

Chesapeake Bay Submerged Aquatic Vegetation (SAV) Ground survey directions
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revised 5-28-08

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1. PURPOSES OF SAV GROUND SURVEYS

Ground surveys of SAV in the tidal waters of Chesapeake Bay have four main purposes:

- A. Ground truthing to verify that beds mapped in the SAV Aerial Survey conducted by Virginia Institute of Marine Science (VIMS) are in fact SAV;
- B. To identify and map the SAV species in those mapped beds;
- C. to supplement the SAV aerial survey by locating additional SAV beds that are too small to be seen from the air, or were not visible when the photo was taken that year; and
- D. more detailed ground surveys done for research or for permitting such activities as dredging and dock construction.

These directions are designed to be used for the first three purposes, which are addressed by the volunteer SAV Hunt coordinated by VIMS. They can be used as the starting point for a detailed survey of the fourth type, but do not give complete instructions for detailed surveys. They do not apply to SAV in non-tidal waters, where more species are present, and different survey methods may be needed.

These directions recommend the planning needed, the best types of boats and tools to use, the best times and places to look for SAV, and how to record the data. There is no one right way to hunt for SAV, but following these directions will reduce the chance of recording false negatives, which means concluding an area has no SAV when in fact some was present. False positives are always possible if other types of plants in the water are mis-identified as SAV. How to do SAV

identification is outside of the scope of this document, and requires a field guide or key (see below for a list and sources).

2. MAPS

Obtain the most recent USGS quad map(s) of the site(s) you plan to survey from the VIMS aerial SAV survey. The published (final) and some draft maps from this survey are available on the World Wide Web at: <http://www.vims.edu/bio/sav>.

Maps from 2-3 recent years are best because SAV is dynamic, and ground truthing is not done every year in all quads. These maps include SAV beds mapped in the aerial survey, which are labeled with a letter and number, as seen in the photo taken on the date flown marked on the map. The letters are sequential identifying labels and the numbers represent the visually estimated density (1=least dense, 4=most dense). Each quad is photographed once per year, near the peak of growth for most of the SAV species present, and VIMS staff convert the photos into maps of SAV bed locations. The maps may include ground truth symbols labeled with a 2 or 3-letter species abbreviation, which may be inside or outside of mapped beds. These are point observations made at the sites marked; the dates on which they were surveyed are listed in Appendix D of the printed report, which also has a key for the species abbreviations. The unpublished maps on the VIMS web site may not have the ground truth symbols added yet, and a published map may lack ground truth symbols because no one surveyed that area in that year. The aerial survey does not pick up small beds, beds in small creeks, or species such as horned pondweed that die back before the photo was taken, so ground truth information is an essential supplement to it.

3. BOATS

Some areas can be surveyed adequately for SAV by wading from shore but this is unusual. A boat is needed for any complete surveys. Recommended survey boats include:

-Canoe or Kayak:

Pros--can get in very shallow water, easier to launch, volunteer hunters may have one already
Cons--can't cover as much area per day; can't easily get in and out of boat without beaching it, which makes it harder to wade or snorkel to check beds

-Small john boat or skiff with outboard motor (shallowest draft possible; no inboard engines)

Pros--can more easily get in and out of boat without beaching it, making it easier to wade or snorkel; more room for gear and people; can cover more area per day. A boat with a center console is good if its draft is shallow, because you can see beds better when standing up.
Cons--can't get into shallowest water (but can wade there); harder to launch than canoe

-Larger boats or sail boats are not recommended because they can't get into shallow water, and passengers are too far from the water.

If you want to hunt for SAV but don't have access to one of these boats, you can either rent a canoe or kayak, or locate someone with one of the recommended boats who will take you out. Fishers may be glad to help you scout for SAV beds because they are good fishing spots, and they often have small motorboats that are good for SAV hunting.

4. RAKES OR NETS

Unless you get in the water, a rake is needed to get samples for identification, but there's no one rake that will find all species at all times, and some species will not be found by raking. Whenever you use a rake, you should check by direct observation if possible to make sure the rake is picking up all the SAV that is present. This can be done by wading, snorkeling, SCUBA, a "view scope," or underwater video camera (see below for details on the last two). If a rake is picking up all the SAV that are present, then it is the right rake.

Recommended rakes include:

A. In shallow water and with short stems, especially from a canoe or kayak:

short bamboo Shrub rake for getting leaves off shrubs (ones with plastic tines don't snag as much SAV); can attach extension pole with hose clamps to the handle for deeper water. Most plastic shrub rakes have 5-10 tines and the bamboo ones have about 20 tines. Both rakes are about 8-10" across the head, with a 3'-4' handle. Bamboo shrub rakes are available online, just be sure they are the small size. Mark the handle with 0.1 m depths to get water depth in shallow water.

Crab landing net with a wire basket and 6' wooden handle works better on very short, sparse SAV. The SAV gets caught in the junctions on the net. This would not work well on very dense SAV, and it is somewhat hard to get one sample off the net so you can collect another

a regular metal garden "Bow" rake with short, stiff tines is used by some hunters. It only picks up the denser beds, and it won't go deeper than the handle length.

B. "Throw" rakes or nets for deeper water and longer stems:

All of the rakes listed above are limited because they won't go deeper than the handle length. A "throw" rake on a rope can be useful for deeper SAV and to cover a larger area.

(1). double-sided Throw rake on a rope. This can be made from a double-sided metal "lawn thatch rake" or two single-sided metal garden or bow rakes welded or fastened together (tines outward). Either design can be weighted with (optional) 4 pounds of dive weights, attached to a short handle and rope with an optional float on the end of the rope. You can throw it out away from the boat or off a pier, drag or troll from a moving boat, and use it in water too deep for a rake handle. Watch out for crab pots, lines, and woody debris which may snag the rake. This usually will NOT pick up very short, unbranched plants (about 2" tall or less), however. Thatch

rakes should be available in large garden shops or hardware stores. **WARNING**—the tines are sharp, especially on the thatch rake, so use this with great caution.

(2). metal collapsible crab basket with weight. Use a "double ring (or two ring) crab net, wire mesh with a weight and longer rope attached. These are sold to catch crabs when baited and laid on the bottom. Similar crab nets are also made out of string which would NOT snag SAV; it has to be the collapsible wire mesh. The junctions of the mesh are what snag the SAV. It picked up some 2" strands of horned pondweed that would have been missed by the thatch rake, and most other rakes. Attach an 8 ounce in-line fishing weight to the bottom of the net with nylon cord, and replace the strings with nylon cord, and attach about 20' of nylon cord with a float on the end.

(3). Two bow rakes attached with pivot, like oyster tongs. Uses two wooden-handle bow rakes with metal tongs (approx. 33 cm wide tongs). Approximately half way up the handle on each rake, we drilled a hole for a bolt to combine the two rakes like oyster tongs. Near the top of the rake, we attached a metal chain to both handles and set the length of the chain such that the tong opening is 1 m. If you use triplicate rake collections to sample a site a total of 1 m² is sampled this way}. This rake can pick up sparse *Vallisneria* in sand sediments, and small *Chara* sprigs in peat sediments, as well as enough sediment to show the sediment type. You can modify this for deeper water sampling by sliding a PVC pipe that just fits over the handle, and do the bolt/chain attachment through this. This extends its depth range to just over 2m, but is limited by how far the user can spread their arms. The rakes seem to hold up for a good period of time, but does take some punishment with *Hydrilla* and other dense (heavy) materials. They work best on boats such as pontoon boats where you can stand near the surface of the water (otherwise you could not reach the bottom without bending over). This sampling method has been used for two years in Florida lakes, and is cited in this article:

Havens, K.E., Harwell, MC., Brady, MA., Sharfstein, B., East, T.L., Rodusky, AJ., Anson, D., and Maki, RP. 2002. Large-scale mapping and predictive modeling of submerged aquatic vegetation in a shallow eutrophic lake. *The Scientific World* 2: 949-965.

5. FIELD GUIDES TO CHESAPEAKE SAV

There are three printed field guides to Chesapeake SAV, but one is almost out of print, and one is not yet available. MD DNR has an online key. The three printed guides are:

A. This is the shortest of the three guides, showing 15 species of SAV and 2 of algae. It can be obtained in laminated, waterproof form from CBF, or downloaded from their web site.

CBF Field Guide to Underwater Grasses. 2000. Download from:

http://www.cbf.org/site/DocServer/Guide_to_Underwater_Grasses.pdf?docID=116

B. This one from 1990 is out of print:

Field guide to the submerged aquatic vegetation of Chesapeake Bay. L. M. Hurley. United States Department of Interior, Fish and Wildlife Service, Chesapeake Bay Estuary Program, Annapolis, Maryland. 1990.

C. This is the longest of the three guides, with photos, and maps, and text, for all of the SAV species found in local tidal waters.

Underwater Grasses in Chesapeake Bay & Mid-Atlantic Coastal Waters: Guide to Identifying Submerged Aquatic Vegetation. Peter W. Bergstrom, Robert F. Murphy, Michael D. Naylor, Ryan C. Davis, and Justin T. Reel. 2006. Available from <http://www.mdsg.umd.edu/store/books/sav/index.php>

D. MD DNR online key at <http://www.dnr.state.md.us/bay/sav/key/> has photos and will be updated as new information is found.

6. OTHER USEFUL GEAR

Footwear:

-Shoes or sandals that can get wet, for wading, or chest waders if water is cold.

-Waterproof sandals can be useful in very sparse beds because you may feel the grass on your bare feet or catch some in the straps, but poor for use in dense beds because they tear out too much SAV. They do not protect your feet very well..

-wet suit booties or water shoes for kayaking are better for cold water, rough bottoms with debris, and/or sea nettles.

-Mask and snorkel or SCUBA, with wet suit if water is cold, for deep or short plants that can't be raked

-protection from sea nettles if they are present (long pants, nylon nettle suit, or wet suit, with shoes or boots that cover your feet)

-Polarized sun glasses to help you see under the water

-Global Positioning System (GPS) if available. Units costing about \$150-\$200 that will store waypoints and download them to a computer work well for general surveys. Those with WAAS tend to be more accurate.

-a View scope may be useful in some situations, even in fairly murky water. You can purchase the "Aquascope" from:

>Forestry Suppliers <http://www.forestry-suppliers.com>

>Ben Meadows <http://www.benmeadows.com>

>Water Monitoring Equipment Inc. <http://www.watermonitoringequip.com/pages/lake.html>

or you can make one from a 4" x 5' section of PVC pipe with a circle of Plexiglas cut to fit the bottom and glued on. If 5' is too long, shorten the top as needed. You can attach metal handles, but ones made of rope may be better because they can be moved as needed. You can attach a swim mask to the top with the glass removed to help keep out stray light. This can be used both when walking in shallow water, or off the side of a small boat. It is hard to hold steady when the boat is moving very fast, though.

-Underwater video camera may be useful, although you may not be able to identify the species. It could be used to find beds to study more intensively by raking or diving.

-Measured lines if you will be recording SAV along a transect (for more detailed surveys).

7. WHEN TO HUNT SAV

a. Dates:

Two or more visits per year are usually needed to find all the species present, because they may have different growing seasons. Look during the peak biomass of the SAV species of interest:

-May 15 through June 15 for Horned pondweed in lower salinity areas (spring species), possibly to July 1 if water temperatures are low and die-back is delayed.

-July 15 through September 15 for other lower salinity species (earlier is better if waterfowl are eating the SAV, since biomass drops off faster in that case). If weather is warm and grazing is low you can often find healthy beds into the first week of October.

-For eelgrass in higher salinity portions (mainly in Virginia), look during the eelgrass growing season (March-May OR September-November, NOT during the summer when the plants die back).

If you are finding lots of SAV it's probably a good time to look, but you may still be missing some species. The safe dates are designed to avoid doing surveys outside the growing season which find no SAV, and erroneously concluding from them that no SAV grows there.

b. Times of day

If at all possible, look **WITHIN TWO HOURS OF LOW TIDE ON A SUNNY DAY WHEN WATER IS FAIRLY CLEAR**. You'll find many more beds if you can spot beds visually; raking the bottom is very slow business. If there is an unusually low wind-driven tide that may be a good time to look for horned pondweed or other intertidal species since much of it will be exposed. However, it may be necessary to hunt at **HIGH** tide to get the boat into very shallow areas, so more than one visit may be needed to each area surveyed. In areas with heavy weekend boat traffic, it's better to look on a weekday since boats tend to cloud the water, and you won't have to be looking for oncoming boats and SAV at the same time.

8. WHERE TO HUNT SAV

Try to locate any SAV beds shown on the most recent SAV survey map of your area, and identify species if possible. Also look for SAV outside the mapped beds in shallow areas (2 meters deep or less) and identify species if possible. If time permits, look for SAV in all the shoals that are marked on a quad map or navigation chart.

9. HOW TO HUNT SAV

-If the tide is low and the water fairly clear, stand up in the boat (if this is safe) and use polarized sunglasses to look for dark patches in shallow water, or calmer patches of surface water surrounded by ripples. If you see one, go over and investigate by raking, wading or snorkeling.

-If the tide is too high and/or the water too murky to see patches of SAV, you'll have to rake or wade likely sites, including those with mapped SAV.

-To find all the species in a shallow mixed bed (some have 5-6 species in a small area) wade it slowly at low tide, or move over it in a canoe, raking with small bamboo rake. You may need several people wading to find all the species since sometimes there is just one clump of a species visible. If water is too deep to wade, try snorkeling if the water is fairly clear. If the water is quite clear or fairly shallow, you may be able to notice different species by looking from a slow-moving boat. A viewscope may be useful.

-If one or more teams of 5-6 people in canoes or kayaks are available, a more coordinated survey may work well. Each team should be assigned to part of the survey area, marked on a map. The team leader (who has a GPS and data sheet and can identify SAV) will choose a bed in their area and have the team move their boats into a circle around the edge of the bed. Then each boat in the team will move in towards the center of the bed, raking and/or looking as they go, and keeping track of what species they see or get on their rake. Bring samples of any species you don't know to the center. The boats will meet in the center of the bed and compare what species were found by each boat; the team leader will store a waypoint at the center of the bed and record the species found (using VIMS abbreviations), with the waypoint number, on the provided data sheet. Then the team will move on to the next bed in their area; the team leader will "X" off each bed on their map as it is visited.

-For some species (e.g. eelgrass in summer when it is short) you will need to get in the water and snorkel or use SCUBA, since no rake picks it up reliably.

-For detailed SAV surveys using transects, some surveyors check for SAV at regular intervals along transects 30-50 feet apart, or as close as 20 feet apart when SAV is found. It is useful to record the water depth at each point where SAV is found, as well as the distance from shore and species found.

10. HOW TO IDENTIFY ANY SAV FOUND

-Bring a Chesapeake Bay SAV Field Guide and try to match specimens with the photos or drawings in the guide, or use the key if available. If you bring back samples in plastic bags, you can also use the MD DNR online key at <http://www.dnr.state.md.us/bay/sav/key/>.

- It helps if you know the typical salinity where you are hunting: the lower the salinity, the more SAV species are able to grow there. Typical species in each salinity zone are listed on page 5 of the FWS guide, and spring salinity zones are shown on page 4. Chesapeake SAV species grouped by salinity are also listed at <http://www.vims.edu/bio/sav/aboutsav.html>.
- Bring zip-lock bags for samples of any species you can't identify. Samples in bags will keep for one or two weeks in the refrigerator, especially if kept in tap water that is changed regularly, until you can get them to an expert to identify. Samples not in bags will dry up in minutes (because SAV has no waxy cuticle).
- Don't record floating SAV since it may have come from elsewhere.
- Don't record terrestrial plants or floating or emergent aquatics that may be growing underwater during a very high tide or in the spring. All three have a waxy cuticle and will not shrivel quickly in air as SAV does. True SAV will not be growing above the water surface, except for the flowers of a few species (mainly redhead grass and parrotfeather).
- Do record one floating species, water chestnut, since it is highly invasive and is targeted by MD DNR control efforts.

11. HOW TO RECORD DATA

- Record rooted SAV species found and locations on a map and/or record locations from GPS.
- Keep any maps and data sheets DRY, write with pencil, and use waterproof paper if available. See last page for a sample data sheet.
- Do not rely on your memory after you return to record the species found. However, it may be helpful if field notes are copied over clearly before sending them off for others to interpret.
- If you use a small (8.5 x 11") quad map to record data, you can put a letter on the map at the site and list that letter and the species found there on a separate sheet in the field.
- If you use a full size quad map (available from USGS and camping stores) you can outline beds and write notes adjacent to beds, and write a zero in any shallow water area you checked on the quad that had no SAV.
- If you use GPS you can store the locations on some units and download them later to a computer, but make sure you write down in the field which species were found at each stored location (usually the GPS stores locations with a sequential number). To be safe, it's best to write down all the latitude/longitude values in the field also, with the species found at that location and sequence number. In Chesapeake Bay we use one- to three-letter abbreviations for each species reported in ground surveys, usually based in the first letter(s) of the genus and species names, or just the genus when the species is not identified.

The abbreviations used for the 1998 survey are as follows:

Tidal Chesapeake Bay SAV species

Abbr. Scientific & common name

Zm	<i>Zostera marina</i> (eelgrass)
Rm	<i>Ruppia maritima</i> (widgeon grass)
C	<i>Chara</i> sp. (muskgrass)
Cd	<i>Ceratophyllum demersum</i> (coontail)
Cl	<i>Callitriche</i> sp. (water-starwort)
Ec	<i>Elodea canadensis</i> (common elodea)
Ed	<i>Egeria densa</i> (water-weed)
Hd	<i>Heteranthera dubia</i> (water stargrass)
Hv	<i>Hydrilla verticillata</i> (hydrilla)
Ms	<i>Myriophyllum spicatum</i> (Eurasian watermilfoil)
N	<i>Najas</i> spp. (naiad)
Nfl	<i>Najas flexilis</i> (northern naiad)
Ngr	<i>Najas gracillima</i> (slender naiad)
Ngu	<i>Najas guadalupensis</i> (southern naiad)
Nm	<i>Najas minor</i>
Nt	<i>Nitella</i> sp. (muskgrass)
Pcr	<i>Potamogeton crispus</i> (curly pondweed)
Pe	<i>Potamogeton epihydrus</i> (leafy pondweed)
Pn	<i>Potamogeton nodosus</i> (American pondweed)
Ppc	<i>Potamogeton pectinatus</i> (sago pondweed)
Ppf	<i>Potamogeton perfoliatus</i> (redhead-grass)
Ppu	<i>Potamogeton pusillus</i> (slender pondweed)
S	<i>Sparganium</i> sp. (burreed)
Tn	<i>Trapa natans</i> (water chestnut)
Va	<i>Vallisneria americana</i> (wild celery)
Zp	<i>Zannichellia palustris</i> (horned pondweed)
U	Unknown species composition

Note that this Key from the VIMS survey includes only those species reported in ground surveys that year. Thus, the species listed varies from year to year, and it is always possible that some were mis-identified. This list is from 1998 was used here because the largest number of species was reported, from <http://www.vims.edu/bio/sav/sav98/quads/key.html>

Many more species of SAV occur in non-tidal fresh waters; to identify them you need a larger guide such as the one by Neil Hotchkiss, *Common Marsh, Underwater, and Floating-Leaved Plants of the United States and Canada*, published by Dover, or large plant manuals.

-GPS locations can be entered in a spreadsheet with the species abbreviations, and imported directly to GIS software. Be sure to use the NAD83 or WGS84 map datum if available, and record the map datum used in any case and include it with the GPS data. Recording locations in

degrees and decimal minutes works well in most GIS software. A sample spreadsheet from the Magothy River is included below; in most salinity regimes the maximum number of species per bed will be less than seven, so there could be fewer species columns. The VIMS survey has a number assigned to each USGS quad used; elsewhere you would list the quad name.

-Go over your field data soon after you do the survey to check for any errors, and if you collected specimens you couldn't identify, try to get them identified. Submit your SAV Hunt data to VIMS staff (in electronic form if possible) by the winter of the year in which it was collected. To contact VIMS staff go to <http://www.vims.edu/bio/sav> and click "Contact us" which should generate an email to savadmin@vims.edu.

12. SAMPLE DATA FROM SAV HUNT

	Date	Time	River	VIMS Quad	Site Name	2005 VIMS bed	Way-point	LAT	LONG	Species	Salin (ppt)	Notes
4	6/8/06	9:49	Eastern Bay		Marshy Ck		5	38.95275	76.22751	Zp Ms		New GPS unit
5	6/8/06	10:09	Eastern Bay		Marshy Ck		7	38.95223	76.22541	Ppf Ms Ppc Ec		
6	6/8/06	10:19	Eastern Bay		Marshy Ck		8	38.95297	76.22332	Ppf Zp Ppc Rm		
7	6/8/06	10:28	Eastern Bay		Marshy Ck		9	38.95247	76.22281	Zp Ms Ppf		
8	6/8/06	10:33	Eastern Bay		Marshy Ck		10	38.95219	76.22222	Ec Ppf Zp Rm		
9	6/8/06	10:56	Eastern Bay		Marshy Ck		11	38.95294	76.22197	Ppf Zp Ec		
10	6/8/06	11:06	Eastern Bay		Marshy Ck		12	38.95028	76.22406	Ppc Ppf Zp		
11	6/8/06	11:26	Eastern Bay		Marshy Ck		13	38.95432	76.23005	Ppc Rm Ppf Zp Ms		