Protocol for In Water Mapping

of Acroporid Corals

BY

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TABLE OF CONTENTS

INTRODUCTION

This project is a targeted survey effort aiming to better characterize the distribution of living and historical acroporid populations in the Caribbean. Diver propelled vehicles (DPV) will be used to document the location of living *Acropora palmata* and *A. cervicornis*, as well as areas of extensive intact, standing dead thickets which represent historical deistribution. Surveys should target particular habitat strata known to be favored by *Acropora* spp. (e.g., patch reef, shallow hard-bottom, back-reef, reef crest, or shallow fore-reef and fringing reef areas). Information from these surveys will be used to populate a GIS database and to construct maps designating the following types of areas: 1) living *A. palmata* colony(ies) present, 2) living *A. cervicornis* colony(ies) present 3) historical populations (i.e. extensive dead standing skeletons with no live colonies), 4) *Acropora* spp. absence, and 5) area not searched. This GIS data is being compiled by NOAA's Biogeography Team in cooperation with NOAA-Fisheries Southeast Regional Office and will be used for management and critical habitat planning.

MATERIALS AND EQUIPMENT

The basic assembly used by the mapper in the field is shown in Figure 2, detailed instructions on setup are in the following section.

1) Diver propelled vehicles (DPV or"scooter"), 1 extra battery. (i.e. SeaDoo VS Supercharged is an economical option, www.seadoo.com)
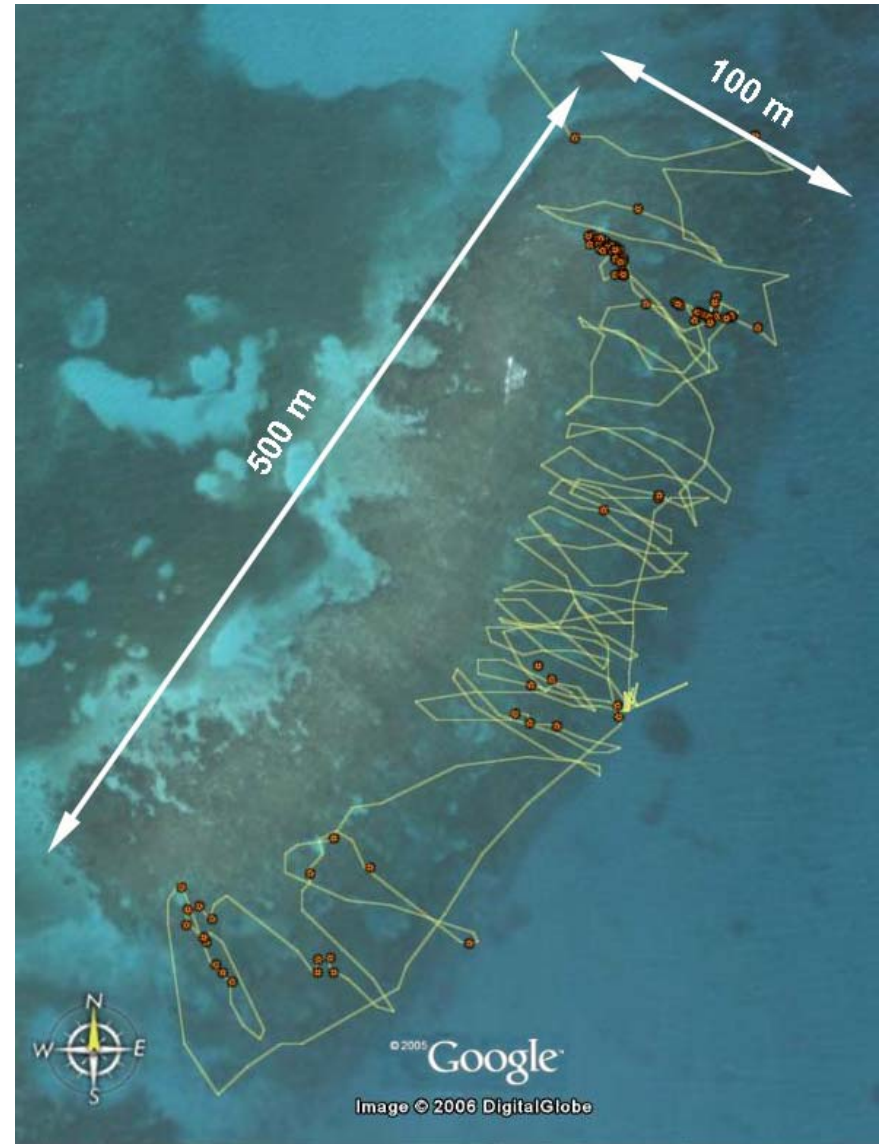

Figure 1. Example of raw scooter mapping data. The yellow line represents the track surveyed by the mappers and the Orange dots represent individual colonies of *A. palmata*. This fore reef area was surveyed by two mappers in approximately 90 minutes using the protocol described here.

2) Hand held GPS unit, extra batteries (Garmin GPS76 is an economical option, www.garmin.com).

3) Waterproof plastic case (for GPS) (www.aquapac.net)

4) Towable dive flag (with a float and pole)

5) 1.5m section of rope, 2 brass clips

6) Clipboard, mechanical pencils, Large rubber bands

7) Field datasheet template (Appendix 1)

8) Underwater paper (for printing data sheets, can use Dura Copy, J.L Darling Co.)

9) Cable ties & scissors

10) Snorkel gear

11) Garmin MapSource® software or other GPS download software

12) GPS download cable

INITIAL EQUIPMENT SET-UP

SCOOTER

1) Attach the dive flag (w/GPS) to the scooter with a 'leash'. To create a leash, splice or knot the brass clips to both ends of a 1.5m rope section. Then clip the ends to the weighted end of the dive flag and to the handle or side of the scooter (Fig. 3).

2) Attach a small clipboard (large enough for a half sheet of paper) by wrapping cable ties around the top of the SeaDoo handles.

3) Attach a mechanical pencil to the clipboard with a string or rubber band- the rubber band should be long

Figure 2. Equipment used in the field portion of the mapping surveys. See 'materials list' in text (p.2) for equipment corresponding to the numbers.

enough to write comfortably on the bottom of the datasheet, but **NOT** long enough to get caught in the propeller!

4) Use rubber bands to attach the datasheet securely to the clipboard (Fig. 3).

GPS UNIT

The following GPS instructions refer to the Garmin GPS 72 or 76 or similar model (Figure 3). It is assumed that the user is somewhat familiar with the GPS unit and that it has been initialized and calibrated for your location (refer to Owners Manual for specifics).

General Settings

Once the following settings are established they should remain in the memory even when the battery is changed. It is worth verifying them occasionally since users may inadvertently change the settings.

5) **Turn the GPS unit on**.
   a) Hit PAGE to acknowledge Garmin disclaimer.
6) **Enable WAAS (Wide Area Augmentation System)**.
   a) Hit MENU twice
   b) Arrow down to select **Setup,** hit ENTER
   c) From **General** tab, arrow down to the 'WAAS' Box
   d) Hit ENTER, select **Enabled**
7) **Set the Beeper** (makes an audible beep when buttons are pushed)
   a) Arrow down to the 'Beeper' box
   b) Hit ENTER, select **Key and Message**, hit ENTER

4

Figure 3. Assembling the mapping field equipment. See text for instructions.

8) Set the time zone & verify the time.
   a) Arrow up to the general tab, arrow right to the time tab hit enter
   b) If Time Zone is not correct, Arrow down twice, hit enter and select the correct time zone, hit enter
   c) Arrow down to adjust Daylight Savings setting, hit enter
9) Hit PAGE to return to the main page
10) **Set 'Track' to log by 'Distance' instead of 'Time'.'**
   a) Hit MENU twice
   b) Select **Tracks**
   c) Hit MENU,
   d) Select **Setup Track Log**
   e) Hit ENTER
   f) On the 'Track Log Setup' page, arrow to the 'Record Method' box
   g) Hit enter, select **Distance**, hit enter
   h) Arrow down to 'Interval' hit ENTER, select **0.01**(regardless of units, this is the smallest non-zero interval) hit ENTER
11) **Setup the map page with useful data**.
   a) Hit PAGE until the map page is displayed
   b) Hit MENU once for the Map Page options
   c) Arrow down to **Setup page layout**, hit ENTER
   d) Select **Setup Page Layout**, hit ENTER
   e) Select **Medium (1 row)**, hit ENTER
   f) Select **Change Data Fields**, hit ENTER

Figure 4

Figure 4. Optimize the settings for mapping surveys. These general settings will remain 'set' even through battery changes, until they are changed.

g) The display will return to the map page, hit enter and a list of choices for the data field will appear, Select **Time**, hit ENTER

h) Arrow right, hit ENTER, Select **Track**, hit ENTER, QUIT

12) **Label GPS units** with a unique number or letter to prevent confusion with data sheets and track data files.

Each GPS unit should be enclosed in the waterproof plastic case, and secured using cable ties to the lower grommet on the dive flag and along the pole just above the float so that it remains face up and above the surface while snorkeling. CAUTION: GPS will likely lose reception if submerged!

FIELD DATA COLLECTION

PLANNING & PREPARATION

If available, habitat maps for the selected survey region are useful for targeting likely *Acropora* spp. habitat. Mappers may choose to prioritize reef areas less than 5m deep, as this will cover the vast majority of *A. palmata*, and observations at deeper depths on snorkel become more unreliable. *A. cervicornis* is likely to be more abundant outside of this depth range, and local and historical knowledge of *A. cervicornis* distribution should inform the prioritization of deeper survey strata. Prior to mapping, check weather and wave conditions. Seas should be at least fairly calm for comfortable and efficient scootering. Sunny skies allow for maximum visibility. Water visibility should be clear enough to allow a thorough view of the benthos.

Tracks Page Options

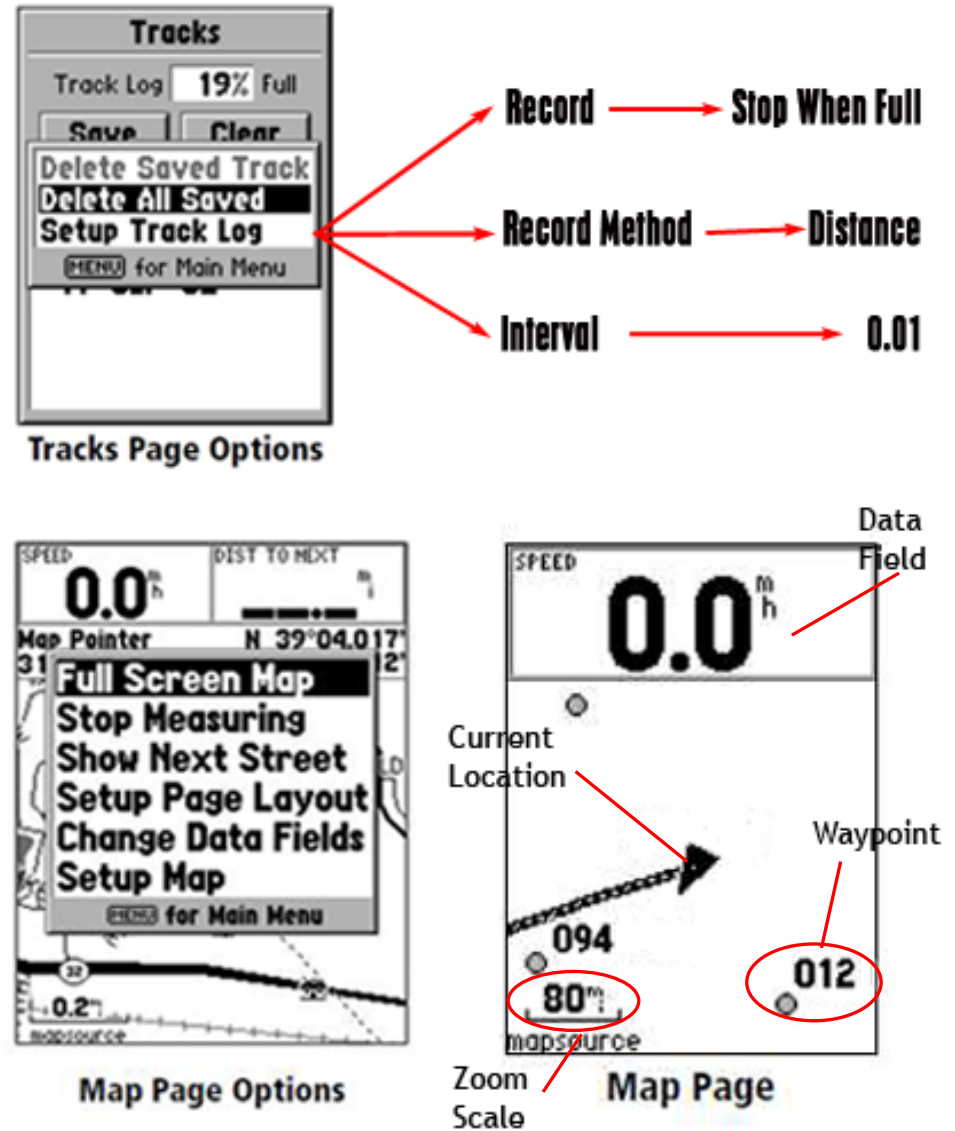**Map Page Options**

Map Page

Figure 5. a) Setup the tracklog to lay tracks at a minimum distance interval rather than by time (which yields too many points). B) Change the data fields on the map page to display current time and 'track' heading.

Prior to mapping, the team should clearly divide the selected reef area into regions that can be reasonably covered in approximately 1 hour (life of the scooter battery). If the reef doesn't have any surface reference points (such as mooring balls, lobster traps, pilings etc.), an additional weighted dive flag with line and a dive weight as an anchor can be placed temporarily as a boundary between 'territories' assigned to each observer. The anchor line of the boat can also serve as a useful boundary.

BEGIN MAPPING

Record all header information on the field data sheet (Figure 8), including Date, GPS unit number, Start time, Site, Observer initials and Method (Scooter, Tow, or Snorkel- see section Other Survey Methods below).

1) Turn the GPS unit on.
   a) Hit ENTER to acknowledge Garmin disclaimer.
2) **Acquire satellites**.
   a) Hold unit upright and wait while unit is '**Acquiring Satellites**'. Once acquired, this will change to '**2D GPS Location**' or '**3D GPS Location**' status.
   b) **IMPORTANT NOTE:** At all times during the survey, the unit status should be '**2D GPS Location**' or '**3D GPS Location**'. This is the default mode when satellite reception is adequate. The status can be confirmed at any time by hitting Page until the 'GPS info screen' is displayed. The unit enters 'Simulation Mode' (Fig 6) when it loses reception (which often happens when the unit is submerged). The mapper should frequently

Figure 6

GPS Information Page
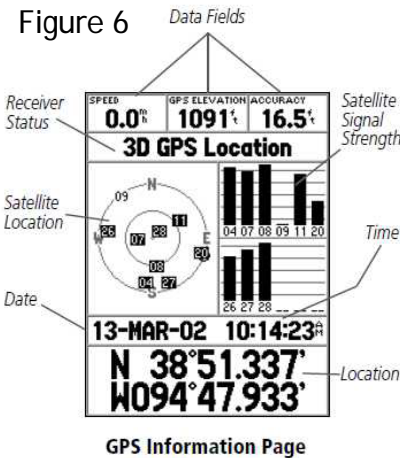
Simulator Mode can easily be unintentionally selected:
1. by hitting MENU once, then ENTER,
2. by hitting ENTER on the 'Poor Satellite Reception' warning screen, which comes up automatically after the unit loses satellite reception (e.g. when submerged or face down during survey).

IMPORTANT: **If 'Receiver Status' reads 'Simulating GPS', tracking data and waypoints are NOT recording.**
Exit this mode immediately: Hit Menu once, then select 'Stop Simulator'.

The **ONLY** two signs you are in Simulator Mode:

1. Info Page says: "Simulating GPS"
2. When a waypoint is marked the unit will beep twice (instead of the normal single beep).
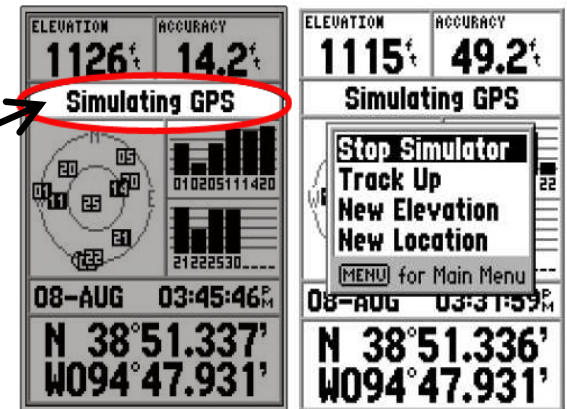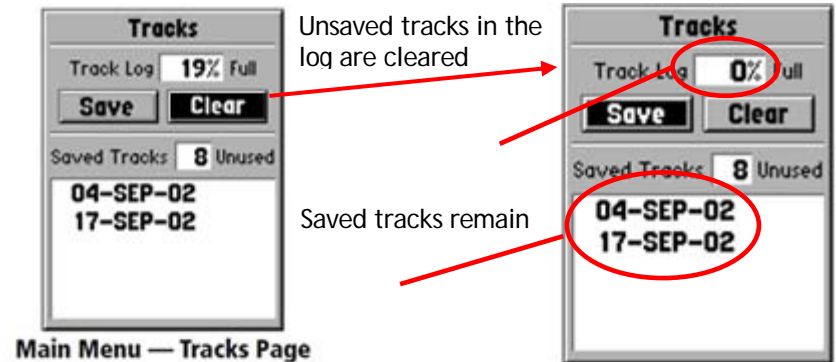

Figure 6. Simulator mode is a "feature" designed for use when satellite reception is poor- Exercise extreme caution to avoid this mode! This figure and the text explain how.

check to make sure 'Simulation Mode' is not selected or displayed.

3) **Clear the track log prior to a survey**.
   a) Hit MENU twice,
   b) Select '**Tracks**'
   c) Select '**Clear**' and '**Yes**'

4) **Once in the water and ready to survey, take a 'START' waypoint**.
   a) Hit PAGE until the map page appears
   b) Hold ENTER until the GPS unit sounds a single two-toned beep. (Note that this beep sounds different than <u>any</u> other beeps, which is helpful in the field when the screen is difficult to read.
   c) The 'Mark Waypoint Page' will appear displaying the waypoint number, and other information
   d) Record the waypoint number and the time on the datasheet next to 'START'
   e) Hit ENTER to accept the point; the GPS will beep once and return to the previous page. NOTE: The waypoint will not be recorded until you hit 'Enter' the second time and hear the second beep

5) Using the scooter, **begin linear transects** of the selected region. Allow the dive flag and GPS unit to tow behind you. The width of each transect should be adjusted according to site conditions including depth, relief and water visibility, so that the benthos are thoroughly observed with minimal overlap. In practice, this can be very difficult to accomplish, and a compass along with frequent reviews of the track on the GPS unit are helpful.

8

A. Clear Track Log

Unsaved tracks in the log are cleared

Saved tracks remain

Main Menu — Tracks Page

B. Mark a Waypoint

Another single Beep

Map Page will reappear

Hit Enter to OK

Press and Hold Enter

Mark Waypoint Page appears

Single dual-tone beep

Double beep

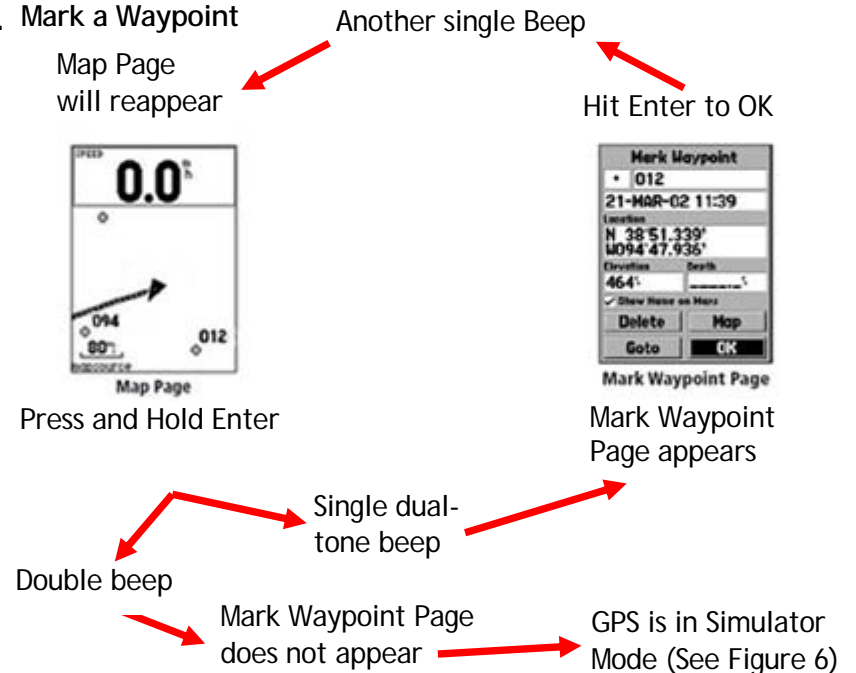Mark Waypoint Page does not appear

GPS is in Simulator Mode (See Figure 6)

Figure 7. a) Clear the track log immediately before the survey. Previous logs that have been saved will not be deleted. B) Mark waypoints.

6) A **waypoint should be marked when any of the features listed below** (Table 1) are encountered. The waypoint number and type of feature are recorded on the datasheet using the attribute codes. These codes are also listed at the foot of the datasheet (Figure 8). To save time, waypoint numbers only need to be recorded when the attribute changes and the time is only recorded at the beginning and end of the survey (Figure 8).

7) At the end of a survey (i.e. as soon as the mapper is no longer looking for and marking attributes) , **take an END waypoint**, and record the time and waypoint number on the datasheet

8) **Save the tracklog.**
   a) Hit MENU twice, select TRACKS, select SAVE
   b) Choose the appropriate '**Save Back Through**' time (check the START time recorded on the data sheet), hit ENTER
   c) Give the track file a unique filename
   d) Arrow key to scroll-up to the 'Name' field, hit ENTER. This allows the name to be changed from the default (**DD-MMM-YY**).
   e) It is especially important to include the GPS unit number in the trackfile name since all units will assign the same default name. A simple standard naming scheme would be: **14-SEP-06 6A,** where "6" is the GPS unit #, and "A" is the first track on that unit for that date. Subsequent tracks throughout the day should have sequential lettering (e.g., **14-Sep-06 4B**, **14-Sep-06 4C**, etc.).

Date:	4/20/2006	Start Time (GPS):	10:42AM
GPS#:	#6	Observer:	JQM
Site:	Molasses Reef	Method:	Scooter

Wpt#/Time	Attribute	Notes
041	START	
042	Ap	
068-081	ApTHIC	outline- thicket ~40% live
082	Ap	
088	AcDEAD	~ 5 colonies all dead
095	Ac	
096	Ap	
115-120	ApDEAD	shallow crest area w/ dead Ap
121	Ap	
128	Ac	
129	END	11:55am - battery running out!
		not done- come back later

Depth range:	4ft to 15ft
Track name:	042006-6A
Habitat type:	crest/back reef- rubble bottom leading to Thallasia grass
General notes:	most Ap colonies healthy but small.

Attribute Codes:			
START	Start of scooter search	END	End of scooter search
Ap	Live A. palmata colony	Ac	Live A. cervicornis
ApDEAD	Standing Dead Ap	AcDEAD	Standing Dead Ac
ApTHIC	Outline of a thicket	AcTHIC	Outline of a thicket
SEARCH	Point collected to mark track searched		

Figure 8. Example data recorded on a mapping data sheet.

Attribute Codes

When a waypoint is taken the following codes can be used to characterize which type of attribute the waypoint is marking (these codes can also be found at the bottom of a field datasheet, see Figure 8):

Ap- live *A. palmata* colonies. Every effort should be made to give each colony a separate waypoint, and the waypoints should be taken as close to the center of the colony as possible. See Figure 9 for examples.

ApTHIC- the boundaries of a live *A. palmata* thicket. A 'thicket' is an area where *A. palmata* growth is dense, such that individual colonies are difficult to distinguish and branches are often interlocking. If possible record an estimate of the % live of the outlined area. See Figure 9 for examples.

ApDead- an area with only standing dead (i.e. no live) *A. palmata* colonies are encountered. See Figure 9 for examples. These points are intended to mark the general vicinity of historical populations. A large area of standing dead can be outlined or a few waypoints can be taken to mark the extent of the area. Unlike live colonies or thickets, these areas are generally poorly defined so it is not important to be exact, instead a description recorded on the datasheet may be more useful.

Ac: This code should be used to classify waypoints taken over live *A. cervicornis* colonies. Every effort should be made to give each colony a separate waypoint, and the waypoints should be taken as close to the center of the colony as possible. See Figure 10 for examples.

THICAc: the boundaries of a live *A. cervicornis* thicket. A 'thicket' is an area where *A. cervicornis* growth is dense, such
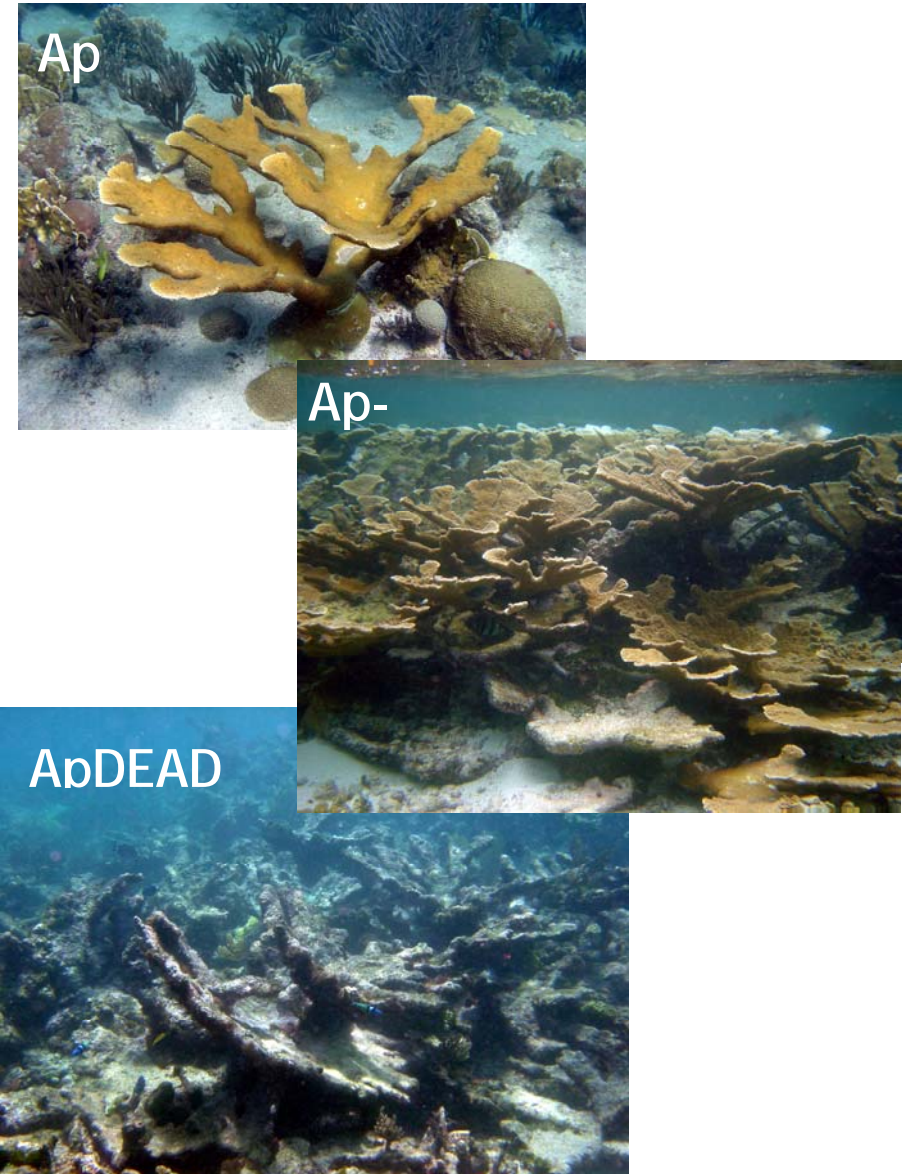

Figure 9. Examples of *A. palmata* corresponding to each of the three 'attribute codes'.

that individual colonies are difficult to distinguish and branches are often interlocking. If possible record an estimate of the % live of the outlined area. See Figure 10 for examples.

AcDEAD: an area with only standing dead (i.e. no live) *A. cervicornis* colonies are encountered. *A. cervicornis* colonies do not remain in tact as long as *A. palmata* so it is rare to find 'standing' dead colonies. See Figure 10 for examples.

Additional relevant or notable information about each waypoint/attribute can be recorded in the 'Notes' column on the field sheet (Appendix 1). Examples include any observed disease or bleaching conditions, notable colony size (very large or small), and estimated percent live. If time is limiting, this information is not necessary.

DATA DOWNLOADS AND PROCESSING

Whenever possible, each GPS unit should be downloaded and cleared after each day of use. Downloading ensures that data is stored safely, but it is equally important to clear the GPS after download so that there is adequate memory for the next survey!

1) Open MapSource® software (see Appendix 4)
2) Using the appropriate cable, attach the Garmin GPS unit to the computer, and power the GPS unit on.
3) Select 'File', then 'Open from device'.
4) Click the 'Auto Detect' button to allow the software to recognize the attached GPS unit. Once 'Connected', click 'OK'.
5) Make sure data types 'waypoints' and 'tracks' are selected from the 'What to Open' region of the window, then click the 'Open' button.

Figure 10. Examples of *A. cervicornis* corresponding to each of the three 'attribute codes'.

6) **Allow the unit to download**. Click OK when the 'the data was successfully opened.' prompt appears.

7) Using the field datasheet, confirm that all waypoints and tracks saved to the unit are downloaded into the Map-Source® file.

8) **Select 'File', then 'Save'**.
   a) Use a standard file naming scheme, such as **14-Sep-06-4**. Where "4" is the GPS unit number. This file should contain all tracks and waypoints collected on the unit during that day (so there may be multiple tracks).

9) **Clear all tracks and waypoints from the GPS unit**.
   a) Hit MENU twice, arrow down to **tracks**, hit ENTER
   b) Hit MENU again and arrow down to **delete all saved**.

10) **Delete all waypoints**:
   a) Hit MENU twice, select **Points**, hit ENTER,
   b) Select **Waypoints**, hit ENTER,
   c) Hit MENU, select **Delete All**,
   d) Select **Yes** to confirm that you are deleting all stored waypoints from the unit.

11) **Save the MapSource® file as a text document** (using the 'Save-Type-As' pull-down menu), then open this document in Excel. Enter attribute codes recorded for each waypoint.
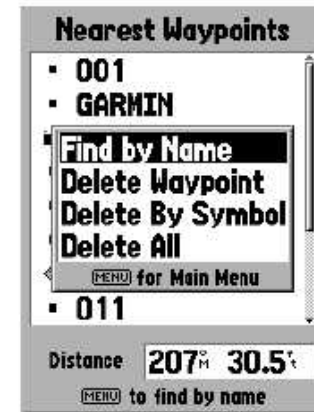
Point — Waypoint Option Menu

Figure 11. After downloading and saving all tracks and waypoints, clear the G.P.S. Unit. In the screen above, the 'Delete All' menu selection would be used to clear all waypoints.

Appendix 1: Template for field data collection (See attached spreadsheet file).

Date:		Start Time (GPS):	
GPS#:		Observer:	
Site:		Method:	
Wpt#/Time	Attribute	Notes	
	START		
Depth range:			
Track name:			
Habitat type:			
General notes:			
Attribute Codes:			
START	Start of scooter searc	END	End of scooter search
Ap	Live A. palmata colony	Ac	Live A. cervicornis
ApDEAD	Standing Dead Ap	AcDEAD	Standing Dead Ac
ApTHIC	Outline of a thicket	AcTHIC	Outline of a thicket
SEARCH	Point collected to mark track searched		

Appendix 2: Further Information: Scooter Maintenance (excerpts from the SeaDoo SeaScooter VS Supercharged User's Manual).
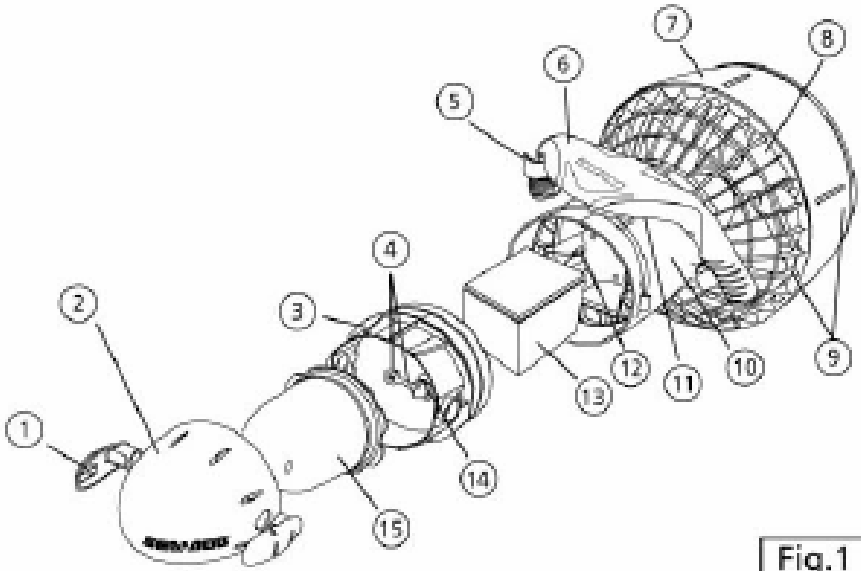
i)

Parts Diagram

Fig.1

① Latch	⑪ Master Switch
② Nose Cone	⑫ Battery Leads
③ Inner Nose Cone	⑬ Battery
④ Vent Plug	⑭ Vent Hole
⑤ Triggers	⑮ Buoyancy Control Chamber
⑥ Handle	⑯ Silicone Ring
⑦ Nozzle	⑰ Pump
⑧ Propeller	⑱ Lubricant
⑨ Protective Grilles	
⑩ Battery Housing	

## ii) Loading, Unloading and Charging the Battery

Charging the battery

For battery charging follow these instructions.

1. Always ensure that the Master Switch is Off - see fig. 2.

2. Always ensure that the SEA-DOO® SEASCOOTER™ VS Supercharged is out of the water and placed in a dry area.

3. Give a half turn to the Latches and remove them from the Nose Cone as shown in fig. 4.

4. Remove the Outer Nose Cone and Buoyancy Control Chamber.

5. Open the Vent by unscrewing the Vent Plug.

6. Remove the Inner Nose Cone. To do this, first feed the silicone ring (provided with this manual) through the latch holes in the Inner Nose Cone and hook over the hooks on the Battery Housing (see fig. 6). Then screw the Pump Nozzle onto the Vent Hole and pump air into the Battery Chamber until the Inner Nose Cone pops off and then remove the silicone ring.

7. Allow two minutes for any gasses to dissipate.

8. Disconnect the battery cable from the housing cable (if not already disconnected - the cable will be disconnected when you buy your SEASCOOTER™) by pressing the locking feature, as shown in fig. 7.

Fig.6

Press here to release and pull to disconnect

Fig.7
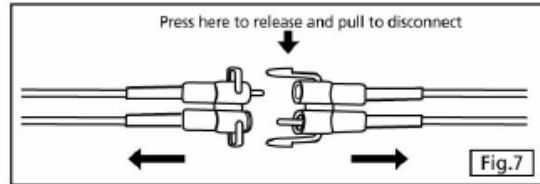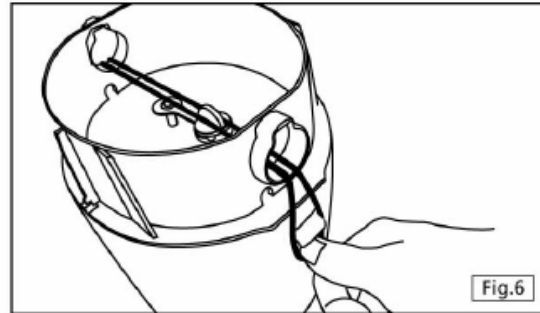
9. Connect the battery cable to the charger cable.

10. Plug charger into mains, and turn on the supply. Do not replace the Nose Cone.

11. Charging will take 4 to 6 hours for a fully discharged battery. When the battery is charging the LED charger remains on, when the battery is charged the LED flashes.

12. Unplug the adapter from the mains.

13. Unplug the battery cable from the charger cable and reconnect to the housing cable.

14. Make sure the seals and sealing surfaces are clean and lubricated before replacing the Inner Nose Cone. See fig. 8.

Ensure sealing surface is clean

Ensure the seals are clean and lubricated

Close up view of seals

Seals

Fig.8
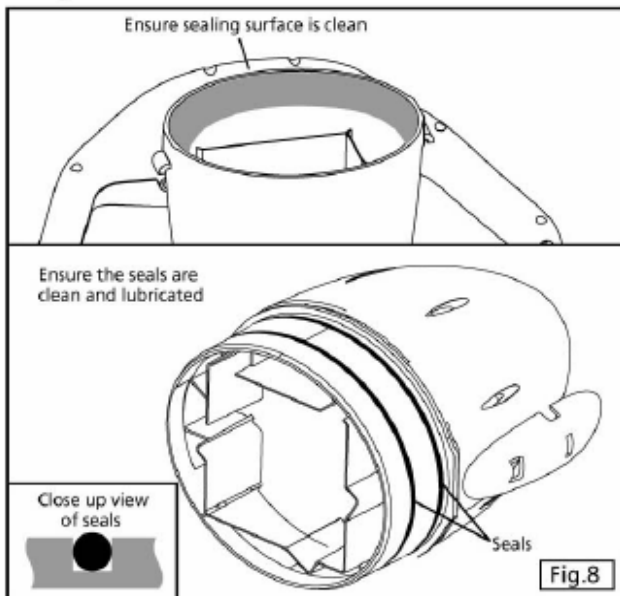
15. Replace the Inner Nose Cone making sure the key is aligned correctly. See fig. 9.

16. Ensure the Vent O Ring is fitted correctly. See fig. 10.

17. Screw in the Vent Plug to seal the vent.

18. Replace the Buoyancy Control Chamber.

19. Replace the Outer Nose Cone making sure the key is aligned correctly and insert the Latches and lock the Nose Cone by giving them a half turn. See fig. 11.

Close up view

Fig.9

O Ring correctly fitted into groove and lubricated

Fig.10