

APMS by the Decade – A 60-Year Review

As we celebrate the 60th Anniversary of the Aquatic Plant Management Society, it is insightful to look back at the events that have led us to today. The following trends and events are summarized from the Society’s Journal articles, Newsletters and Board and Annual Business Meeting Minutes over the previous six decades as well as issues in the headlines related to aquatic plant management.



1961 – 1970

The Hyacinth Control Society incorporates on July 17, 1961 primarily for managers to share information on their efforts to control water hyacinth in Florida’s lakes, rivers and canal systems. Accordingly, the Society is one of the first organizations formed exclusively to manage invasive species in natural areas. The first years of the Society are dedicated to defining the extent of the problem and establishing infrastructure for planning and sustaining funding to control water hyacinth. The scope of the Society quickly expands to include hydrilla (first mistakenly identified as elodea) and by the end of the decade, research begins to focus on specific tools to manage these two plants.

Key Events and Issues of the 1960s

- APMS organizational years
 - Articles of Incorporation are developed, a Board is elected, and Bylaws are adopted
 - Annual meetings are scheduled to share ideas and research results
- A Journal is published to provide information to aquatic plant managers throughout the year
- *Hyacinth Control Journal* articles:
 - Majority of articles are on assessing environmental problems, planning, funding, etc.
 - Most management articles focus on herbicide registration and general environmental impacts
 - Plant management articles concentrate equally on water hyacinth and hydrilla
 - Emphasis is on Florida waters and issues
- **Hydrilla is reported in FL – misidentified and called elodea through the mid 1960s**

The following tables and the tables at bottom of the next five pages summarize the focus of APMS Journal articles through the decades. The first table condenses subjects of Journal articles into three categories: invasive plants, plants not considered to be invasive (i.e. native or non-problem causing exotic plants) and general articles. General articles do not concentrate on a particular plant or group of plants; rather, their focus is on establishing management programs, control priorities, funding sources, mapping protocols, etc. The second table lists plants that were the primary subject of Journal articles at least five times during the decade. Both tables list the source of the article as from the USA or outside the USA (International). These summaries can reveal interesting trends. For example, from the two tables below, of the 47 invasive plant articles (top table), 37 focused on water hyacinth and hydrilla (bottom table). Nearly 2/3 of all articles during the 1960s addressed general issues related to aquatic plant management rather than control methods for specific plants.

Subjects of APMS Journal articles during the 1960s

Subject	# USA	# International	# Total	Percent
Invasive plant	43	4	47	30
Non-invasive plant	3	1	4	3
General	101	4	105	67

Plants occurring in more than five APMS Journal articles as primary focus of research during the 1960s

Plant	Status	# USA	# International	# Total
Water hyacinth	Invasive	17	4	21
Hydrilla	Invasive	16	0	16



1971 - 1980

Pesticide issues like DDT and Agent Orange compel the U.S. federal government to revise pesticide regulations. The U.S. Environmental Protection Agency (EPA) is created, and the Federal Water Protection and Clean Water Acts are passed by Congress. The Society further broadens its scope in the 1970s addressing plant management issues across the U.S. After five years of debate, Society Membership votes to rename from the Hyacinth Control Society and reincorporates as The Aquatic Plant Management Society. Most of the research reported in the newly re-named *Journal of Aquatic Plant Management* centers on specific control methods for invasive aquatic plants. The species of primary concern are water hyacinth, hydrilla, and Eurasian watermilfoil; a plant that is more problematic in waters outside of Florida. Several regional chapters form to address specific operational needs of field managers. Student participation is emphasized to bring fresh ideas and leadership into the Society.

Key Events and Issues of the 1970s

- The U.S. Environmental Protection Agency is formed
 - Pesticides are hereafter registered under EPA vs. the U.S. Department of Agriculture
 - The Federal Water Protection Act (1972) and Clean Water Act (1977) are enacted
 - President Ford signs Noxious Weed Bill to prevent introduction/spread of noxious weeds in U.S.
 - First NPDES (National Pollution Discharge Elimination System) permits are issued
- The Hyacinth Control Society broadens its reach to a national scope
 - In 1976, the Hyacinth Control Society becomes the Aquatic Plant Management Society, Inc.
 - Annual Meetings are increasingly held outside Florida – First in Huntsville, AL in 1970
- APMS expands to cover regional issues
 - Regional Chapters form:
 - Florida (1976), South Carolina (1979), MidSouth (1979), Midwest (1980)
 - *Aquatics* magazine is first published by FAPMS in 1979
- The 1st APMS student paper contest is held at the 1974 Annual Meeting
- APMS becomes 26th member of Council for Agricultural Science and Technology (CAST) in 1979
- *Journal of Aquatic Plant Management* articles:
 - Emphasis increases on specific control methods for targeted plants
 - Most management articles address chemical and biological control methods
 - Plant management articles focus on specific invasive aquatic plants
 - water hyacinth¹, hydrilla², and Eurasian watermilfoil³
- **Hydrilla is first reported in AL, CA, DE, GA, LA**

Subjects of APMS Journal articles during the 1970s

Subject	# USA	# International	# Total	Percent
Invasive plant	104	11	115	56
Non-invasive plant	17	1	18	9
General	61	10	71	35

Plants occurring in more than five APMS Journal articles as primary focus of research during the 1970s

Plant	Status	# USA	# International	# Total
Water hyacinth	Invasive	33	6	39
Hydrilla	Invasive	33	0	33
Eurasian watermilfoil	Invasive	25	1	26
Egeria	Invasive	5	2	7
Alligatorweed	Invasive	5	0	5



1981 - 1990

APMS grows both internally and internationally during the 1980s. Steps are taken to improve internal organization and financial sustainability of the Society as well as to reach out to the international community. APMS sponsors an International Symposium on Watermilfoil in conjunction with the Silver Anniversary Annual Meeting in Vancouver, Canada in 1985. Research increases on understanding plant physiology to better exploit weaknesses in plants targeted for control and to conserve non-target, comingled plants. Debate increases regarding utilizing hydrilla as a fishery and water clarity improvement tool in several southeastern states where hydrilla has colonized.

Key Events and Issues of the 1980s

- Internal growth of APMS:
 - Initiatives: develop financial plan, operating manual, membership drives, fund student initiatives,
 - Projects: purchase computer, develop membership database, video tapes and other educational materials are developed
- APMS joins the Weed Science Society of America with representation on the WSSA Board (1987)
- APMS first collaborates with the North American Lake Management Society (1989)
- Increase international contacts and relevance
 - Watermilfoil symposium at 25th APMS Anniversary Meeting in Vancouver, Canada
- Hydrilla expansion - especially monoecious hydrilla in the Potomac River and surrounding states
- Hydrilla debates:
 - Clears water in VA and MD
 - Supports fisheries in NC and FL
- Two additional APMS Regional Chapters form:
 - Western APMS forms in 1981, Texas APMS forms in 1989
- *Journal of Aquatic Plant Management* articles:
 - Emphasis on additional plants: algae, water lettuce, duckweed, spikerush, sago pondweed
 - Increasing emphasis on plant physiology, morphology, and genetics
 - Plant management focused primarily on hydrilla¹, water hyacinth², and Eurasian watermilfoil³
- **Hydrilla is first reported in AZ, CT, MD, MS, NC, SC, TX, VA**

Subjects of APMS Journal articles during the 1980s

Subject	# USA	# International	# Total	Percent
Invasive plant	114	15	129	54
Non-invasive plant	56	8	64	27
General	32	12	44	19

Plants occurring in more than five APMS Journal articles as primary focus of research during the 1980s

Plant	Status	# USA	# International	# Total
Hydrilla	Invasive	42	1	43
Water hyacinth	Invasive	27	6	33
Eurasian watermilfoil	Invasive	26	1	27
Algae	Native / exotic	10	0	10
Duckweed	Native	8	0	8
Water lettuce	Invasive	6	2	8
Sago pondweed	Native	5	1	6
Spike rush	Native	6	0	6
Alligatorweed	Invasive	5	0	5
Cattail	Native	5	0	5



1991 – 2000

Eurasian watermilfoil continues to gain importance as an invasive weed of national significance in the U.S. as water hyacinth continues to fade as an APMS research priority. Nearly three decades after the formation of the Hyacinth Control Society, a national awareness of problem-causing, non-native or alien plants and animals begins to take shape and the term “invasive plant” enters the lexicon to describe non-native species that have profound negative impacts on the environment and the economy. Federal funding through the U.S. Army Corps of Engineers (USACE), the long-time leader in invasive aquatic plant research and control, is substantially reduced during the mid-1990s prompting an increased role in state and non-government entity involvement in aquatic plant management. This transition is facilitated via the years of networking through APMS.

Key Events and Issues of the 1990s

- Increasing use of terms like holistic management, biological pollution, and invasive species
- Reduction in federal funding leads to increased APMS management role
 - USACE research and operational cost-share funds are significantly reduced nationwide
 - Aquatic Ecosystem Restoration Foundation (AERF) is founded
 - More state and APMS regional chapter activity
 - APMS members assist MN and WA in developing aquatic plant management strategies
- Education and Outreach efforts
 - Scholastic Endowment Committee established in 1991 to raise funds for APMS projects
 - First Graduate Student Research Grant awarded in 1998 – co-funded by AERF and APMS
 - Considerable outreach efforts with BASS including Memorandum of Understanding (1995)
 - Establish APMS website and online Member Directory
 - APMS creates the Education and Outreach Committee in the Bylaws
- APMS holds international Annual Meetings – Daytona (1992) and San Diego (2000)
- Northeast APMS forms in 1999
- *Journal of Aquatic Plant Management* articles:
 - Management articles have increasing focus on impacts to non-target plants
 - Hydrilla¹ & Eurasian watermilfoil² peak in numbers of research articles; hyacinth³ is a distant third
 - Numbers of plant physiology articles draw close to chemical control research projects
- **Hydrilla is first reported in AR, PA, TN, WA**

Subjects of APMS Journal articles during the 1990s

Subject	# USA	# International	# Total	Percent
Invasive plant	120	13	133	55
Non-invasive plant	28	16	44	18
General	52	15	67	27

Plants occurring in more than five APMS Journal articles as primary focus of research during the 1990s

Plant	Status	# USA	# International	# Total
Hydrilla	Invasive	50	2	52
Eurasian watermilfoil	Invasive	35	0	35
Water hyacinth	Invasive	10	3	13
Algae	Native / exotic	5	0	5
Torpedograss	Invasive	5	0	5



2001 – 2010

Seeking to re-energize, APMS increases efforts to support student involvement at all grade levels through instructional materials, scholarships, and financial assistance to attend and present information at APMS Annual Meetings. Hydrilla and Eurasian watermilfoil still top the list in terms of numbers of research articles; however, nearly a dozen invasive and native plants share the limelight with increasing awareness of giant salvinia and harmful algae blooms leading the newcomers. Standardization of regulations and federal oversight of pesticide applications to waters of the U.S. for the control of aquatic plants takes shape during the decade culminating in a 2010 EPA draft Pesticide General Permit under the National Pollution Discharge Elimination System (NPDES) permitting program. This effort shapes the direction of the APMS for the next decade.

Key Events and Issues of the 2000s

- APMS Education and Outreach
 - Graduate Student Research Grant increase in funding
 - Student Poster and Presentation competitions established; complimentary rooms / registration
 - APMS and sponsors produce 16-page *Understanding Invasive Aquatic Weeds* booklet
 - 800,000 copies distributed nationwide 2001-2010; online interactive version activated in 2009
- NPDES permitting for aquatic plant control evolves from northwestern states to nationwide
 - 9th Circuit Court rules in 2001 that NPDES permits are required for aquatic plant control (APC)
 - EPA issues 2006 rule negating NPDES permits for APC conducted according to the EPA label
 - 6th Circuit Court vacates EPA 2006 rule, requiring national NPDES permitting for APC
 - EPA publishes draft Pesticide General Permit for APC under the NPDES permitting program
- Researchers at several universities and institutions confirm fluridone resistance in Florida hydrilla
 - APMS works with Industry and EPA to register new herbicide compounds for hydrilla control
- Harmful algae blooms become an increasing environmental and management issue
- *Journal of Aquatic Plant Management* articles:
 - Numbers of Eurasian watermilfoil¹ articles surpass hydrilla²; giant salvinia articles match hyacinth
 - 25 different invasive species are focus of published research
- **Hydrilla is first reported in ID, IN, KY, MA, ME, NJ, NY, OK, WI, WV**

Subjects of APMS Journal articles during the 2000s

Subject	# USA	# International	# Total	Percent
Invasive plant	137	19	156	60
Non-invasive plant	42	1	43	17
General	46	13	59	23

Plants occurring in more than five APMS Journal articles as primary focus of research during the 2000s

Plant	Status	# USA	# International	# Total
Eurasian watermilfoil	Invasive	30	2	32
Hydrilla	Invasive	26	1	27
Water hyacinth	Invasive	11	4	15
Giant salvinia	Invasive	11	3	14
Algae	Native / exotic	8	0	8
Cordgrass (in US NW)	Invasive	7	0	7
Melaleuca	Invasive	6	1	7
Water celery	Native	6	0	6
Variable leaf milfoil	Native / invasive	6	0	6
Parrott feather	Invasive	5	0	5

As of 2011, all states and U.S. territories are covered under the NPDES General Permit for pesticide use to control aquatic plants and algae in waters of the U.S. (WOTUS). Several bills were forwarded by the U.S. House of Representatives to amend duplicative regulations under NPDES, but efforts failed in the Senate. EPA and USACE finalized a WOTUS rule in 2015 expanding federal jurisdiction of the Clean Water Act. The rule was immediately challenged and in January 2020, a new rule was implemented that returned regulatory jurisdictions to pre-2015 levels. During strategic planning sessions (2012 & 2017), APMS reaffirms its commitment to student initiatives including the Michael D. Netherland Graduate Student Research Grant (GSRG). APMS amends its Mission to include algae ecology and management as key Society initiatives.

Key Events and Issues of the 2010s

- APMS broadens focus to ecology and management of aquatic plants and algae
 - Revise Mission and Vision statements to include algae
 - Work with Industry and Chapters to fund Starry Stonewort GSRG
- APMS outreach publications and web site upgrades
 - White Papers: *Managers Definition of Aquatic Plant Control - Herbicide Resistance Stewardship*
 - CAST Commentary Paper: *Benefits of Controlling Nuisance Aquatic Plants and Algae in the U.S.*
 - APMS blog evolves into regularly scheduled posts by social media editor
 - Newsletter becomes online only / email service provides job listings and other news to members
 - Formation of LinkedIn Aquatics Group / Online Abstract Submittal System for Annual Meetings
- Five new herbicides representing five mechanisms of action are registered during the 2010s
 - Flumioxazin, bispyribac, topramezone, sethoxydim, florpyrauxifen-benzyl
- World Health Organization lists glyphosate as “probably carcinogenic to humans” in 2015
- EPA announces results of regulatory review of glyphosate in 2020: ...there are no risks or concern to human health when glyphosate is used according to the label and that it is **not a carcinogen**.
- *Journal of Aquatic Plant Management* – 211 articles are published during the 2010s:
 - 79% focused on invasive plants; 11% native / non-native, 10% mapping / education / planning
 - Numbers of Eurasian watermilfoil articles equal hydrilla; giant salvinia articles surpass hyacinth
 - 46 different invasive species are focus of research - many to evaluate efficacy of new herbicides
 - 35 native or non-invasive spp. are research focus - mostly to evaluate selectivity of new herbicides
- COVID-19 pandemic compels APMS to cancel 2020 Annual Meeting and increase online presence
- **Hydrilla is first reported in IA, IL, KS, MO, OH and is now present in 33 states.**

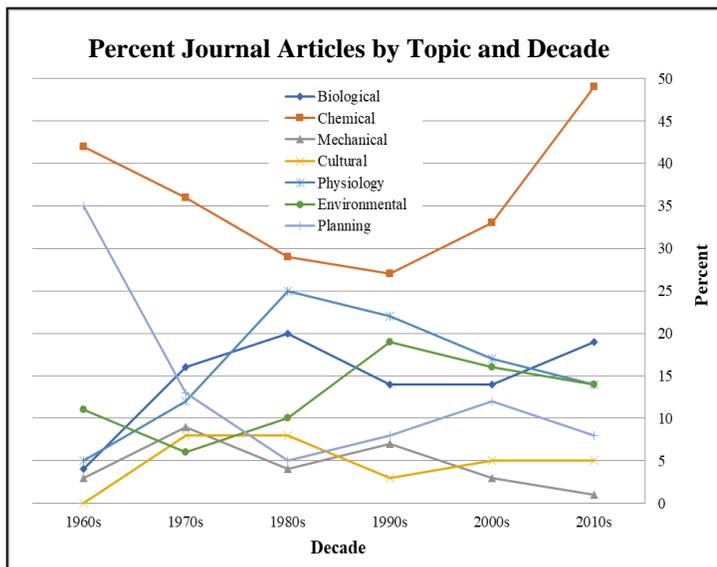
Subjects of APMS Journal articles during the 2010s

Subject	# USA	# International	# Total	Percent
Invasive plant	151	16	167	79
Non-invasive plant	18	5	23	11
General	18	3	21	10

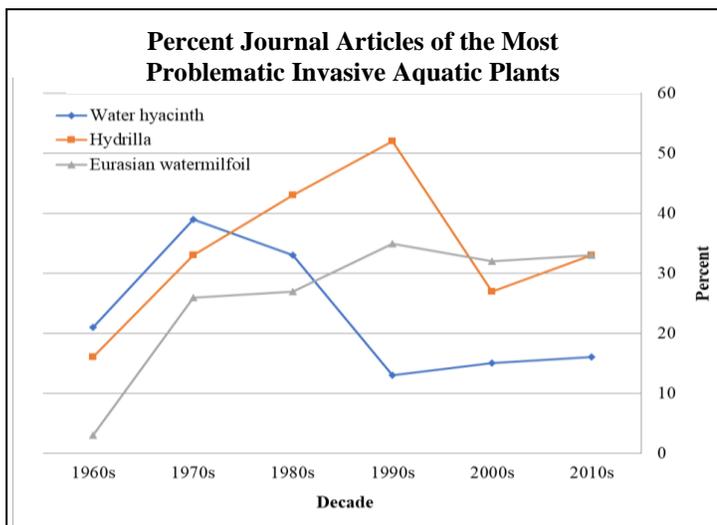
Plants occurring in more than six APMS Journal articles as primary focus of research during the 2010s

Plant	Status	# USA	# International	# Total
Eurasian (& hybrid) watermilfoil	Invasive	32	1	33
Hydrilla	Invasive	30	3	33
Giant salvinia	Invasive	17	0	17
Water hyacinth	Invasive	12	4	16
Algae	Invasive / non	12	3	15
Flowering rush	Invasive	11	0	11
Curlyleaf pondweed	Invasive	8	0	8
Brazilian waterweed	Invasive	5	2	7
Torpedograss	Invasive	7	0	7

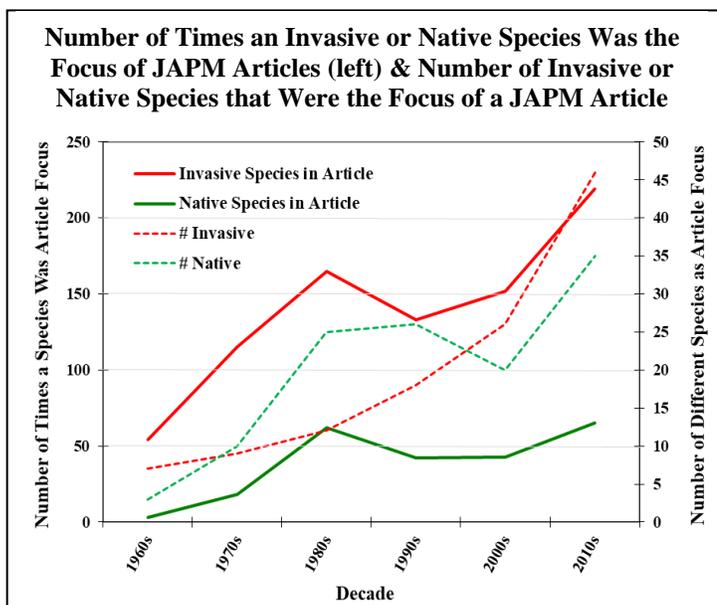
Summary of *Journal of Aquatic Plant Management* Articles



Through the decades, APMS Journal articles focused primarily on chemical control of aquatic plants. Articles range from application strategies, to efficacy and selectivity, to evaluating mechanisms of action. Planning articles were abundant in the 1960s as managers developed regulations and economic strategies to implement them. More recent planning articles evaluate mapping and sampling techniques. Mechanical and cultural control articles remained consistently low through the years. Attention to biological controls tapered off in the 1990s-2000s but increased again in the 2010s. Articles focusing on plant physiology and environmental parameters that impact plants and management increased steadily during APMS's first 30 years and have converged with biological control and planning articles during the past three decades.



Early objectives of the Hyacinth Control Society included organizing management and funding efforts to control water hyacinth. Shortly thereafter, hydrilla was identified in Florida and became the focus of attention for researchers contributing to the Society's Journal. Hydrilla's expansion into more states also came with increasing awareness of other invasive plants like Eurasian watermilfoil, ironically a problem in nearly every state except Florida. Although there has been increasing research on other invasive as well as native plants in recent years, these three species remain high as the primary focus of JAPM articles for 60 years; ranking in the top 3-4 most studied and reported aquatic plants in each of APMS's six decades.



In the 1960s-1970s most JAPM articles focused on managing three invasive species: water hyacinth, hydrilla and Eurasian watermilfoil, with little mention of native plants. The graph at the left depicts the increasing focus of JAPM articles on additional invasive plants along with native or otherwise non-invasive species. This is especially evident since the mid-2000s. As new chemistries with new mechanisms of action have been registered by EPA, so have the number of research articles that focus on invasive plant efficacy as well as selectivity toward multiple non-target native species. In the graph to the left, the left Y-axis depicts the number of times an invasive or native plant species was the focus in a research article. The right Y-axis shows the number of different invasive or native species that were the focus in a research article during each decade.