NAS - Nonindigenous Aquatic Species

Myriophyllum spicatum L.

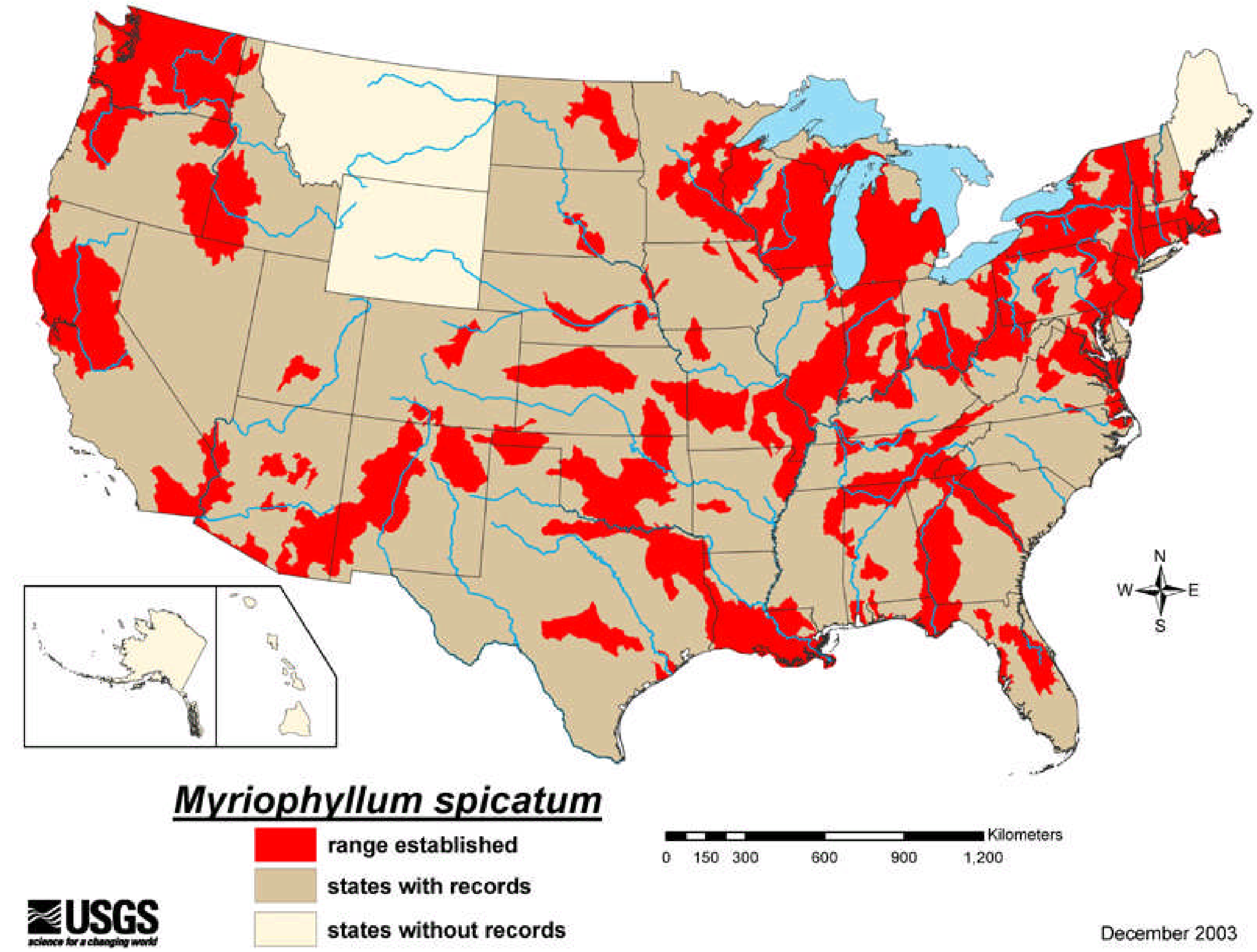
Common Name: Eurasian water-milfoil

Taxonomy: Family-Haloragaceae (Water-milfoil Family); Order- Haloragales; Subclass-Rosidae; Class-Magnoliopsida (Dicots); Division-Magnoliophyta (Angiosperms).

Identification: A submersed, rooted, perennial herb. Consisting of long underwater stems that branch and produce many whorled, finely divided leaves upon nearing the surface. Distinguished from the native *M. sibiricum* primarily by the overall shape of the leaf and then by the number of leaflets. Leaves are divided in to threadlike leaflets, usually in pairs of more than 14 (Nichols 1975). Leaflets are uniformly tapered so that the leaf shape is more like an equilateral triangle with a curved base. Leaflets stand at acute angles (less than 45 degrees) to the rachis and are parallel to each other (Ceska 1985). Meanwhile, *M. sibiricum* has basal leaflets that are as long as the leaf. They curve over and extend almost to the top of the leaf, forming a more feathery shape. Aiken (1981) provides a detailed key for fertile specimens.

Native Range: Europe, Asia, and northern Africa

Habitat: Lakes, ponds, shallow reservoirs and low energy areas of rivers and streams. Brackish water of protected tidal creeks and bays. Particularly troublesome in waterbodies that have experienced disturbances such as nutrient loading, intense plant management, or abundant motorboat use (Nichols 1994).



Map indicates recorded presence in at least one site within the drainage (USGS Hydrologic Unit 8), but does not necessarily imply occurrence throughout that drainage.

Nonindigenous Occurrences:

Northeast - Expanding through northeastern **New York**, particularly into the Upper Hudson River-Albany region and into lakes in the foothills and mountains of the Adirondacks (Madsen 1994). Found in **Vermont** at 53 lakes, most concentrated in the western drainages, where *Myriophyllum spicatum* covers thousands of aquatic acres, including large bays in Lake Champlain and Lake Bomoseen (Crosson 2000). Eradicated from the interior of **New Hampshire** when a single site, Mountain Pond in Brookfield, was drained (R. Esterbrook, New Hampshire Dept. of Environmental Services, pers. comm. 1996); since found in the Connecticut River, bordering Vermont and New Hampshire, and under **New Hampshire** jurisdiction (Engel 1998). Locally abundant and aggresssive in **Massachusetts** and **Connecticut** (Crow and Hellquist 1983). Occurring in **Rhode Island** lakes and ponds (Sheath and Nerone 1988). Spreading rapidly through lakes and rivers in **Pennsylvania,** while the native *M. sibiricum* has been listed as endangered (Pennsylvania Flora Project 1998); established in the tidal regions of the Delaware River, where salt intrusion and industrial pollution are eliminating native submersed plants (Schuyler et al. 1993). Known from **New Jersey's** Upper Delaware drainage basin since its collection at Lake Musconetcong in 1952 (Schuyler 1989). Later reported from all major drainages in New Jersey, although most problematic in the state's northern lakes (Trudeau 1982). Newly observed in **Delaware** from a pond along the Chesapeake & Delaware Canal (C. Martin, Delaware Dept. of Natural Resources and Environmental Control, pers. comm. August 1997). Common in fresh to oligohaline waters of the Upper Chesapeake Bay and its tributaries in **Maryland** (Orth et al. 1996).

Southeast - Fluctuating in abundance for the past three decades in the Potomac River Estuary, **Virginia** (Carter and Rybicki 1994). Once dominating the shallow waters of Currituck Sound, **North Carolina**, until climatic factors and sediment suspension precipitated its decline in 1990 (Carter and Rybicki 1994). More recently covering 4000 acres in the Currituck and Albermarle Sounds; established inland at Lake Gaston and the adjoining Roanoke Rapids Lake, North Carolina (NCDWR 1996). Known since 1972 at only a few public lakes in **South Carolina**; currently noted at Lake Murray and at Stevens Creek reservoirs (S. deKozlowski, South Carolina Dept. of Natural Resources, pers. comm. 1997). Replaced by hydrilla following extensive 2,4-D treatment in Lake Seminole, **Georgia** (Bates and Smith 1994), however widespread throughout Georgia in private impoundments (G. Lewis, Univ. of Georgia, pers. comm. 1999). Often the dominant species in lower portions of the Apalachicola, Homosassa, Chassohowitzka and Crystal Rivers of **Florida**, where they meet the Gulf of Mexico (BAPM 1982-1994). The most abundant submersed species in bays and creeks of the Mobile River Delta, **Alabama** (Zolczynski and Shearer 1997); longstanding at freshwater reservoirs throughout the rest of the state (Bayne 1979). Observed along the Tennessee-Tombigbee waterway of northeastern **Mississippi** since 1987 (Kight 1988).

West of Appalachians - Documented in **West Virginia** (Harmon et al 1996). Declined, from four thousand to a few hundred acres in Kentucky Lake, **Kentucky**; large populations still exist at other impoundments throughout the state (B. Kenman, Kentucky Fish and Wildlife, pers. comm. 1996). Established, in shifting populations, through the Tennessee River system, **Tennessee** (Smith and Barko 1996). Initially introduced to that river at Watts Bar Reservoir in the 1950s (Couch and Nelson 1985). Spreading through the Cumberland River system in the late 1980s, possibly as the result of deliberate planting (Simpson 1990).

Great Lakes Region - Decreasing, while native species return, as nonindigenous mussels clear the once turbid waters of Put-in-Bay Harbor, Lake Erie, **Ohio** (Stuckey and Moore 1995). Reported from over 160 glacially-formed natural lakes in **Indiana**, 90 of which are located in the northern St. Joseph drainage (INDNR 1997). Also known in reservoirs across central Indiana (IDNR 1997), including Monroe Reservoir, where the species thrives in silt laden zones (Landers and Frey 1980). Declining in McCullom Lake, **Illinois**, in conjunction with the appearance of herbivorous *Euhrychiopsis* weevils (Weinberg 1995). Aggressive and long standing in nutrient rich, recreational lakes of southern **Wisconsin**, where infestations have occurred since the 1960s. It now foliates 54 counties and 319 waterbody sites (298 ponds, lakes and flowages) in Wisconsin - the most of any state (Engel 1999). Atypically occurring in bays of Lake Michigan; spreading northward through lakes in **Michigan's** lower peninsula (Nichols 1994; Trudeau 1982). Spreading rapidly since its 1987 arrival in **Minnesota**, Eurasian water-milfoil is know to occur in 75 lakes and 4 streams that radiate from the Twin Cites area (Bratager et al. 1996).

Great Plains - New to **North Dakota**, September 1996, where localized populations were discovered by students surveying the Sheyenne River at Valley City (B. Alexander, Valley City State Univ., pers. comm. 1997); not found there in 1997, following flooding and drawdown (Engel 1998). **New to South Dakota, at Lake Sharpe,** a 61,010 acre impoundment of the **Missouri River,** extending from Fort Thompson to Pierre, where a few small beds were found in **August 1999** (D. Ode, South Dakota Game, Fish and Parks, pers. comm. 2000). Rare and of little concern in most of **Nebraska**; although noted as declining at Wildwood Lake, Lancaster County while increasing in Hord Lake, Merrick County (R. Kaul, Univ. of Nebraska, pers. comm. 1997; T. LeGrange, Nebraska Game and Parks, pers. comm. 1996). Reports are limited in **Kansas** (Couch and Nelson 1985). Long standing along the Kerr-McClellan waterway and in ponds and lakes of southern and central **Oklahoma** (Nelson and Couch 1985). Appearing at scattered sites since 1993 in **Iowa**, where nutrient loading, sedimentation and the maintenance of artificially high water levels have contributed to the absence of native vegetation. Currently established at Wilson Grove Lake and at Snyder Bend Lake, a shallow oxbow of the Missouri River (G. Phillips, Iowa Lakes Community College, and J. Wahl, Iowa Dept. of Natural Resources, pers. comm. 1997).

South Central - Collected since 1962, from eleven counties within 9 river drainages in **Missouri** (Padgett 2001); most problematic in the southcentral and southeastern portions of the state, especially at major recreational water bodies including Lake of the Ozarks (Whitley et al. 1990) and the upper Gasconade River (Padgett 2001). Tentatively identified in **Arkansas** from sterile (no flower) specimens collected at Lake Ouachita (herbarium specimen UARK 1997); also suspected to occur downstream in Lake Hamilton (M. Armstrong, Arkansas Dept. of Game and Fish, pers. comm. 1996). Found locally in lakes and bayous of western and southeastern **Louisiana**, more commonly occurring in fresh to brackish marshes and bays of the Mississippi Delta and the southern Coastal zone (Montz 1980; Chabreck and Condrey 1979). Established at reservoirs in eastern and central **Texas**; especially troublesome at Lake Austin, Pat Mayse Reservoir and Buescher State Park (Helton and Hartmann 1996).

Northwest - Review of herbarium specimens clarifies *Myriophyllum spicatum* as undocumented from Montanta and Wyoming (Engel 1998). Although reported earlier from pristine areas in **Montana** (Rabe and Chadde 1994) and from Jackson Reservoir in **Wyoming** (Brewer and Parker 1990) specimens cannot be located for verification. In both cases, confusion with nomenclature probably resulted in misidentification of the native *M. sibiricum*. Recently discovered in the warm summer of 1998 at the Pend Oreille River, Hayden

Lake, Spirit Lake and Eagle Island State Park, in western **Idaho** (C. Holly and V. Mason, Idaho Dept. of Agric., pers. comm. 1998), the first records for the state. Managed with triploid grass carp (*Ctenopharyngodon idella*) in Devils Lake, **Oregon** (Bonar et al. 1993). Monitored at lakes across **Washington** and along the Columbia, Little Spokane, and Pend Orielle Rivers (Parsons 1996); replacing native vegetation in shallow lakes found east of Puget Sound, Washington (Walton 1996).

Southwest - Reported for first time from Colorado during 1998 from the **Rio Grande River** as it passes through the southern town of Alamosa (F. Nibling, U.S. Bureau of Reclamation, pers. comm. 1999); its presence in the Rio Grande has caused concern for regional irrigation systems. Previously reported at ponds and lakes in four counties of northern **New Mexico** (Martin and Hutchins 1981), however, **new to Abiquiu and Cochiti Lakes, impoundments on the Rio Chama and the Rio Grande Rivers,** New Mexico (Charles Ashton, U.S. Army Corps of Engineers, pers. comm. **2000**). More of a curiosity than a problem in the warm, arid climate of **Arizona**, where it occurs in a few ponds in the Colorado River Indian Tribe Reservation and in a small reservoir in the Verde Valley (E. Hall, Arizona Dept. of Agriculture, pers. comm. 1997). Known in **Utah** since 1993, at Fish Lake and Otter Creek Reservoir (UDWR 1993). First reported from **Nevada**, September 1995, from marinas along the northern shore of Lake Tahoe (Anderson and Ryan 1996). Uncommon in ditches and at lake margins in regions surrounding San Francisco Bay and San Joaquin Valley, **California** (Hickman 1993).

Means of Introduction: First documented in 1942 from a pond in Washington D.C., Eurasian water-milfoil was probably intentionally introduced to the United States (Couch and Nelson 1985). Spread occurred as the species was planted into lakes and streams across the country. Water currents disseminated vegetative propagules through drainage areas. Stem fragments are important for the colonization of new habitats while local colony expansion occurs mainly by stolons (Aiken et al. 1979; Madsen et al. 1988). Motorboat traffic contributes to natural seasonal fragmentation and the distribution of fragments throughout lakes. Transport on boating equipment plays the largest role in introducing fragments to new waterbodies. Road checks in Minnesota have found aquatic vegetation on 23% of all trailered watercraft inspected (Bratager 1996). Avoiding obstacles associated with plant identification, the transport of any aquatic vegetation is now illegal in Minnesota.

Status: One of the most widely distributed of all nonindigenous aquatic plants; confirmed in 45 U.S. states, and in the Canadian provinces of British Columbia, Ontario and Quebec.

Impact of Introduction: Eurasian water-milfoil competes aggressively to displace and reduce the diversity of native aquatic plants. It elongates from shoots initiated in the fall, beginning spring growth earlier than other aquatic plants. Tolerant of low water temperatures, it quickly grows to the surface, forming dense canopies that overtop and shade the surrounding vegetation (Madsen et al. 1991). Canopy formation and light reduction, are significant factors in the decline of native plant abundance and diversity observed when Eurasian water-milfoil invades healthy plant communities (Smith and Barko 1990; Madsen 1994). Both eelgrass (*Vallisneria americana*) and southern naiad (*Najas guadalupensis*) are known to have been displaced by this nonindigenous species in the Mobile Delta of Alabama (Bates and Smith 1994). Its establishment in Lake George, New York, reduced native plants from 5.5 to 2.2 species per square meter, in just two years (Madsen et al 1991). Eurasian water-milfoil has less value as a food source for waterfowl than the native plants it replaces (Aiken et al. 1979). And although fish may initially experience a favorable edge effect, the characteristics of Eurasian water-milfoil's overabundant growth negate any short-term benefits it may provide fish in healthy waters. At high densities, its foliage supports a lower abundance and diversity of invertebrates, organisms that serve as fish food (Keast 1984). Dense cover allows high survival rates of young fish, however, larger predator fish lose foraging space and and are less efficient at obtaining their prey (Lillie and Budd 1992; Engel 1995). Madsen et al. (1995) found growth and vigor of a warm-water fishery reduced by dense Eurasian water-milfoil cover. The growth and senescence of thick vegetation degrades water quality and depletes dissolved oxygen levels (Honnell 1992; Engel 1995). Typical dense beds restrict swimming, fishing and boating, clog water intakes and result in decaying mats that foul lakeside beaches.

Remarks: The occurrence of sixteen species including *Potamogeton illinoensis* and *Potamogeton pectinatus* may be indicaters of conditions suitable for Eurasian water-milfoil invasion. Searching areas colonized by these species may provide early detection, the best method for preventing new invasion (Nichols and Buchan 1997).
A North American weevil, *Euhrychiopsis lecontie*, may be associated with natural declines at northern lakes (Sheldon 1994, Bratager et al. 1996, Weinberg 1995). Studies have found the herbivorous weevil to cause significant damage to Eurasian water-milfoil while having little impact on native species (Sheldon and Creed 1995), suggesting the insect as a potential biocontrol agent.

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