DATA ON THE DISTRIBUTION AND ABUNDANCE OF SUBMERSED AQUATIC VEGETATION IN THE TIDAL POTOMAC RIVER AND TRANSITION ZONE OF THE POTOMAC ESTUARY, MARYLAND, VIRGINIA, AND THE DISTRICT OF COLUMBIA, 1987

U.S. GEOLOGICAL SURVEY

Open-File Report 88-307

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By Nancy Rybicki, R.T. Anderson and Virginia Carter

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who prefer inch-pound units rather than the metric (International System) units used in this report, the following conversion factors may be used:

Multiply metric units	By	To obtain inch-pound unit
meter (m)	3.281	foot (ft)
square meter (m^2)	11.11	square foot (ft^2)
centimeter (cm)	0.3937	inch (in)
square centimeter (cm^2)	0.1550	square inch (in^2)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5405	nautical mile (nmi)
hectare (ha)	2.471	acre

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ABSTRACT

This report documents the distribution of submersed aquatic vegetation collected in the tidal Potomac River and transition zone of the Potomac Estuary during 1987. Maps illustrate the distribution of submersed aquatic plants and *Hydrilla verticillata* in the tidal Potomac River, based on shoreline surveys. Species of submersed aquatic plants found on vegetated transects in the transition zone of the Potomac Estuary are reported for each transect location. Regrowth of harvested *Hydrilla* is presented for four mechanically harvested sites. Data on the distance from shore and greatest depth of water in which aquatic plants grew on four transects and on Secchi depths throughout the study reach are reported. These data can be used to quantify changes in water clarity and plant distribution.

INTRODUCTION

Carter and Rybicki (1986) reported that submersed aquatic plants, absent from the tidal river for decades, returned in 1983. A calendar of events for submersed aquatic vegetation and *Trapa natans L.* (waterchestnut) in the tidal Potomac River and transition zone of the Potomac Estuary is presented in Table 1. By 1984 there were 240 hectares of aquatic vegetation, and in 1985 and 1986, 1,460 hectares were reported between Washington, D. C. and Indian Head, Maryland (fig. 1) (Carter and Rybicki, 1986). *Hydrilla verticillata*, an exotic species from Southeast Asia was among 13 species found in the tidal river. *Hydrilla* grows rapidly and outcompetes other species. By 1986, more than 80 percent of the vegetated area above Marshall Hall, Md. was dominated by *Hydrilla* (Rybicki and others, 1987). In the transition zone of the Potomac estuary, *Hydrilla* was only found in Mallows Bay, Maryland (fig.1).

The U. S. Army Corps of Engineers (COE) began a mechanical harvesting program in the reach between Alexandria, Virginia and Marshall Hall, Maryland in 1986. The COE harvested 17 sites to allow recreational boaters access to boat slips and ramps. Monitoring efforts are necessary to determine the spread of *Hydrilla* and other aquatic plants and to better determine sites and timing and frequency of mechanical harvesting.

Table 1. -- Calendar of events for submersed aquatic vegetation and *Trapa natans* L. in the tidal Potomac River and transition zone of the Potomac Estuary [Also see Stevenson and Confer, 1978]

Year	Reference	Event
1875	Seaman (1875)	*Vallisneria*, *Ceratophyllum*, *Nitella flexilis* (Willd.) Rostk. and Schmidt, and *Elodea* in the vicinity of Washington, D.C.
1904	U.S. Coast and Geodetic Survey Maps	Submersed plants on shoals from just below the Wilson Bridge to Hallowing Point, Md. and in Gunston Cove, Va.
1916	Cumming (1916)	Narrow open-channel and wide shallow margins covered with submersed aquatic plants from Washington, D.C., to Dogue Creek, Va.
1923	Gwathmey (1945)	*Trapa natans* L. was first recorded in Oxon Creek and quickly spread 5 miles up the river and 35 miles downstream.
1933	Secretary of Treasury (1933)	The flats of Oxon Creek, Md. and Hunting Creek, Va. were covered with *Vallisneria* ('eelgrass'), *Ceratophyllum* and other plants.
1933	Rawls (1964, p. 51)	10,000 acres of *Trapa* from Washington, D.C. to just south of Quantico, Va.
1939	Martin and Uhler (1939)	The loss of aquatic plants in the tidal river was noted.
1939-45	Gwathmey (1945)	U.S. Army Corp of Engineers brought *Trapa* under control with underwater cutting techniques.
1950	Stewart (1962)	*Potamogeton pectinatus*, *Najas* and *Vallisneria* reported in the tidal river.
1952	Bartsch (1954)	Submersed aquatic plants were essentially nonexistent in the upper Potomac River.

Table 1. -- Calendar of events for submersed aquatic vegetation and *Trapa natans* L. in the tidal Potomac River and transition zone of the Potomac Estuary, continued [Also see Stevenson and Confer, 1978]

Year	Reference	Event
1961	Chesapeake Biological Laboratory (1961)	A *Myriophyllum* distribution map showed that in the reach above Quantico, Va. *Myriophyllum* occured near Key Bridge and in Dogue Creek. In the transition zone of the estuary, *Myriophyllum* was found in the vicinity of Mallows Bay, Nanjemoy Creek, and Port Tobacco River, Md. and Aquia Creek, Va.
1962	Stewart (1962)	Abundant submersed plants were found in the Nanjemoy Creek and Port Tobacco River, Md. area.
1963	Steenis and King (1964, p. 8)	Maryland permitted treatment of *Myriophyllum* with 2,4-D.
1963	Rawls (1964)	*Myriophyllum* cutting begins. *Myriophyllum* thrived in most bays and tributaries from near the mouth of the Potomac River to Mattawoman Creek, Md. and possibly further upriver.
1969-72	Stevenson and Confer (1978)	Very little vegetation between Quantico and Port Tobacco River. *Vallisneria*, *Ruppia* and *Myriophyllum* found in the Port Tobacco River.
1970-71	Rawls and others (1975, p. 28)	No submersed plants of significance in the upper Potomac River.
1976-77	Washington Suburban Sanitary Commission	*Elodea* in two tidal creeks south of of Piscataway Creek, Md.

Table 1. -- Calendar of events for submersed aquatic vegetation and *Trapa natans* L. in the tidal Potomac River and transition zone of the Potomac Estuary, continued [Also see Stevenson and Confer, 1978]

Year	Reference	Event
1977	Haramis (1983)	Vegetation on Maryland side across from Quantico, Va. to the 301 Bridge (mostly *Vallisneria* and *Potamogeton perfoliatus*).
1979-81	Carter and Rybicki (1985)	Isolated patches of *Vallisneria* and *Zannichellia* in tidal river above Marshall Hall, Md.
1982	Steward and others (1984)	*Hydrilla* found in Dyke Marsh, Va.
1983	Carter and Rybicki (1986)	Twelve species of submersed aquatic plants colonized the tidal river from Washington, D.C. to Marshall Hall, Md.
1984-85	Carter and Rybicki (1986)	Submersed aquatic plant coverage in the tidal Potomac River was 243 hectares (600 acres) in 1984 and >1,457 hectares (3600 acres) in 1985. *Hydrilla* dominated plant populations in Swan Creek and in the area between Dyke Marsh and Hunting Creek. *Hydrilla* also found at Mallows Bay, Md., in the transition zone of the Estuary.
1986	Rybicki and others (1987)	Plant coverage remains about 1,457 hectares. *Hydrilla* dominates most vegetated areas above Marshall Hall, Maryland.

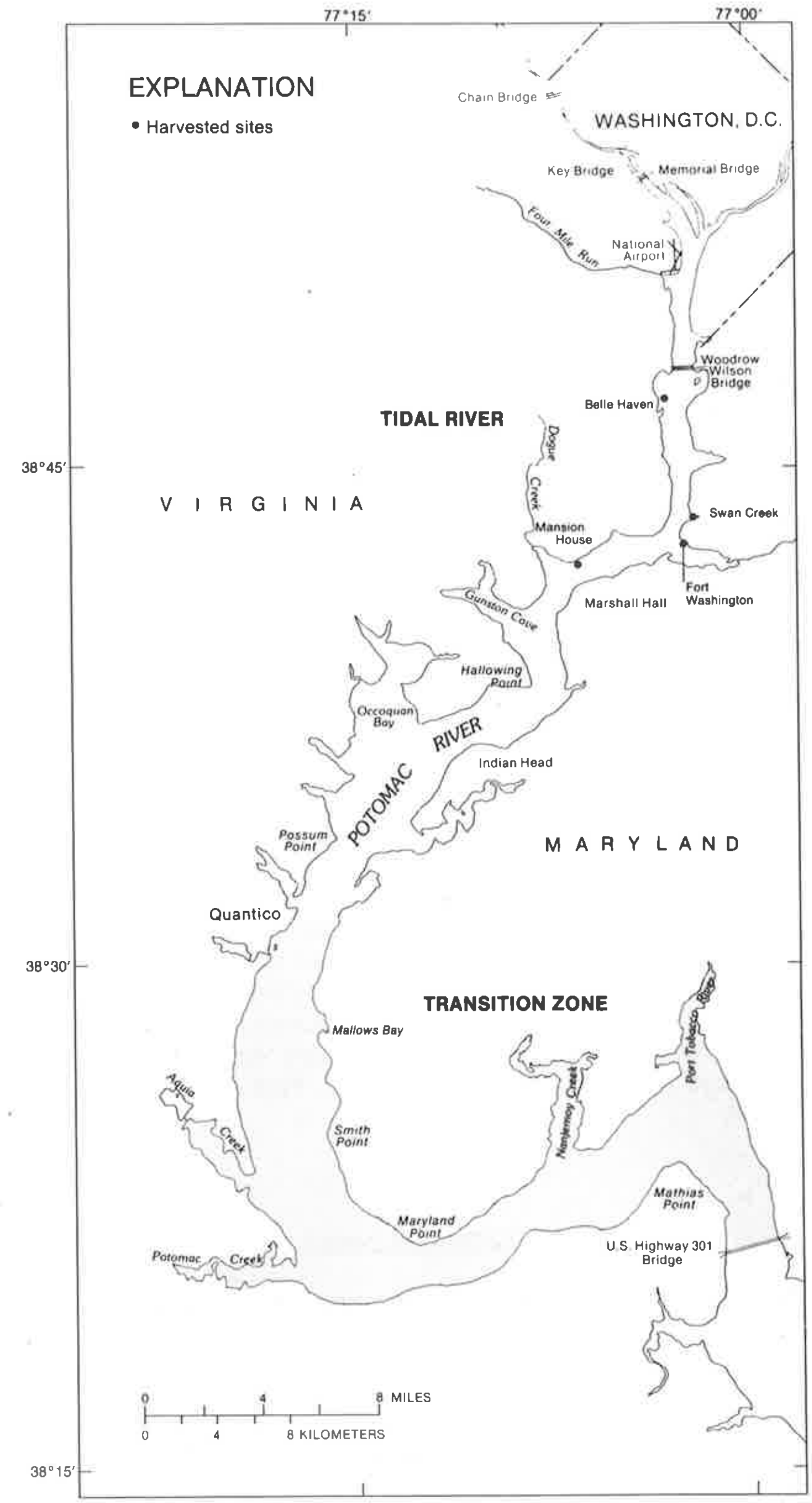

Figure 1.--The tidal Potomac River and transition zone of the Estuary and location of four harvested sites

Purpose and Scope

The purpose and scope of this study was to:

1. Use shoreline surveys and sampled transects to document the distribution of the submersed aquatic vegetation in the tidal Potomac River and transition zone;

2. Measure Secchi depth to quantify changes in water clarity between 1978-1987;

3. Measure plant growth at four harvested sites biweekly during the harvest season and monthly thereafter until October; and,

4. Measure the distance from shore and the greatest depth of water in which aquatic plants grew on four transects.

Description of Study Area

The study reach can be divided into two salinity related zones (fig. 1) (Callender and others, 1984). The tidal river above Quantico, Virginia, is fresh except during periods of drought or extremely low river discharge. The transition zone of the estuary between Quantico, Virginia, and the U.S. Highway 301 Bridge has fresh to brackish water (0.5 to 18 milligrams per liter ocean-derived salts) and extensive saltwater-freshwater mixing occurs. The tidal river, and transition zone of the estuary, and their major tributaries have a deep channel that is flanked on either side by wide shallow flats or shoals suitable for the growth of submersed aquatic plants.

Acknowledgments

This work was partially supported by the U.S. Army Corps of Engineers.

SUBMERSED AQUATIC VEGETATION

Distribution

Shoreline surveys for submersed aquatic vegetation in the tidal river and tributaries were conducted in late June and early October of 1987. These surveys were done by boat, at low tide, using rakes to gather samples and to check whether vegetation was rooted or floating. The proportion of each species in vegetated areas was estimated and referenced on U. S. Geological Survey 7 1/2 minute topographic maps with bathymetry added. These data (not shown) were supplied to the U.S. Environmental Protection Agency for use in their Chesapeake Bay-wide status report on submersed aquatic vegetation (Orth and others, 1988). The distribution information was transferred to a small-scale map for publication in this report. Figure 2 shows the percent cover by *Hydrilla verticillata* in vegetated areas, and figure 3 shows percent cover of submersed aquatic vegetation.

A survey was also conducted in the transition zone of the estuary in late July. This survey included sampling (raking) for vegetation at previously established vegetation transects (Carter and others, 1985a,b; Rybicki and others, 1988) and spot-checking between transects and in small tributaries (fig. 4). Transects were perpendicular to the shoreline and terminated just beyond vegetation or at 60 meters, when no vegetation was present. All species were identified. A list of submersed aquatic plants found in the tidal Potomac River and Estuary is shown in Table 2. Taxonomic nomenclature is according to Hotchkiss (1950,1967), Radford and others (1964), and, Godfrey and Wooten (1979). Species of submersed aquatic vegetation found on or near vegetated transects in the transition zone of the Potomac River Estuary are listed by transect location (Table 3).

Water transparency measurements were made using a Secchi disk (readings were made outside plant beds if plants were present); the measurements are listed by harvest site or nearest transect (table 4). (For transect locations see figures 4 and 5.) Codes for the transects in figures 4 and 5 provide information on location and the river or tributary mile for each location. For example, in MN-01T-2, MN is Mattawoman Creek, 01T is 1 nmi (nautical mile) up the tributary from the mouth, and 2 is the second transect for that tributary mile. In PY-01R, PY is Piscataway Creek, R refers to a transect on the main river, and 01R is the first transect on the edge of the main river.

Abundance

Plant height and biomass were measured at four harvest sites during the harvest season (June-September) and once in October. The four sites are Belle Haven Marina (BH), Swan Creek, in the canal on Firth of Tae (SC), Fort Washington Swim and Sail Club (FW), and Mansion House Yacht Club (MHYC) (fig. 1). All four sites are dominated by *Hydrilla*. Four stations

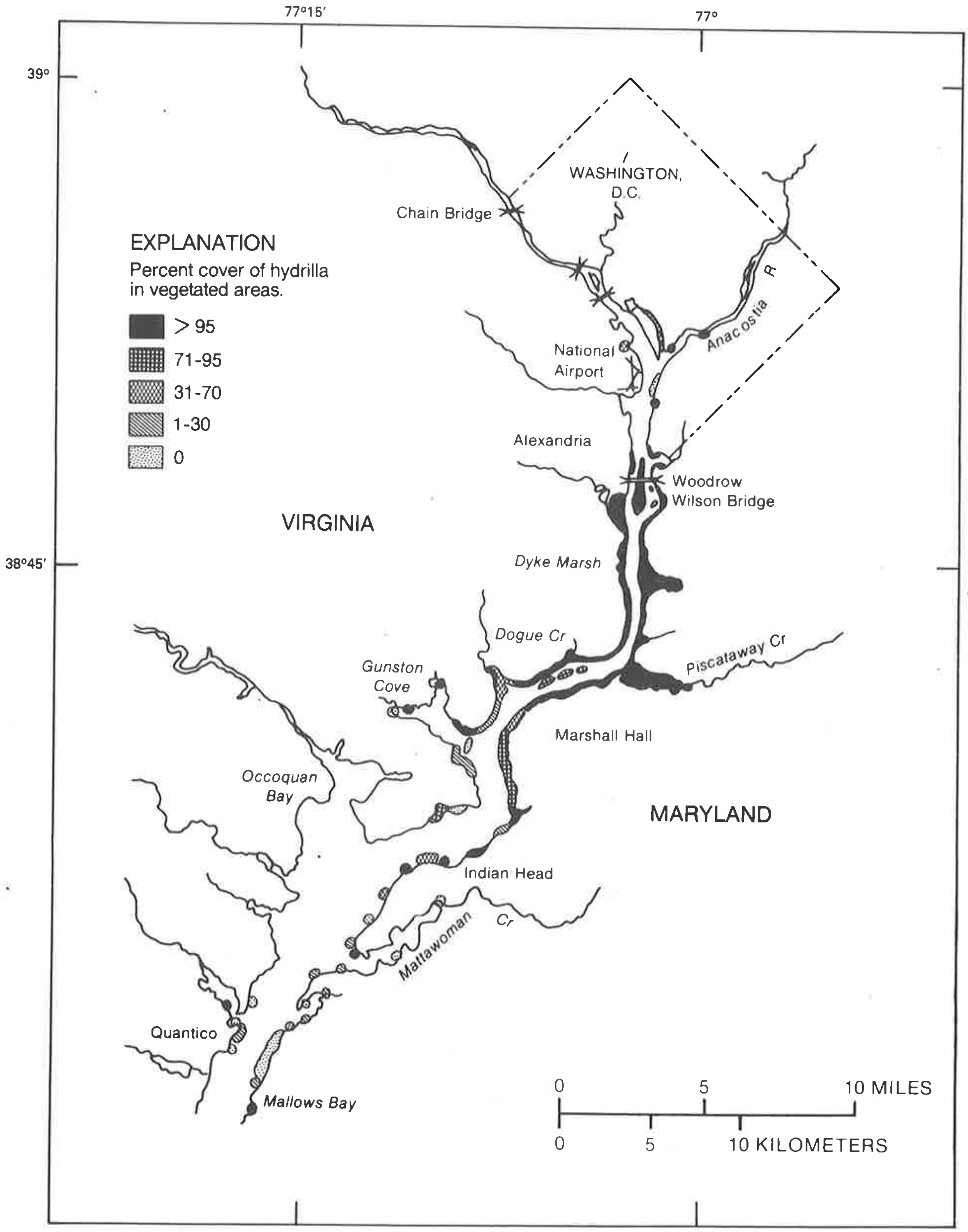

Figure 2.--Percent cover of hydrilla (*Hydrilla verticillata*) in vegetated areas of the tidal Potomac River, 1987

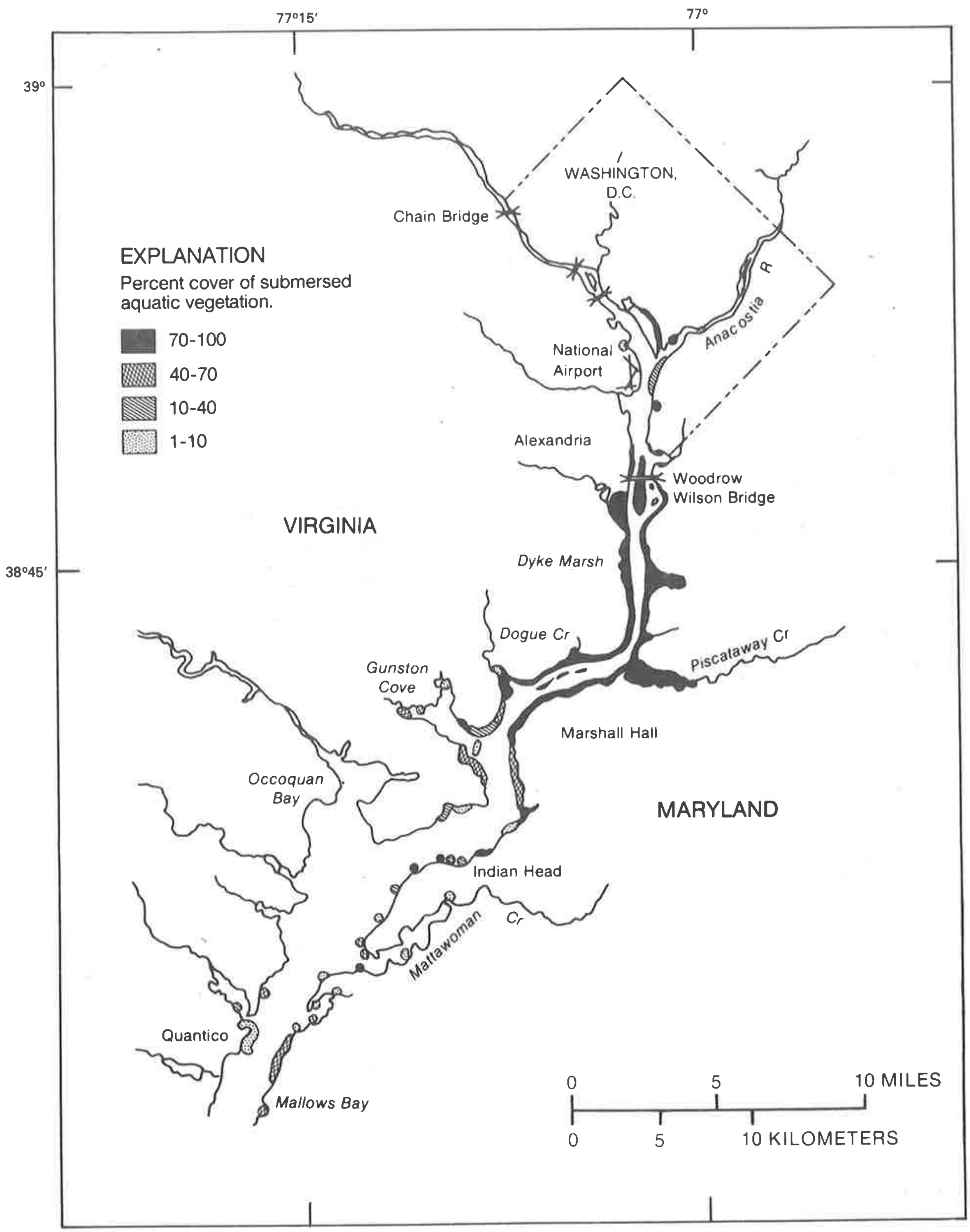

Figure 3.--Percent cover of submersed aquatic plants in the tidal Potomac River, 1987

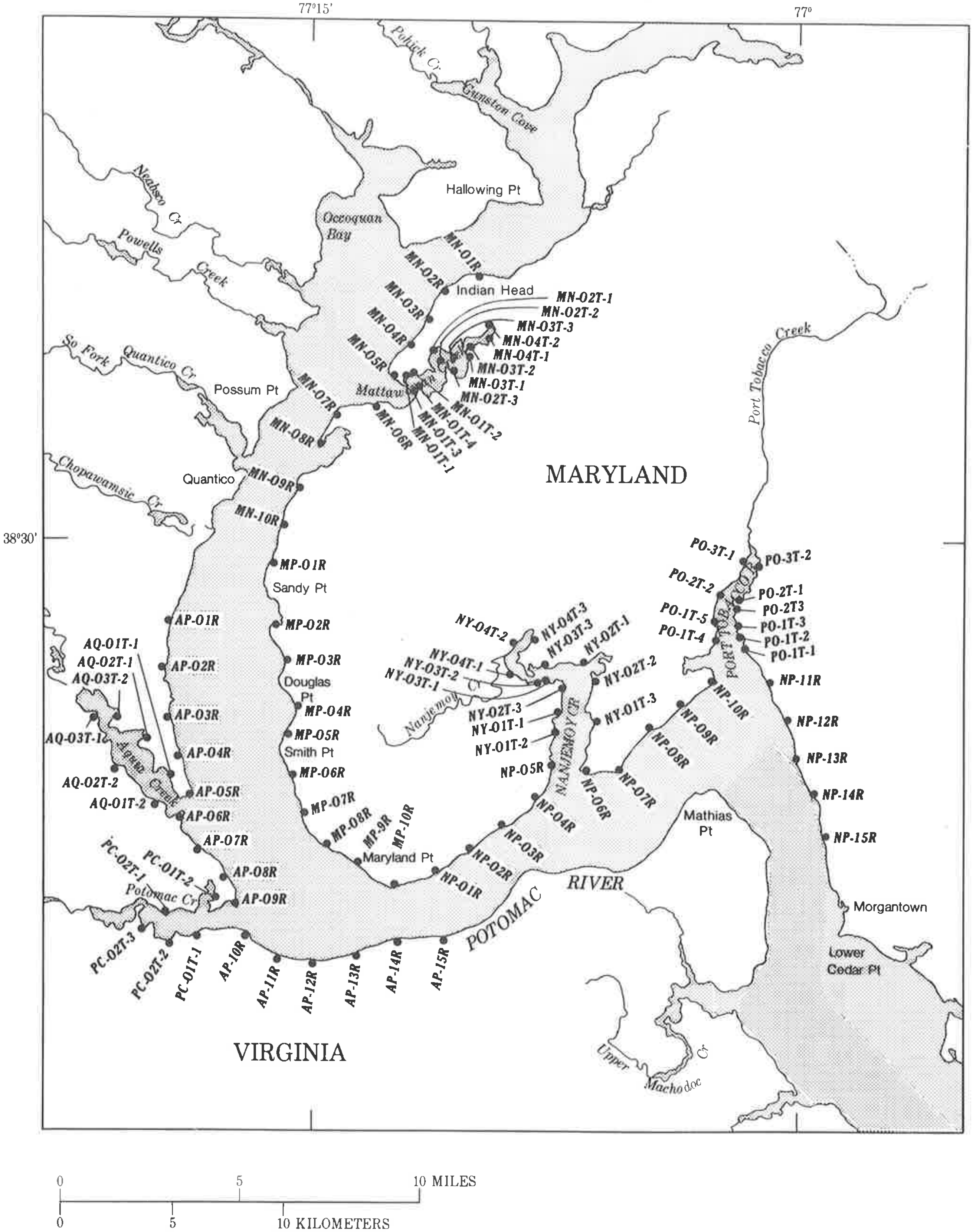

Figure 4.--Location of vegetation sampling transects from Mattawoman Creek to Port Tobacco River. Codes for transects give location and tributary or river-mile for each location. MN is Mattawoman Creek, MP is Maryland Point, NP is Nanjemoy Creek-Port Tobacco River, PO is Port Tobacco River, AQ is Aquia Creek, PC is Potomac Creek, AP is Aquia Creek-Potomac Creek

Table 2.--List of submersed aquatic plants found in the tidal Potomac River and Estuary, 1987 [Taxonomy follow Hotchkiss (1950, 1967) unless otherwise noted.]

Family	Species	Common Name
Najadaceae (pondweed family)	*Potamogeton perfoliatus*	Redhead-grass
	Potamogeton pectinatus L.	Sago pondweed
	Zannichellia palustris L.	Horned pondweed
	Najas guadalupensis (Sprengel) Morong	Southern naiad
	Najas minor All	
Hydrocharitaceae (frogbit family)	*Vallisneria americana* Michaux	Wildcelery
	Hydrilla verticillata (L.f.) Caspary.[1]	Hydrilla
Ceratophyllaceae (coontail family)	*Ceratophyllum demersum* L.	Coontail
Haloragidaceae (watermilfoil family)	*Myriophyllum spicatum* L.	Eurasian watermilfoil
Pontedariaceae (pickerelweed family)	*Heteranthera dubia* (Jacquin) MacMillan[2]	Water-stargrass

[1]Keyed from Godfrey and Wooten (1979).
[2]Keyed from Radford and others (1974).

Table 3.--Species of submersed aquatic plants found on vegetated transects in the transition zone of the Potomac River Estuary, July 27-30, 1987 [Cer = *Ceratophyllum demersum*, Het = *Heteranthera dubia*, Hydr = *Hydrilla verticillata*, Myrio = *Myriophyllum spicatum*, N. guad = *Najas guadalupensis*, N. min = *Najas minor*, P. pect = *Potamogeton pectinatus*, P. perf = *Potamogeton perfoliatus*, Val = *Vallisneria americana*, Zan = *Zannichellia palustris*]

Nearest transect	Species
AP-01R	Hydr, Val, Cer, Myrio
AP-02R	Val
AP-06R	Cerat
MP-02R	Hydr
Mallows Bay (wrecks)	Hydr, N. min, Val, Myrio, Het, Cer, N. guad
MP-03R	Val
MP-04R	Val, Myrio
MP-05R	Val, P. pect
MP-09R	Val
NP-01R	Val, P. pect, Cer
NP-02R	Val, P. pect, Cer
NP-03R	Val, P. pect
NP-04R	Val, P. perf
NP-05R	Val, P. pect, Myrio
NP-06R	Val, P. perf
NP-07R	Val
Between NP-07R and NP-08R	Val, P. pect, Zan
NP-08R	Val, P. perf
NP-09R	Val, P. perf
NP-10R	Val, P. perf
NP-11R	P. pect, Val, P. perf
NP-12R	Val, P. perf
NP-13R	P. perf
NP-14R	P. perf
NP-15R	P. perf, Val
NY-2T-3	Val
Between 2T-3 and 3T-1	Myrio, Val, Cer
NY-03T-2	Val, Myrio
NY-4T-1	Myrio, Val, Cer
NY-4T-2	Val
NY-4T-3	Val, Myrio
NY-3T-3	Myrio, Cer
NY-2T-1	Myrio
NY-2T-2	Val
NY-1T-3	Val
PO-1T-4	Val
PO-1T-5	Myrio, P. pect
PO-2T-2	Val
PO-3T-1	Val, Myrio

Table 3.--Species of submersed aquatic plants found on vegetated transects in the transition zone of the Potomac River Estuary, July 27-30, 1987--continued

[Cer = *Ceratophyllum demersum*, Het = *Heteranthera dubia*, Hydr = *Hydrilla verticillata*, Myrio = *Myriophyllum spicatum*, N. guad = *Najas guadalupensis*, N. min = *Najas minor*, P. pect = *Potamogeton pectinatus*, P. perf = *Potamogeton perfoliatus*, Val = *Vallisneria americana*, Zan = *Zannichellia palustris*]

Nearest transect	Species
PO-1T-3	Val, P. perf
PO-1T-2	Val, P. perf, P. pect.
PO-1T-1	Val, P. perf

Table 4.--Secchi depths in the tidal Potomac River and Estuary, 1987
[cm is centimeter]

Nearest transect or harvest site	Date (month-day)	Secchi depth (cm)	Nearest transect or harvest	Date (month-day)	Secchi depth (cm)
BH	7-31	112	NB-01R	10-5	59
BH	8-13	83	NB-01R	10-5	35
BH	8-28	85	AP-01R	7-29	118
BH	9-14	84	AP-05R	7-29	56
SC	6-19	79	AP-09R	7-29	83
SC	7-31	96	AP-10R	7-30	73
SC	8-13	98	AP-15R	7-30	95
SC	8-28	82	AP-15R	7-30	82
SC	9-14	84	AQ-1T-1	7-29	47
FW	6-19	98	AQ-2T-2	7-29	34
FW	7-17	104	AQ-3T-1	7-29	35
FW	7-31	84	PC-1T-2	7-30	47
FW	8-13	98	PC-2T-1	7-30	36
FW	8-28	78	PY-04R	9-17	70
FW	9-14	60	PY-08R	6-8	82
MHYC	6-19	43	PY-08R	6-30	91
MHYC	7-17	72	PY-09R	7-6	96
MHYC	7-31	80	PY-09R	6-8	108
MHYC	8-13	76	PM-01R	6-8	47
MHYC	8-28	112	PM-02R	7-6	110
GC-04R	6-24	78	PM-02R	10-2	56
GC-05R	6-24	52	PM-04R	7-10	93
GC-05R	9-24	70	PM-04R	9-24	100
GC-06R	6-24	75	MN-01R	7-6	84
GC-06R	6-24	75	MN-02R	7-6	80
GC-06R	9-24	65	MN-02R	7-7	81
GC-07R	6-24	67	MN-04R	10-19	108
GC-07R	6-30	60	MN-08R	7-7	74
GC-08R	9-24	50	MN-09R	7-10	82
GC-09R	6-24	50	MN-09R	7-10	63
GC-09R	9-24	45	MN-10R	7-7	95
GC-10R	6-23	62	MN-10R	7-29	116
GC-10R	6-23	54	MP-02R	7-29	65
GC-10R	7-10	34	MP-06R	7-29	75
GC-10R	7-10	37	NP-01R	7-27	65
GC-10R	7-10	37	NP-07R	7-27	49
GC-1T-3	6-24	42	NP-13R	7-27	100
GC-1T-3	6-30	20	NY-3T-2	7-27	51
GC-IT-3	6-30	30	PO-1T-3	7-27	52
NB-01R	7-10	47	PO-3T-1	7-27	43
NB-01R	7-10	51			

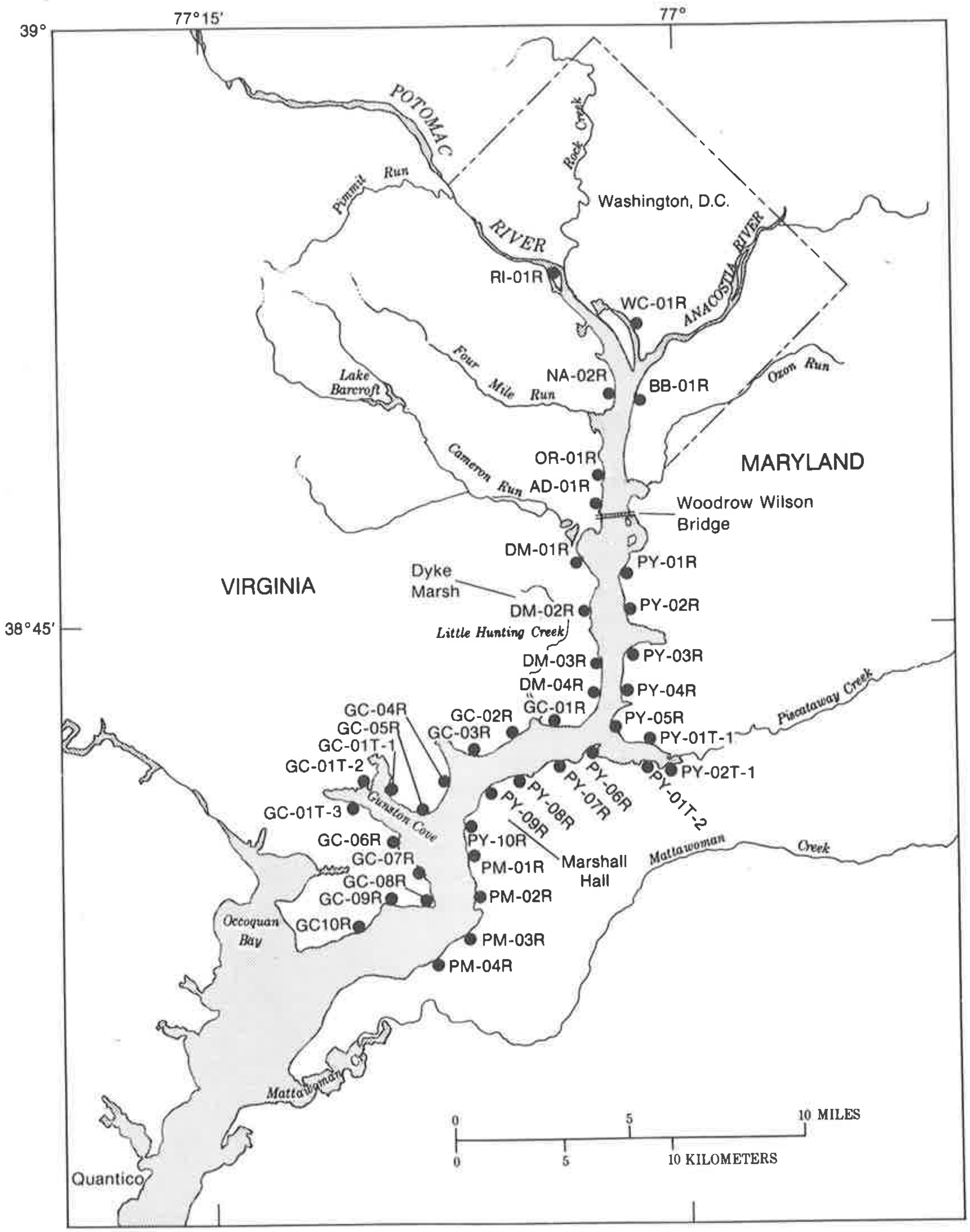

Figure 5.--Location of vegetation sampling transects in the tidal Potomac River above Mattawoman Creek. Codes for transects give location and tributary or river-mile for each location. RI is Roosevelt Island, NA is National Airport, OR is Oronoco Bay, AD is Alexandria Dock, DM is Dyke Marsh, GC is Gunston Cove, BB is Bolling Air Force Base, PY is Piscataway Creek, PM is Pomonkey Creek and NB is Neabsco Bay

at BH and SC, and five stations at FW and MHYC were sampled using modified oyster tongs with blades welded across the teeth to bite into the sediment to collect rooted plants. The area sampled with the tongs was about 930 square centimeters. Plant height was measured and samples were placed in plastic mesh bags and hung to air dry. They were then oven-dried at 110 degrees Celsius. Dry weight was calculated in grams per square meter for each sample. Plant height and biomass for each sample, and the mean and standard error per site are shown on tables 5 and 6. Harvest dates at BH, SC, FW, and MHYC are listed on table 7. Figures 6-9 show mean biomass and plant height versus sample date at each site, and include harvest dates and height of mean low water at each site.

The distance from shore and the greatest depth of water (mean low water) in which aquatic plants grew was measured on four vegetation transects; DM-02R, DM-04R, GC-01R, and PY-02R (previously sampled in Carter and others, 1985a,b, and Rybicki and others, 1985, 1986, 1988) (fig 5). *Hydrilla* was the dominant plant on all transects. Transects were sampled perpendicular to the shoreline. Transects had sampling stations at 10-meter intervals from shore. Depth and plant density was measured at each station. Transects were terminated if no plants were found at two consecutive stations. Density was determined visually; dense is defined as greater than or equal to 40 percent cover, and sparse is defined as less than 40 percent cover. Where no vegetation was visible, modified oyster tongs were used to determine presence and density of plants. Greatest water depth and distance from shore of submersed aquatic plants on the four transects are shown on table 8.

Table 5.--Plant height and biomass at four harvested sites, Belle Haven Marina (BH), Swan Creek (SC), Fort Washington Swim and Sail Club (FW), Mansion House Yacht Club (MHYC), 1987
[Biomass in grams per meter square.]

Site	Date (month-day)	Plant height (meters)	Biomass
BH	6-19	0	0
		0	0
		0	0
		0	0
		0.1	3
	7- 1	0	0
		0	0
		0.1	4
		0.1	2
		0.2	15
	7-17	0.3	15
		0.5	6
		0.3	20
		0.4	6
		0.4	23
	7-31	0.1	49
		0.6	53
		0.3	261
		0.3	52
		0.3	90
	8-13	0.2	37
		0.5	110
		0.7	74
		0.4	39
		0.3	28
	8-28	0.4	132
		0.8	33
		0.4	192
		0.8	134
		0.2	207
	9-14	0.4	136
		0.7	196
		0.5	53
		0.5	26
		0.3	101
	10-19	0.4	325
		0.4	260
		0.4	78
		0.3	545
		0.4	327

Table 5.--Plant height and biomass at four harvested sites, Belle Haven Marina (BH), Swan Creek (SC), Fort Washington Swim and Sail Club (FW), Mansion House Yacht Club (MHYC), 1987--continued
[Biomass in grams per meter square.]

Site	Date (month-day)	Plant height (meters)	Biomass
SC	6-19	1.0	27
		1.0	4
		1.0	4
		1.0	9
		1.0	19
	7- 1	1.3	247
		0.7	-
		1.0	31
		0.8	53
		0.8	61
	7-17	0.7	16
		0.6	15
		0.3	16
		0.6	18
		0.7	66
	7-31	0.5	135
		0.6	134
		0.5	240
		0.0	0
		0.5	85
	8-13	0.4	386
		0.6	294
		0.0	0
		1.1	154
		1.0	217
	8-28	0.6	12
		0.4	183
		0.6	19
		0.1	13
		0.7	320
	9-14	0.4	53
		0.3	19
		0.3	50
		0.5	54
		0.2	19
	10-19	0.3	259
		0.5	178
		0.4	135
		0.4	158
		0.4	231

Table 5.--Plant height and biomass at four harvested sites, Belle Haven Marina (BH), Swan Creek (SC), Fort Washington Swim and Sail Club (FW), Mansion House Yacht Club (MHYC), 1987--continued
[Biomass in grams per meter square.]

Site	Date (month-day)	Plant height (meters)	Biomass
FW	6-19	0.7	392
		0.7	204
		0.7	286
		0.7	730
	7- 1	0.2	41
		0.3	206
		0.2	90
		0.3	210
	7-17	1.0	649
		0.9	509
		1.0	264
		0.9	413
	7-31	0.8	751
		1.0	914
		0.7	460
		0.6	453
	8-13	0.5	922
		0.6	1387
		0.5	549
		0.6	773
	8-28	0.2	26
		0.0	0
		0.1	87
		0.1	57
	9-14	0.3	270
		0.1	55
		0.2	37
		0.3	221
	10-19	0.9	171
		0.8	79
		0.7	47
		0.8	164
MHYC	6-19	0.7	446
		0.7	264
		0.7	509
		0.7	182
	7- 1	0.3	87
		0.3	79
		0.4	83
		0.3	34

Table 5.--Plant height and biomass at four harvested sites, Belle Haven Marina (BH), Swan Creek (SC), Fort Washington Swim and Sail Club (FW), Mansion House Yacht Club (MHYC), 1987--continued
[Biomass in grams per meter square.]

Site	Date (month-day)	Plant height (meters)	Biomass
MHYC	7-17	0.4	310
		0.3	287
		0.4	136
		0.5	304
	7-31	0.5	329
		0.4	394
		0.4	479
		0.5	758
	8-13	0.6	242
		0.4	602
		0.5	652
		0.3	321
	8-28	0.6	1632
		0.5	1040
		0.4	605
		0.5	746
	9-14	0.3	277
		0.2	43
		0.3	94
		0.2	106
	10-19	0.6	1
		0.6	127
		0.7	306
		0.8	552

Table 6.--Plant height and biomass means at four harvested sites, Belle Haven Marina (BH), Swan Creek, canal at Firth of Tae (SC), Fort Washington Swim and Sail Club (FW), and Mansion House Yacht Club (MHYC), 1987
[SE is standard error of the mean; N is number of samples]

		Plant height (meters)			Plant biomass (grams per square meter)		
Site	Date	Mean	SE	N	Mean	SE	N
BH	6-19	<.1	.020	5	1	0.60	5
	7-01	.1	.037	5	4	2.80	5
	7-17	.4	.037	5	14	3.51	5
	7-31	.3	.080	5	101	40.7	5
	8-13	.4	.086	5	58	15.3	5
	8-28	.5	.120	5	140	30.6	5
	9-14	.5	.066	5	102	30.1	5
	10-19	.4	.020	5	307	74.8	5
SC	6-19	1.0	.000	5	13	4.52	5
	7-01	.9	.107	5	98	50.1	4
	7-17	.6	.074	5	26	9.96	5
	7-31	.4	.107	5	119	39.0	5
	8-13	.6	.201	5	210	65.3	5
	8-28	.5	.107	5	109	61.9	5
	9-14	.3	.051	5	39	8.19	5
	10-19	.4	.032	5	192	23.0	5
FW	6-19	.7	.000	4	403	116	4
	7-01	.3	.029	4	137	42.3	4
	7-17	1.0	.029	4	459	81.0	4
	7-31	.8	.085	4	644	114	4
	8-13	.6	.029	4	908	177	4
	8-28	.1	.040	4	43	18.9	4
	9-14	.2	.048	4	146	58.6	4
	10-19	.8	.041	4	115	30.9	4
MHYC	6-19	.7	.000	4	350	76.4	4
	7-01	.3	.025	4	71	12.4	4
	7-17	.4	.041	4	259	41.4	4
	7-31	.5	.029	4	490	94.5	4
	8-13	.5	.065	4	454	102	4
	8-28	.5	.041	4	1006	228	4
	9-14	.3	.029	4	130	50.9	4
	10-19	.7	.048	4	246	120	4

Table 7.--Harvest dates at four harvested sites, Belle Haven Marina (BH), Swan Creek (SC), Fort Washington Swim and Sail Club (FW), and Mansion House Yacht Club (MHYC), 1987

Site	Date
BH	August 6 September 8 and 9
SC	July 9 and 10 September 5
FW	June 22 and 23 August 26,27 and 28
MHYC	June 28,29 and 30 August 28,29 and 30

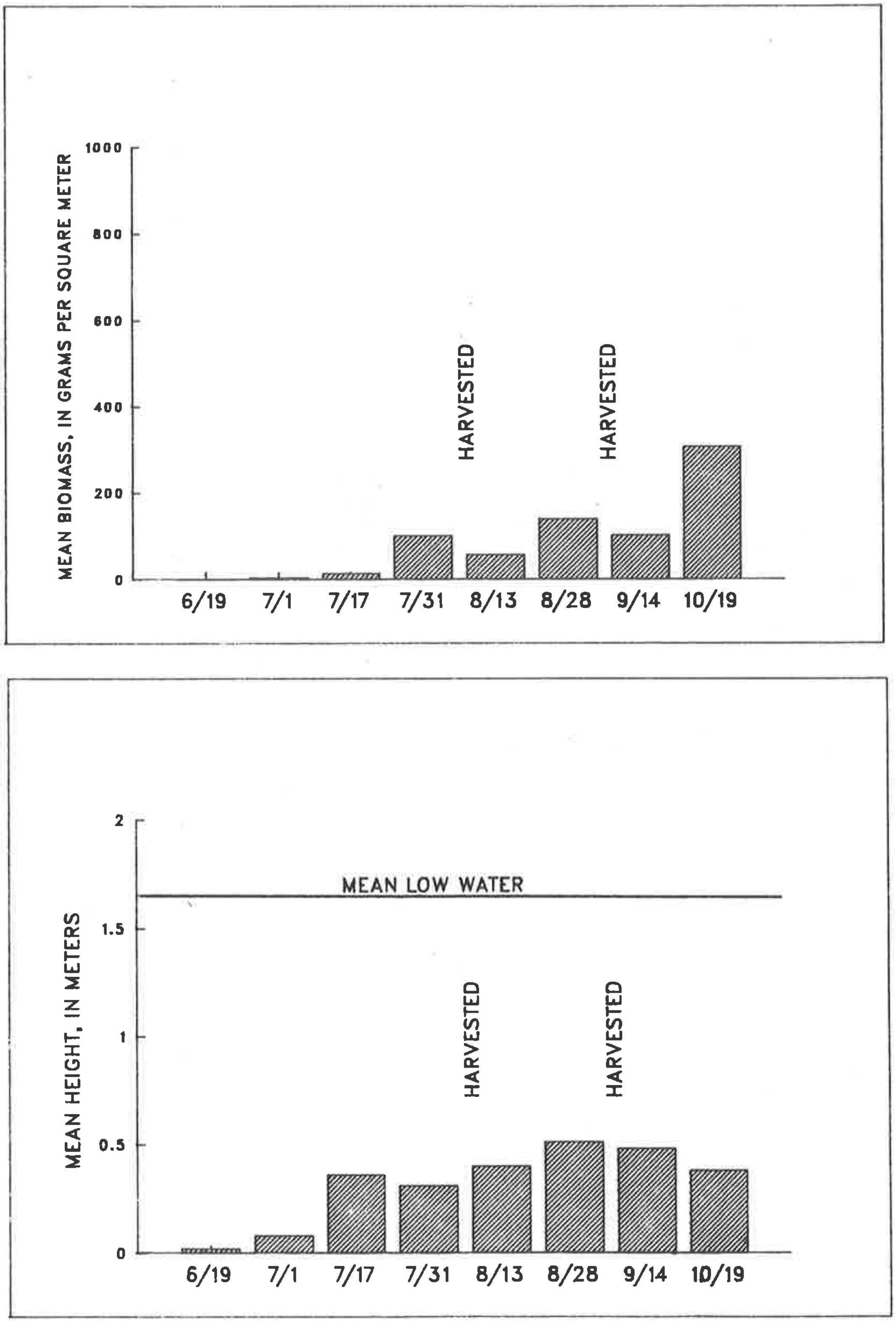

Figure 6.--Mean biomass and plant height on sampling dates at Belle Haven Marina

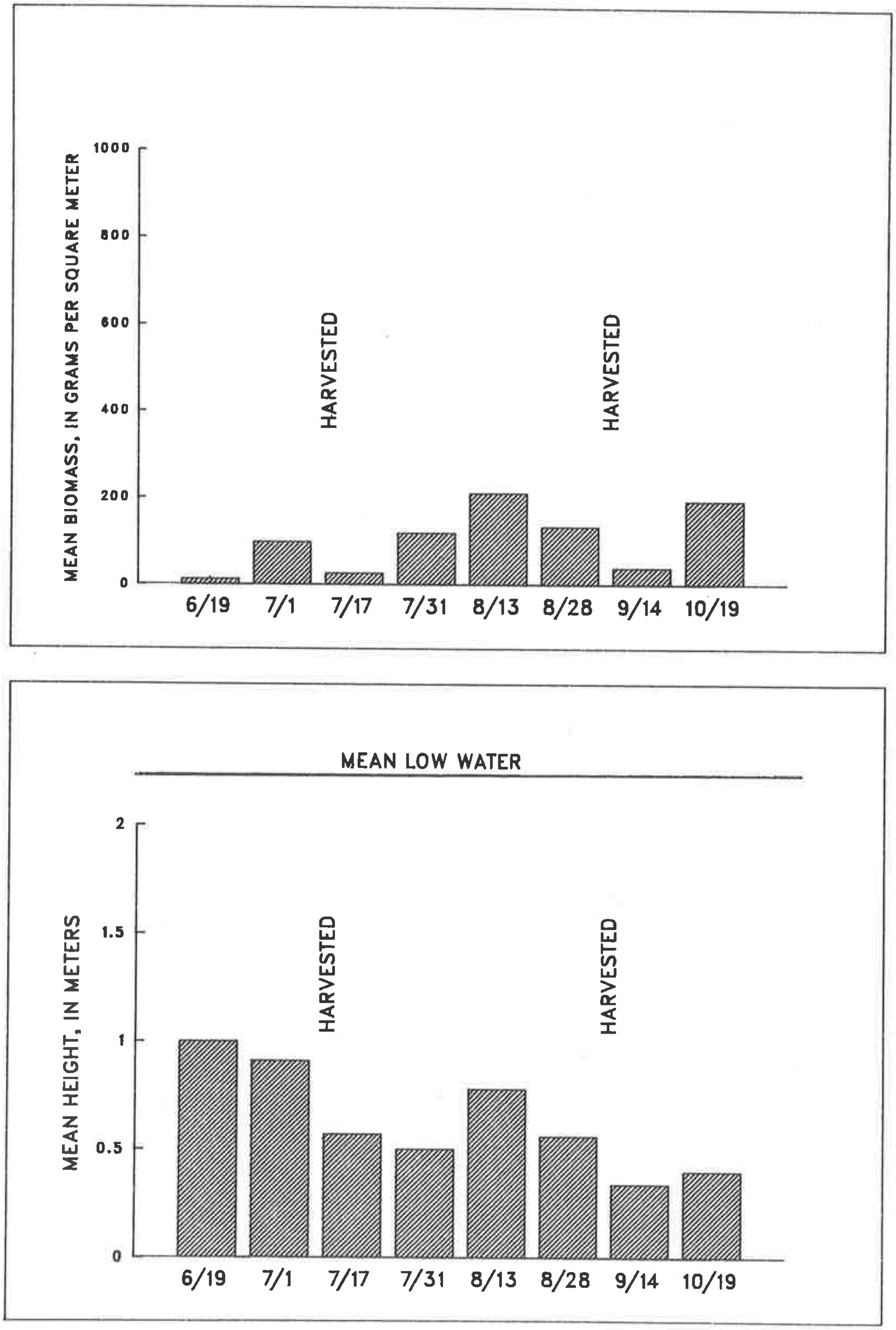

Figure 7.--Mean biomass and plant height on sampling dates at Swan Creek

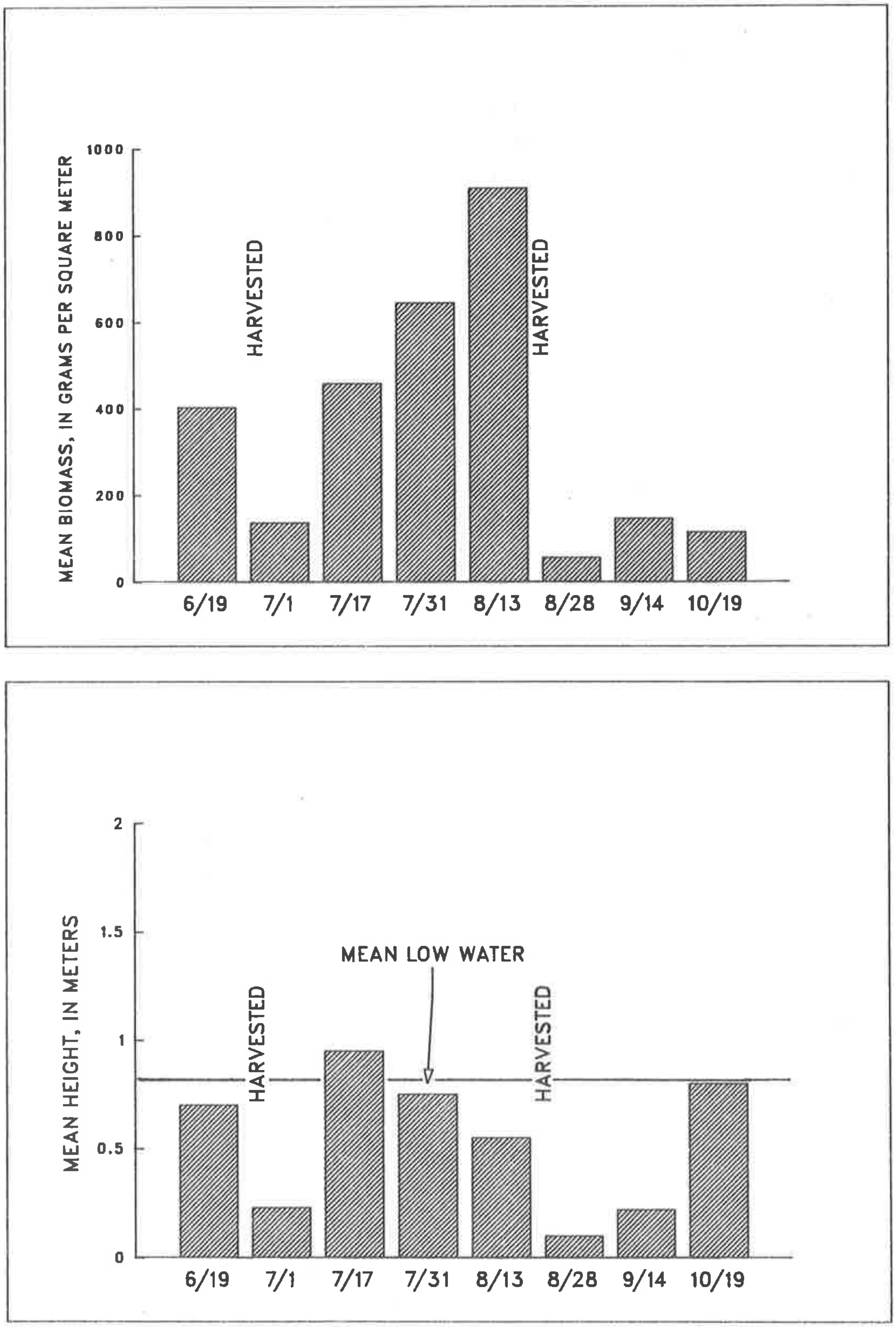

Figure 8.--Mean biomass and plant height on sampling dates at Fort Washington

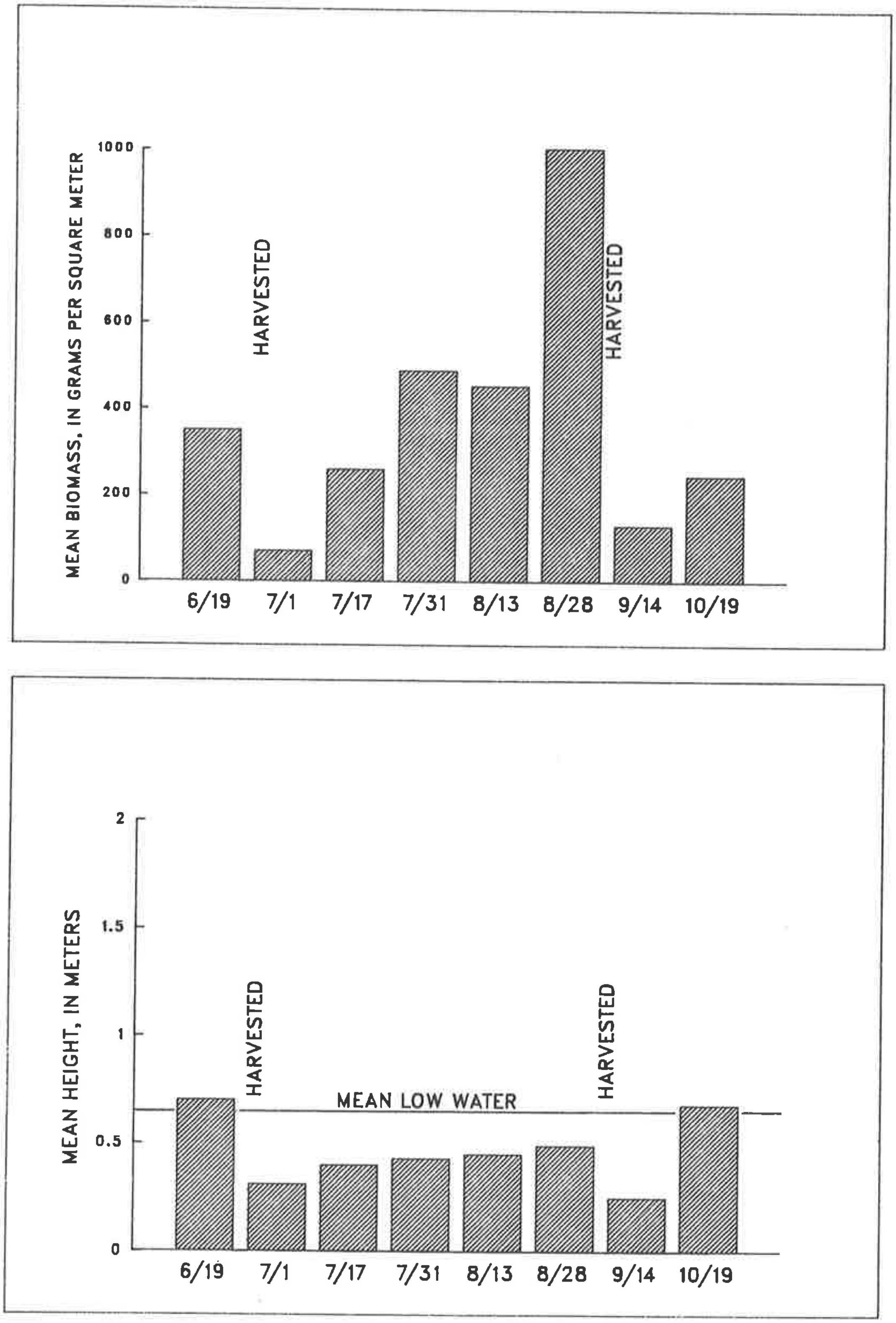

Figure 9.--Mean biomass and plant height on sampling dates at Mansion House Yacht Club

Table 8.--Greatest water depth and distance from shore of submersed aquatic plants at four transects in the tidal Potomac River, September 28, 1987
[Depth in meters at mean low water]

Transect	Distance from shore		Greatest water depth	
	Dense vegetation	Sparse vegetation	Dense vegetation	Sparse vegetation
DM-02R	0-40	40-90	2.1	2.5
DM-04R	0-340	340-360	1.6	1.6
GC-01R	0-230	230-260	1.7	2.1
PY-02R	0-150	none	.9	.9

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