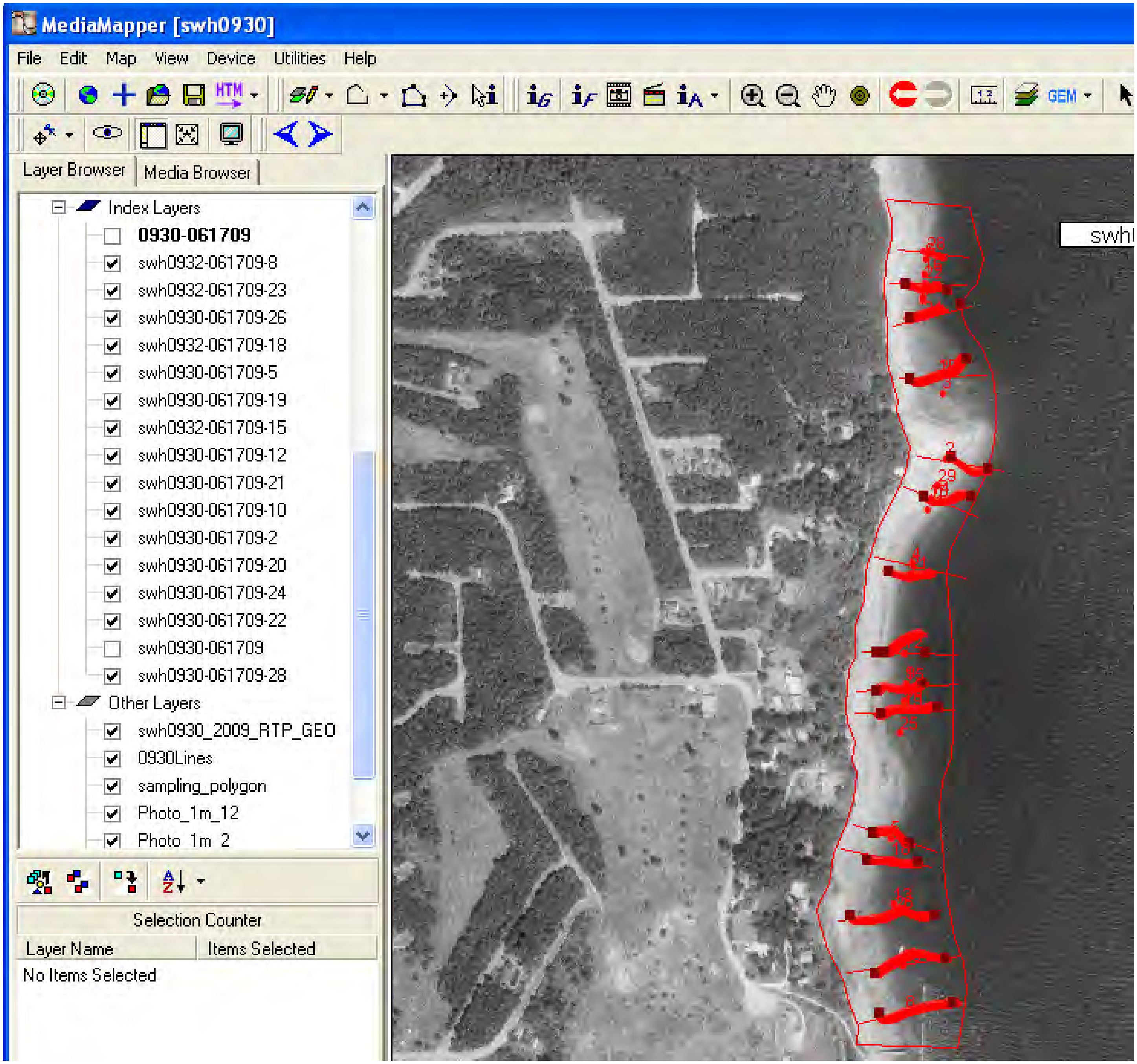
4. click on the video map trace where the clip should end (end of transect run)

5. click on the "Extract" button and a "Save…" screen will appear. Browse to the "Transect Media" folder for this site and type the name to include the transect point number displayed on the map at the end (e.g. swh0930-061709**_2**).

6. click "Save" and repeat the process for all the transects.



Each of thetransects will be added to the map (or can be imported a new media) and displayed as below.



This process has met with mixed success. Sometimes the clipping step fails for no apparent reason – all the other transects clips work and one or a few don't. Other video editing programs can also make video clips, but none allow you to see the start/stop point simultaneously on a map as in Mediamapper. To use other programs you must first determine the time from start of video recording using Mediamapper (including frame number or fraction of a second) or use the overlayed information on the video (Date, Time, Depth,GPS Coordinates) to determine where to cut. Using the overlayed information, you may be off by as much a second since that information only updates every second. This process is very time consuming and can be avoided if during underwater video collecting the XM-DVR is started and stopped at the beginning and end of each transect run resulting in one file per transect.

V10. Export Transect Shape Files

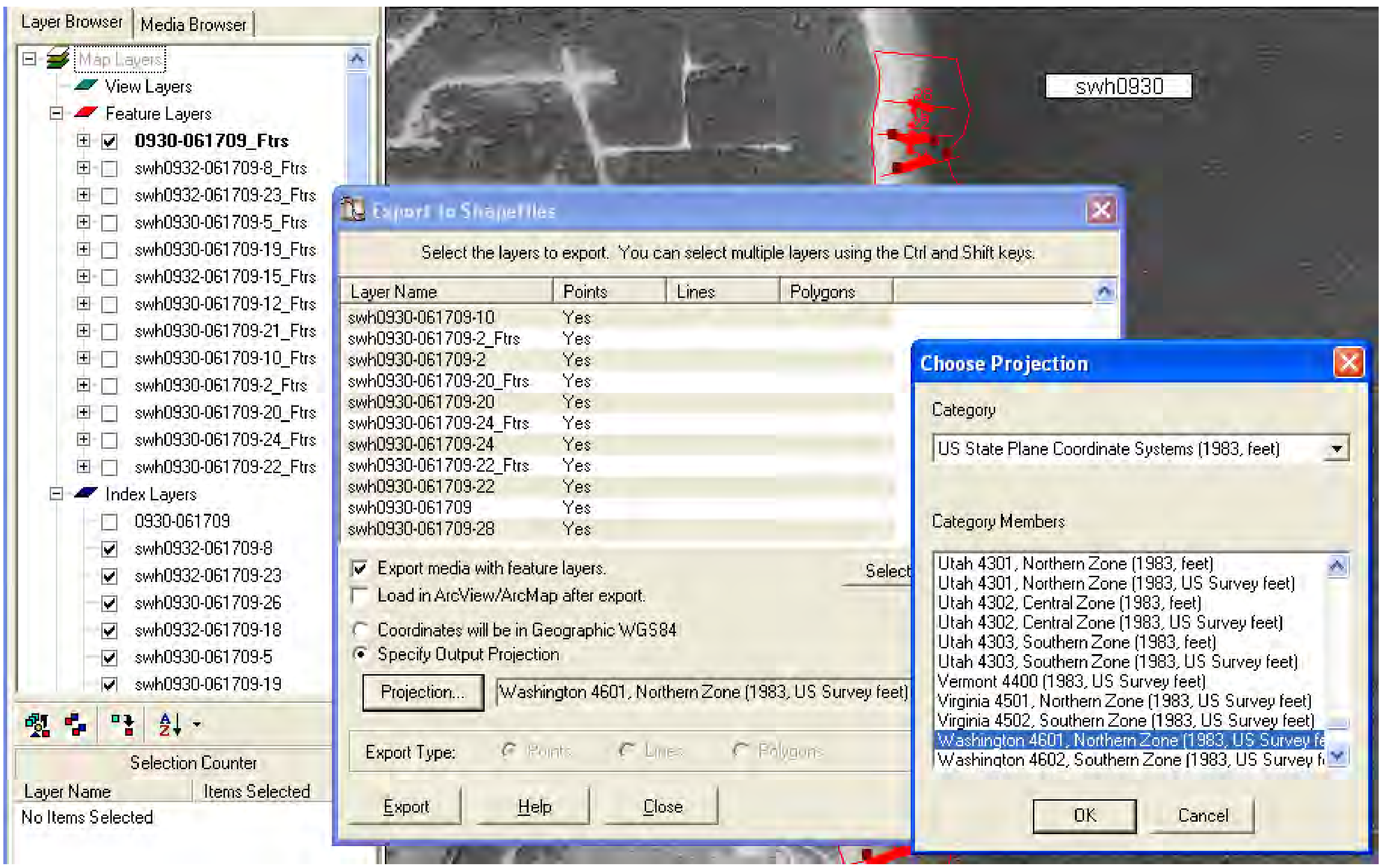
Since ArcMap has become the standard platform for GIS data, at this stage we can quit using Mediamapper and switch to ArcMap. To do this create shape files (.shp) in Mediamapper and to import them into ArcMap:

1. under the File menu in Mediamapper, choose Export>Shapefiles to see the windows below

2. specify the output Projection as US State Plane in feet; Washington 4601 Northern Zone and click “OK”

3. select all the transect video clip files you created in the previous task (V9)

4. click “Export and browse to the appropriate “Transect SHP” folder for the site and save.



5. Once this is done, backup the SVMP folder onto the external drive.

V11. Create ArcMaps for the individual sites.

To make an ArcMap of the site of interest:

1. click on the ArcMap to create a new map

2. use the Add Data button to import the transect points and sampling polygon from the DNR file you used in task V1.

3. use the same tool to import the transect shape files you created in task V10. You can also create a group layer.

4. add data from the aerial background image from the island county image file (naip_1-1_1n_s_wa029_2006_1.sid) found at the web site: rocky2.ess.washington.edu/data/raster/naip/Island/index.html and stored in the Documents and Settings>Eelgrass>MyDocuments> folder on the laptop.

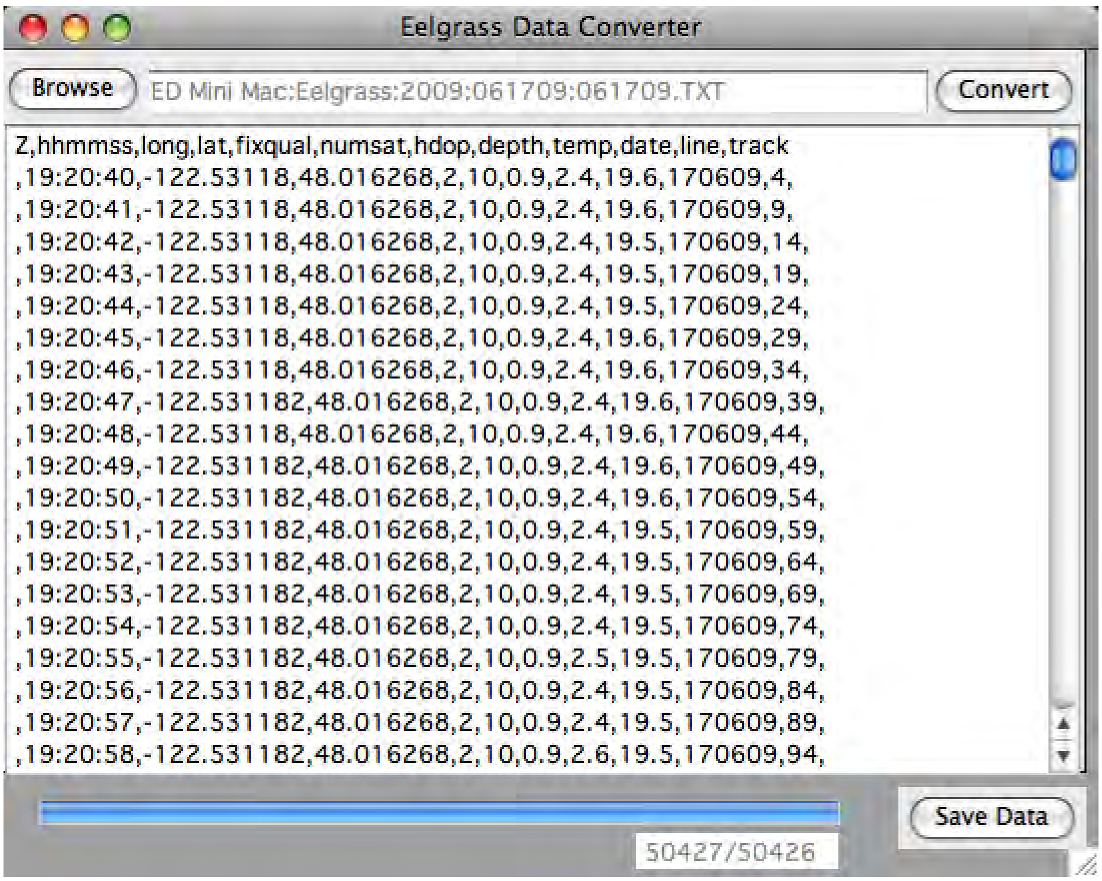
5. adjust the color and style of the different layers using the "Properties" of each element.

6. Save the ArcMap to the site folder in the SVMP folder.

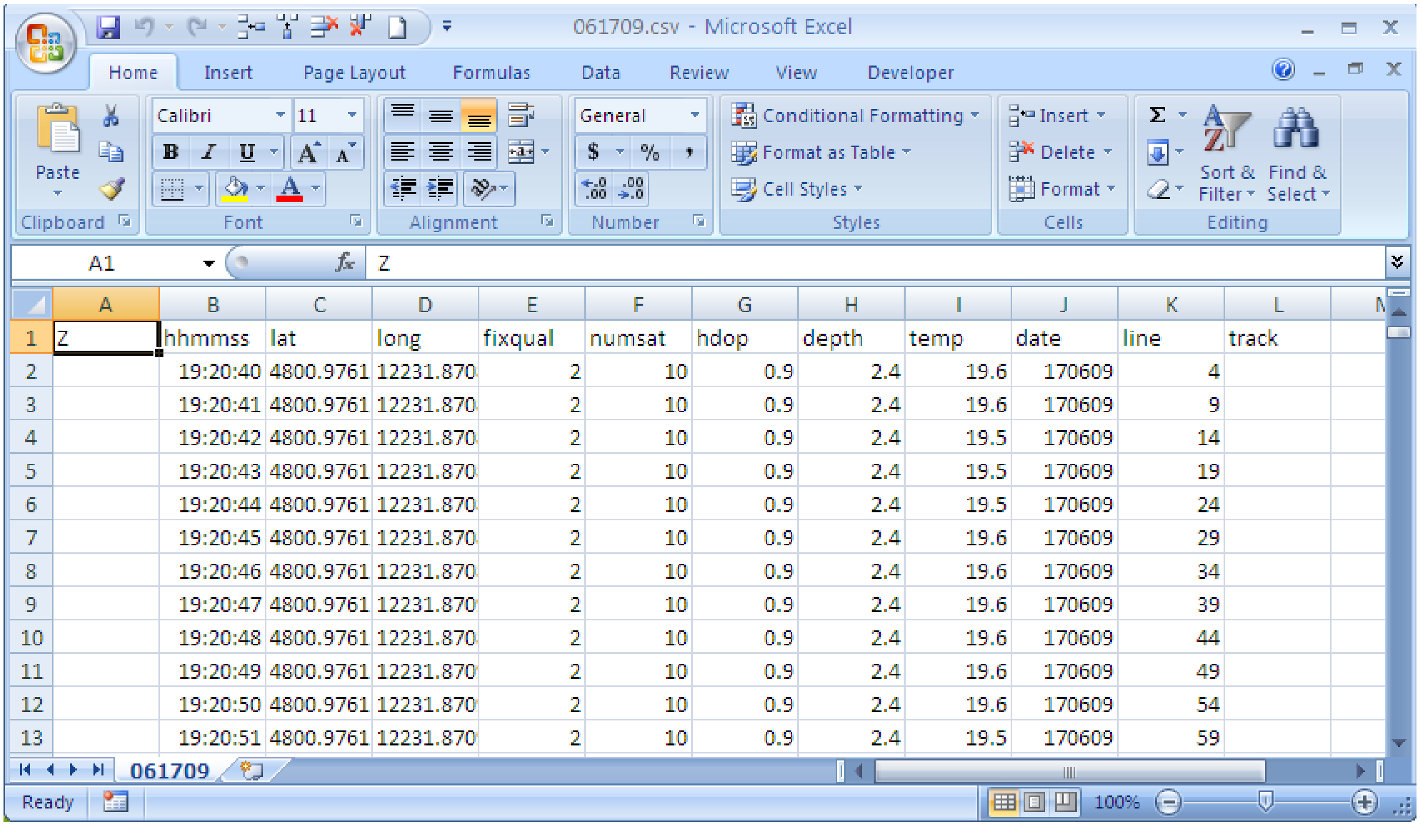
V12. Translate the Tracklog

The tracklog contains the recorded GPS coordinates and depth transducer data. It is formatted as ASCII strings of NMEA sentences multiplexed together from the GPS and Depth transducer once every second. We need to convert the text of these strings to data that can be put into a spreadsheet and so that video analysis can be linked to the depth (and GPS) data. Remember, the GPS data was simultaneously recorded to the tracklog and to the audio channel of the video recording. This task is to decode the text strings into a list of GPS and Depth information for each second.

To accomplish this task I wrote a program ("Eelgrass Data Converter" SuperCard 4.6).



Use “Browse” to select the tracklog text file, “Convert” to create a comma delimited text file (.csv) and “Save Data” to save the file to the same folder as the tracklog file. The .csv file can then be opened in Excel and looks like:



	A	B	C	D	E	F	G	H	I	J	K	L
1	Z	hhmmss	lat	long	fixqual	numsat	hdop	depth	temp	date	line	track
2		19:20:40	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	4	
3		19:20:41	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	9	
4		19:20:42	4800.9761	12231.870	2	10	0.9	2.4	19.5	170609	14	
5		19:20:43	4800.9761	12231.870	2	10	0.9	2.4	19.5	170609	19	
6		19:20:44	4800.9761	12231.870	2	10	0.9	2.4	19.5	170609	24	
7		19:20:45	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	29	
8		19:20:46	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	34	
9		19:20:47	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	39	
10		19:20:48	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	44	
11		19:20:49	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	49	
12		19:20:50	4800.9761	12231.870	2	10	0.9	2.4	19.6	170609	54	
13		19:20:51	4800.9761	12231.870	2	10	0.9	2.4	19.5	170609	59	

The Z column was created to allow the video analyst to score the video for presence or absence of eelgrass, the lat and long columns are in a format DNR uses as is the date (ddmmyy).

In the next task (V13) a second program (“Video Analysis”) is used to reformat the spreadsheet again for more convenient use by an analyst relying on the GeoStamp overlay data to synchronize the spreadsheet with the video.

The script of the Convert button is as follows:

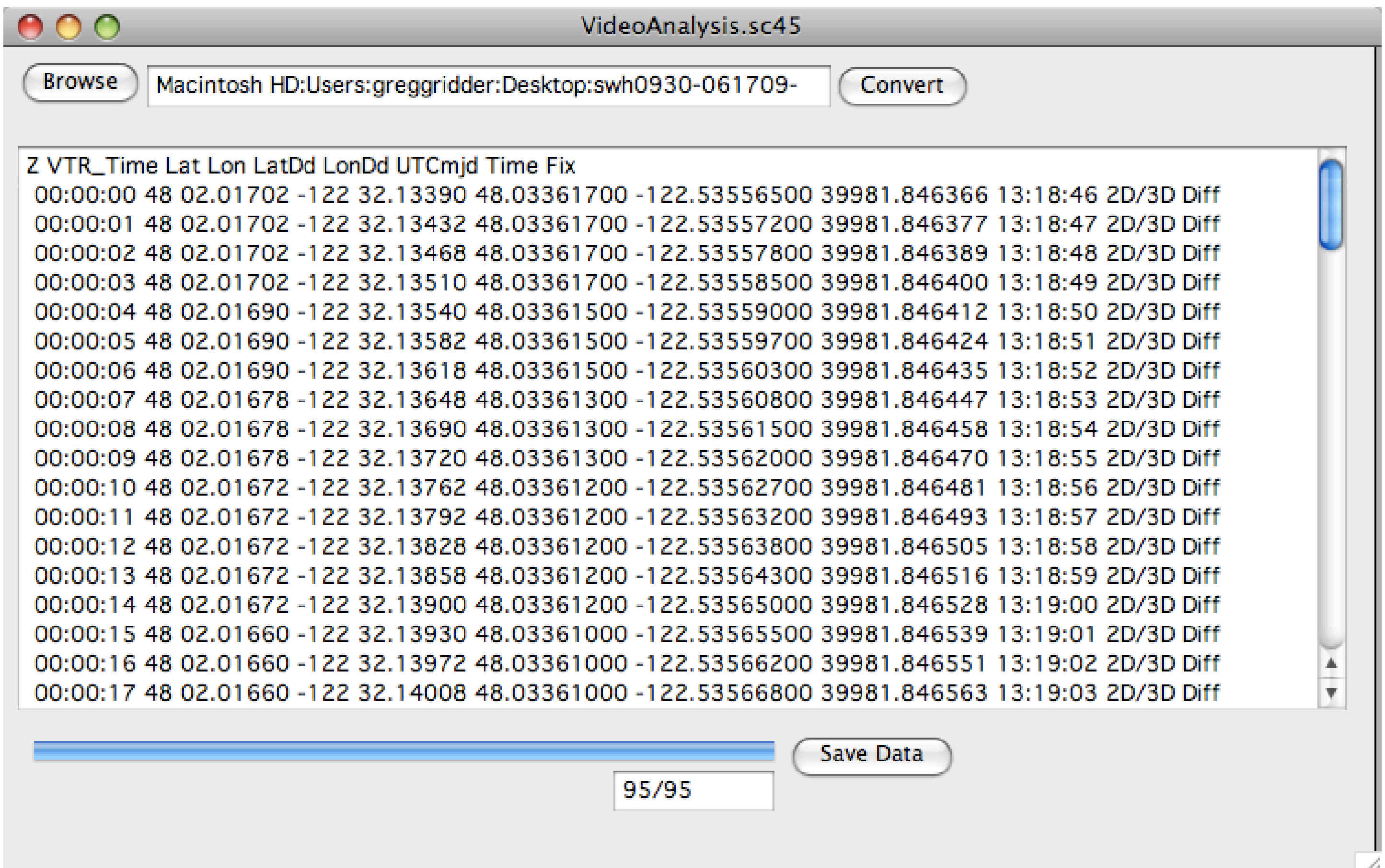
```
on  mouseUp
   global  theFile
   put line 1 of cd fld "File" into theFile
   put "" into cd fld "FileData"
   put "" into cd fld "Data"
   open file theFile
   read from file theFile until eof
   close file theFile
   put it into cd fld "FileData"
   get the number of lines in it
   put it into nLines
   set the maximumValue of cd btn "Progress" to nLines/10
   set the minimumValue of cd btn "Progress" to 0
   set the currentValue of cd btn "Progress" to 0
   put 1 into x
   put 0 into y
   put false into findSatInfo
   put false into findDepth
   put false into findTemp
    put  "Z,hhmmss,long,lat,fixqual,numsat,hdop,depth,temp,date,line,track"  into  newLine
   repeat
     put "" into dpth
     if y > nLines then exit repeat
     put line y of cd fld "FileData" into it
     if "$GPRMC" is in it then
        put newLine into line x of cd fld "Data"
        put "," into newLine
       add 1 to x
        put char 1 to 2 of item 2 of it into hh
        put char 3 to 4 of item 2 of it into mm
        put char 5 to 6 of item 2 of it into ss
         put hh&":"&mm&":"&ss into item 2 of newLine
        put item 4 of it into lat
        put char 1 to 2 of lat into latD
        put char 3 to 9 of lat into latM
        put latM/60 into latM
        add latM to latD
        --put item 5 of it into latNS
        put latD into item 4 of newLine
        put item 6 of it into lng
        --put item 7 of it into lngEW
        put char 1 to 3 of lng into lngD
        put char 4 to 10 of lng into lngM
        put lngm/60 into lngM
        add lngM to lngD
        put "-"&lngD into item 3 of newLine
         put item 10 of it&","&y&"," into item 10 of newLine
        put true into findSatInfo
        put true into findDepth
        put true into findTemp
      else if "$GPGGA" is in it and findSatInfo is true then
        put item 7 of it into item 5 of newLine
        put item 8 of it into item 6 of newLine
        put item 9 of it into item 7 of newLine
         put false into findSatInfo
      else if "$SDDBT" is in it and findDepth is true then
        put item 2 of it into item 8 of newLine
        put false into findDepth
      else if "$YXMTW" is in it and findTemp is true then
        put item 2 of it into item 9 of newLine
        put false into findTemp
     end if
      set the currentValue of cd btn "Progress" to y/10
     add 1 to y
     --set the scroll of cd fld "Data" to y-15
      put y&"/"&nLines into cd fld lineCntr
   end  repeat


   put newLine into line x of cd fld "Data"
   beep
end  mouseUp
```

V13. Create Spreadsheet for Video Analysis

The .CSV file created in the last task was meant to submit to DNR for their analysis. For our own analysis, however, that format would be impossible to correlate with GeoStamp information overlayed on the video with the exception of time/date. Also, it has been noted that the video recording has on occasion skipped, causing differences in the duration of the transect run from using the video recording time and the duration using absolute GMT time from the GPS. To deal with these two issues, I have written a program “Video Analysis” to take the information from the video shape file and format it for the convenience of the analyst. At a later time, the two spreadsheets can be reconciled using GMT time.

To create this spreadsheet, first double click on the .dbf file that was created with the shape file (e.g. swh0930-061909-2.dbf) and stored in the shape file folder (e.g. SVMP 2009\swh0930\Shape Files\). This will open in Excel; save it as a .txt file in the same folder (e.g. swh0930-061909-2.txt).

Run the SuperCard 4.6 program, “Video Analysis” (on a MacBook Pro) and use the “Browse” button to find the text file. Then click on Convert to reformat the file and “Save” to overwrite the text file in the new format.

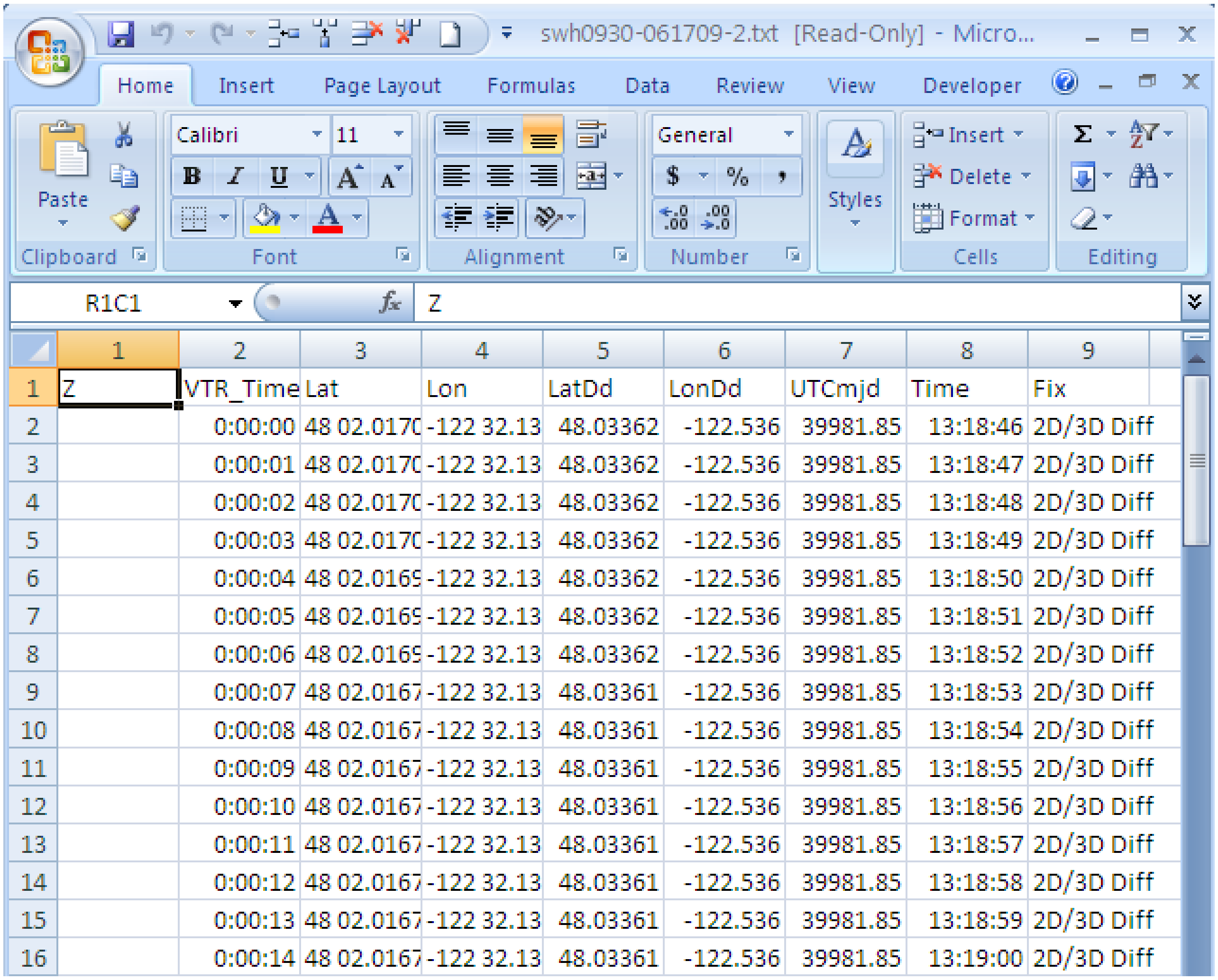


Script of “Video Analysis” Button “Convert”

```
on mouseUp
  global theFile
  put line 1 of cd fld "File" into theFile
  put "" into cd fld "FileData"
  put "" into cd fld "Data"
  open file theFile
  read from file theFile until eof
  close file theFile
  put it into cd fld "FileData"
  get the number of lines in it
  put it into nLines
  set the maximumValue of cd btn "Progress" to nLines/10
  set the minimumValue of cd btn "Progress" to 0
  set the currentValue of cd btn "Progress" to 0
  put 1 into x
  put 2 into y
  set the numberFormat to "00"
  put the numberFormat into oldFormat
  set the itemDelimiter to tab
  put "Z"&tab&"VTR_Time"&tab&"Lat"&tab&"Lon"&tab&"LatDd"&tab&"LonDd"&tab&"UTCmjd"&tab&"Time"&tab
  repeat
    put newLine into line x of cd fld "Data"
    if y > nLines-1 then exit repeat
    put tab into newLine
    add 1 to x
    put line y of cd fld "FileData" into it
    put item 1 of it into Lon
    put item 2 of it into Lat
    put item 4 of it into UTC
    put item 5 of it into VTR_Time
    put item 6 of it into Fix

    --Change Longitude format from D.d to D_M.d
    delete char 1 of Lon
    put Lon into LonDd
    put char 1 to 4 of Lon into LonD
    put char 5 to 11 of Lon into LonM
    set the numberFormat to "00.00000"
    put LonM*60 into LonM
    put LonD&" "&LonM into Lon
    put Lon into item 4 of newLine
    put LonDd into item 6 of newLine
    set the numberFormat to oldFormat

    --Change Latitude format from Dd to D_Md
    put Lat into LatDd
    put char 1 to 2 of Lat into LatD
    put char 3 to 9 of Lat into LatM
    set the numberFormat to "00.00000"
    put LatM*60 into LatM
    put latD&" "&LatM into Lat
    put Lat into item 3 of newLine
    put LatDd into item 5 of newLine
    set the numberFormat to oldFormat

    --Change VTR_Time format to hh:mm:ss.s
    put char 1 to 2 of VTR_Time into hh
    put char 4 to 5 of VTR_Time into mm
    put char 7 to 8 of VTR_Time into ss
    --Calculate to nearest 1/10th of second using frame info
    --put char 10 to 11 of VTR_Time into ff
    --set the numberFormat to ".0"
    --put ff/29.97 into ff
    --delete char 1 of ff
    --put hh&":"&mm&":"&ss&ff into item 2 of newLine
    put hh&":"&mm&":"&ss into item 2 of newLine
    set the numberFormat to oldFormat
```

```
    --Change UTC Time from MLD to hh:mm:ss
    set the numberFormat to "0.000000"
    put UTC/1 into UTCMJD
    put UTCMJD into item 7 of newLine
    put UTC-trunc(UTC) into UTC
    put trunc(24*UTC) into hh
    put trunc(24*60*UTC)-hh*60 into mm
    put round(24*60*60*UTC)-hh*60*60-mm*60 into ss
    if ss=60 then
      put 0 into ss
      add 1 to mm
      if mm=60 then
        put 0 into mm
        add 1 to hh
        if hh=24 then put 0 into hh
      end if
    end if
    set the numberFormat to oldFormat
    if hh>6 then put hh-7 into hh else put hh+17 into hh
    put hh&":"&mm&":"&ss into UTC
    put UTC into item 8 of newLine

    put Fix into item 9 of newLine

    set the currentValue of cd btn "Progress" to y/10
    add 1 to y
    --set the scroll of cd fld "Data" to y-15
    put y&"/"&nLines into cd fld lineCntr
  end repeat
  beep
end mouseUp
```

The new spreadsheet is shown below when opened in Excel.



1	2	3	4	5	6	7	8	9
Z	VTR_Time	Lat	Lon	LatDd	LonDd	UTCmjd	Time	Fix
	0:00:00	48 02.0170	-122 32.13	48.03362	-122.536	39981.85	13:18:46	2D/3D Diff
	0:00:01	48 02.0170	-122 32.13	48.03362	-122.536	39981.85	13:18:47	2D/3D Diff
	0:00:02	48 02.0170	-122 32.13	48.03362	-122.536	39981.85	13:18:48	2D/3D Diff
	0:00:03	48 02.0170	-122 32.13	48.03362	-122.536	39981.85	13:18:49	2D/3D Diff
	0:00:04	48 02.0169	-122 32.13	48.03362	-122.536	39981.85	13:18:50	2D/3D Diff
	0:00:05	48 02.0169	-122 32.13	48.03362	-122.536	39981.85	13:18:51	2D/3D Diff
	0:00:06	48 02.0169	-122 32.13	48.03362	-122.536	39981.85	13:18:52	2D/3D Diff
	0:00:07	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:53	2D/3D Diff
	0:00:08	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:54	2D/3D Diff
	0:00:09	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:55	2D/3D Diff
	0:00:10	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:56	2D/3D Diff
	0:00:11	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:57	2D/3D Diff
	0:00:12	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:58	2D/3D Diff
	0:00:13	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:18:59	2D/3D Diff
	0:00:14	48 02.0167	-122 32.13	48.03361	-122.536	39981.85	13:19:00	2D/3D Diff

1. the Z column is for analyst scores

2. the VTR_Time column shows elapsed time from the beginning of the transect video clip

3. the Lat/Lon columns are formatted for degrees and decimal minutes (like the GeoStamp overlay)

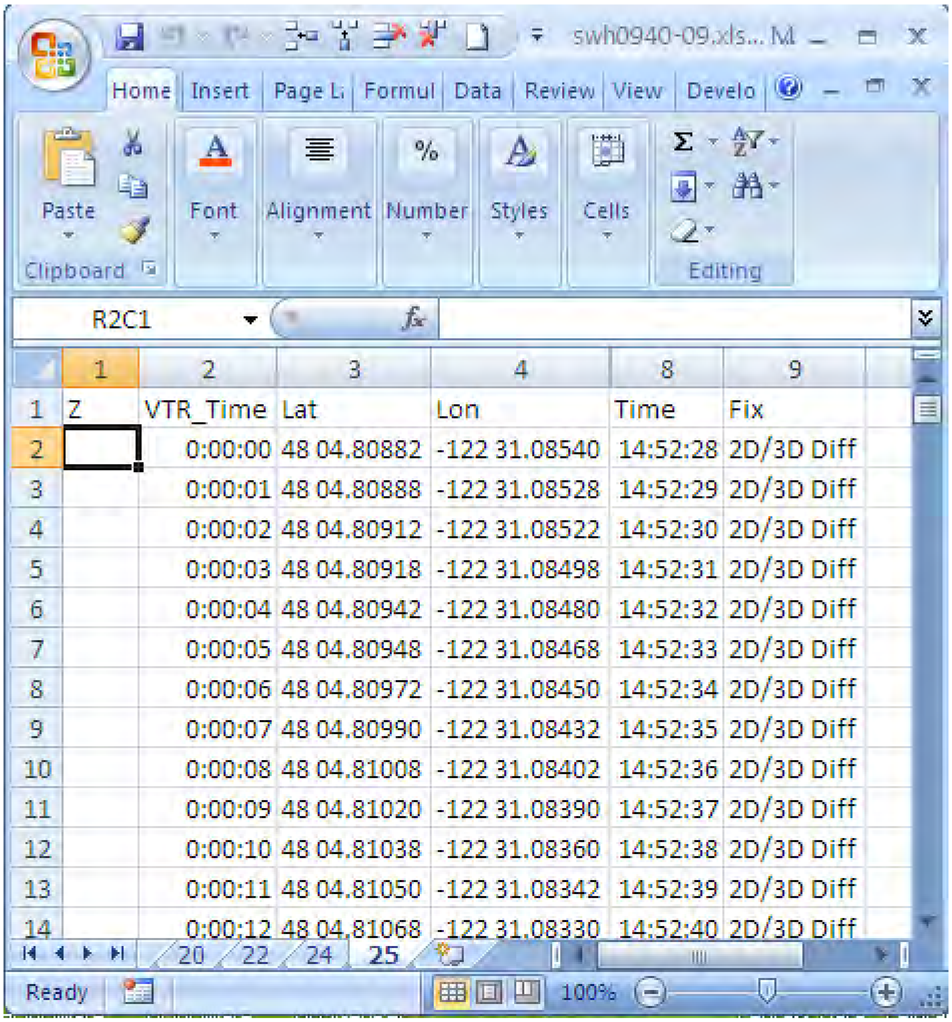
4. the LatDd/LonDd columns are formatted for decimal degrees (useful for importing to ArcMap)

5. the UTCmjd is universal time in modified Julian date (OK, this is how it got translated from Mediamapper!)

6. the Time contains local time (as displayed on the GeoStamp overlay) calculated from UTCmjd

7. Fix indicates the quality of the GPS signal (sometimes it get lost)

All the transect files for a site were then consolidated in a workbook with tabs for each transect. Columns 5,6,&7 were hidden to simplify the sheet for the analysts. The workbook and the corresponding transect video clips were burned onto DVD(s) and given to analysts to be scored.



	1	2	3	4	8	9
1	Z	VTR_Time	Lat	Lon	Time	Fix
2		0:00:00	48 04.80882	-122 31.08540	14:52:28	2D/3D Diff
3		0:00:01	48 04.80888	-122 31.08528	14:52:29	2D/3D Diff
4		0:00:02	48 04.80912	-122 31.08522	14:52:30	2D/3D Diff
5		0:00:03	48 04.80918	-122 31.08498	14:52:31	2D/3D Diff
6		0:00:04	48 04.80942	-122 31.08480	14:52:32	2D/3D Diff
7		0:00:05	48 04.80948	-122 31.08468	14:52:33	2D/3D Diff
8		0:00:06	48 04.80972	-122 31.08450	14:52:34	2D/3D Diff
9		0:00:07	48 04.80990	-122 31.08432	14:52:35	2D/3D Diff
10		0:00:08	48 04.81008	-122 31.08402	14:52:36	2D/3D Diff
11		0:00:09	48 04.81020	-122 31.08390	14:52:37	2D/3D Diff
12		0:00:10	48 04.81038	-122 31.08360	14:52:38	2D/3D Diff
13		0:00:11	48 04.81050	-122 31.08342	14:52:39	2D/3D Diff
14		0:00:12	48 04.81068	-122 31.08330	14:52:40	2D/3D Diff

V14. Video Analysis

Using the transect video clips and the spreadsheet developed in task V13, volunteers that have been trained to recognize eelgrass can use video player software (VLC among others) to and Excel to fill in the Z score column of the spreadsheet. Once this is done the results can be displayed in ArcMap and measured to quantify the area of eelgrass beds at each site. The instructions for volunteers in 2009 to score the video are:

Procedure for Analyzing Eelgrass Video

1. Download Media Player: VLC from VideoLan.com

2. Configure VLC Player (PC only) for jump back/forward, slower/faster tools

3. Insert Eelgrass DVD(s) for your site (flats29, swh0943, swh0940)

4. (Copy the spreadsheet and VLC files to your Hard Drive)

5. Open Excel File and use tab to pick transect

6. Open VLC file for the chosen transect

7. Stop (space bar) and Rewind Video (or drag time bar indicator to beginning)

8. Use space bar to start/stop:

MAKE SURE THE VIDEO WAS PLAYING AND TIME WAS COUNTING BEFORE STOPPING AND NOTING TIME

9. Key for Z Scoring:

blank – nothing to note
1 - Z marina
2 - Z japonica
3 - both Zm and Zj
4 - unusable video (too blurry or out of focus to tell if eelgrass is there)
5 - indicate something unknown (not necessary)
6 - indicate a skip in the video (not necessary)

10. As you play the video, note the presence of Eelgrass (even one plant!) when the plant base crosses the bottom of the frame. Enter the score in the Z column in the corresponding row (by matching VTR_Time, or GeoStamp information if available) of the spreadsheet.

11. Fill Down the score in the spreadsheet to where a transition to a different score (or blank) occurs. If time is less than 1 second, don't fill down (only 1 second will be entered).

12. When done, click the tab for another transect and open the corresponding .mpg file.

13. When all transects are finished; email the spreadsheet to gridder@whidbey.com

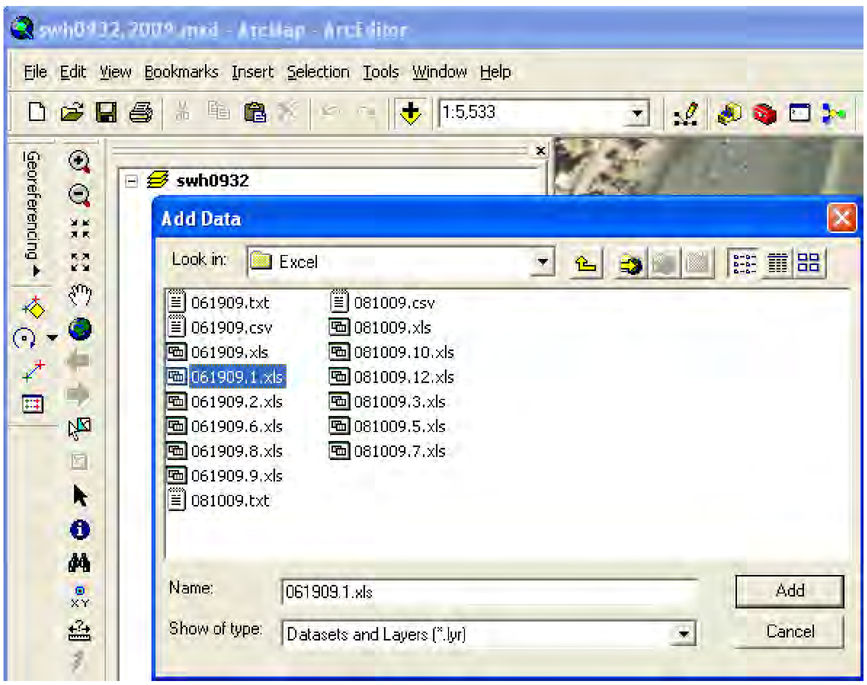
14. You will receive a report with your group's results mapped and quantified.

15. Thank you for your help!!!!

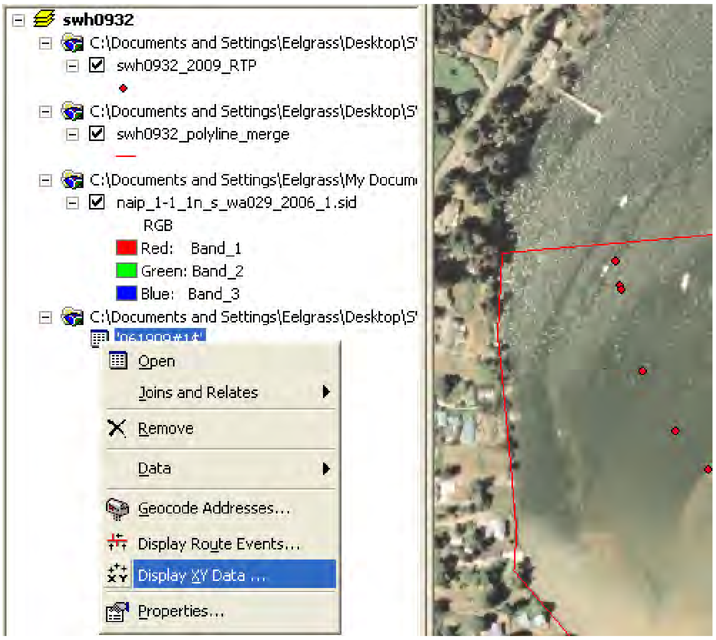
V15. Measuring Transect Line Lengths from Video Scores

For this task we will import the scoring spreadsheet into ArcMap and display the position of each score as a category value. Since I have not yet learned how to measure line lengths in ArcMap, I used Image Analysis to get an estimate another way. Therefore, I will only roughly outline this method since it will not be used in the future and the one site I did analyze will be redone.

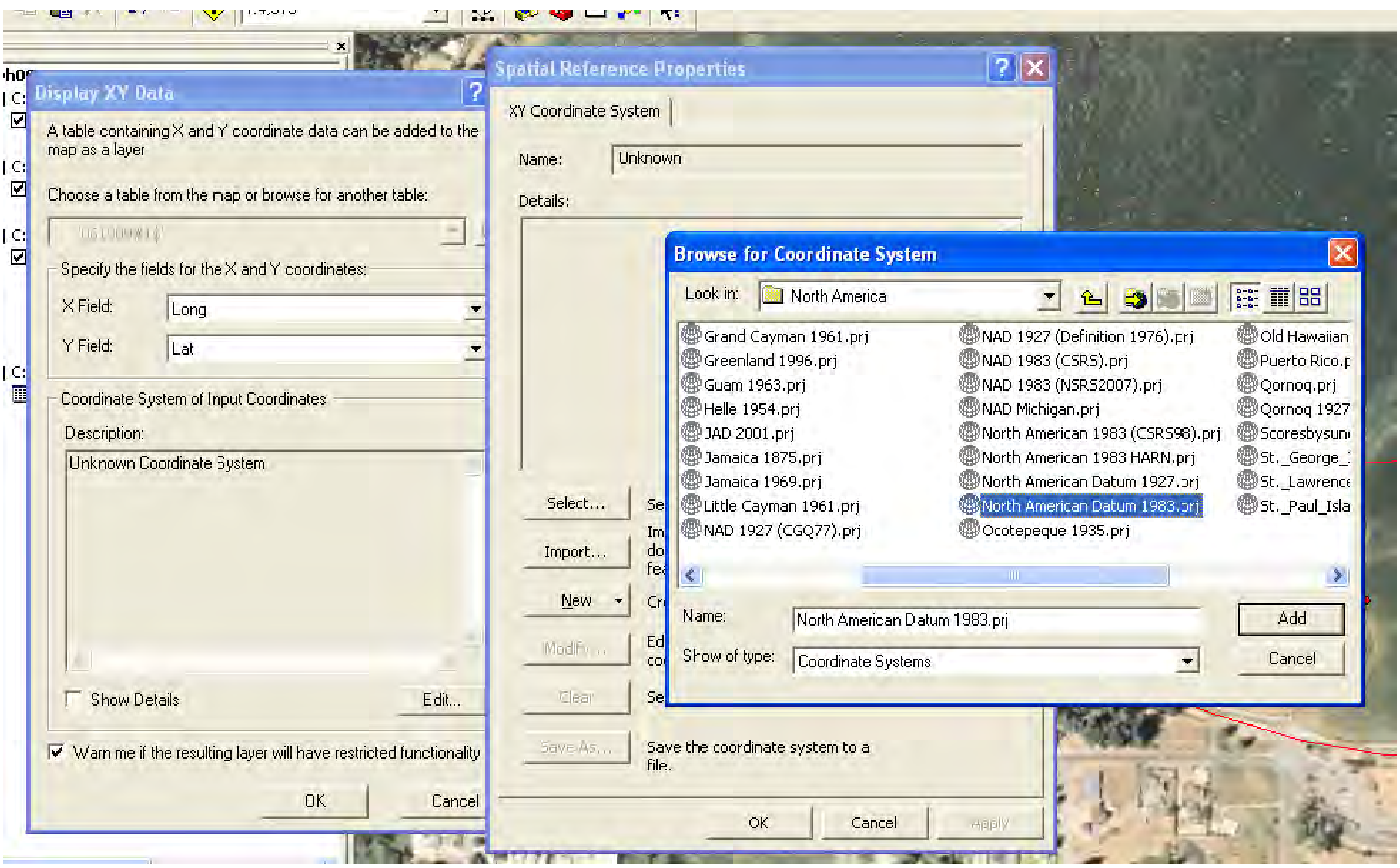
Regardless of the analysis method, the first step is to import data from the Excel spreadsheet into ArcMap. To do this we open the ArcMap for the site (.mxd file) and click on "Add Data", and navigate to the Excel spreadsheet in the appropriate SVMP folder (e.g. SVMP 2009\swh0932\Excel\061909.1.xls) for a transect line (alternatively if all lines are in one workbook, you can pick the worksheet for a transect line).



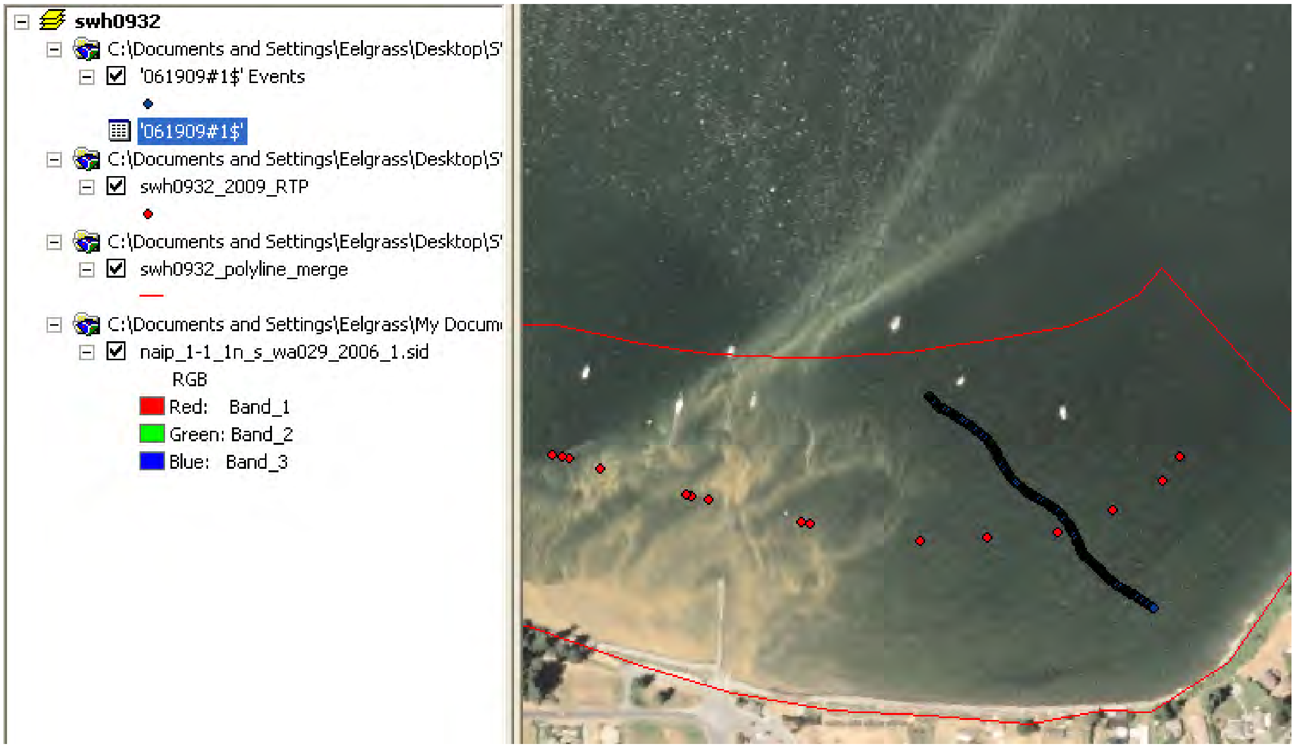
Click on "Add". Right click on the new spreadsheet icon and select "Display XY Data…"



In the" Display XY Data" click "Edit" to specify the coordinate system, then click "Select" in the "Spatial Reference Properties" window and navigate to the Geometric>North American>North American Datum 1983.prj and click "Add".

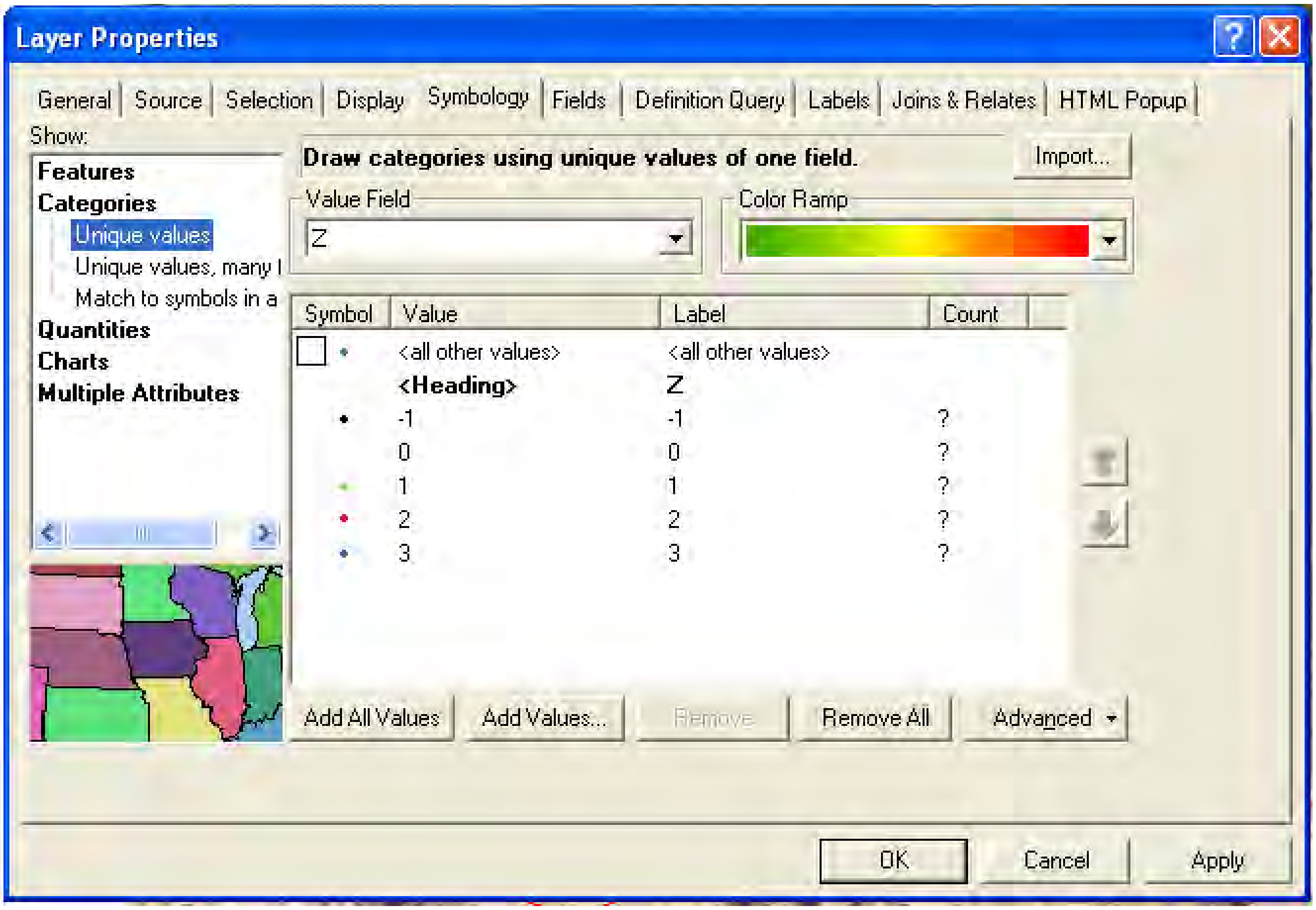


When you close out all these windows by clicking “Apply”, and “OK”, you will see a new “ Events” layer added above the spreadsheet icon and your data drawn on the map.



You can now remove the spreadsheet and adjust the properties of the Events layer to show the Z score information.

To do this right click on the Events data and adjust the properties to display the Z scores as Categories color coded as below: (Symbology tab,Unique Categories, Z Value Field, add all values, then choose the symbols for each value)



When you import the other transect lines, choose to import the symbology table from the first transect so they will all appear the same. The result:

The transect lines are now color coded to show the positions of the various Z scores. At this point, several things need to be done.

1. The sampling polygon (red line) need to be redrawn to meet the start and stop boundaries of the transect lines.

2. The area of the sampling polygon needs to be measured.

3. The line lengths of each category and the entire transect line need to be measured.

These numbers will allow us to estimate the area of eelgrass coverage (see V16).

To redraw the sampling polygon ( ), select the polygon and use the editor toolbar, click start editing, modify the polygon one segment at a time, click stop editing and save results.

At this point I depart from the using ArcMap to make the measurements, save the image (as a .TIFF file so no blending occurs during compression) and use Image Analysis (NIH Image J) to measure the area and line lengths. These measurements are estimates only and will be replaced by ArcMap measurements **as soon as I learn how**.

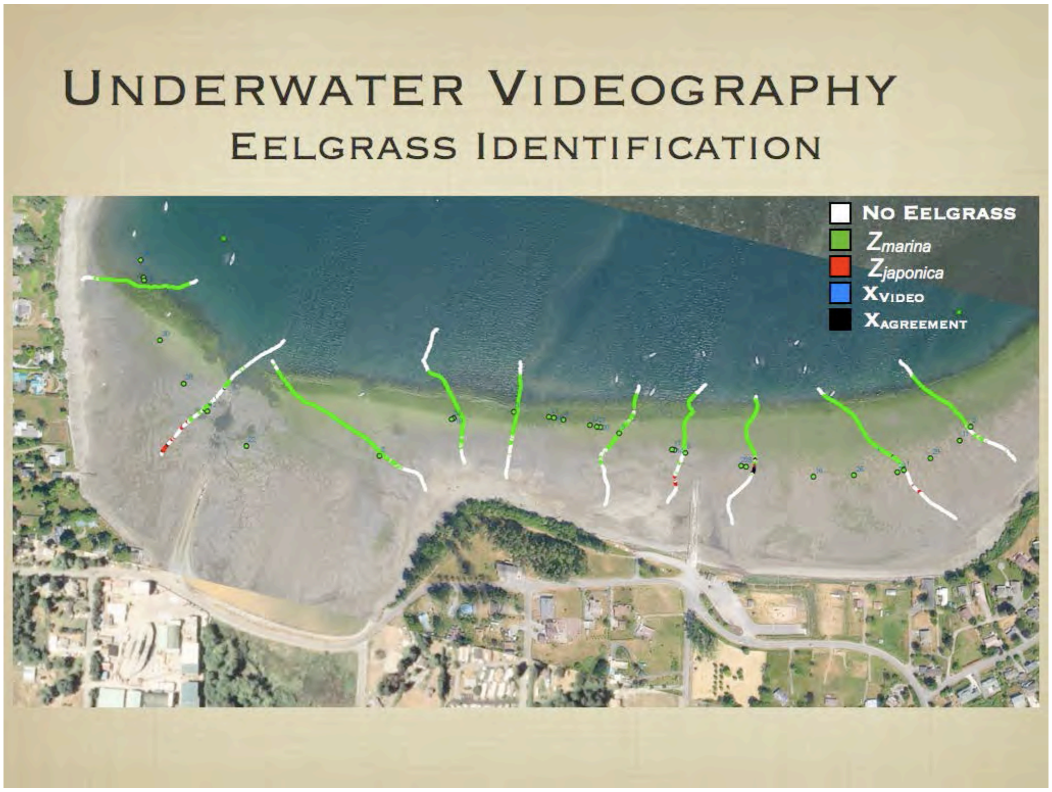
V16. Calculating Eelgrass Area.

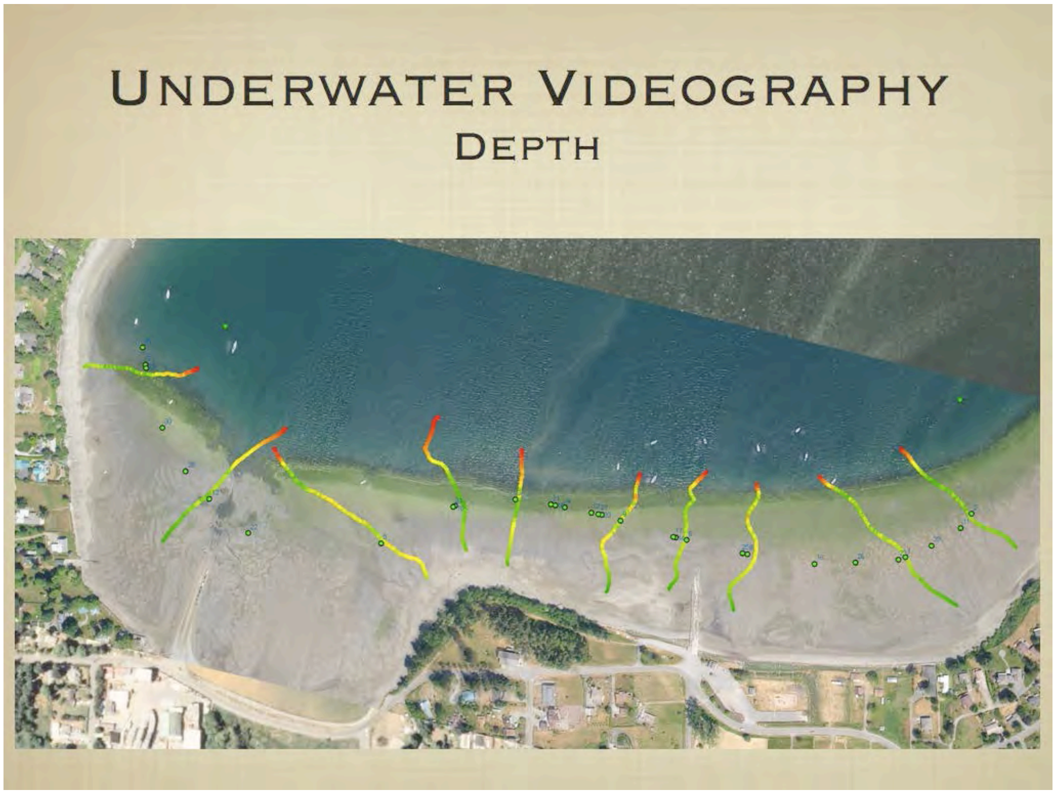
My understanding of DNR's calculations of eelgrass area from transect line measurements and the sample polygon measurement comes from using a discipline called Stereology (Practical Sterology, John C. Russ 1986) to reduce the requirement for making 2-dimensional measurements (area) to making only 1-dimensional measurements (line length). The reason is that by underwater videography we can make a series of linear transect measurements, but to cover an entire area would be prohibitive for many reasons. However, we can easily define a sampling polygon and measure its area in GIS because no measurement of eelgrass presence is required. The assumption is that the ratio of the transect line length (TLL) where eelgrass is present divided by the total transect line length is proportional to the area of the sampling polygon (SP) where eelgrass is present. Therefore we can use the following calculation to estimate eelgrass area in a site.

$$\frac{\Sigma TLL_{eelgrass}}{\Sigma TLL_{total}} * Area_{SP} = Area_{eelgrass}$$

V17. Map the Results in ArcMap

ArcMap can be used to display geographically all the information we have collected and calculated. The examples below show our results from aerial and underwater videography on maps that have been annotated in a presentation program (Keynote).




UNDERWATER VIDEOGRAPHY
DEPTH

Appendix B: Aerial Photography Manual v1_1

Aerial Photography Tasks

(Gregg Ridder 6/8/11)

A1. Taking Aerial Photographs

I developed a system to acquire aerial images using a small private plane with a remotely controlled camera mounted under the wing (see images below). The camera (Canon G10) was mounted to be as vertical as possible during flight. All images were taken within 30 minutes of lowest tides. The airplane (Cessna 177RG Cardinal) was flown at 2500 feet at 100 knots along the entire shoreline of all regions while taking pictures at an interval of approximately 4 seconds using a remote radio-controlled trigger (Optika) to provide overlap between successive images. The wings were kept level for all photographs.

Figure 1. Aerial Camera at 2500'

Figure 2. Camera mounted under wing

The camera was set at a fixed exposure time of 1/500 sec, a resolution of 14 megapixels, highest quality JPEG compression, image stabilization, and fixed focus (infinity). Complete details of the photographic parameters are recorded in the EXIF information within each image.

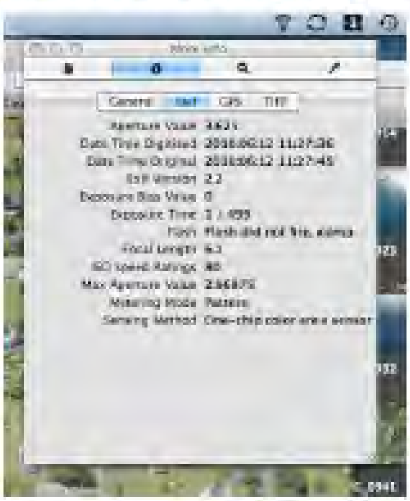


Figure 3. Details about the photograph is stored in the picture information.