

Distribution and Abundance of Submersed Aquatic Vegetation in the Tidal Potomac River and Upper Potomac Estuary, Maryland, Virginia, and the District of Columbia, 1993-1998

**By Henry A. Ruhl, Nancy B. Rybicki, Justin T. Reel, and
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CONTENTS

	Page
Abstract	1
Introduction	1
Mapping methods	2
Acknowledgments	2
References cited	4

ILLUSTRATIONS

1993

Figures 1-3. Maps showing distribution and abundance of *Hydrilla verticillata* in the Potomac River, 1993

1. Washington, D.C. to Broad Creek	7
2. Swan Creek to Chicamuxen Creek	8
3. Chicamuxen Creek to Aquia Creek	9

Figures 4-5. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1993

4. Washington, D.C. to Quantico, Virginia	10
5. Quantico, Virginia to Aquia Creek	11

1994

Figures 6-8. Maps showing distribution and abundance of *Hydrilla verticillata* in the Potomac River, 1994

6. Washington, D.C. to Broad Creek	12
7. Swan Creek to Chicamuxen Creek	13
8. Chicamuxen Creek to Maryland Point	14

Figures 9-10. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1994

9. Washington, D.C. to Quantico, Virginia	15
10. Quantico, Virginia to Maryland Point	16

1995

Figures 11-13. Maps showing distribution and abundance of *Hydrilla verticillata* in the Potomac River, 1995

11. Washington, D.C. to Broad Creek	17
12. Swan Creek to Chicamuxen Creek	18
13. Chicamuxen Creek to Maryland Point	19

Figures 14-15. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1995	
14. Washington, D.C. to Quantico, Virginia	20
15. Quantico, Virginia to Maryland Point	21

1996

Figures 16-18. Maps showing distribution and abundance of <i>Hydrilla verticillata</i> in the Potomac River, 1996	
16. Washington, D.C. to Broad Creek	22
17. Swan Creek to Chicamuxen Creek	23
18. Chicamuxen Creek to Maryland Point	24

Figures 19-21. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1996	
19. Washington, D.C. to Broad Creek	25
20. Swan Creek to Chicamuxen Creek	26
21. Chicamuxen Creek to Maryland Point	27

1997

Figures 22-24. Maps showing distribution and abundance of <i>Hydrilla verticillata</i> in the Potomac River, 1997	
22. Washington, D.C. to Broad Creek	28
23. Swan Creek to Chicamuxen Creek	29
24. Chicamuxen Creek to Rt. 301 Bridge	30

Figures 25-27. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1997	
25. Washington, D.C. to Broad Creek	31
26. Swan Creek to Chicamuxen Creek	32
27. Chicamuxen Creek to Rt. 301 Bridge	33

1998

Figures 28-30. Maps showing distribution and abundance of <i>Hydrilla verticillata</i> in the Potomac River, 1998	
28. Washington, D.C. to Broad Creek	34
29. Swan Creek to Chicamuxen Creek	35
30. Chicamuxen Creek to Maryland Point	36

Figures 31-33. Maps showing distribution and abundance of submersed aquatic vegetation in the Potomac River, 1998	
31. Washington, D.C. to Broad Creek	37
32. Swan Creek to Chicamuxen Creek	38
33. Chicamuxen Creek to Maryland Point	39

DISTRIBUTION AND ABUNDANCE OF SUBMERSED AQUATIC VEGETATION IN THE TIDAL POTOMAC RIVER AND UPPER POTOMAC ESTUARY, MARYLAND, VIRGINIA, AND THE DISTRICT OF COLUMBIA, 1993-1998

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ABSTRACT

The U.S. Geological Survey determined submersed aquatic vegetation distribution and abundance in the tidal Potomac River and upper Potomac Estuary annually from 1993-1998. Observations were made on the location and abundance of submersed aquatic vegetation and the relative coverage of species present at the end of the growing season. The survey area extended from Chain Bridge in Washington, D.C. to Maryland Point, or as far downstream as the Route 301 Bridge depending on annual research needs. A set of 1:24,000-scale maps was created in the field and laboratory using aerial photographs and shoreline survey data collected over a period of several weeks. A set of smaller scale maps was also created to summarize the distribution and abundance of submersed aquatic vegetation and *Hydrilla verticillata* in the tidal Potomac River and upper Potomac Estuary.

INTRODUCTION

Submersed aquatic vegetation (SAV) is an important part of the food web in the Chesapeake Bay, providing shelter and nursery grounds for shellfish and finfish of commercial importance, as well as food for a diversity of waterfowl. SAV disappeared from the freshwater tidal Potomac River in the late 1930's (Carter and others, 1985). In the early 1980's, as water quality improved, many species of SAV returned (Carter and Rybicki, 1986, Rybicki and others, 1985). A southeast Asian species, *Hydrilla verticillata*, invaded the tidal Potomac River with the return of SAV, and populations of this exotic species increased dramatically in the mid to late 1980's. *H. verticillata* can be very dense in shallow areas, where it interferes with boat traffic, and the U.S. Army Corps of Engineers (COE), local, and state agencies began a harvesting program in the mid 1980's to provide boaters with access through the *H. verticillata* beds to boat moorings and marinas.

U.S. Geological Survey (USGS) researchers monitored the distribution and abundance as well as species composition of submersed aquatic vegetation (SAV) in the tidal Potomac River and Estuary beginning in 1978 (Carter and others 1985; Rybicki and others 1986; 1987). The USGS documented changes in SAV after the resurgence in SAV and provided information to many agencies, including the COE's Aquatic Plant Management Program. A series of 1:24,000-

scale field data maps and small-scale summary maps of SAV field survey results were produced annually.

This report summarizes the observations on SAV distribution and abundance, including *Hydrilla verticillata*, for the period 1993-1998. These data are used by the Potomac Aquatic Plant Control Program for the Metropolitan Washington Council of Governments, the D. C. Department of Consumer and Regulatory Affairs: Fisheries Division, the Virginia Institute of Marine Science (VIMS), the COE, and the Chesapeake Bay Program to study SAV ecosystem dynamics and to meet local and regional aquatic plant management needs. Annual SAV coverage (in hectares) as well as species present in the survey area are available on the Internet from VIMS (Orth and others, 1993-98; <http://www.vims.edu/bio/sav>).

MAPPING METHODS

The distribution and abundance of SAV, including *H. verticillata*, were determined by shoreline survey from a shallow draft boat and the use of aerial photographs. The shoreline survey was conducted annually at the end of the growing season -- late August through early October. The northern extent of the survey area was at Chain Bridge in the Potomac and near Kingman Island in the Anacostia River. The southern end of the survey area was between Aquia Creek and the Route 301 Bridge, with the extent depending on specific annual research needs. The area surveyed included all navigable tidal tributaries in the reach. Field observations on the location, percent cover of vegetation, and percent of each species in each bed encountered were made within two hours of low tide and were recorded on 1:24,000-scale maps (unpublished data). A metal rake was used to scrape along the bottom to check for the presence of species not visible from the surface and to confirm that plants were rooted and not simply floating (Rybicki and others, 1987). Aerial photographs (1:12,000 and 1:24,000 scale) were obtained annually and were used in the field and in the lab to assist in the delineation of SAV bed boundaries and determination of plant density. A set of smaller scale maps (Figures 1-33) were then created from the 1:24,000-scale maps to illustrate the overall SAV and *H. verticillata* distribution and abundance. These smaller scale maps are theme products, and SAV coverages are not exactly to scale.

ACKNOWLEDGMENTS

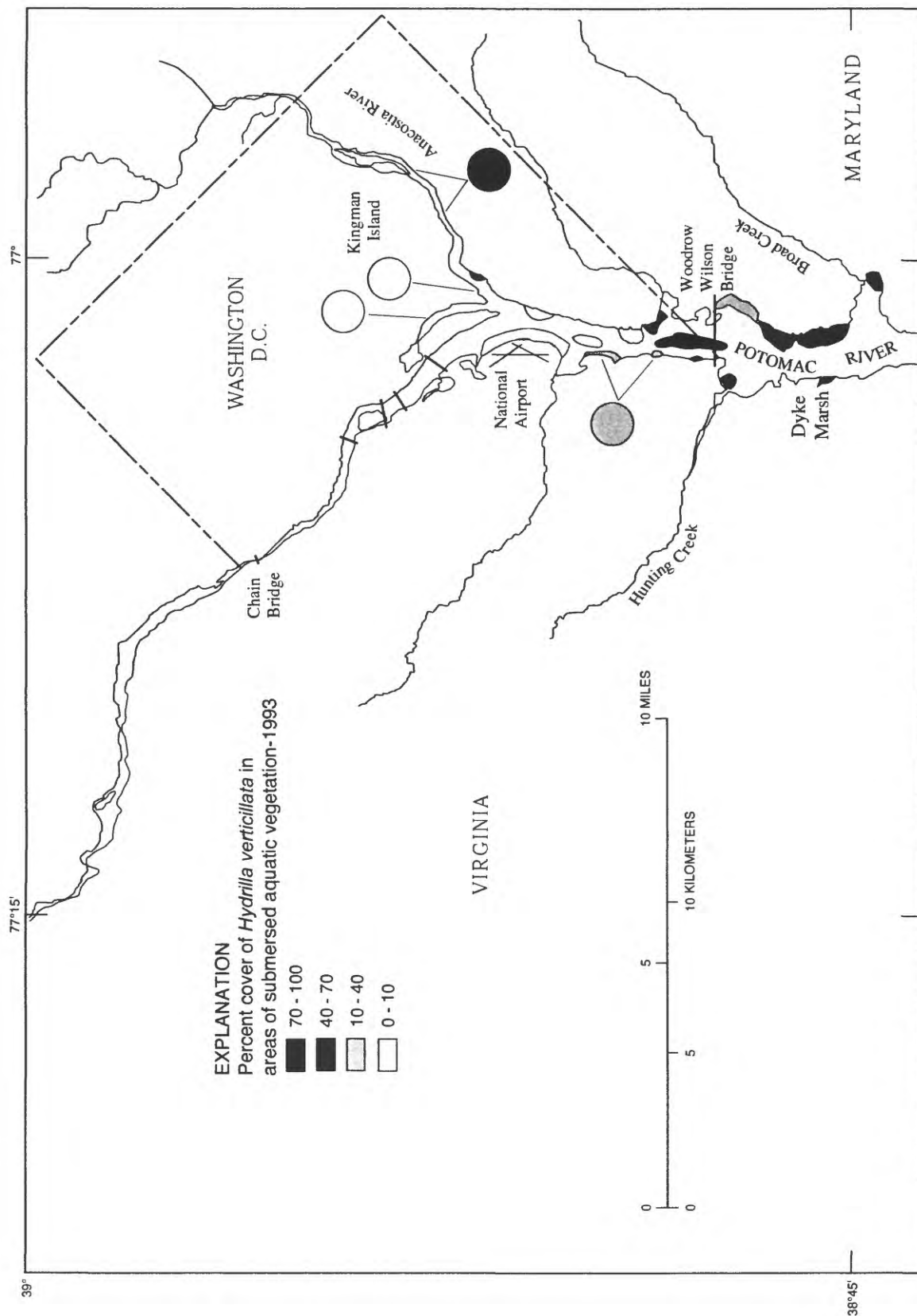
Observation data for the D.C. area for 1996-1998 were provided by Adam Rottman, D. C. Department of Consumer and Regulatory Affairs: Fisheries Division. Aerial photographs were provided by Metropolitan Washington Council of Governments and the Virginia Institute of Marine Science. Support and

assistance was provided by the Metropolitan Washington Council of Governments and the U.S. Army Corp of Engineers.

REFERENCES CITED

- Carter, Virginia, Paschal, J. E., and Bartow, Nancy, 1985, Distribution and abundance of submersed aquatic vegetation in the tidal Potomac River, Maryland, Virginia, May 1978 to November 1981: U.S. Geological Survey Water-Supply Paper 2234-A, 46 p.
- Carter, Virginia, and Rybicki, N. B., 1986, Resurgence of submersed aquatic macrophytes in the tidal Potomac River, Maryland, Virginia, and District of Columbia: *Estuaries*, v. 9, no. 4B, p. 368-375.
- Orth, R. J., Nowak, J. N., Anderson, G. F., and Whiting, J. R., 1993, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and Chincoteague Bay – 1992: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 268 p.
- _____, 1994, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and Chincoteague Bay – 1993: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 262 p.
- Orth, R. J., Nowak, J. N., Anderson, G. F., Wilcox, D. J., Whiting, J. R., and Nagey, L. S., 1995, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and Chincoteague Bay – 1994: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 277 p.
- _____, 1996, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and Chincoteague Bay – 1995: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 293 p.
- Orth, R. J., Nowak, J. N., and Wilcox, D. J., 1997, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and coastal bays – 1996: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 300 p.
- Orth, R. J., Nowak, J. N., Wilcox, D. J., Whiting, J. R., and Nagey, L. S., 1998, Distribution of submerged aquatic vegetation in the Chesapeake Bay and tributaries and coastal bays, 1997: Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Va., 351 p.
- Rybicki, N. B., Anderson, R. T., Shapiro, J. M., Jones, C. L., and Carter, Virginia, 1986, Data on the distribution and abundance of submersed aquatic vegetation in the tidal Potomac River, Maryland, Virginia, and the District of Columbia, 1985: U.S. Geological Survey Open-File Report 86-126, 49 p.
- Rybicki, N. B., Anderson, R. T., Shapiro, J. M., Johnson, K. L., and Schulman, C. L., 1987, Data on the distribution and abundance of submersed aquatic vegetation in the tidal Potomac River, Maryland, Virginia, and the District of Columbia, 1986: U.S. Geological Survey Open-File Report 87-575, 82 p.

Rybicki, N. B., Carter, Virginia, Anderson, R. T., and Trombley, T. J., 1985, *Hydrilla verticillata* in the tidal Potomac River, Maryland, Virginia, and the District of Columbia, 1983 and 1984: U.S. Geological Survey Open-File Report 85-77, 26 p.



U.S. Geological Survey-Shoreline Survey Data

Figure 1. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1993.

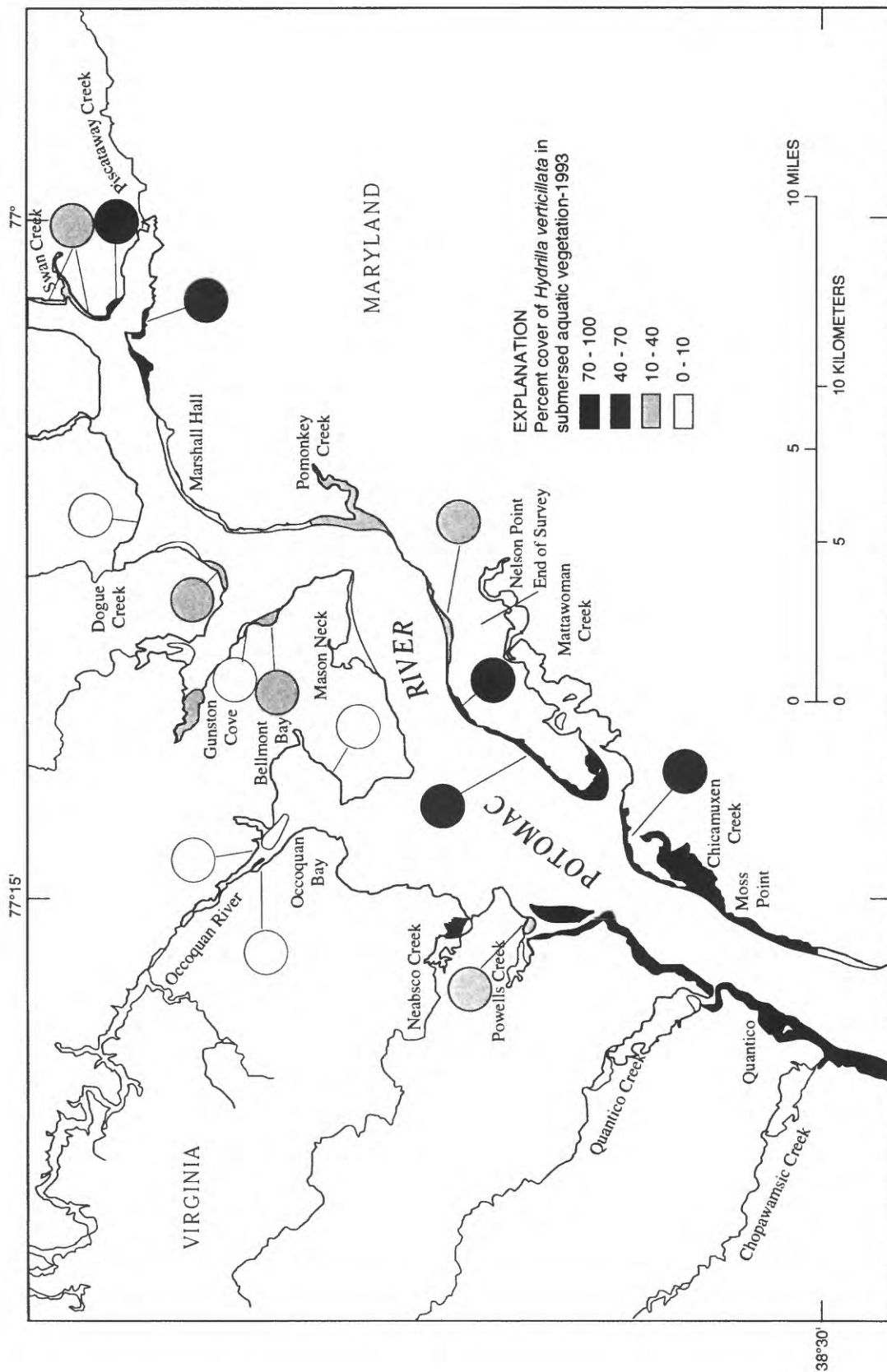
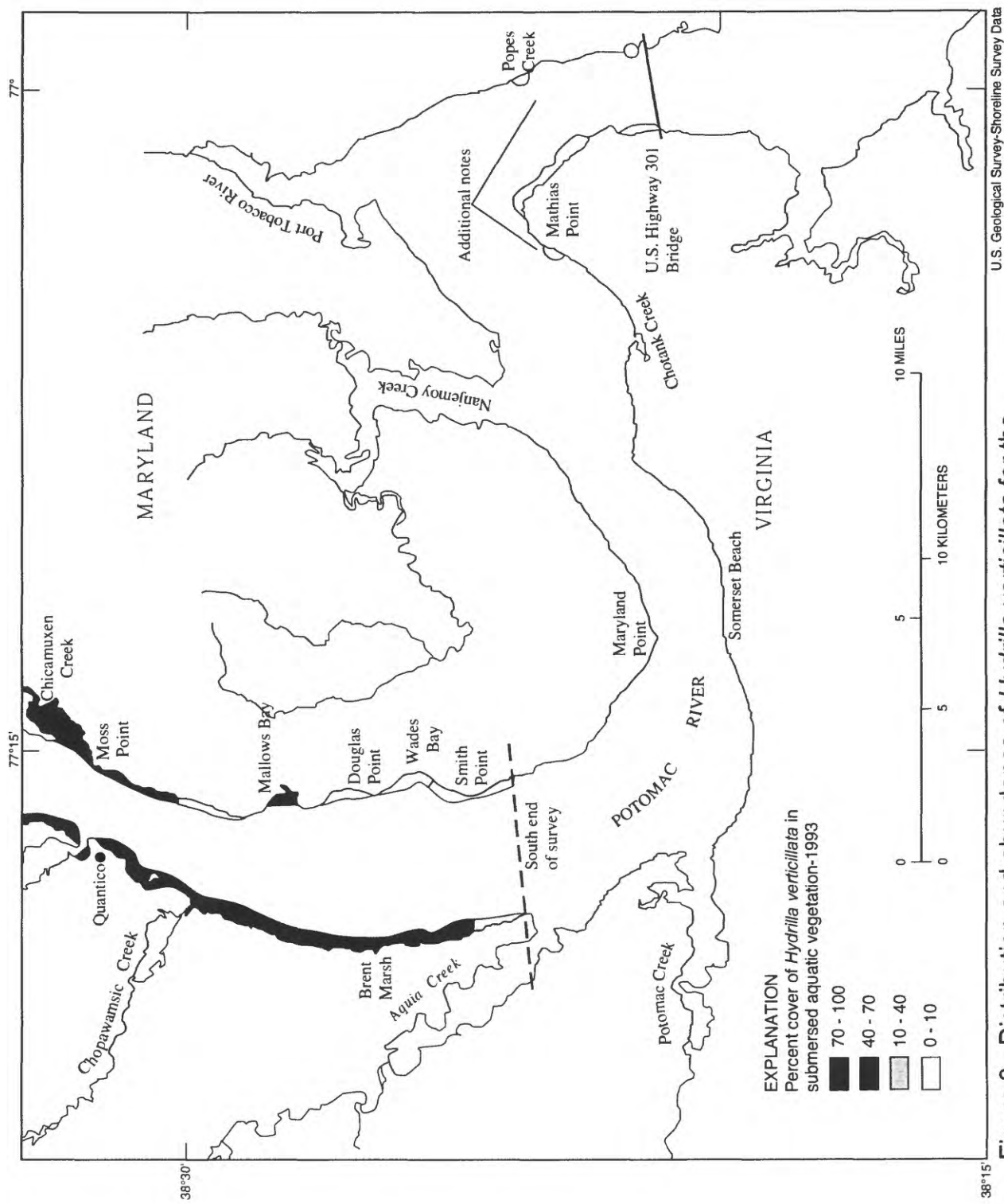


Figure 2. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Swan Creek to Chicamuxen Creek, 1993.



U.S. Geological Survey-Shoreline Survey Data

Figure 3. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Aquia Creek, 1993.

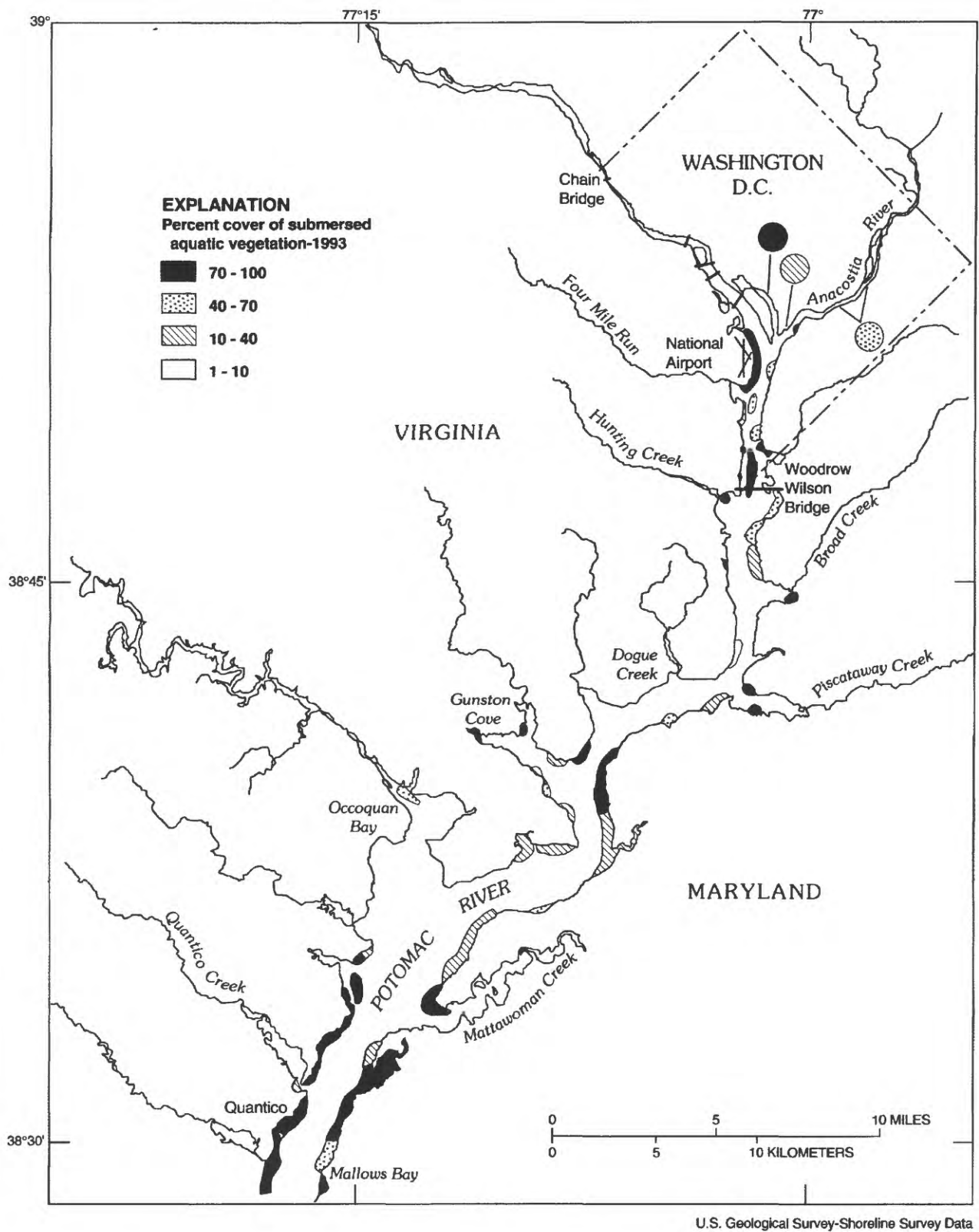
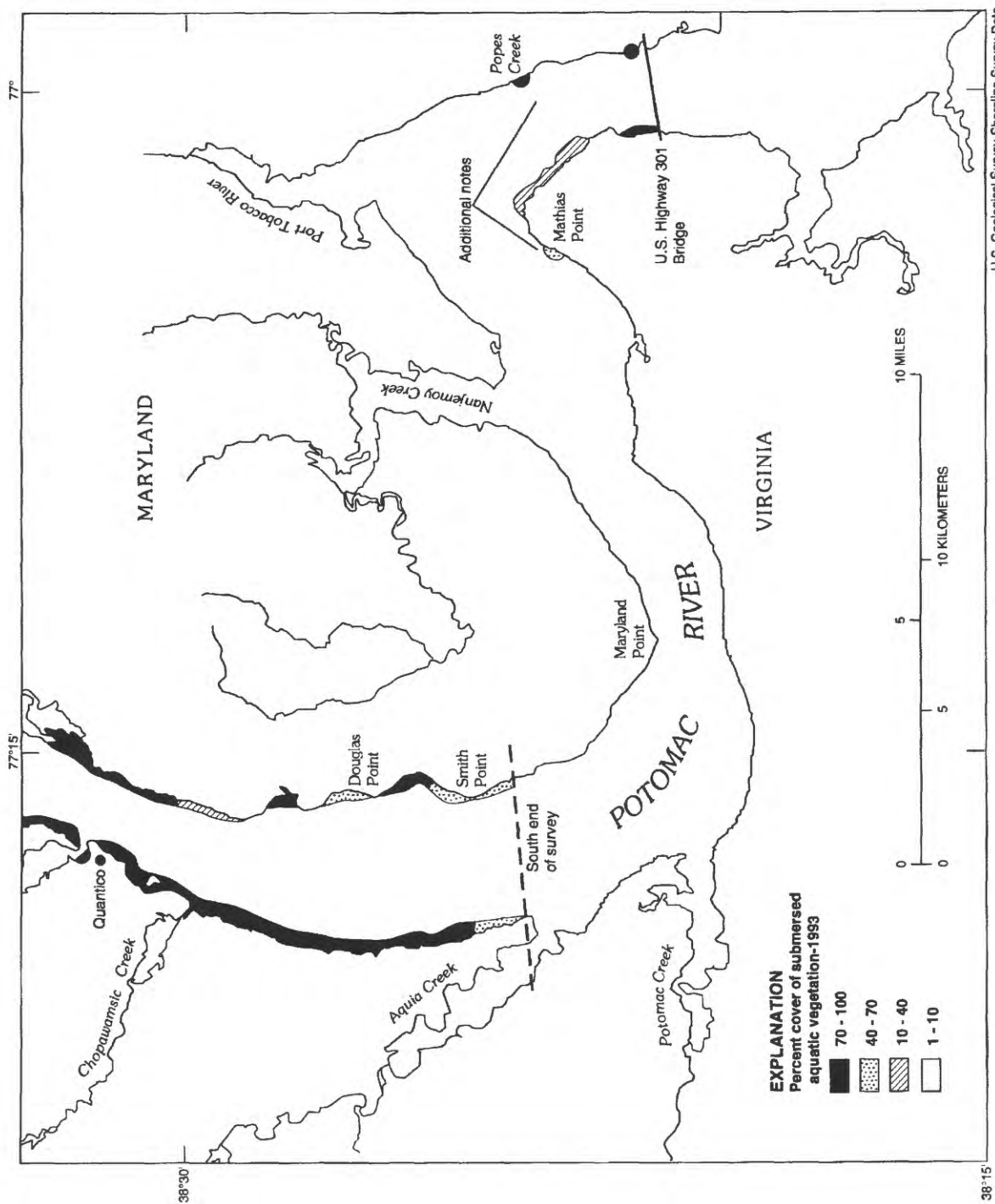


Figure 4. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Quantico, Virginia 1993.



U.S. Geological Survey Shoreline Survey Data

Figure 5. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Quantico, Virginia to Aquia Creek, 1993.

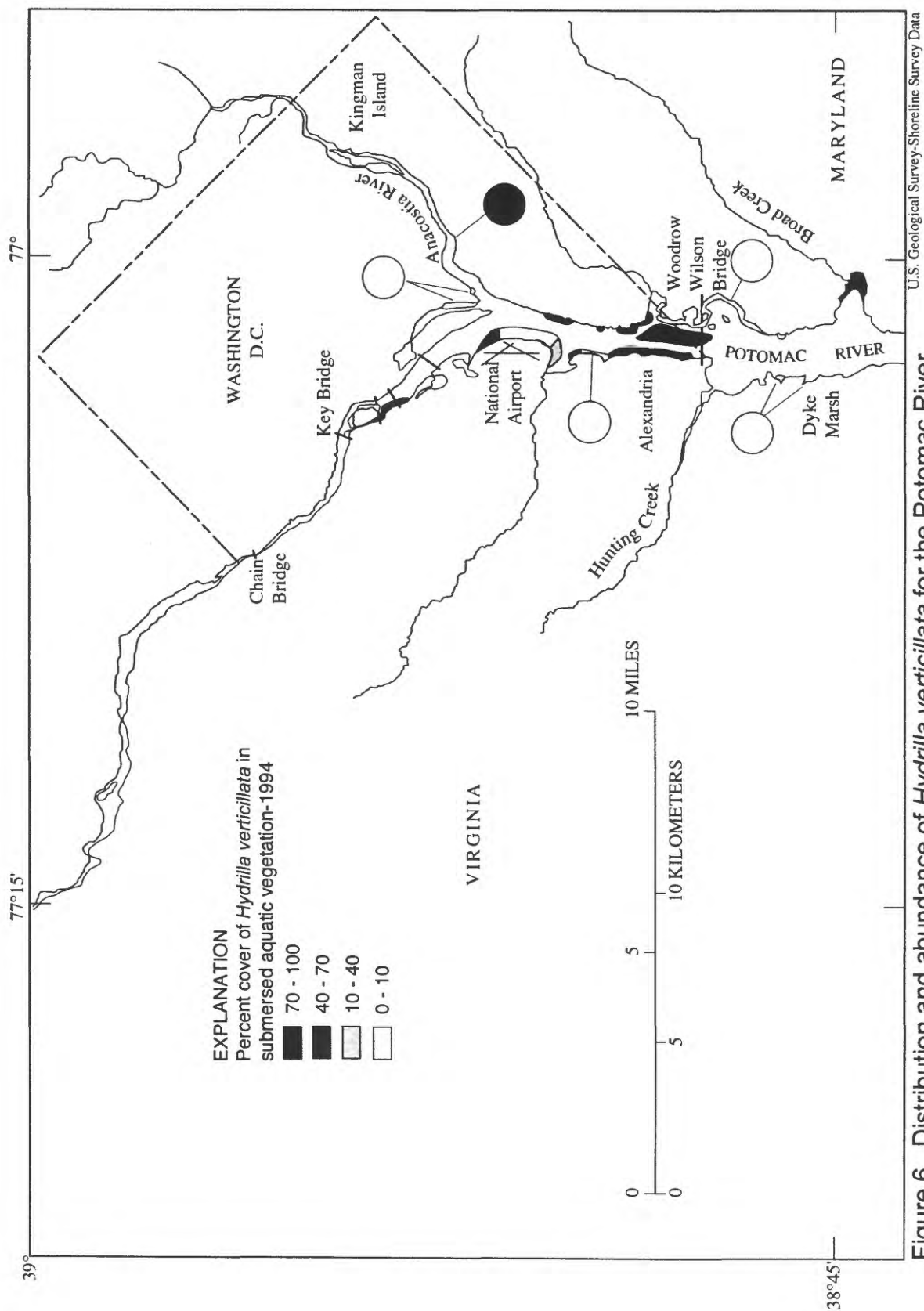


Figure 6. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1994.

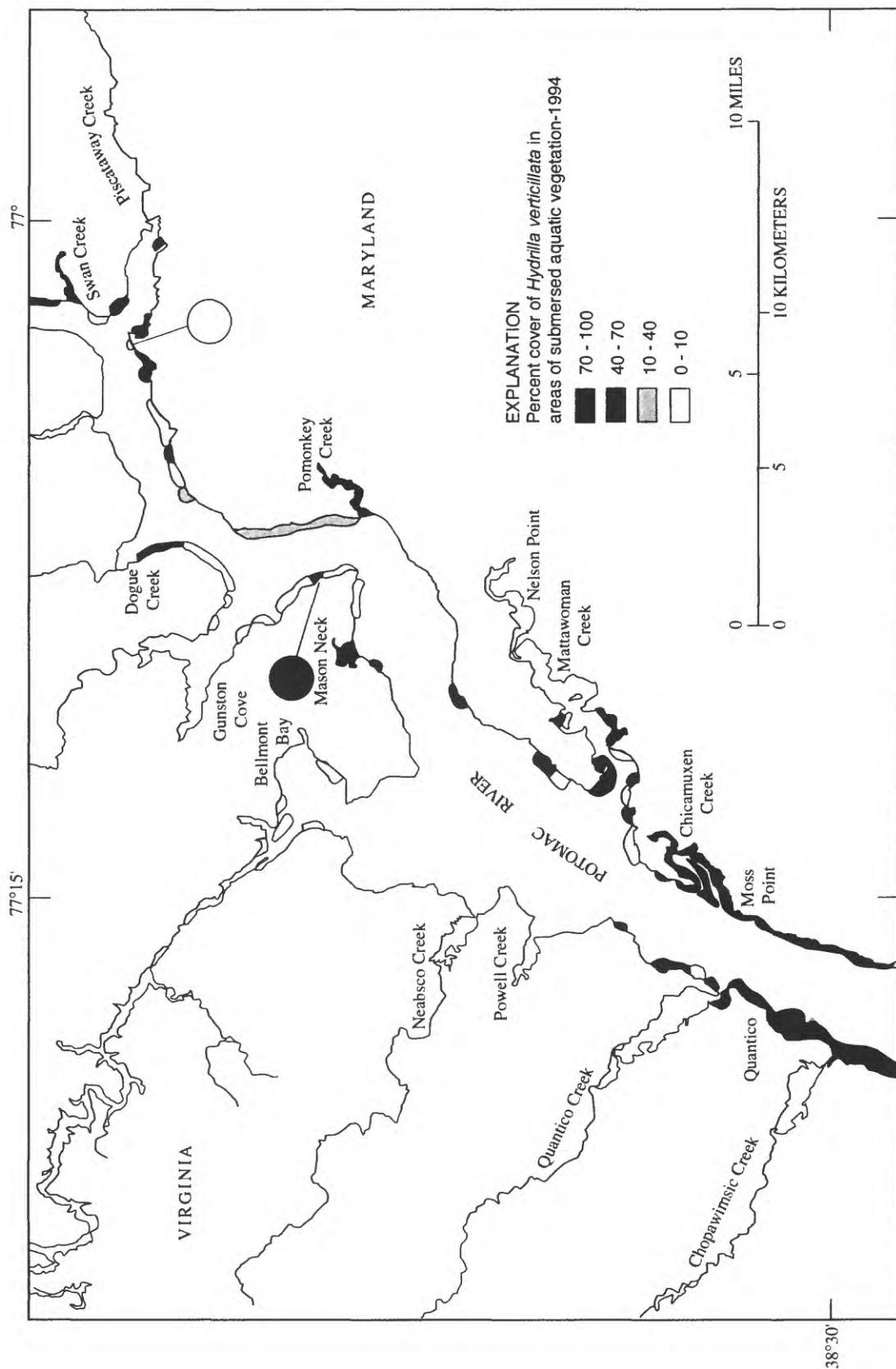
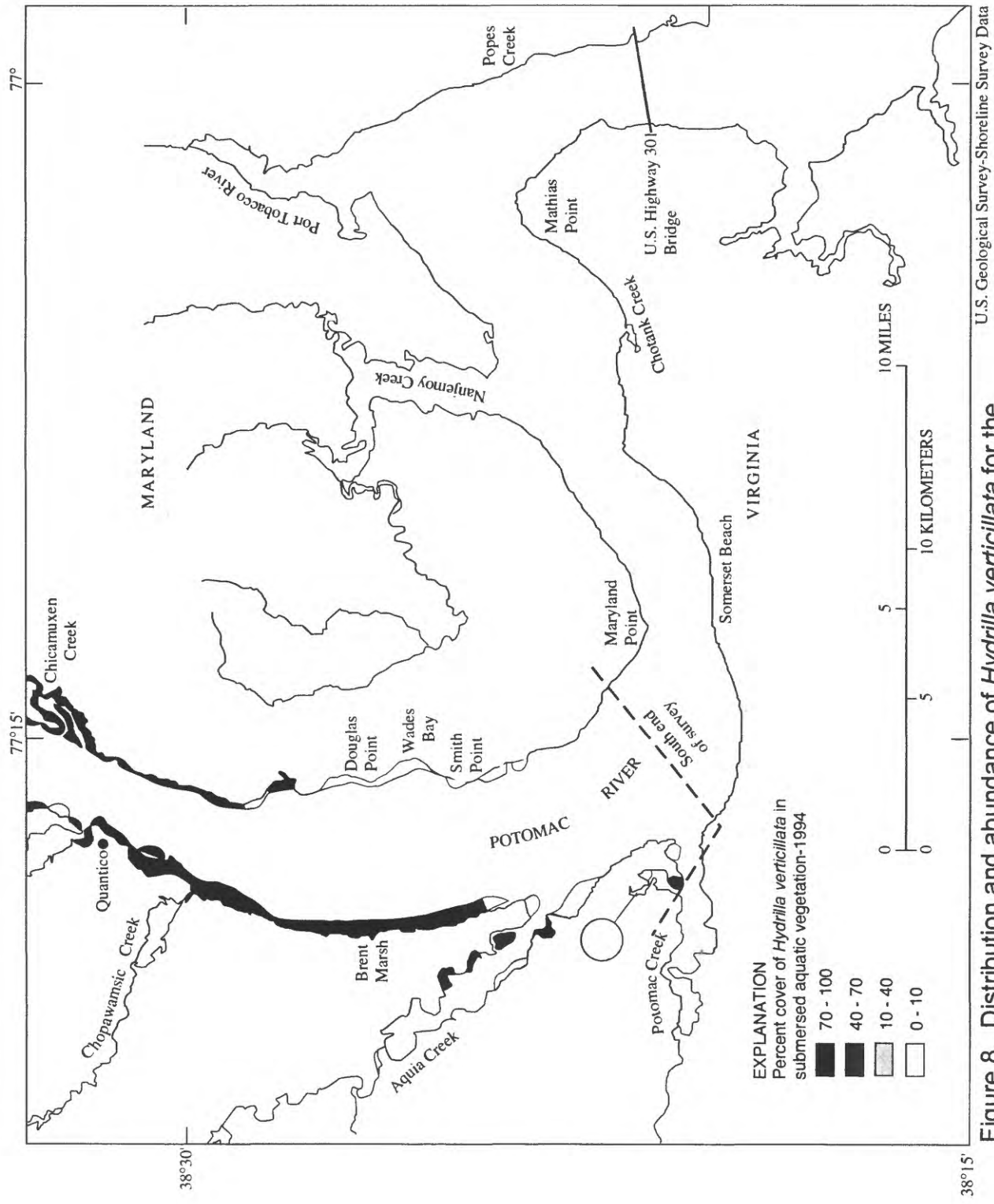


Figure 7. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Swan Creek to Chicamuxen Creek, 1994.

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Figure 8. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Maryland Pt., 1994.

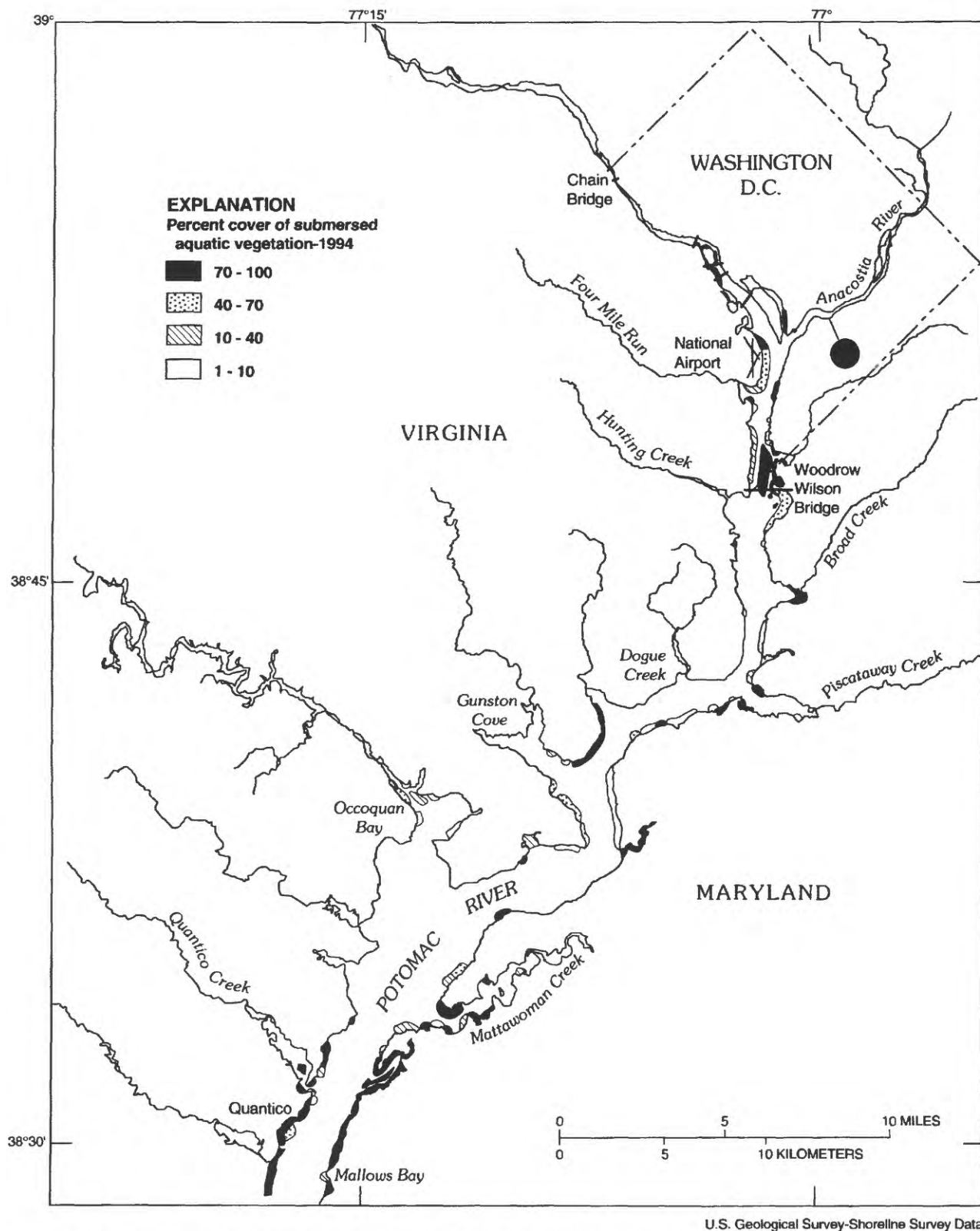


Figure 9. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Quantico, Virginia, 1994.

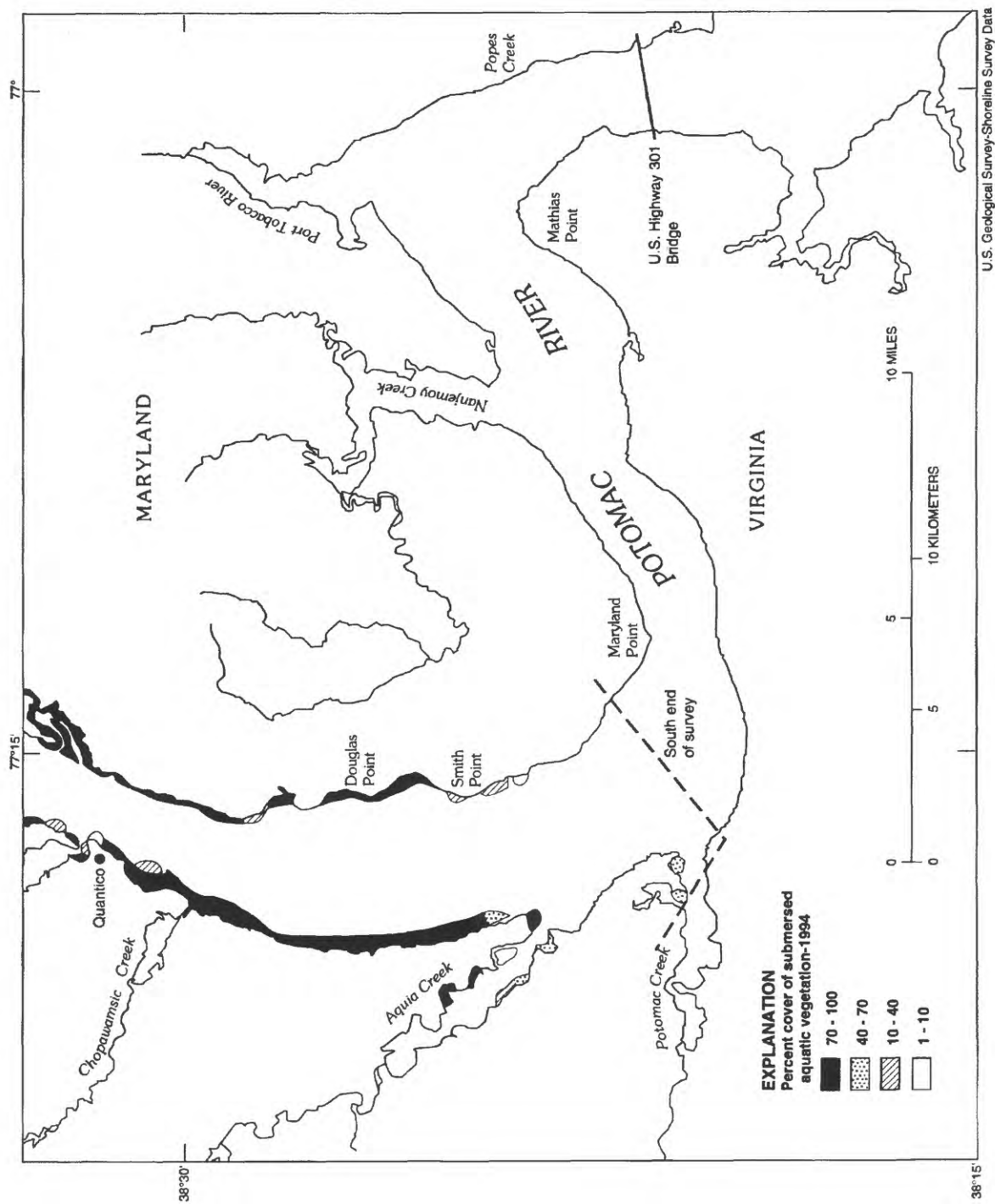
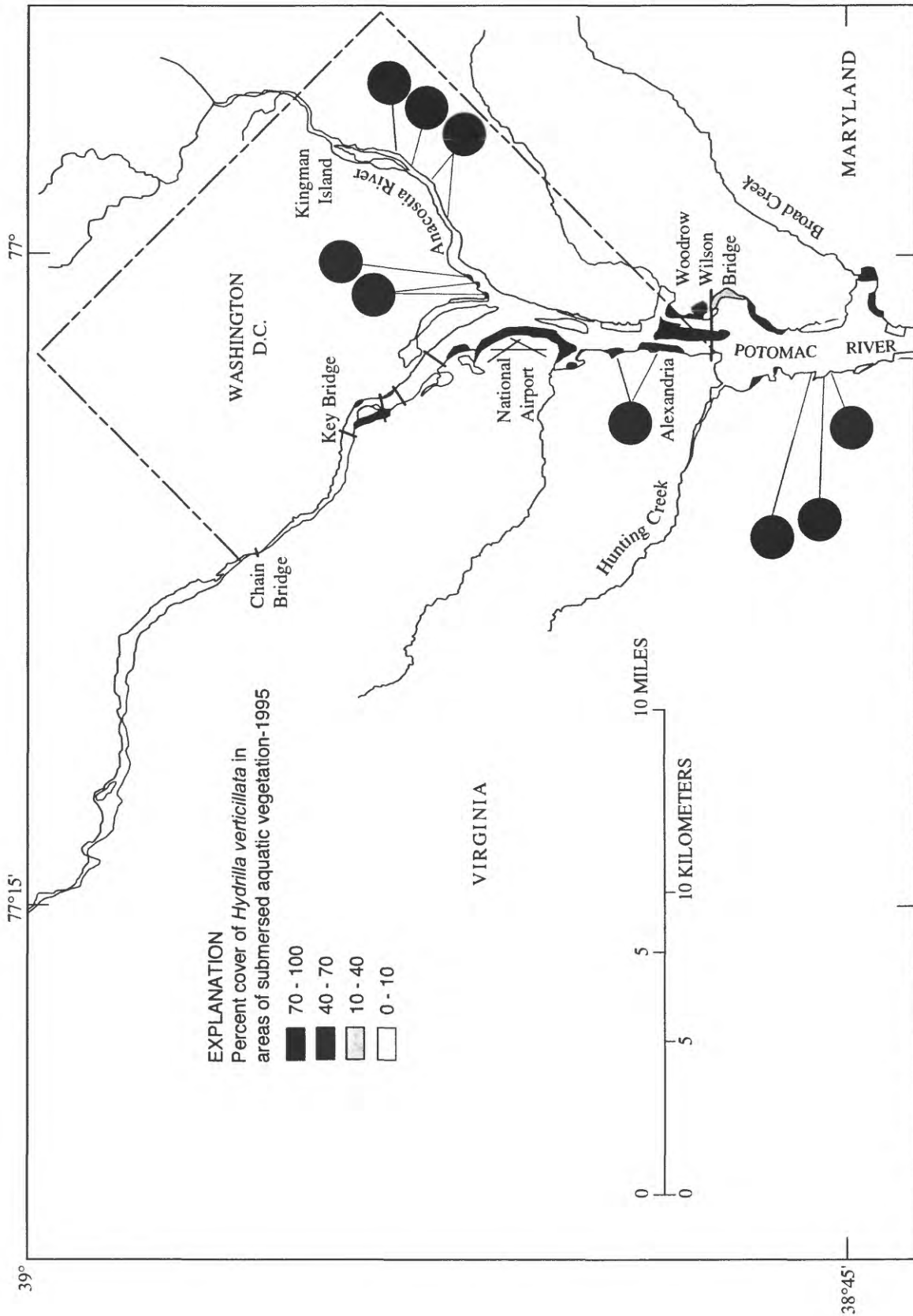
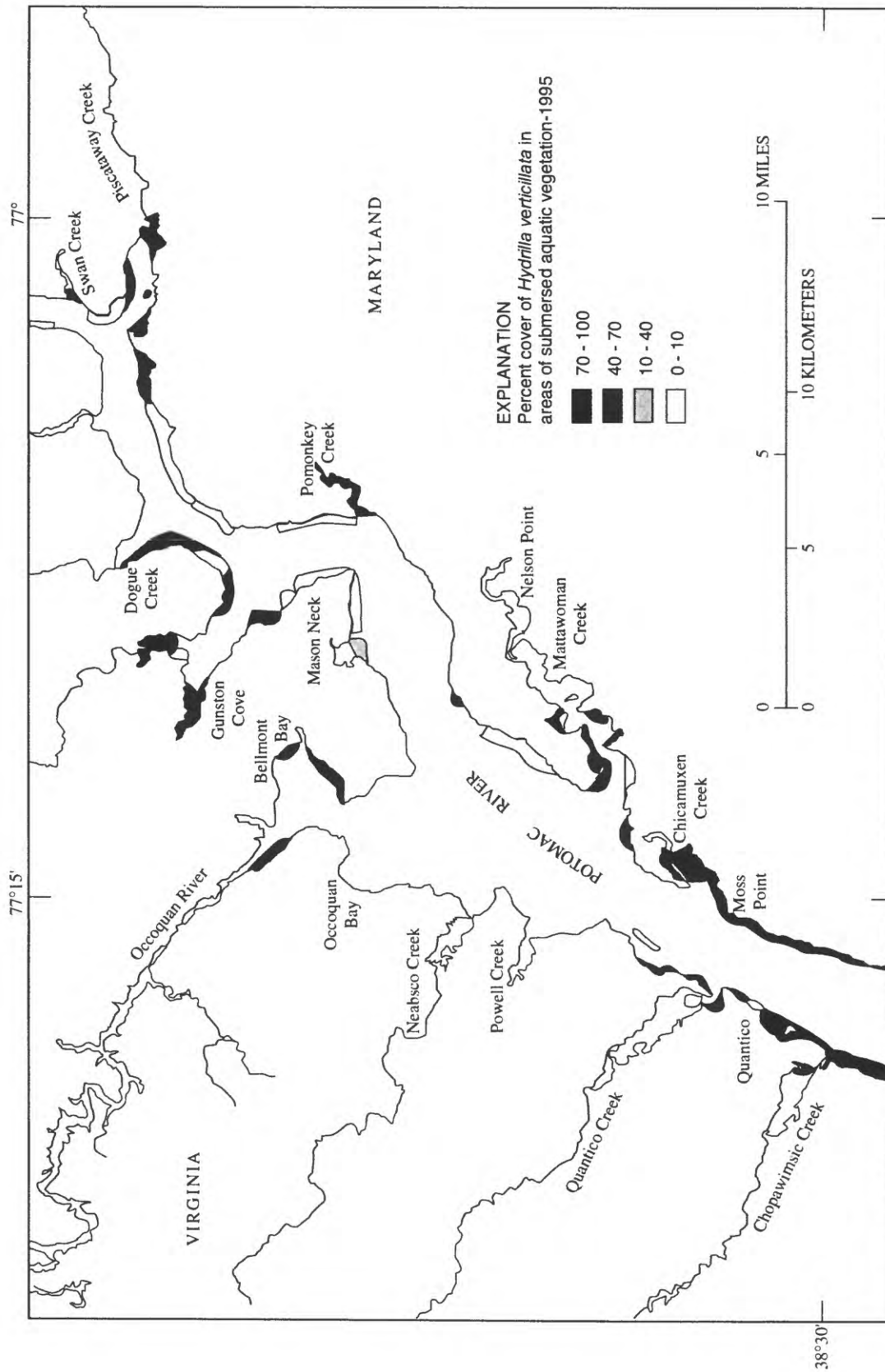


Figure 10. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Quantico, Virginia to Maryland Point, 1994.



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Figure 11. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1995.



U.S. Geological Survey-Shoreline Survey Data

Figure 12. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Swan Creek to Chicamuxen Creek, 1995.

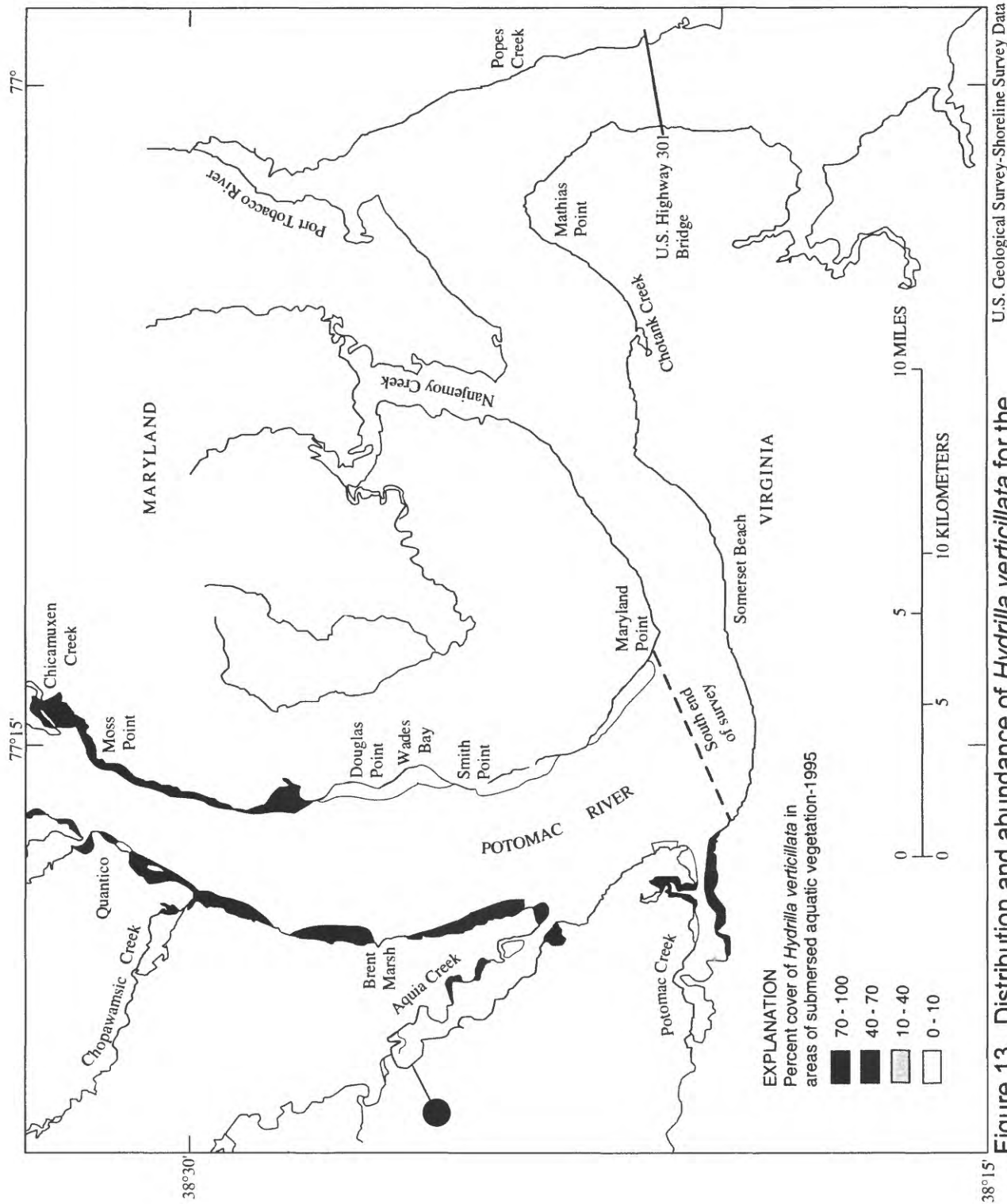


Figure 13. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Maryland Point, 1995.

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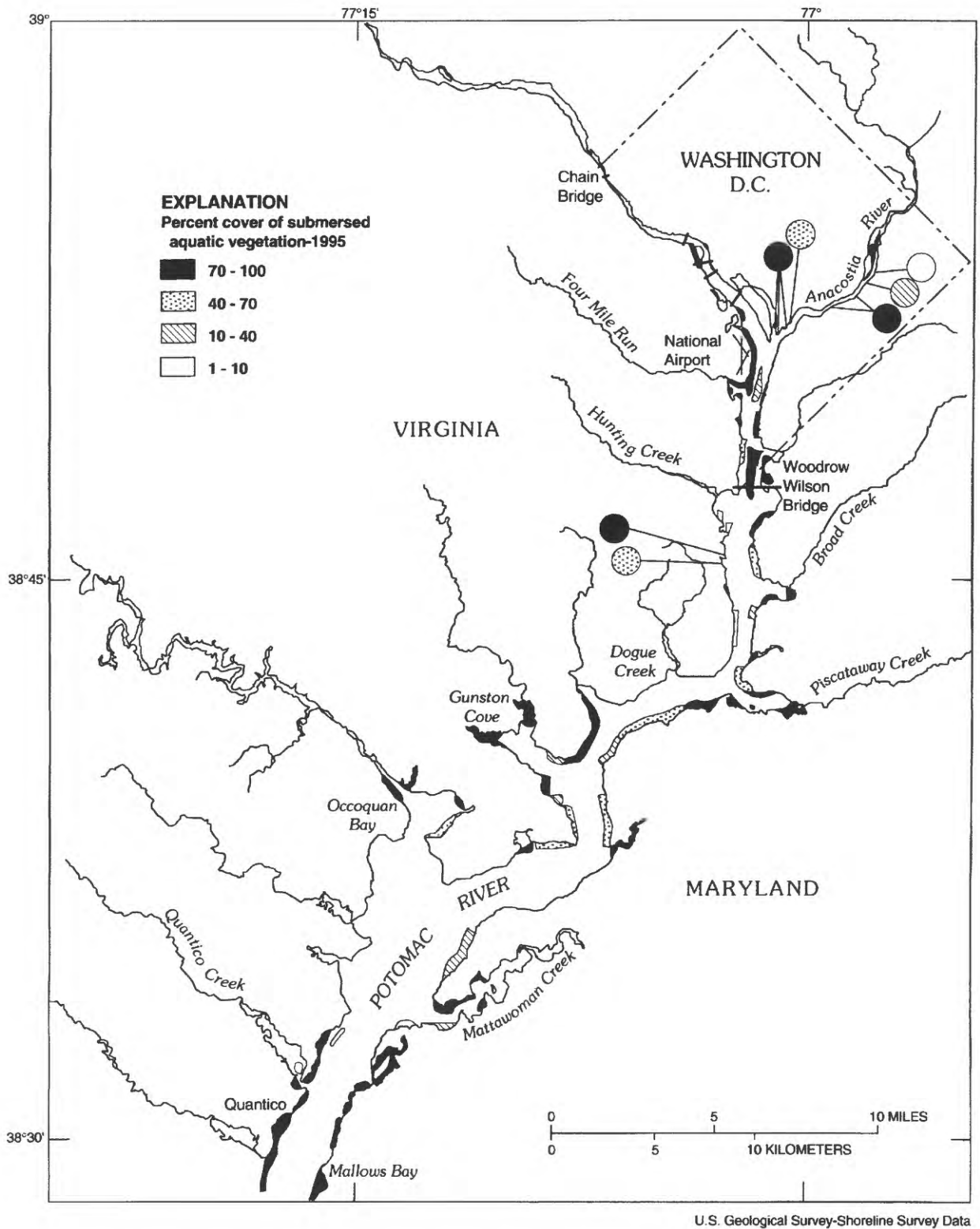


Figure 14. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Quantico, Virginia 1995.

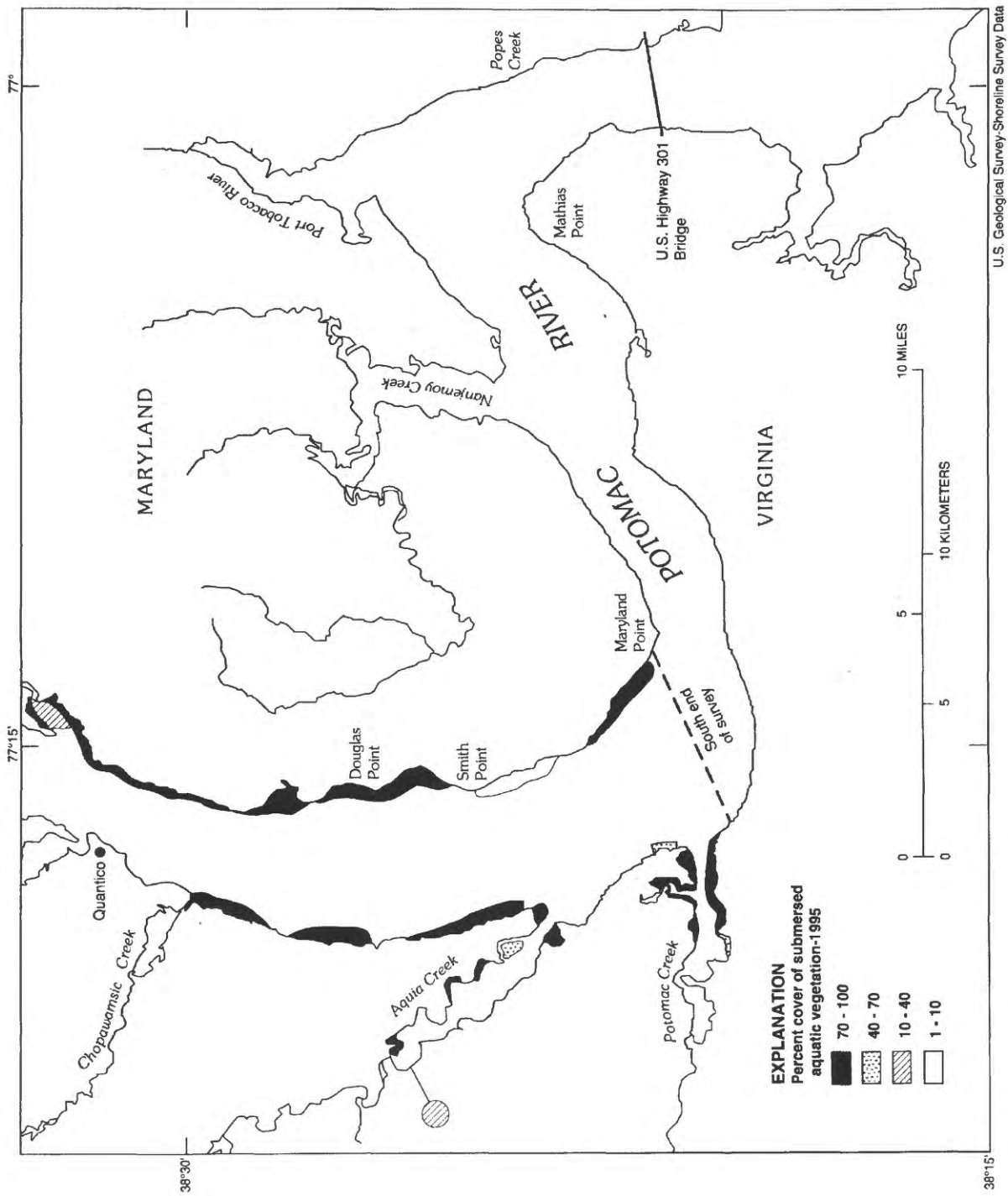


Figure 15. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Quantico, Virginia to Maryland Point, 1995

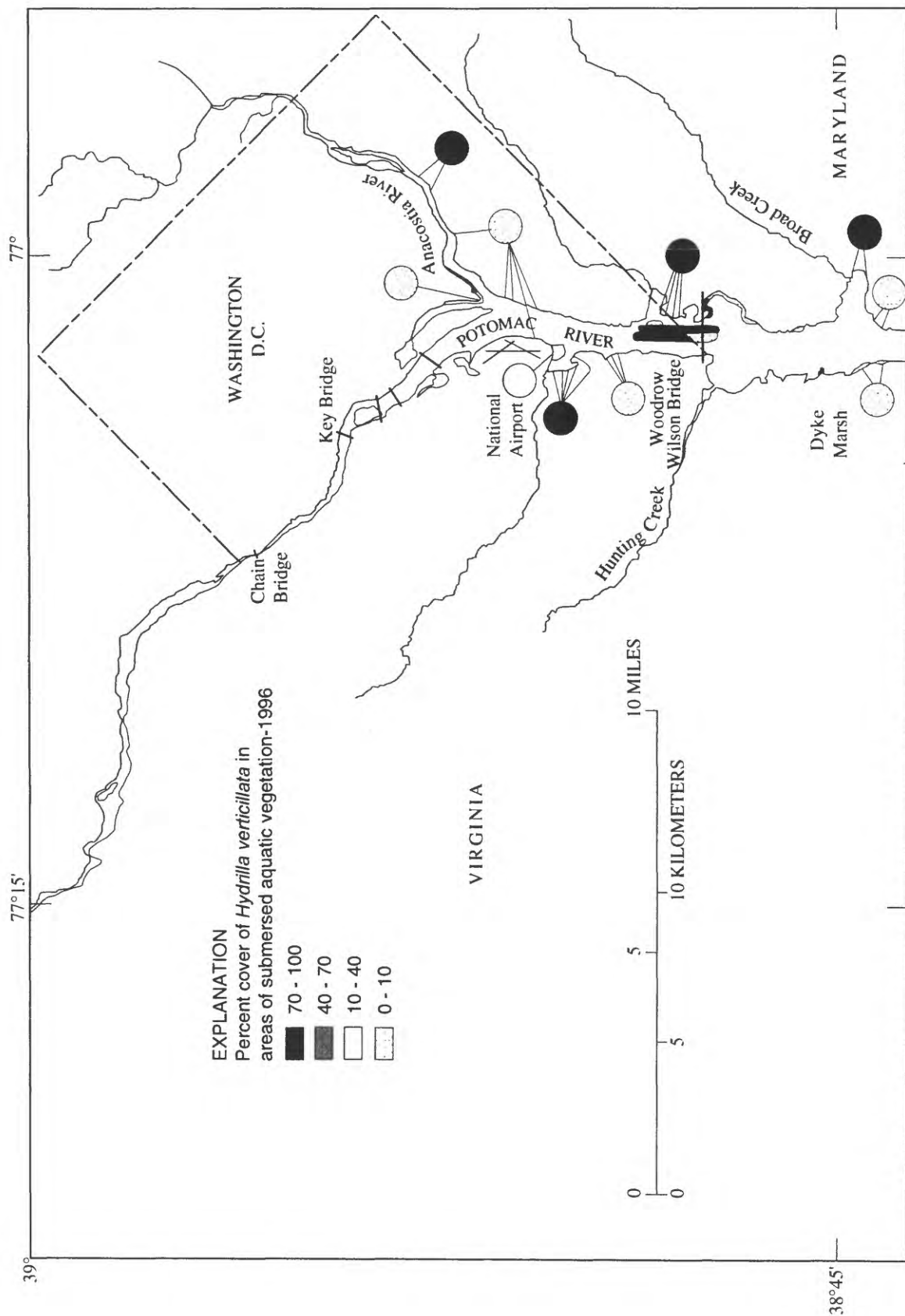


Figure 16. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1996.

U.S. Geological Survey-Shoreline Survey Data

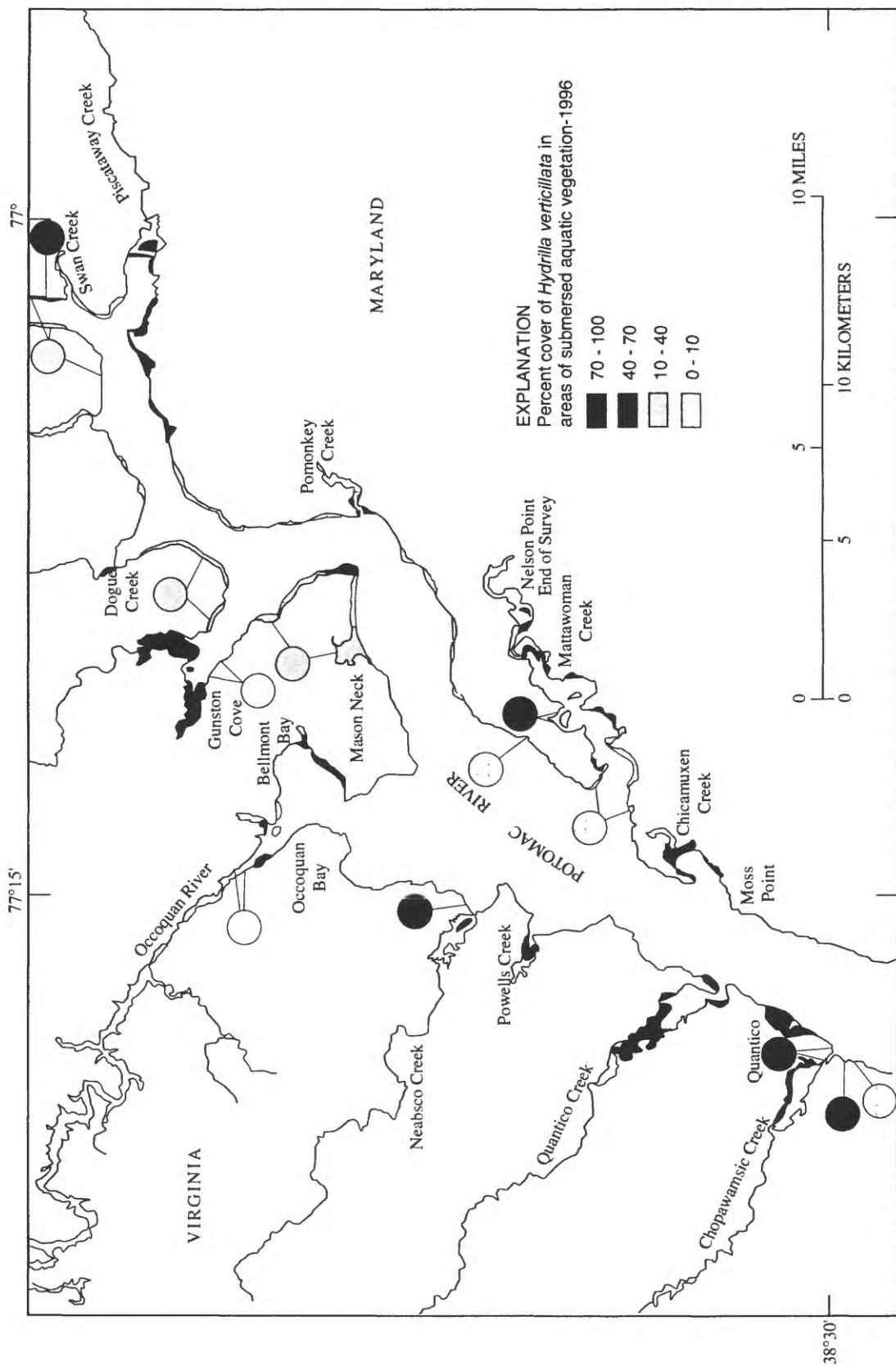


Figure 17. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Swan Creek to Chicamuxen Creek, 1996.

U.S. Geological Survey-Shoreline Survey Data

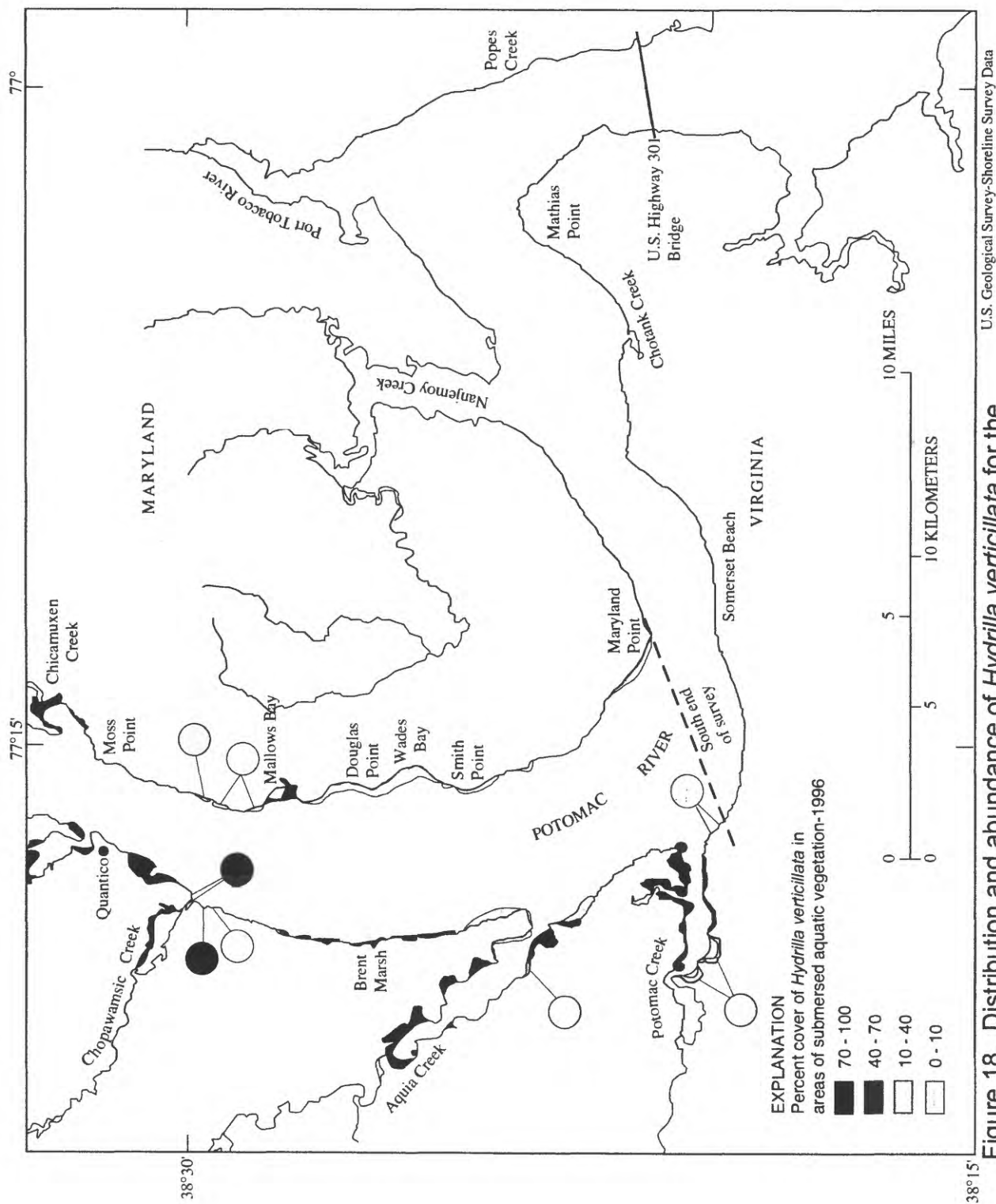


Figure 18. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Maryland Point, 1996.

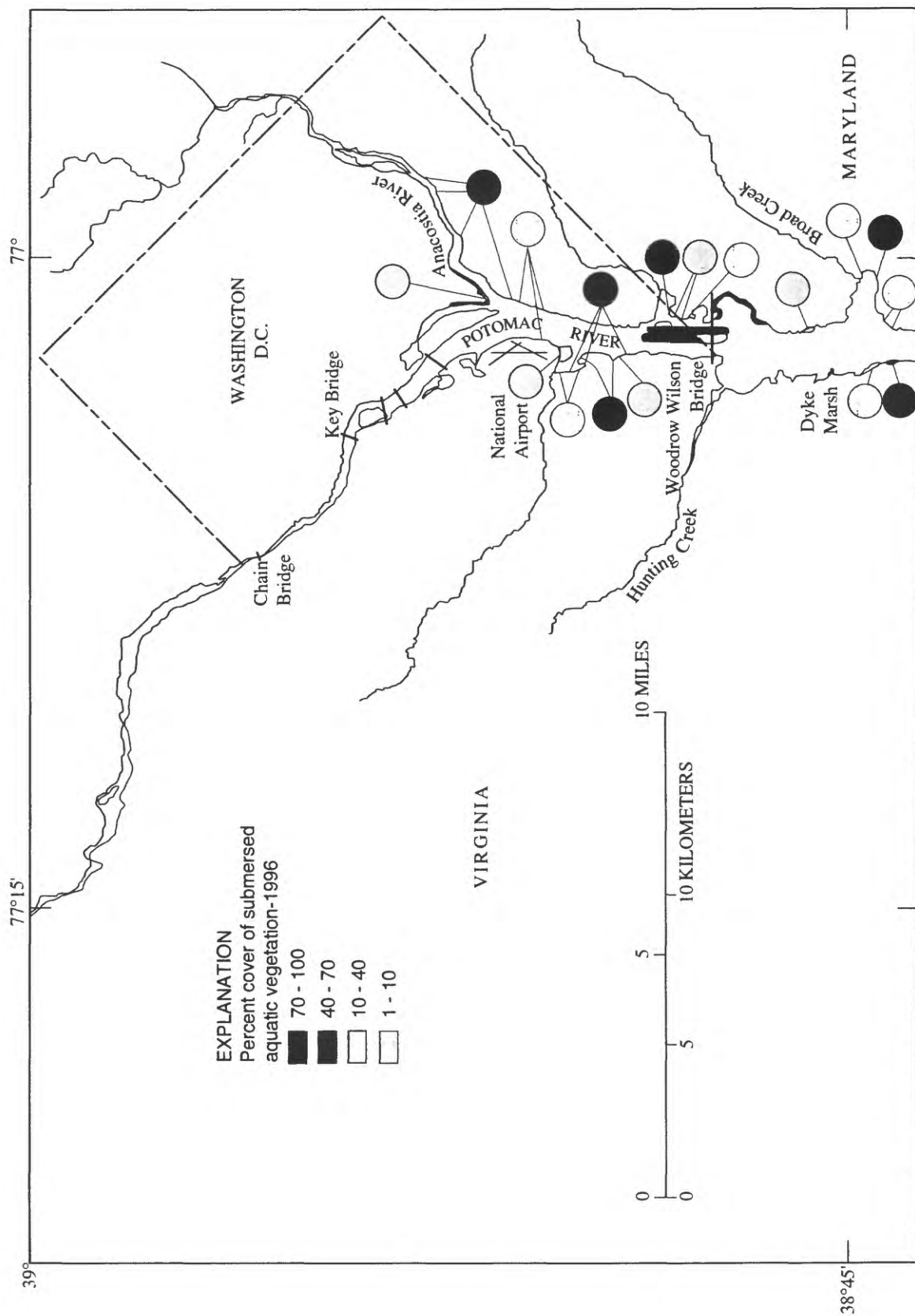
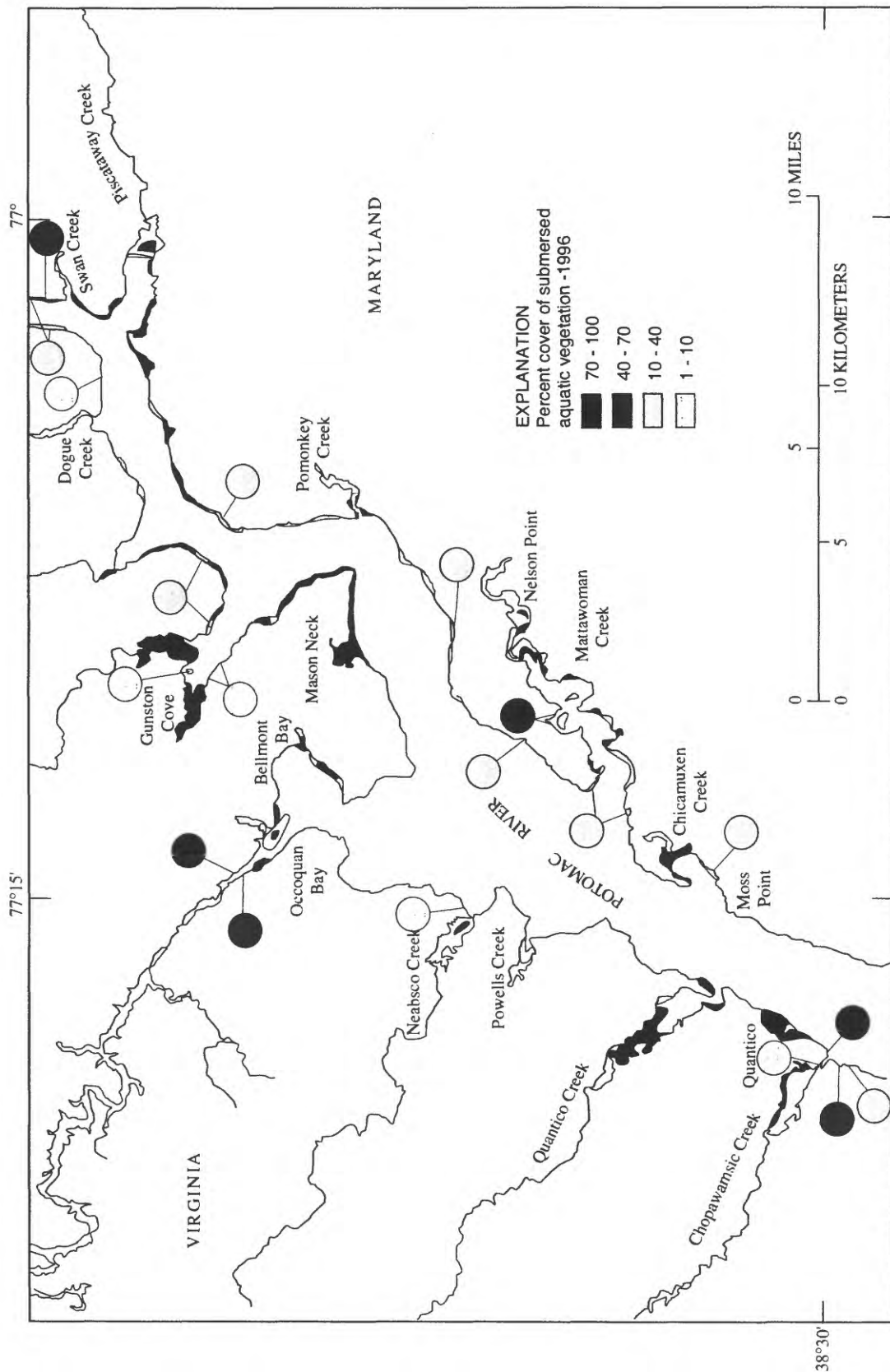
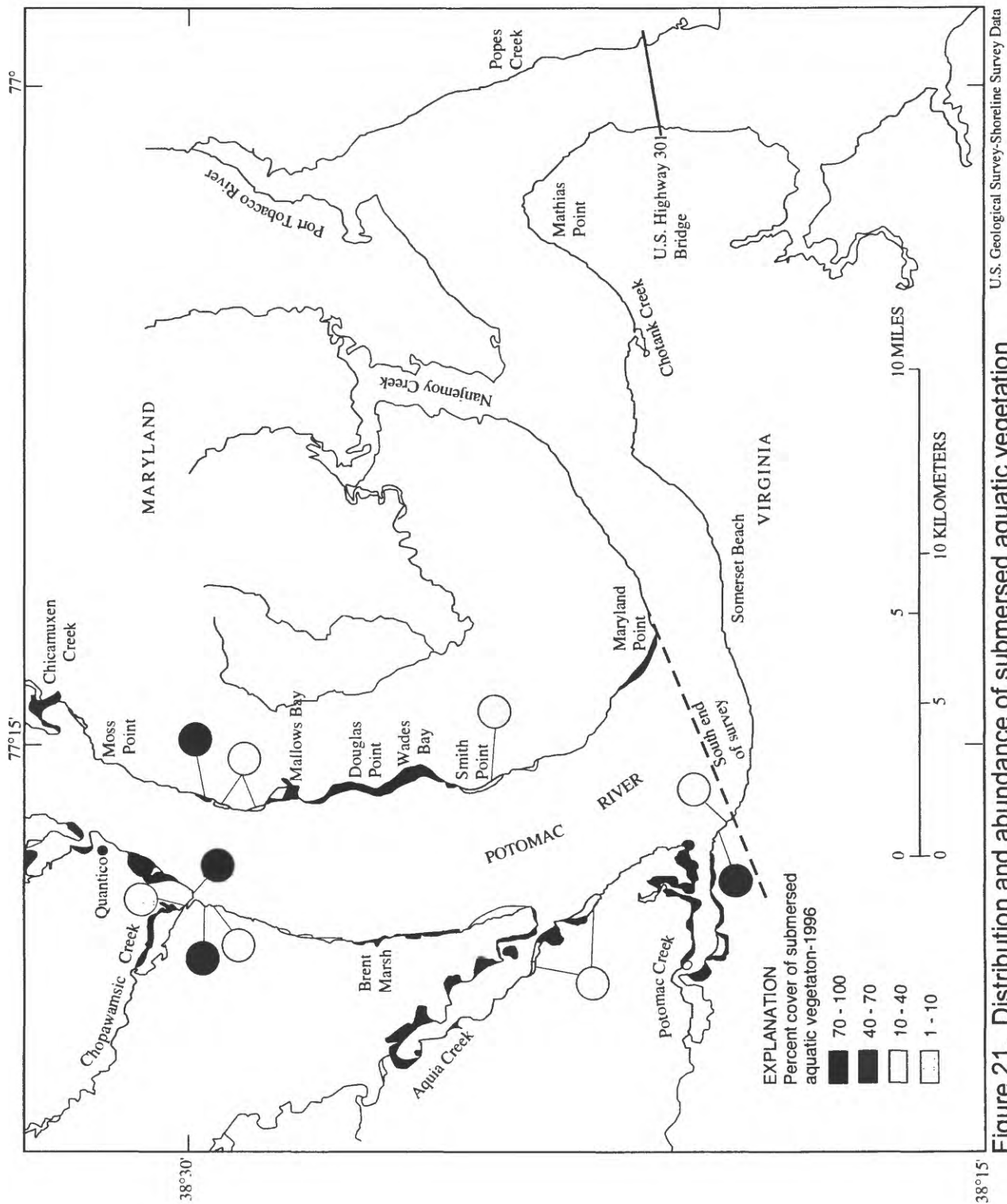


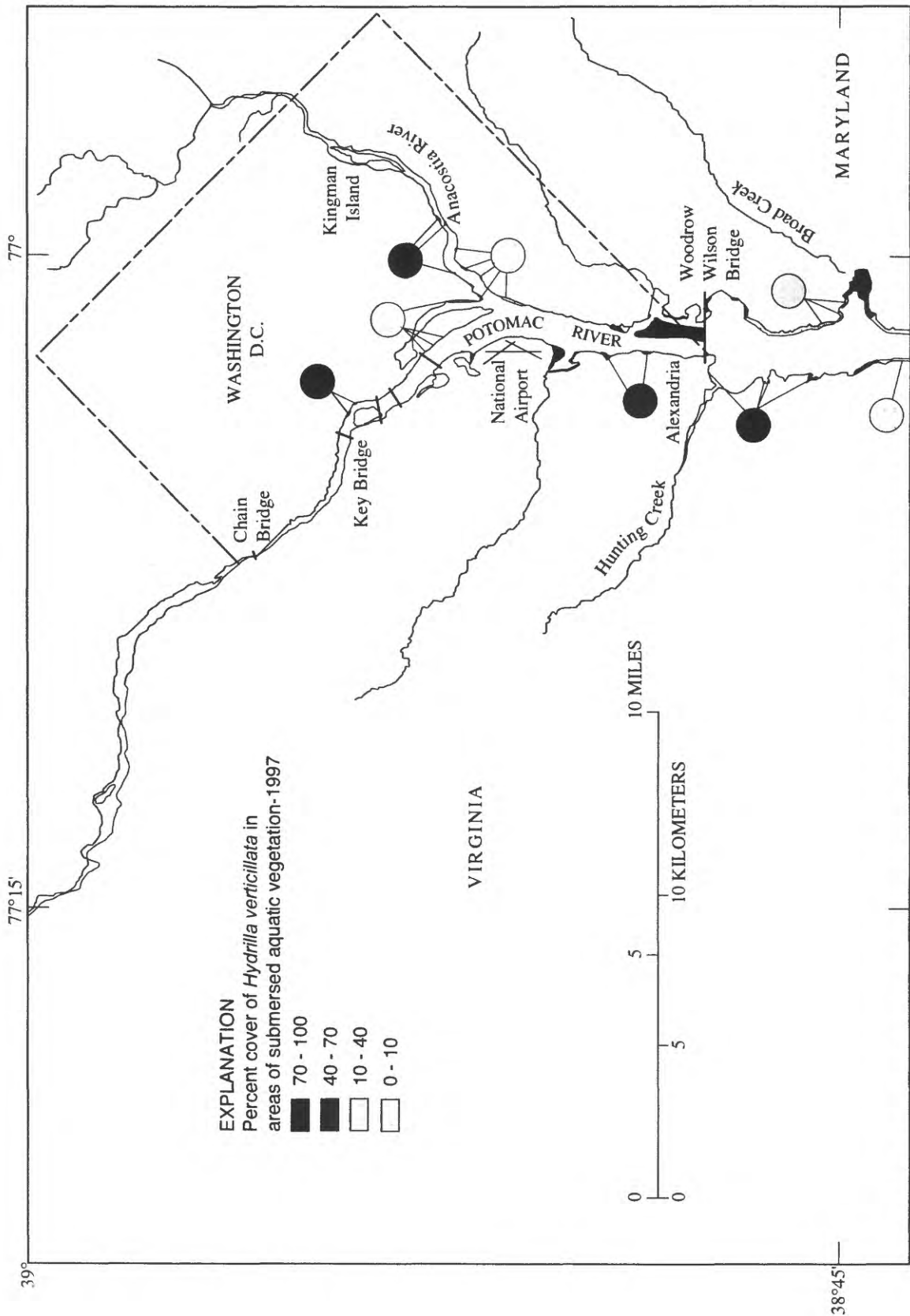
Figure 19. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Broad Creek, 1996.



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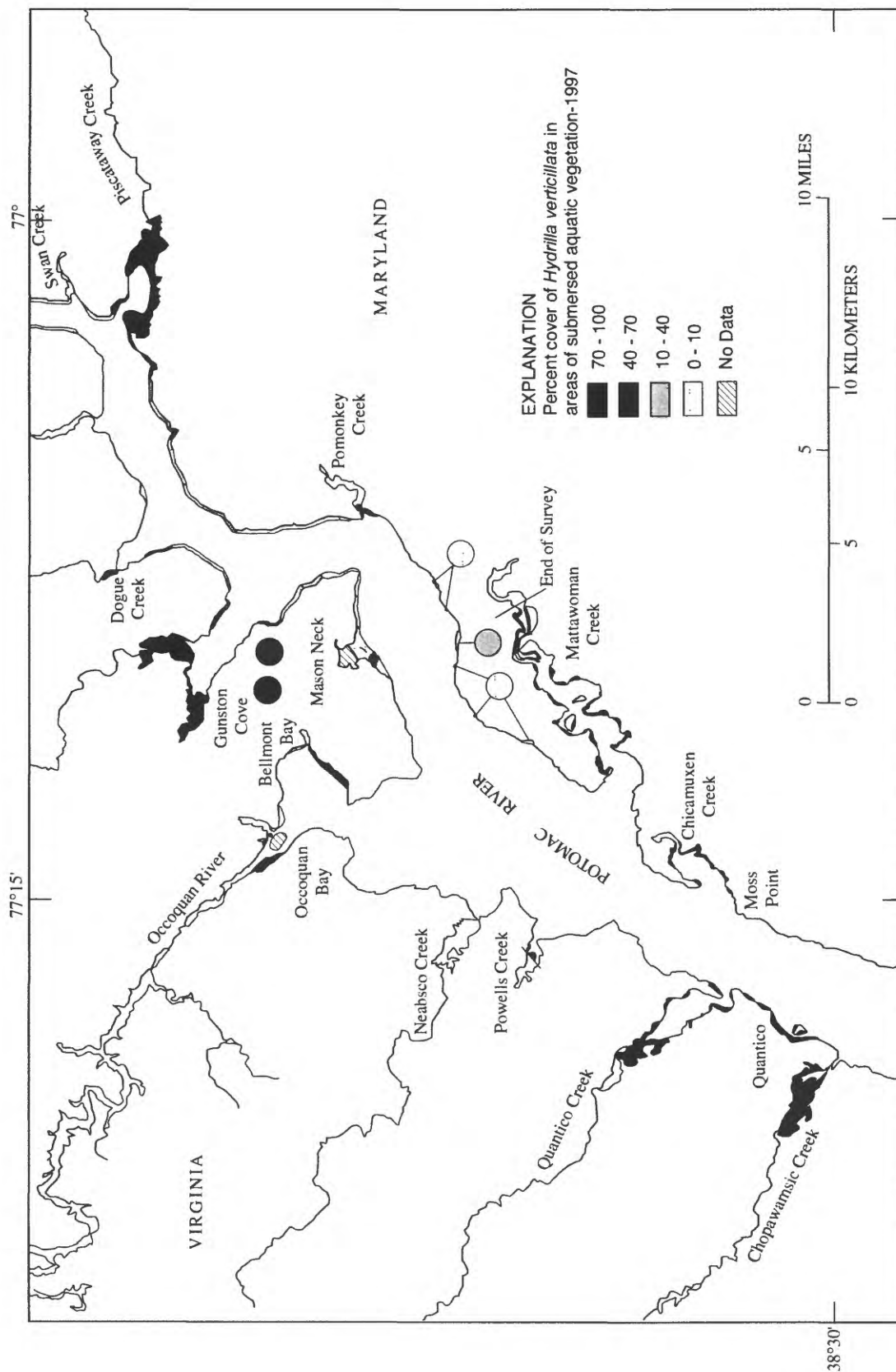
Figure 20. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Swan Creek to Chicamuxen Creek, 1996.





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Figure 22. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1997.



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Figure 23. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Swan Creek to Chicamuxen Creek, 1997.

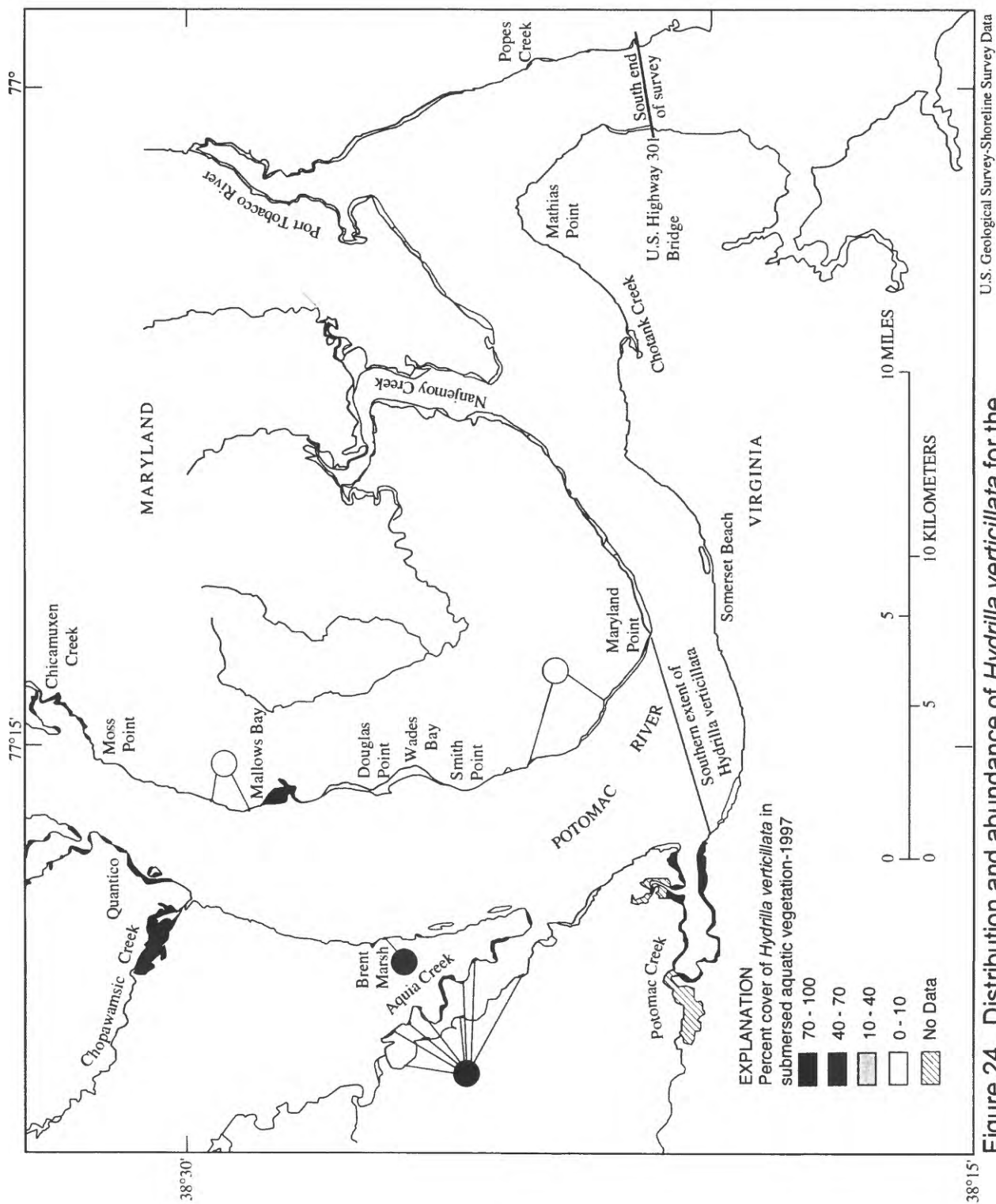


Figure 24. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Rt. 301 Bridge, 1997.

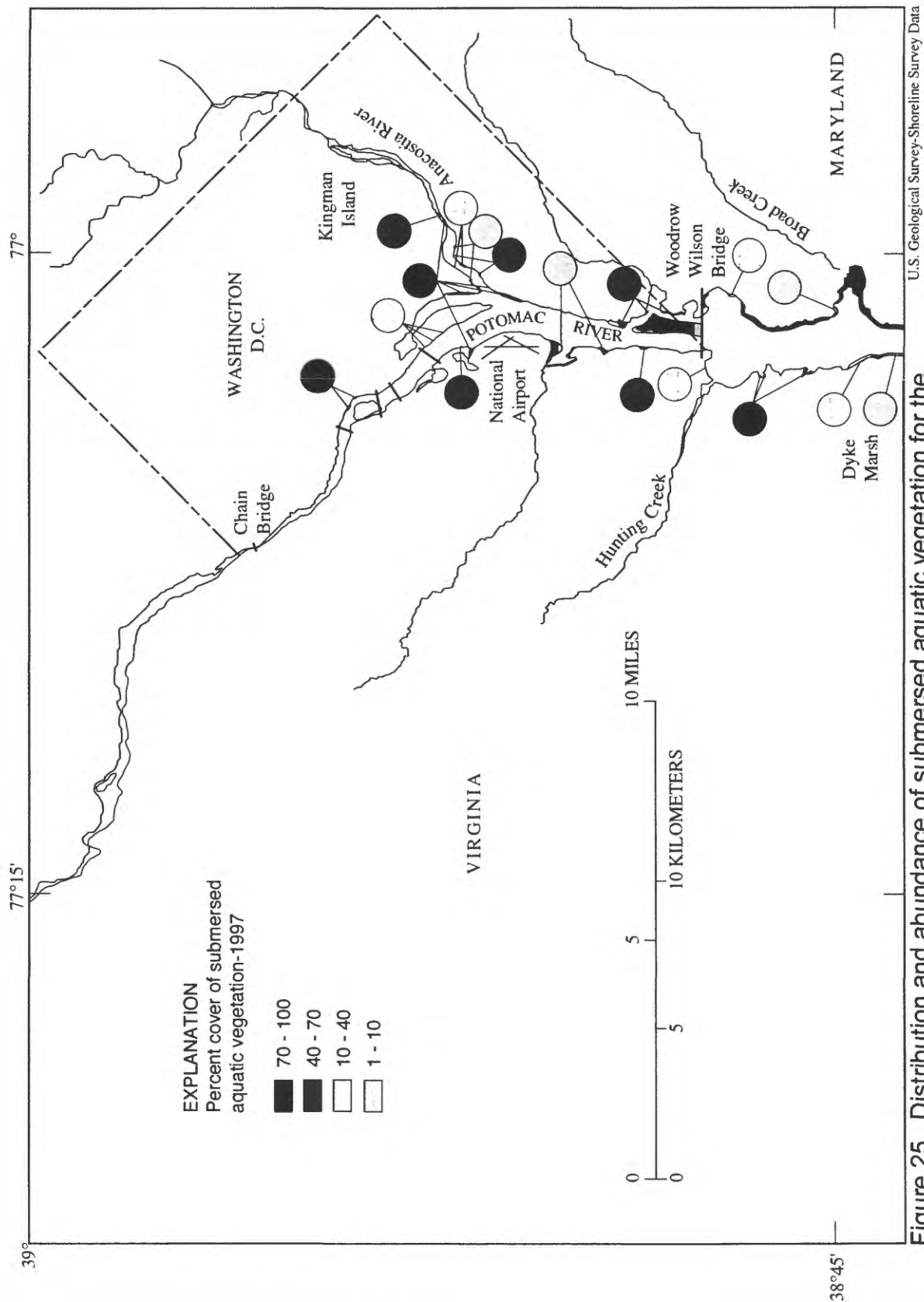
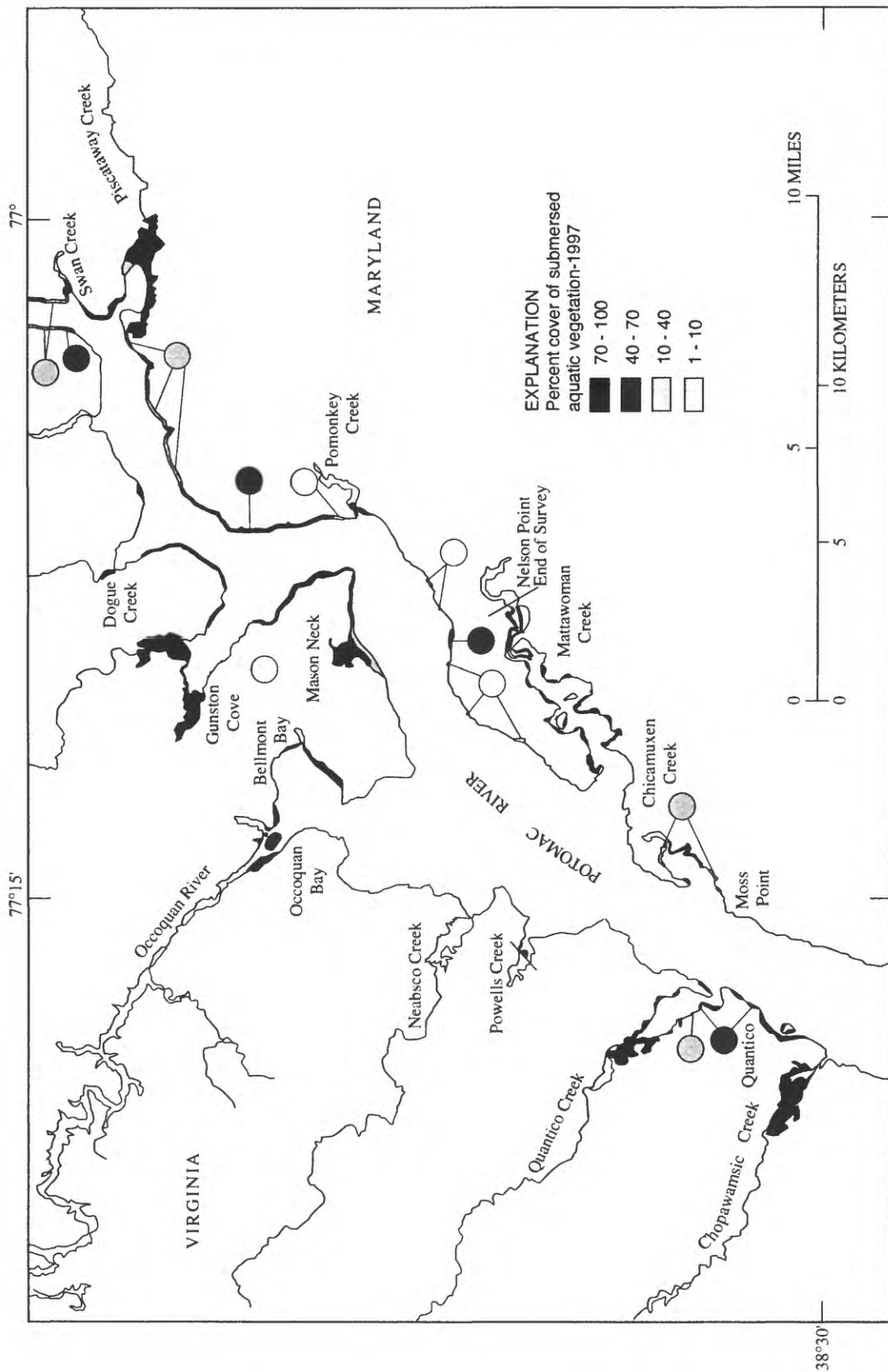


Figure 25. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Broad Creek, 1997.



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Figure 26. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Swan Creek to Chicamuxen Creek, 1997.

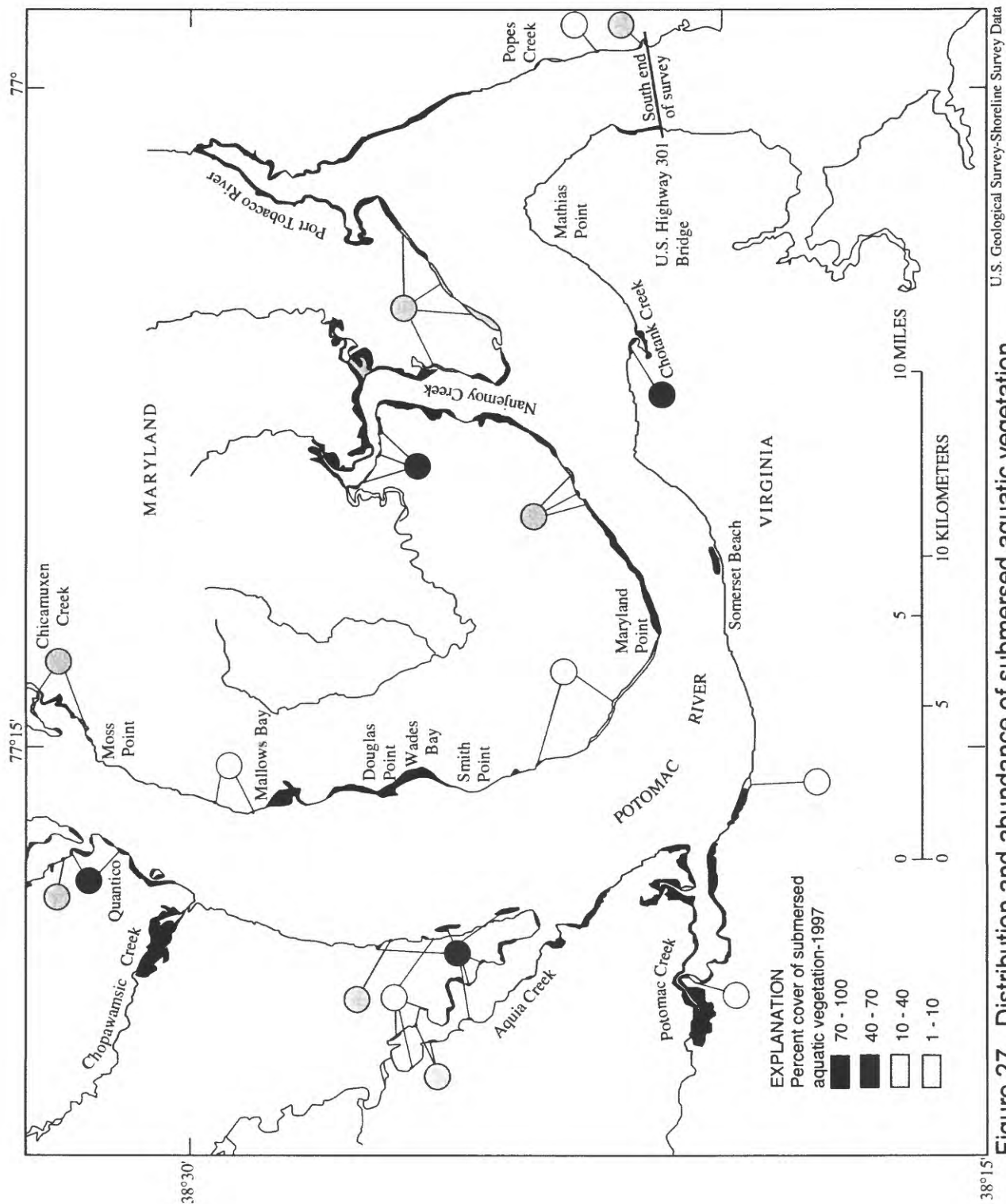
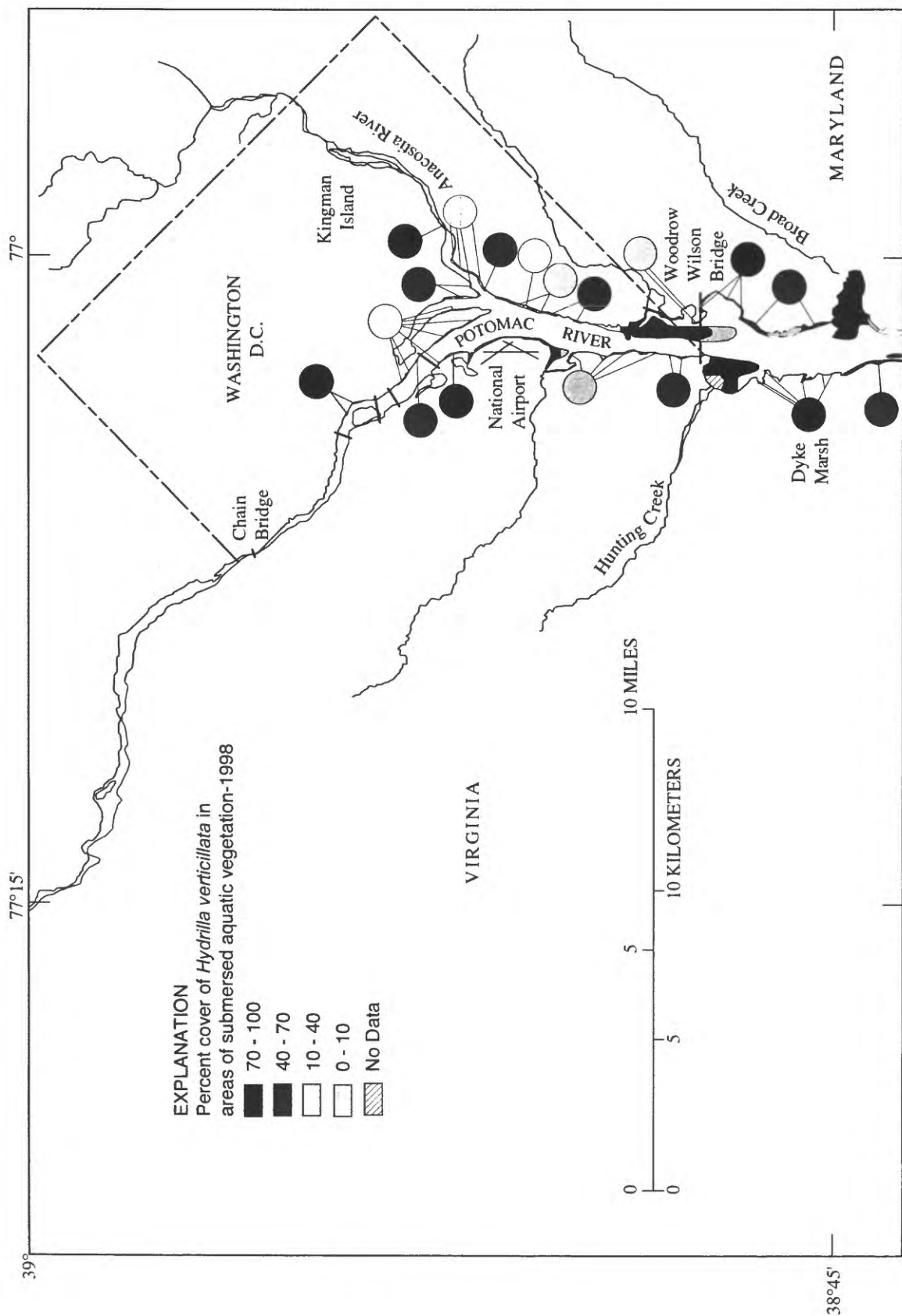
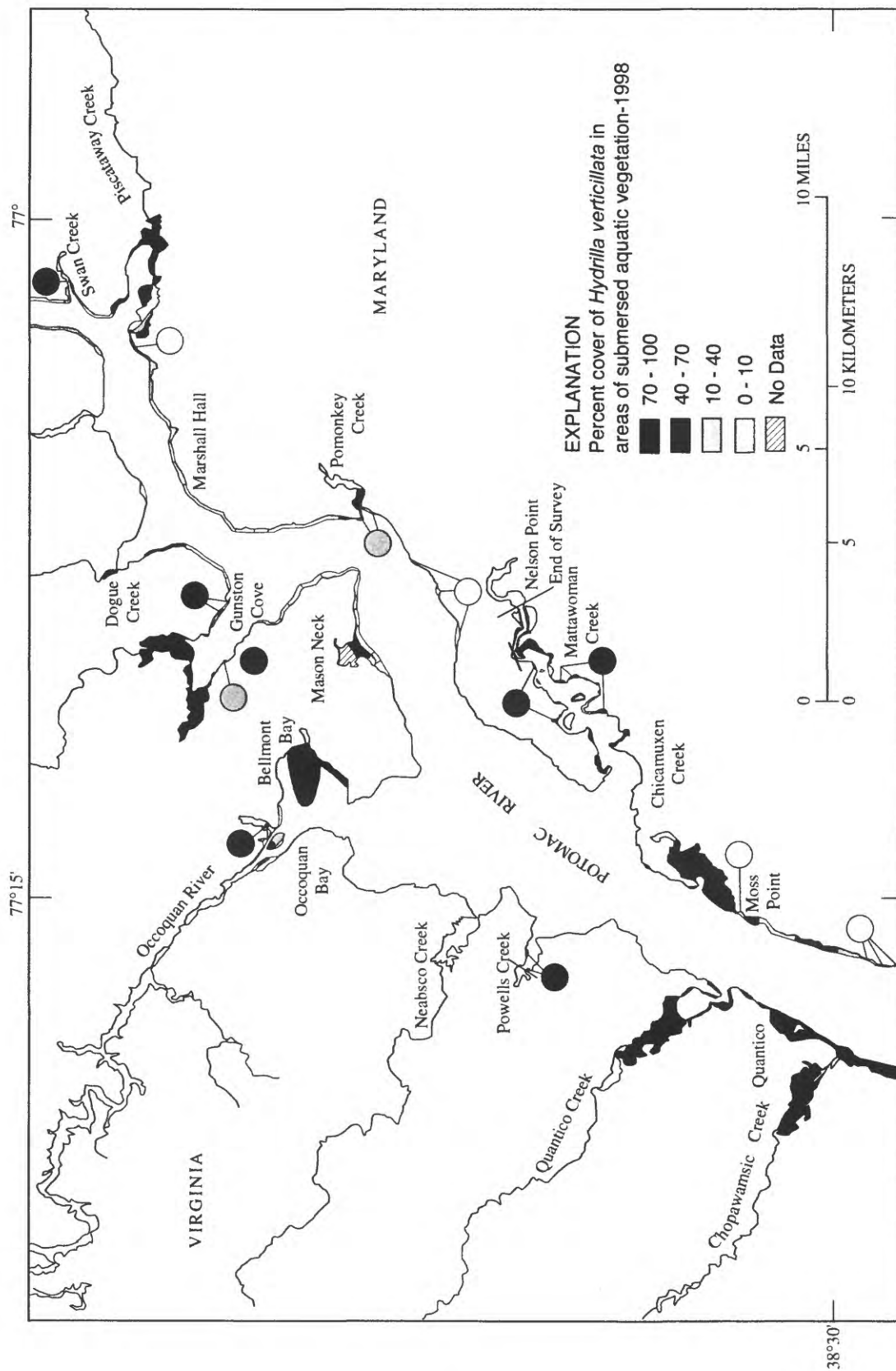


Figure 27. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Chicamuxen Creek to Rt. 301 Bridge, 1997.



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Figure 28. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Washington, D.C. to Broad Creek, 1998.



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Figure 29. Distribution and abundance of *Hydrilla verticillata* for the Potomac River

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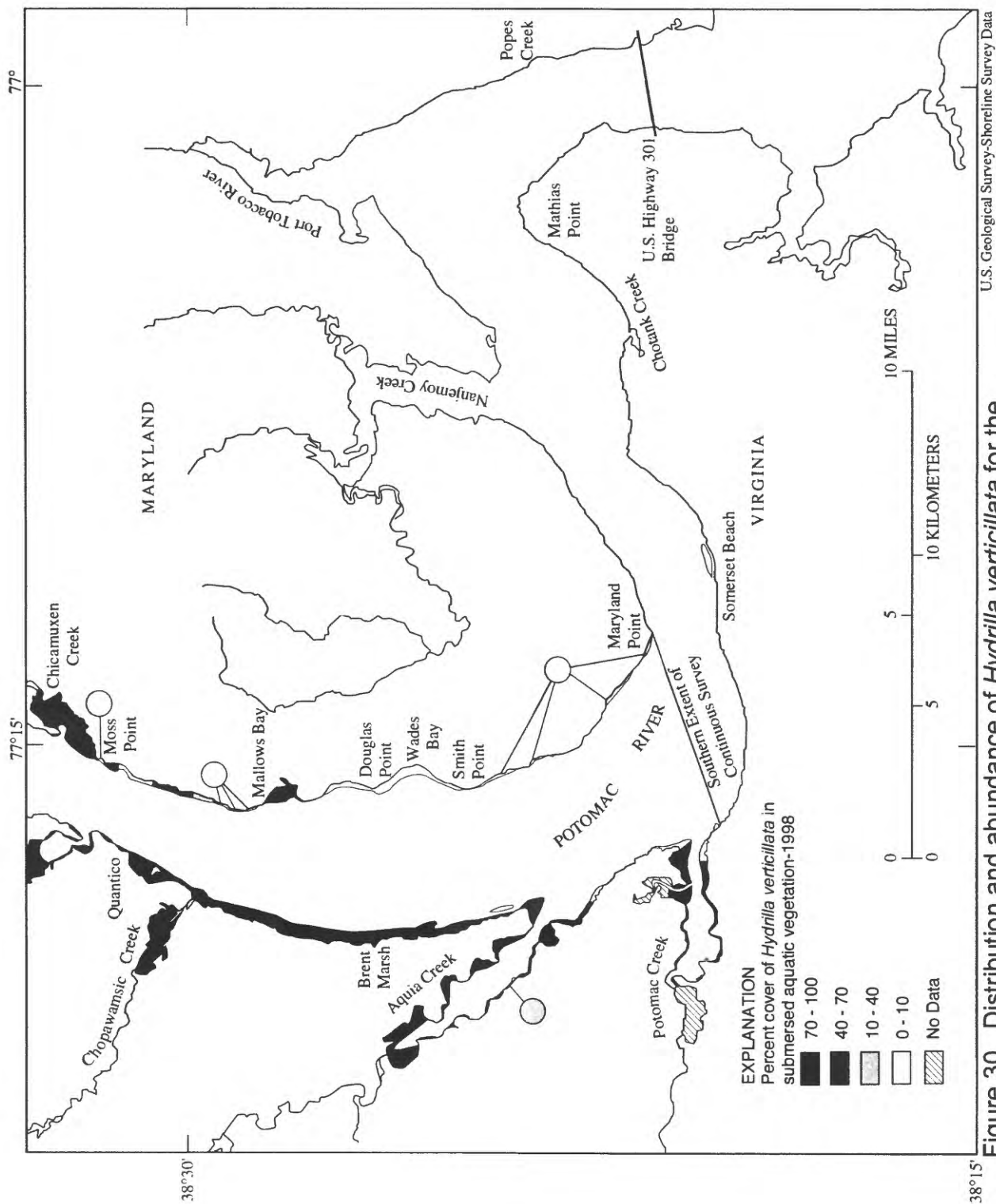


Figure 30. Distribution and abundance of *Hydrilla verticillata* for the Potomac River from Chicamuxen Creek to Maryland Pt., 1998.

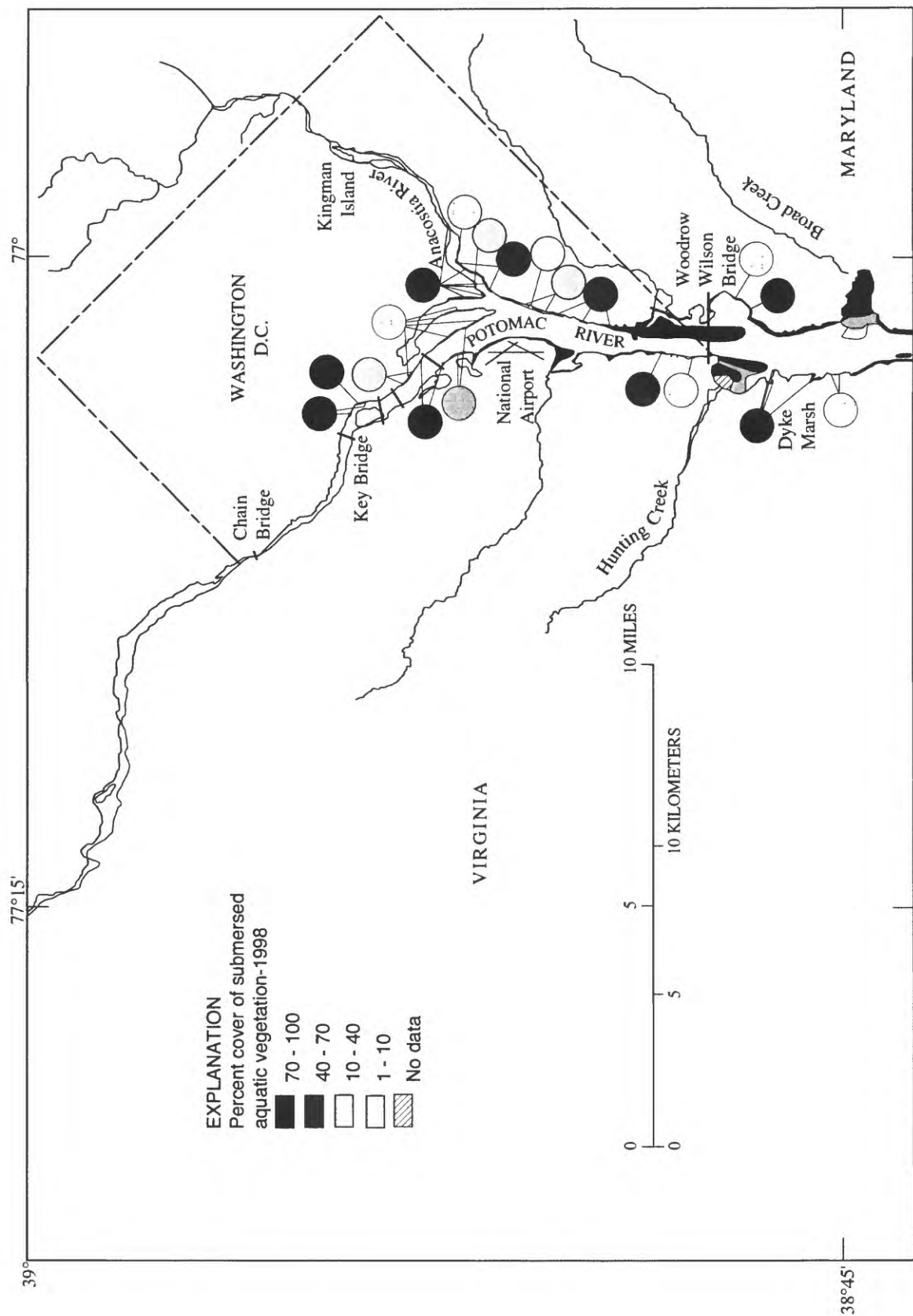
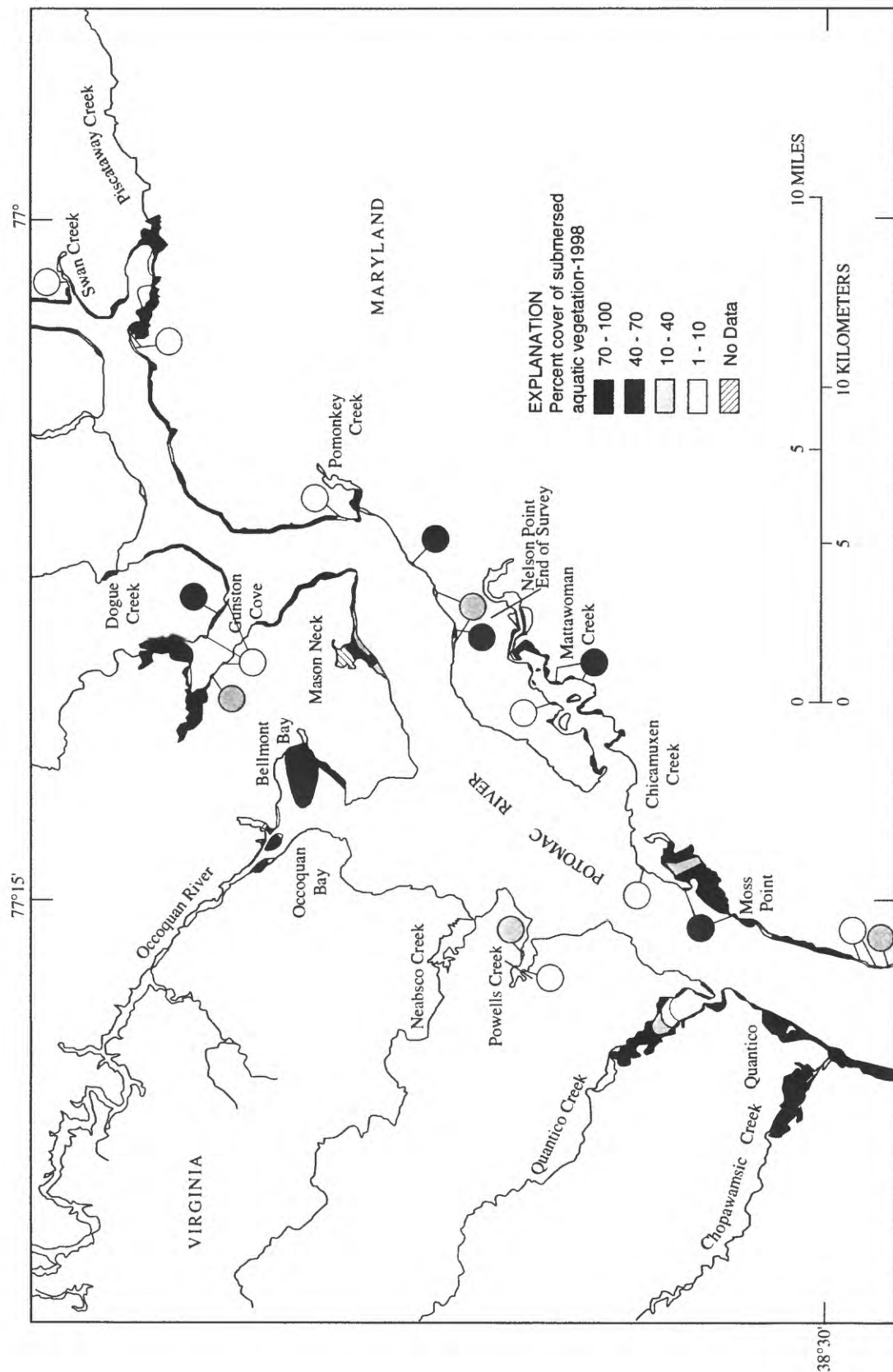


Figure 31. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Washington, D.C. to Broad Creek, 1998.



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Figure 32. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Swan Creek to Chicamuxen Creek, 1998.

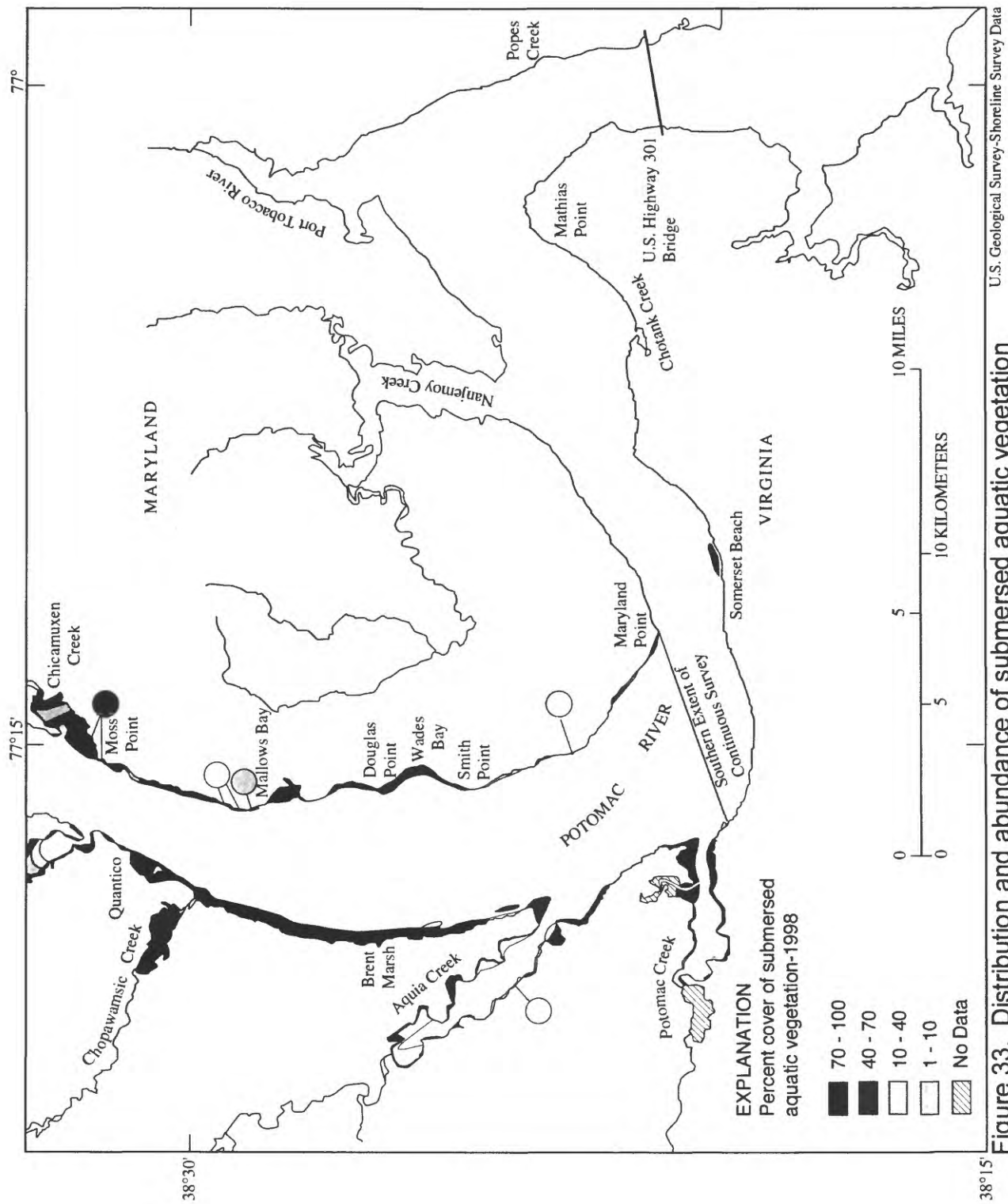


Figure 33. Distribution and abundance of submersed aquatic vegetation for the Potomac River from Chicamuxen Creek to Maryland Point, 1998.