Standard Operating Procedures Manual for Underwater Video

Massachusetts Division of Marine Fisheries

May 2019

Edition 2

FOREWORD

The purpose of this Standard Operating Procedures (SOP) document is to provide DMF employees with consolidated and standardized guidelines and requirements for conducting, processing, and generating underwater camera surveys for various purposes including habitat mapping and groundtruthing of sidescan sonar acoustic imagery. This manual summarizes current best practices and utilizes information from other similar guidance documents including the NOAA Field Procedures Manual for hydrographic surveys (April 2010), the Recommended Operating Guidelines (ROG) for Side-scan Sonar by Mapping European Seabed Habitats (August 2005), and procedures described in the manufacturers guidelines for the equipment referenced.

CHANGE HISTORY

This document will require periodic updating. Recommended changes and other comments regarding the manual should be forwarded via email to steve.voss@state.ma.us. A summary of changes is provided below:

Date	Edition	Description of changes
6/10/2016	First edition	Sections for tasks anticipated in the future are included as place holders.
5/29/2019	Second edition	Significant changes to the description of how to store, name, cull, geotag, and classify photos.

1. Systems Description & Maintenance

Video systems should undergo an annual assessment of condition, thorough cleaning, and parts inventory. This activity will typically occur in the winter. Further detail is provided in each section below.

1.1. Underwater Camera Systems

1.1.1. SeaTrex HD

1.1.1.1. Specifications

- Superb picture quality (2M Pixels)
- Full HD out - No compression
- Multi-format video outputs - 1080i/720p
- 10x optical + 12x digital
- 120x zooming capability
- Submersible to 300ft
- Picture freeze function
- SPOT AE function

1.1.1.2. Inventory

1.1.1.3. Annual maintenance

1.1.2. GoPro Heros

1.1.2.1. Specifications

1.1.2.2. Inventory

1.1.2.3. Annual maintenance

1.1.3. AquaVu Pro V 5

1.1.3.1. Specifications

1.1.3.2. Inventory

1.1.3.3. Annual maintenance

Parts list/inventory

1.1.4. Snake Mate Deep Water Pro

1.1.4.1. Specifications

1.1.4.2. Inventory

1.1.4.3. Annual maintenance

1.1.5. Ocean Systems SplashCam Deep Blue Pro Color

1.1.5.1. Specifications

Camera Specs:

- Imaging Device: 1/3″ 960H High Sensitivity CCD
- Video Format: NTSC
- Picture Elements NTSC: 1020(H)x508(V)
- Effective Picture Elements: NTSC: 976(H) x 494(V)
- Horizontal Resolution: More than 750 TVL
- Sensitivity: .001 lux

Cable Specs:

- Diameter: 0.37”
- Weight in air: 3 lbs. / 50ft.
- Length: Standard 50 ft. to 200 ft. / Long: up to 900 ft.
- Jacket: Poly-urethane cut resistant
- Construction: 1ea. 75 ohm coax, 8ea 600v power wires

Housing Specs:

- Size: 3” D x 3.5” L
- Construction: Anodized cast aluminum
- Finish: Thermoplastic Paint
- Pressure Rating: 300 ft. with compression fitting / 1000 ft. with submarine plug

Light Pod Specs:

- Size: 4” W x 7” L
- Light Rating: 300 lumen
- Depth Rating: 500 feet.
- Power: 4ea. AA batteries x 2 lights – Approx run time 4 hours

1.1.5.2. Inventory

1.1.5.3. Annual maintenance

1.1.1. GPS Systems

1.1.1.1. Trimble GPS

Trimble ProXT with Tempest Antenna

1.1.1.2. Garmin GPS

Garmin GPSmap 76 handheld with Garmin antenna

1.1.3. Vessels

Several different vessels are used to deploy the video systems, including the Mya, skiffs from 14-25 feet in length, and jet skis. All of these vessels have routine maintenance conducted as needed.

1.2. Storage

All instrumentation is rinsed and then allowed to air dry. It is then stored in original packaging or in plastic boxes, adequately padded to protect from damage.

1.3. Calibration Requirements and Methods

1.3.1. Camera Systems

Object detection and classification performance is largely a function of the original system specifications. The cameras will be serviced and calibrated by the manufacturer (or replaced) whenever the optical definition is in doubt.

The table below identifies dates of service.

Date	Description of service

1.3.1.1. Camera Calibration

The only time camera calibration is conducted is if scaling in a routine set of still photos (or video extractions) is required. In this case, a lobster pot mesh will be connected to the frame holding the camera and the camera will be submerged in water. An image will be taken. The lobster pot mesh size will be measured and recorded. This scaling measurement will be used to correct any lens distortion and conducted measurements on objects in the images in post-processing. All successive images will be taken with the camera in the same orientation and height as for the lobster pot mesh image.

1.3.1.2. Periodic Quality Assurance

Before surveying with a camera system, the system should be assembled and checked in the lab before deploying it in the field. Any worn parts should be replaced prior to deployment.

1.3.1.3. Offset Measurement

The purpose of our camera surveys is typically habitat mapping and target identification. Every effort is made to ensure the best possible spatial accuracy. Offsets are approximated based on vessel performance and configuration (e.g. towed vs drop cameras).

1.3.1.3.1. Pole-mounted configuration

The camera is affixed to a pole which is secured to the gunnel of the vessel. Ideally, the GPS antenna is placed directly above the transducer on the top of the pole and no additional measurements are needed. If the GPS antenna is offset from the pole, the X and Y offset will be measured with a measuring tape and recorded on the field sheet. All measurements shall be recorded on the field set-up sheet. The offset will be utilized if the purpose of the survey requires high accuracy. If not, the offset will be recorded in the methods section of any final reports.

1.3.1.3.2. Drop camera configuration

The camera is affixed to a weighted line, the end of which is secured to a point on the vessel (to avoid dropping it overboard). The GPS antenna typically located at a fixed position on the boat and the X and Y offset from the drop location is measured with a measuring tape and recorded on the field sheet. It is typically assumed that the drop location is immediately below the vessel. All measurements shall be recorded on the field set-up sheet. The offset will be utilized if the purpose of the survey requires high accuracy. If not, the offset will be recorded in the methods section of any final reports.

1.3.1.3.3. Pyramid mounted configuration

The camera is affixed to a pyramid frame on a drop cable or line, the end of which is secured to a point on the vessel (to avoid dropping it overboard). The GPS antenna typically located at a fixed position on the boat and the X and Y offset from the drop location is measured with a measuring tape and recorded on the field sheet. It is typically assumed that the drop location is immediately below the vessel. All measurements shall be recorded on the field set-up sheet. The offset will be utilized if the purpose of the survey requires high accuracy. If

not, the offset will be recorded in the methods section of any final reports.

1.3.1.3.4. Towed configuration

The actual towfish position is typically calculated using the tow point and the cable out measurements. Cable out can be estimated visually from calibrated markings on the cable. Cable out should be recorded in feet. All measurements shall be recorded on the field set-up sheet. It is not typical for us to use offset measurements for towed video. Instead, the offset is noted in the methods sections of any final reports.

1.3.2. GPS Systems

1.3.2.1. Trimble GPS

1.3.2.2. Garmin GPS

1.4. Software Systems

The software utilized for data processing is Picasa/Google Photos. The following computer and software maintenance should be conducted annually, usually in the wintertime: 1) All survey data files are backed up to storage devices in at least two locations (for example, the V drive and an external hard drive); 2) Delete all survey data files from the field/data collection system; 3) Complete any software and computer hardware upgrades.

2. Pre-Survey Planning

2.1.Crew & Vessel Safety

Above all, every member of the field party should understand that safety of the crew and vessel is the number one priority. Safety shall be the foremost consideration in all aspects of Office of Coast Survey (OCS) hydrographic surveys, from the planning stages through data submission. It is the responsibility of the Chief-of-Party, as well as vessel crew, to be aware of safety hazards and take steps necessary to ensure undue risks are avoided, even if it means ceasing operations. Good planning and information can minimize risks associated with hydrographic surveying.

Recommended practices to increase safety include, but are not limited to the following:

- Use historical weather information to prepare for seasonal patterns.
- Review the survey region for exposed areas, constricted areas, shallow areas, surf, etc.
- Plan on surveying challenging areas when weather, tides, and currents are optimal.
- Review prior survey field sheets. Often, the field sheets will describe deficiencies, hazards, and challenges from prior surveys and field experience.
- Discuss survey area with other DMF personnel familiar with the site.
- Work progressively from safe water towards unknown, shallow, or potentially hazardous areas.
- Use daily survey information progressively in the field to minimize hazards. Communicate survey and safety information to all personnel involved in operations.

2.2.Project Preparation

The necessary storage media should be identified and packed. Digital data file formats should be used that will enable efficient back-up and retrieval of data for processing. The file location on disk shall be identified on the field log sheet.

2.3.Survey Planning

2.3.1. Survey Scope

Survey limits will be defined prior to conducting field work for the purpose of the field work.

2.3.2. Survey Planning

For towed surveys, survey lines will be established based on the desired amount and location of coverage. For drop-camera and pyramid surveys, sites are ideally pre-planned in either a random, grid, or directed pattern based on the needs of the survey. Line and station plans can be created in ArcGIS, in Google Earth, or on the GPS system being utilized for the survey.

The length of the lines and/or distance between stations will be calculated and used, along with the estimated survey speed (usually 1 knot) and transit speed (usually 12+ knots), to estimate the number of field days needed to cover the survey scope.

Estimations should include buffer to allow for transit to and from the site and navigating to specific stations.

2.3.3. Preparing the Survey Crew

At least two survey crew should conduct data acquisition. Survey crew should be identified and given a pre-cruise briefing that covers the following topics:

- Meeting location and time
- Vessel logistics (which vessel, who is driving)
- Survey location
- Expected length of the survey day
- Need for special equipment and food
- Basic overview of the plan for the day (meeting, loading, transiting and trailering boat to the field location, preparing boat and equipment, transit to survey location, survey logistics/expectations, type of data being collected, etc)
- Contact information in the event survey is cancelled due to weather

3. Data Acquisition

3.1.Sensor Risk Management

3.1.1. Best practices for preventing loss of equipment

A fail safe line shall be attached to the vessel. Equipment mounted on frames should be attached at multiple points and have a fail-safe strap or line in case mounting brackets break.

3.1.2. Best practices for recovery of lost equipment

If the towfish, pyramid, or camera is lost, the Man Overboard button on the vessel-mounted GPS system should be activated. This will place a waypoint on the GPS screen which can be used to set up a search and rescue pattern. The onboard depth/fish finder should be used to scan the area in a pattern near the area of loss. If a target is identified, it should be marked as a waypoint on the GPS unit. Since our surveys typically occur in water shallower than 100 feet, recovery can be achieved by any safe method to do so (e.g. snorkeling or scuba diving). If this is insufficient or impractical, grappling with a grappling hook is recommended.

3.2. Imagery Acquisition

3.2.1. Unrecorded imagery

Based on the needs of the study, imagery collected by some systems may not be recorded. In this case, the camera operator will use a field sheet to take notes about positioning and imagery details of relevance to the study. The bare minimum information would be along these lines:

A	B	C	D
Station	Lat	Lon	Notes
2	42.24762	-70.7780	sand with gravel
3	42.24895	-70.7773	sand with gravel

3.2.2. Hidef Video Camera

3.2.2.1. System Setup

3.2.2.2. Recording Data

3.2.3. Go Pros

3.2.3.1. System Setup

3.2.3.2. Recording Data

3.2.4. AquaVu

3.2.4.1. System Setup

3.2.4.2. Recording Data

3.2.5. Snake Mate Deep Water Pro

3.2.5.1. System Setup

3.2.5.2. Recording Data

3.2.6. SplashCam Deep Blue Pro Color

3.2.6.1. System Setup

3.2.6.2. Recording Data

4. Data Management

4.1. Cruise Reports

A Cruise Report will be generated for every field day or set of field days dedicated to imaging a single survey area. The Cruise Report will be placed in W:\Habitat Project\Habitat Research according to the following naming convention: [Project Name-Year]\CruiseReportMMDDYYY with the date referring to the date of the survey or the last date of a multiple-day survey.

4.2. Data File Naming and Storage

4.2.1. Raw and Processed Survey Data

4.2.1.1. In the Field

All raw survey data will be stored on the instrument that collected the data. For multiple day surveys, the data must be backed up nightly to an external hard drive. Once the multiple-day survey is complete, all raw data should be copied to the V drive and removed from the field computer, SD drive, and/or external drive.

4.2.1.2. In the Office

Download photos to two locations:

W:\Habitat Research\Project Name or other folder\OriginalPhotos

V:\Habitat\Town\ProjectName_YYYY\OriginalPhotos_CameraUnit_MMDDYYY

Delete photos from original storage medium (flash drive, SD card, etc)

Cull photos on W drive by deleting any unnecessary files.

- Keep one station number photo per station.
- Keep one to five representative photos per station. Does each photo provide useful/additional information or a unique perspective that is informative with respect to the habitat at the station?
- If a station number cannot be seen on the station photo, add the station number in Paint.
  - Rename W:\Habitat Research\Project Name or other folder\OriginalPhotos to
  - W:\Habitat Research\Project Name or other folder\CulledPhotos

Rename photo files as follows:

- [TownProjectName]_[CameraUnit]_[MMDDYYYY]_[station]_[imageno]
- Examples:

BostonGallops_GoPro_08012014_14_1

CohassetEelgrass_AquaVu_09052017_1_0 *(use image number 0 for pictures of the station card-you should never have more than one station card image)*

DO NOT use the following characters in folder or file names:

*** : \ / < > | " ? [ ] ; = + $ £ $! ~ @ # ^ %)(**

Windows may allow the usage of certain characters, however, doing so may cause problems when searching and/or opening.

DO Use Letters, Numbers, Underscores, and Hyphens:

To separate words in a file\folder name, primarily use capitalization of the first letter of each word (without additional spaces in between words). If needed, underscore (_) or hyphen (-) can be used e.g. **SmithJohnAIG_Policy20090915.pdf** or **HabRestMylesStand20160921.doc**

Copy culled photos folder to the V drive at this location:

- V:\Habitat\Town\ProjectName_YYYY\CulledPhotos_CameraUnit_MMDDYYY

Optionally, delete the original photos folder from V drive. You may want to keep them if you were concerned the culling was problematic somehow, but in general they should be deleted.

4.2.1.3. Archives and Backups

The raw and processed data will be backed up by EEA IT according to its backup schedule for the V and W drives. The backup procedure is currently not published but a daily onsite backup was described by Bob Sigren, EEA IT.

4.2.2. Interpreted Data

4.2.2.1. Working Files

Copies of the raw data can be transferred to the hard drive of the processing computer. These files should be placed in a file location convenient to the person doing the processing. All working files, including Google Earth and ArcGIS files, should be placed in W:\Habitat Project\Habitat Research\[Project Name-Year]\GIS.

4.2.2.2. Long-term storage

Once a survey is completed, all interpreted survey data will be stored as a Map Package on the V drive under the Habitat Folder according to the following naming convention: V:\Habitat\[Project Name-Year]

The Map Package should be generated such that it can be sent to a potential user and opened with all interpreted files, the sonar mosaic, groundtruthing points, and relevant baseline files intact.

4.2.2.3. Archives and Backups

These data will be backed up by EEA IT according to its backup schedule for the V drive. The backup procedure is currently not published but a daily onsite backup was described by Bob Sigren, EEA IT.

5. Data Processing and Analysis

5.1. Data Processing Workflow

5.1.1. Underwater imagery, unrecorded

The field sheet will be digitized in Excel. The Excel file will be stored at V:\Habitat\[Project Name-YY]\[Project Name]Notes[CameraUnitName][MMDDYYYY]

5.1.2. Underwater photos

5.1.2.1. Scaling

Camera calibration is conducted if scaling in a routine set of still photos (or video extractions) is required. In this case, a lobster pot mesh will be connected to the frame holding the camera and the camera will be submerged in water. An image will be taken. The lobster pot mesh size will be measured and recorded.

The lobster pot mesh will be viewed in photo processing software (e.g. GIMP). Lens distortion will be corrected by flattening the image so the mesh measures the proper dimensions throughout the image. The lens distortion measurement will then be applied to successive images. This can be done in batch mode in GIMP.

5.1.2.2. Georeferencing

Underwater photos are processed so they are accessible in Google Earth.

NEED UPDATED GUIDANCE ON THIS SINCE PICASA METHOD IS NO LONGER VIABLE; one method is to add photos to Flickr and then create a point shapefile in arcgis, add a hyperlink field, and include the Flickr address in the hyperlink field. Problem: this doesn't actually geotag the photo. Including the photo location in the EXIF data for the photos is ideal.

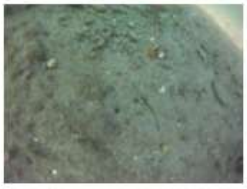
5.1.3. Underwater video

5.2. Analyzing Camera Data

5.2.1. Substrate

Multiple programs are used for interpreting seafloor sediment types based on the accuracy and precision needs of the given project. In general we are processing to provide an approximation of the basic character of the seafloor. In some cases measurements are made to delineate grain sizes (such as pebble, cobble, and boulder), but this is only done on an as-needed basis.

The standard sediment types are as follows (anything softer than sand is Mud):

Sand	
Coarse sand	
Sand mix	
Pebble mix	
Pebble	

Cobble mix	
Cobble	
Boulder mix	
Boulder	

Record coordinate information

- Enter the coordinates into Excel with columns for stations number, lat, lon, description, substrate, and vegetation.

5.2.2. Biological information

Our primary consideration in photo/video analysis is vegetation information, but some projects required the identification and enumeration of other organisms including moon snails, sand dollars, etc. Be as descriptive as possible – species name, red/green algae, or just algae; if mixes, use “mixed algae.”

Ideally, utilize the Coastal Marine Ecological Classification Standard (CMECS).

5.2.3. Standard table format

The basic standard table format is as follows:

	A	B	C	D	E	F	G	H	I
1	Station	Replicate	Lat	Lon	Date	Time	Description	Substrate	Vegetation
2	1	1	41.77227	-70.4831	2018-07-20T	13:18:39Z	cobble, gravel, and algae	cobble mix	algae
3	2	1	41.77216	-70.4837	2018-07-20T	13:18:39Z	cobble and algae	cobble	algae
4	3	1	41.77324	-70.4868	2018-07-20T	13:18:39Z	algae on rock- visual only	rock	algae
5	4	1	41.77364	-70.4858	2018-07-20T	13:18:39Z	gravel and algae	gravel	algae
6	5	1	41.77382	-70.4864	2018-07-20T	13:18:39Z	sand and eelgrass	sand	eelgrass
7	6	1	41.77422	-70.4867	2018-07-20T	13:18:39Z	cobble and gravel with chorda filum	cobble mix	chorda filum

If using the Coastal Marine Ecological Classification Standard (CMECS), confer with CZM (Todd Callaghan) for a copy of the CMECS standard table.

5.3 Final Reports

Final Project Reports will be generated on a per-project basis and placed in W:\Habitat Project\Habitat Research according to the following naming convention: [Project Name-Year]\FinalReportMMDDYYY. The date refers to the date the final report was finished. Whenever possible, final reports will be submitted to the DMF Technical Report series or peer reviewed literature.