U.S. Fish & Wildlife Service

Largemouth Bass (*Micropterus salmoides*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, February 2019
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1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2019a):

"North America: St. Lawrence - Great Lakes, and Mississippi River basins from southern Quebec to Minnesota and south to Gulf; Atlantic and Gulf drainages from North Carolina to Florida and to northern Mexico."

Status in the United States

Froese and Pauly (2019a) list *Micropterus salmoides* as introduced in Puerto Rico, the U.S. Virgin Islands, Guam, and Hawaii.

From Froese and Pauly (2019a):

"Introduced to freshwater ponds [in the U.S. Virgin Islands] and grows to at least 15 lbs; […]"

"The northern strain of largemouth bass is the form found in Hawaii; they occur primarily in reservoirs, frequenting areas with cover like vegetated areas, submerged logs, and boulders [Yamamoto and Tagawa 2000]."

From GISD (2017):

"Largemouth bass were stocked in Fena Lake [Guam] by the Navy in 1955. Growth was initially quite good but they did not survive, perhaps because they were fished out or possibly they could not reproduce because of a lack of suitable habitat."

According to Fuller and Neilson (2019), nonindigenous occurrences of *Micropterus salmoides* have been reported in the following States, with range of years and hydrologic units in parentheses:

- Alaska (2018; Anchorage)
- Arizona (1880-2013; Aqua Fria, Big Chino-Williamson Valley, Bill Williams, Bouse Wash, Brawley Wash, Canyon Diablo, Centennial Wash, Chevelon Canyon, Detrital Wash, Grand Canyon, Grand Wash, Havasu Canyon, Havasu-Mohave Lakes, Imperial Reservoir, Lake Mead, Little Colorado Headwaters, Lower Colorado, Lower Colorado Region, Lower Gila, Lower Lake Powell, Lower Salt, Lower San Pedro, Lower Santa Cruz, Lower Verde, Middle Gila, Middle Little Colorado, San Bernardino Valley, Santa Maria, Silver, Tonto, Upper Gila-San Carlos Reservoir, Upper Little Colorado, Upper Salt, Upper San Pedro, Upper Santa Cruz, Upper Verde, Yuma Desert)
- California (1874-2014; Aliso-San Onofre, California Region, Calleguas, Central Coastal, Clear Creek-Sacramento River, Cottonwood-Tijuana, Crowley Lake, Honcut Headwaters-Lower Feather, Imperial Reservoir, Lake Tahoe, Los Angeles, Lower Colorado, Lower Klamath, Lower Pit, Lower Sacramento, Middle Kern-Upper Tehachapi-Grapevine, Middle San Joaquin-Lower Chowchilla, Mojave, Monterey Bay, Newport Bay, Owens Lake, Pajaro, Russian, Sacramento Headwaters; Salinas; Salton Sea; San Antonio; San Diego; San Jacinto; San Joaquin, San Joaquin Delta, San Luis Rey-Escondido, San Pablo Bay, Santa Ana, Santa Clara, Santa Margarita, Santa Maria, Santa Monica Bay, Santa Ynez, South Fork American, South Fork Kern, Suisun Bay, Surprise Valley, Thomes Creek-Sacramento River, Trinity, Tulare Lake Bed, Upper Cache, Upper Deer-Upper White, Upper Kaweah, Upper Klamath, Upper Pit, Upper Sacramento, Upper San Joaquin, Upper Stony, Upper Tule, Upper Yuba, Ventura)
- Colorado (1878-2019; Animas, Beaver, Big Thompson, Cache La Poudre, Colorado Headwaters, Colorado Headwaters-Plateau, Horse, Huerfano, Lone Tree-Owl, Lower Gunnison, Lower South Platte, Lower White, Lower Yampa, McElmo, Middle South Platte-Cherry Creek, Middle South Platte-Sterling, North Fork Republican, Piedra, Purgatoire, Republican, Rio Grande Headwaters, Rush, San Luis, South Fork Republican, South Platte, St. Vrain, Two Butte, Uncompahgre, Upper Arkansas, Upper Arkansas-John Martin Reservoir, Upper Arkansas-Lake Meredith, Upper Dolores, Upper San Juan, Upper South Platte, Upper White, Upper Yampa)

- Connecticut (1850-2010; Housatonic, Lower Connecticut, New England Region, Pawcatuck-Wood, Quinnipiac, Saugatuck, Shetucket, Thames)
- Delaware (1926-2007; Brandywine-Christina, Broadkill-Smyrna, Choptank, Delaware Bay, Nanticoke, Upper Chesapeake)
- Washington D.C. (1999-2010; Middle Potomac-Anacostia-Occoquan)
- Georgia (1962-2008; Broad, Little, Tugaloo, Upper Oconee, Upper Ogeechee)
- Hawaii (1856-2018; Hawaii, Kauai, Maui, Oahu)
- Idaho (1887-2016; American Falls, Bear Lake, Beaver-Camas, Blackfoot, Boise-Mores, Brownlee Reservoir, C.J. Strike Reservoir, Clearwater, Coeur d'Alene Lake, Curlew Valley, Idaho Falls, Kootenai, Lake Walcott, Lemhi, Little Wood, Lower Bear, Lower Bear-Malad, Lower Boise, Lower Kootenai, Lower North Fork Clearwater, Lower Salmon, Lower Snake-Asotin, Middle Bear, Middle Snake-Boise, Middle Snake-Succor, North Fork Payette, Pacific Northwest Region, Palouse, Payette, Pend Oreille Lake, Portneuf, Spokane, St. Joe, Teton, Upper Snake-Rock, Upper Spokane, Weiser)
- Iowa (1885-1987; North Raccoon)
- Kansas (1958-2008; Beaver, Buckner, Coon-Pickerel, Cow, Crooked, Gar-Peace, Little Arkansas, Lower North Fork Solomon, Lower Republican, Lower Smoky Hill, Lower South Fork Solomon, Lower Walnut Creek, Medicine Lodge, Middle Arkansas-Slate, Middle Republican, Middle Smoky Hill, Ninnescah, North Fork Ninnescah, North Fork Smoky Hill, Pawnee, Rattlesnake, Smoky Hill Headwaters, Solomon, South Fork Ninnescah, South Fork Republican, Upper Cimarron, Upper Cimarron-Bluff, Upper North Fork Solomon, Upper South Fork Solomon, Upper Walnut Creek)
- Kentucky (1961-2004; Upper Cumberland)
- Maine (1910-2009; Aroostook, Dead, Kennebec, Lower Androscoggin, Lower Kennebec, Lower Penobscot, Maine Coastal, New England Region, Piscataqua-Salmon Falls, Presumpscot, Saco, St. George-Sheepscot, Upper Kennebec)
- Maryland (1854-2011; Cacapon-Town, Choptank, Conococheague-Opequon, Gunpowder-Patapsco, Lower Potomac, Lower Susquehanna, Mid Atlantic Region, Middle Potomac-Anacostia-Occoquan, Middle Potomac-Catoctin, Monocacy, Patuxent, Tangier)
- Massachusetts (1860-2009; Blackstone, Cape Cod, Charles, Chicopee, Concord, Farmington, Housatonic, Hudson-Hoosic, Merrimack, Merrimack River, Middle Connecticut, Miller, Narragansett, Nashua, New England Region, Quinebaug, Westfield)
- Minnesota (1982; Cloquet)
- Montana (1914-2014; Arrow, Battle, Beaver, Belle Fourche, Big Dry, Big Horn Lake, Big Muddy, Big Sandy, Bitterroot, Blackfoot, Box Elder, Brush Lake Closed Basin, Bullwhacker-Dog, Charlie-Little Muddy, Clarks Fork Yellowstone, Cottonwood, Fisher, Flathead Lake, Flint-Rock, Fort Peck Reservoir, Judith, Little Bighorn, Little Dry, Little Powder, Lodge, Lower Bighorn, Lower Clark Fork, Lower Flathead, Lower Milk, Lower Musselshell, Lower Powder, Lower Tongue, Lower Yellowstone, Lower Yellowstone-Sunday, Madison, Middle Clark Fork, Middle Kootenai, Middle Milk, Middle Musselshell, Middle Powder, Milk, Missouri Headwaters, Missouri-Poplar, Mizpah, Musselshell, O'Fallon, Peoples, Poplar, Prairie Elk-Wolf, Pryor, Redwater, Rosebud, Sage, South Fork Flathead, Stillwater, Sun, Swan, Teton, Tongue, Upper Clark Fork, Upper Little Missouri, Upper Missouri, Upper Missouri-Dearborn, Upper Musselshell,

Upper Tongue, Upper Yellowstone, Upper Yellowstone-Lake Basin, Upper Yellowstone-Pompeys Pillar, Whitewater)

- Nebraska (1967-2009; Dismal, Frenchman, Harlan County Reservoir, Lewis and Clark Lake, Little Nemaha, Loup, Lower Elkhorn, Lower Middle Loup, Lower Niobrara, Lower North Loup, Lower North Platte, Lower Platte, Lower Platte-Shell, Middle Big Blue, Middle Niobrara, Middle North Platte-Scotts Bluff, Middle Platte-Buffalo, Middle Platte-Prairie, Middle Republican, Missouri Region, North Fork Elkhorn, North Fork Republican, Prairie Dog, Red Willow, Salt, Snake, Upper Elkhorn, Upper Little Blue, Upper Middle Loup, Upper Niobrara, Upper North Loup, Upper Republican, West Fork Big Blue)
- Nevada (1909-2005; Carson Desert, Central Lahontan, Fish Lake-Soda Spring Valleys, Hamlin-Snake Valleys, Havasu-Mohave Lakes, Hot Creek-Railroad Valleys, Imperial Reservoir, Lake Mead, Little Smoky-Newark Valleys, Long-Ruby Valleys, Lower Humboldt, Meadow Valley Wash, Middle Carson, Muddy, Pilot-Thousand Springs, Smoke Creek Desert, South Fork Owyhee, Spring-Steptoe Valleys, Thousand-Virgin, Truckee, Upper Amargosa, Walker, West Walker, White)
- New Hampshire (1940-2009; Black-Ottauquechee, Contoocook, Merrimack River, Middle Connecticut, Miller, Nashua, New England, Pemigewasset, Piscataqua-Salmon Falls, Saco, Upper Androscoggin, Upper Connecticut, Upper Connecticut-Mascoma, Waits, West, Winnipesaukee River)
- New Jersey (1871-2014; Cohansey-Maurice, Crosswicks-Neshaminy, Great Egg Harbor, Hackensack-Passaic, Lower Delaware, Lower Hudson, Mid-Atlantic Region, Middle Delaware-Mongaup-Brodhead, Middle Delaware-Musconetcong, Mullica-Toms, Raritan, Rondout, Sandy Hook-Staten Island)
- New Mexico (1957-2015; Chaco, Jemez, Mimbres, Rio Grande-Albuquerque, Rio Grande-Santa Fe, San Francisco, Upper Canadian, Upper Gila, Upper Gila-Mangas, Upper Pecos-Black, Upper Pecos-Long Arroyo, Upper Rio Grande, Upper San Juan, Zuni)
- New York (1930-2013; Bronx, Chenango, Hudson-Wappinger, Lower Hudson, Middle Delaware-Mongaup-Brodhead, Middle Hudson, Mohawk, Owego-Wappasening, Raquette, Rondout, Saranac River, Schoharie, Seneca, St. Regis, Upper Delaware, Upper Hudson, Upper Susquehanna)
- North Carolina (1925-2013; Albemarle, Black, Cape Fear, Chowan, Coastal Carolina, Contentnea, Deep, Fishing, Haw, Little Pee Dee, Lower Cape Fear, Lower Catawba, Lower Dan, Lower Neuse, Lower Pee Dee, Lower Roanoke, Lower Tar, Lower Yadkin, Lumber, Lynches, Meherrin, Middle Neuse, Middle Roanoke, Neuse, New River, Northeast Cape Fear, Nottoway, Pamlico, Pamlico Sound, Roanoke, Roanoke Rapids, Rocky, Seneca, South Fork Catawba, South Yadkin, Tugaloo, Upper Broad, Upper Cape Fear, Upper Catawba, Upper Dan, Upper Neuse, Upper New, Upper Pee Dee, Upper Tar, Upper Yadkin, Waccamaw, White Oak River)
- North Dakota (1980-2005; Apple, Cedar, Knife, Lower Cannonball, Lower Heart, North Fork Grand, Painted Woods-Square Butte, Upper Cannonball, Upper James, Upper Lake Oahe, West Missouri Coteau)
- Oklahoma (1973-1997; Arkansas-White-Red Region, Middle North Canadian)
- Oregon (1888-2013; Alsea, Applegate, Brownlee Reservoir, Bully, Clackamas, Coast Fork Willamette, Coos, Coquille, Donner und Blitzen, Goose Lake, Guano, Harney-

Malheur Lakes, Illinois, Jordan, Klamath, Lost, Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Lower Crooked, Lower Deschutes, Lower John Day, Lower Malheur, Lower Owyhee, Lower Rogue, Lower Willamette, Middle Columbia-Hood, Middle Columbia-Lake Wallula, Middle Fork Willamette, Middle Rogue, Middle Snake-Payette, Middle Willamette, Molalla-Pudding, Necanicum, Nehalem, North Santiam, North Umpqua, Pacific Northwest, Pacific Northwest Region, Powder, Siletz-Yaquina, Siltcoos, Silver, Siuslaw, Sixes, South Santiam, South Umpqua, Sprague, Tualatin, Umatilla, Umpqua, Upper Crooked, Upper Deschutes, Upper Grande Ronde, Upper John Day, Upper Klamath, Upper Klamath Lake, Upper Malheur, Upper Rogue, Upper Willamette, Warner Lakes, Willamette, Willow, Wilson-Trusk-Nestuccu, Yamhill)

- Pennsylvania (1980-2002; Bald Eagle, Conococheague-Opequon, Crosswicks-Neshaminy, Delaware, Lehigh, Lower Juniata, Lower Susquehanna, Lower Susquehanna-Penns, Lower Susquehanna-Swatara, Lower West Branch Susquehanna, Middle Delaware-Mongaup-Brodhead, Monocacy, Pine, Potomac, Schuylkill, Susquehanna, Upper Juniata, Upper Susquehanna, Upper Susquehanna-Lackawanna, Upper Susquehanna-Tunkhannock, Upper West Branch Susquehanna)
- Puerto Rico (1915-2009; Cibuco-Guajataca, Culebrinas-Guanajibo, Eastern Puerto Rico, Puerto Rico, Southern Puerto Rico)
- Rhode Island (1979-2009; Narragansett, New England Region, Pawcatuck-Wood, Quinebaug)
- South Carolina (1960-2012; Black, Broad-St. Helena, Carolina Coastal-Sampit, Edisto River, Enoree, Lake Marion, Lower Catawba, Lower Pee Dee, Lower Savannah, Lynches, North Fork Edisto, Salkehatchie, Saluda, Seneca, South Fork Edisto, Stevens, Upper Broad, Upper Savannah, Waccamaw, Wateree)
- South Dakota (1934-2003; Angostura Reservoir, Bad, Cherry, Cheyenne, Elm, Fort Randall Reservoir, Grand, James, Keya Paha, Lake Thompson, Lewis and Clark Lake, Little White, Lower Belle Fourche, Lower Cheyenne, Lower James, Lower Lake Oahe, Lower Moreau, Lower White, Medicine, Medicine Knoll, Middle Big Sioux, Middle Cheyenne-Elk, Middle Cheyenne-Spring, Middle James, Middle White, Mud, North Fork Snake, Ponca, Rapid, Snake, South Fork Grand, Turtle, Upper James, Upper Lake Oahe, Upper Little Missouri, Upper Moreau, Vermillion, West Missouri Coteau)
- Texas (1941-2018; Amistad Reservoir, Austin-Travis Lakes, Bois D'arc-Island, Buchanan-Lyndon B. Johnson Lakes, Buffalo-San Jacinto, Caddo Lake, Cedar, Chambers, Colorado Headwaters, Denton, Double Mountain Fork Brazos, East Fork Trinity, El Paso-Las Cruces, Elm Fork Trinity, Farmers-Mud, Hubbard, International Falcon Reservoir, Jim Ned, Lake Fork, Lake Meredith, Lake O'the Pines, Lake Texoma, Lampasas, Leon, Little Cypress, Little Wichita, Los Olmos, Lower Angelina, Lower Brazos-Little Brazos, Lower Colorado-Cummins, Lower Frio, Lower Guadalupe, Lower Nueces, Lower Pecos-Red Bluff Reservoir, Lower Prairie Dog Town Fork Red, Lower Sulpher, Lower Trinity-Kickapoo, Lower Trinity-Tehuacana, Lower West Fork Trinity, Medina, Middle Brazos-Lake Whitney, Middle Brazos-Millers, Middle Brazos-Palo Pinto, Middle Colorado, Middle Colorado-Elm, Middle Guadalupe, Middle Sabine, Navasota, Navidad, North Bosque, North Concho, North Fork Double Mountain Fork Brazos, Paint, Palo Duro, Pecan Bayou, Richland, Rio Grande-Fort Quitman, San Ambrosia-Santa Isabel, San Fernando, San Gabriel, South Concho, South Laguna Madre,

Sulphur Headwaters, Toledo Bend Reservoir, Toyah, Tule, Upper Angelina, Upper Clear Fork Brazos, Upper Colorado, Upper Guadalupe, Upper Neches, Upper North Fork Red, Upper Nueces, Upper Prairie Dog Town Fork Red, Upper Sabine, Upper Salt Fork Red, Upper San Antonio, Upper Trinity, Upper West Fork Trinity, Upper Wolf, West Fork San Jacinto, White, White Oak Bayou, Wichita, Yegua)

- Utah (1880-2015; Bear Lake, Great Salt Lake, Hamlin-Snake Valleys, Jordan, Little Bear-Logan, Lower Bear-Malad, Lower Beaver, Lower Dolores, Lower Green-Desolation Canyon, Lower Green-Diamond, Lower Lake Powell, Lower San Juan, Lower San Juan-Four Corners, Lower Sevier, Lower Weber, Middle Bear, Middle Sevier, Montezuma, Provo, San Pitch, San Rafael, Sevier Lake, Upper Bear, Upper Colorado-Dirty Devil, Upper Colorado-Kane Springs, Upper Green-Flaming Gorge Reservoir, Upper Lake Powell, Upper Virgin, Utah Lake)
- Vermont (1980-2011; Black-Ottauquechee, Deerfield, Hudson-Hoosic, Lamoille River, Mettawee River, Middle Connecticut, Missiquoi River, St. Francois River, Upper Connecticut, Upper Connecticut-Mascoma, Waits, West, White)
- Virginia (1961-2012; Albemarle, Appomattox, Banister, Blackwater, Chincoteague, Chowan, Conococheague-Opequon, Eastern Lower Delmarva, Great Wicomico-Piankatank, Hampton Roads, James, Lower Chesapeake Bay, Lower Dan, Lower James, Lower Potomac, Lower Rappahannock, Lynnhaven-Poquoson, Mattaponi, Maury, Meherrin, Middle James-Buffalo, Middle James-Willis, Middle New, Middle Potomac-Anacostia-Occoquan, Middle Potomac-Catoctin, Middle Roanoke, North Fork Shenandoah, Nottoway, Pamunkey, Potomac, Rapidan-Upper Rappahannock, Rivanna, Roanoke, Roanoke Rapids, Shenandoah, South Fork Shenandoah, Upper Chesapeake, Upper Dan, Upper James, Upper New, Upper Roanoke, Upper Yadkin, Western Lower Delmarva, York)
- Washington (1890-2011; Banks Lake, Chief Joseph, Colville, Deschutes, Dungeness-Elwha, Duwamish, Franklin D. Roosevelt Lake, Grays Harbor, Hangman, Hoh-Quillayute, Hood Canal, Kettle, Lake Chelan, Lake Washington, Lewis, Little Spokane, Lower Chehalis, Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Lower Cowlitz, Lower Crab, Lower Skagit, Lower Snake, Lower Snake-Tucannon, Lower Spokane, Lower Yakima, Methow, Middle Columbia-Hood, Middle Columbia-Lake Wallula, Nisqually, Nooksack, Okanogan, Pacific Northwest Region, Palouse, Pend Oreille, Puget Sound, Puyallup, Rock, San Juan Islands, Sanpoil, Similkameen, Skokomish, Skykomish, Snohomish, Snoqualmie, Stillaguamish, Strait of Georgia, Upper Chehalis, Upper Columbia-Entiat, Upper Columbia-Priest Rapids, Upper Crab, Upper Spokane, Upper Yakima, Walla Walla, Wenatchee, Willapa Bay)
- West Virginia (1993-1994; James, Middle New, Potomac)
- Wyoming (1880-1999; Big Horn, Big Horn Lake, Blacks Fork, Lower Laramie, North Platte, Powder, South Platte, Upper Belle Fourche, Upper Cheyenne, Upper Green-Flaming Gorge Reservoir)

From Fuller and Neilson (2019):

"Established in most locations. Expanding its range in inland locations in the Great Lakes basin."

Means of Introductions in the United States

From Fuller and Neilson (2019):

"This species has been an important sport fish for many years and as such has been stocked widely in areas where it is nonindigenous. Intentional stocking for sportfishing."

From CABI (2019):

"Within its native range, introductions causing range expansions have occurred largely for angling. Most introductions within the species' native range occur as authorized stocking to provide angling opportunities, although some unauthorized introductions for angling have occurred (Fuller et al., 1999). […] Within the United States, extensive introductions have occurred for sport within the species' native and non-native range. As a result, the species now occupies all [48] contiguous states and Hawaii (Maciolek, 1984; Fuller et al., 1999), and will likely continue to increase its range through natural dispersal within the United States and Canada."

Remarks

From CABI (2019):

"*M. salmoides* is a member of the sunfishes family (Centrarchidae), evolving primarily within eastern North American drainages. Within its native range, two subspecies have been identified, *Micropterus salmoides salmoides*, north of Florida, and *Micropterus salmoides floridanus* within Florida (Hubbs and Lagler, 1957)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Fricke et al. (2019):

"**Current status:** Valid as *Micropterus salmoides* (Lacepède 1802)."

From ITIS (2019):

"Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Deuterostomia
      Phylum Chordata
        Subphylum Vertebrata
          Infraphylum Gnathostomata
            Superclass Actinopterygii
              Class Teleostei
                Superorder Acanthopterygii
                  Order Perciformes
                    Suborder Percoidei

Family Centrarchidae
Genus *Micropterus*
Species *Micropterus salmoides* (Lacepède 1802)"

Size, Weight, and Age Range

From Froese and Pauly (2019a):

"Max length : 97.0 cm TL male/unsexed; [Page and Burr 2011]; common length : 40.0 cm TL male/unsexed; [Muus and Dahlström 1968]; max. published weight: 10.1 kg [International Game Fish Association 1991]; max. reported age: 23 years [Quinn 2001]"

Environment

From Froese and Pauly (2019a):

"Freshwater; benthopelagic; pH range: 7.0 - 7.5; dH range: 10 - ?; depth range ? - 7 m [Scott and Crossman 1998]. […]; 10°C - 32°C [water temperature] [Eaton et al. 1995]; […]"

"[…] and to occur in estuaries with a salinity up to 13 ppt [Kottelat and Freyhof 2007]."

From CABI (2019):

"The species has wide habitat tolerances that allow it to colonize many temperate and sub-tropical freshwaters. However, the species may tolerate ice-cover for up to six months in its native range, suggesting that ice cover within the introduced range may not hinder dispersal success providing that suitably warm temperatures (>15.6°C) exist during spawning season."

"Survival within ice-covered lakes is possible assuming sufficient dissolved oxygen (> 1.5 mg/L). Relatively clear waters are preferred due to the species' method of visual predation, although the species is known from certain turbid systems where it presumably relies on scent and vibration to obtain prey items. […] The species is not known to be particularly sensitive to organic or inorganic contaminants."

Climate/Range

From Froese and Pauly (2019a):

"Subtropical; […]; 46°N - 24°N, 125°W - 65°W [Malabarba et al. 2012]"

Distribution Outside the United States

Native

Part of the native range of *Micropterus salmoides* is in the United States, see Section 1 for a full description.

From Froese and Pauly (2019a):

"North America: St. Lawrence - Great Lakes, and Mississippi River basins from southern Quebec […] and south to Gulf [of Mexico]; Atlantic and Gulf drainages […] to northern Mexico."

Introduced

Froese and Pauly (2019a) list *Micropterus salmoides* as introduced to Algeria, Botswana, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Tunisia, Zambia, Zimbabwe, China, Cyprus, Hong Kong, Iran, Japan, North Korea, South Korea, Malaysia, Philippines, Albania, Austria, Belarus, Belgium, Czech Republic, France, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine, some provinces in Canada, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, one area of Mexico, Panama, Fiji, New Caledonia, Argentina, Bolivia, and Colombia. *M. salmoides* is listed as introduced but status questionable in Estonia and Norway; and introduced but not established in Cameroon, Costa Rica, Denmark, Egypt, Finland, Germany, the Netherlands, Sweden, Taiwan, and the United Kingdom.

In addition to the areas listed above, GISD (2017) lists *M. salmoides* as alien and established in British Columbia, Canada; alien and establishment uncertain in Ecuador, Nigeria, Uganda; introduced but failed to establish a population in Republic of the Congo, French Polynesia; and alien and present only in containment facilities in Reunion.

Pagad et al. (2018) lists *M. salmoides* as introduced to Croatia, Micronesia, and Vietnam in addition to countries listed above.

From Froese and Pauly (2019a):

"[In Kenya:] Introduced in various natural and artificial still waters and dams [Seegers et al. 2003], including Lake Naivasha [Welcomme 1988; Muchiri et al. 1995; Okeyo 2003a; Seegers et al. 2003]. It is probably also established in affluent rivers of Lake Victoria [Seegers et al. 2003]. It did probably not establish in the Tana River [Seegers et al. 2003]."

"Introduced in Mauritius in 1949 from South Africa. No information about its establishment [Keith et al. 2006]."

"[In Morocco:] After early successful colonization of many waters the species diminished throughout its acquired range. It is now maintained by stocking [Welcomme 1988] in some regions. Naturalized in suitable waters from Lac Nfiss near Marrakech to the Arbaoua_larache region in the Rif Mountains in the north at altitudes ranging from sea level to 1700m [Lever 1996]."

"Known from Lake Chicamba [Mozambique] [Weyl and Hecht 1999]."

“Widely distributed within central Namibian impoundments and farm dams (Omatako Omuramba, Von Bach dam) [Hay et al. 1999] and river drainages of Omatako and Swakopmund [Okeyo 2003b]. Ornamental fish [Coppola et al. 1994].”

“Occurs in the Great Fish river [South Africa] [Weyl et al. 2009].”

“Introduced [in Tanzania] into some highland dams as a sporting fish. Survives in some cool areas [Eccles 1992]. Occurs in Mwanza Gulf, Lake Victoria [Fermon 1997]”

“Introduced in Lake Kariba [Zambia] [Losse 1998].”

“Found in all river systems [in Zimbabwe] except the Upper Zambezi, Pungwe and Lower Save/Runde. Occurs mostly in dams but some weirs on rivers have been stocked. Breeding in rivers does not seem to be successful, although a wild population exists in a small tributary of the Buzi River near Mt. Selinda.”

“Namak Lake basin [Iran].”

“Occurs in lakes and rivers of southern Japan. Also recorded from Lake Biwa [Fisheries Management Division of the Shiga Prefecture Agriculture and Fisheries Department 2007].”

“Recorded from the Han, Nakdong and Kum rivers [South Korea] [Jang et al. 2002].”

“[In the Philippines:] Stocked in Trinidad Lake, Province of Benguet and in Caliraya Lake in Laguna Province. Established in Lake Caliraya. Reported from Lake Lanao [Mercene 1997; Mamaril 2001; Ismail et al. 2014].”

“Widespread [in Albania, Slovakia, and Slovenia] [Kottelat and Freyhof 2007].”

“Brought to France at the end of the XIXth [19th] century and introduced in several sites but exists only in the east central, southeast and southwest part [Billard 1997]. It reproduced successfully for the first time in a pond in the region of Versailles. It was then transferred to the ponds in Sologne [Keith et al. 1992]. This species, which has established itself, appears to be diminishing.”

“Established all over the country [Italy]. Naturalized in 1897 [Bianco and Ketmaier 2001].”

“Introduced by anglers and have been caught from Lake [Colibiţa] and Lake Bicaz [Romania].”

“Was Stocked [*sic*] in the Abrau and Limanchik lakes near Novorossisk as well as in the vicinity of Moscow [Russia] [Berg 1965; Reshetnikov et al. 1997].”

“Widespread in the country [Spain], including Mallorca.”

“[…]; present in Lakes Atitlan and Calderas [Guatemala] [Welcomme 1988].”

“Introduced in the Lerma River basin [in Mexico] [Lyons et al. 1998].”

“Stocked in Vaturu reservoir [Fiji].”

“Introduced [to Estonia] [Blanc et al. 1971]. Occurrence not supported by [Anonymous 1999].”

“[In Norway:] Introduction and establishment in the wirld [*sic*] need confirmation.”

“Introduced to private ponds [in Costa Rica] but had little dissemination. Has not established in natural waters [Bussing 1998].”

“Introduced from North America [to Denmark] just before the turn of the last century [Muus and Dahlstrøm 1990]. Reintroduced from 1906 to 1907 [Welcomme 1988]. No known surviving populations [T. A. S. Østergaard, personal communication].”

“Introduced [in Germany], but presence not confirmed by [Gerstmeier and Romig 1998; Monnerjahn 1999] in 1998. Reported to be totally wiped-out [Kottelat and Freyhof 2007].”

“Introduced [to Taiwan] in the late 1970s [Welcomme 1988]. […]; not stocked in natural waters [Welcomme 1988; Liao and Lia 1989].”

“Introduced into England and Scotland [Scott and Crossman 1998]. Species is now absent in the UK; initial reproduction was followed by a period of no recruitment, and the last known specimens were killed by an angler a few years ago (Gordon Copp, pers. Comm., Oct. 17, 2006).”

From GISD (2017):

“Introduced into Austria from Germany for fisheries. […] In 1911, Lake Worthersee (Province Carinthia) was accidentally stocked when a dam of a nearby pond broke, Besides [*sic*] another smaller lake (Forstsee/Carinthia) there is no water body known to be inhabited by this species. After a phase of mass occurrence of this species, shortly after its introduction, population density decreased. *M. salmoides* is now of minor importance.”

“Introduced into Belgium from the US for angling/sport and for aquaculture. This species is now extinct. The species appears to have survived in small numbers in the Meuse.”

“Established in the watersheds of the central highlands [in Colombia].”

“Introduction [to the Republic of the Congo] was unsuccessful. The species was introduced to control the proliferation of tilapia in ponds. The species had not acclimatized and was abandoned thus favoring *Clarias*.”

“Established in two dams [in Cyprus] where it is popular for angling.”

“Natural populations occur in the Danube [in the Czech Republic] although it is rare. This species should also be recorded from other Danube countries due to its presence in that river.”

“Present in two small lakes [in El Salvador] but is disappearing.”

“In 1926, the SEO (Society for Oceanic Studies) carried out a distribution [in French Polynesia] of 50 carp, 20 black-bass and 12 catfish (*Ictalurus* sp.) to various members of the Society who owned water bodies. These three species of fish did not acclimatise (Keith, 2002).”

“Established in Lake Yojoa [Honduras].”

“Introduced before World War II. Found in few reservoirs in Hong Kong.”

“Reintroduced [to Hungary] in 1910 and in the 1950s. May have also been introduced through diffusion from neighboring countries. Very few localized self-sustaining population in cooling ponds of power stations. Presumably also in Danube.”

“Introduced into Madagascar from France for angling/sport. Successful at high altitudes.”

“[In Malawi:] Popular angling fish in estate dams, in shire highlands, area of Malawi, Blantyre, Zomba, Thyolo, Mulanje.”

“Present in small numbers [in Mauritius]; not used in fishery.”

“*Micropterus salmoides* was introduced into Lake Yaté [Grand Terre Island, New Caledonia] in order to develop sportfishing and control the large population of tilapia (*Oreochromis mossambicus*), which was introduced earlier (Marquet et al., 2003).”

“Maintained [in Poland] in some aquaculture ponds only.”

“Widespread [in Swaziland] where there is suitable habitats.”

From Schulz and Leal (2005):

“*Micropterus salmoides* introduction to Brazil was documented by Godoy (1954). The species was introduced in 1922 by Jair Lins of Belo Horizonte. After several frustrated attempts he finally succeeded in his efforts to reproduce the species in captivity. Today the black bass is widely distributed in artificial systems like angling ponds, and semi-natural systems like reservoirs, from Rio de Janeiro to Rio Grande do Sul. In these systems black bass frequently form self-reproducing populations.”

Means of Introduction Outside the United States

From Froese and Pauly (2019a):

“The species has been introduced widely as a game fish and is now cosmopolitan.”

“Introduced for aquaculture [Xie et al. 2001].”

“Introduced [to Malaysia] by the Boh Tea Plantation Ltd., Cameron Highlands to revive their recreational program. About 1,000 fry were imported from Florida and raised in the Boh hatchery to fingerling size before being released in two lakes previously used for trout. Angling was permitted after one year and mature adults weighing about 300-350 g were caught. There were no reports of the same fish downstream of the lakes. Fish are presumed to be restricted to the lakes.”

Short Description

From Froese and Pauly (2019a):

“Dorsal spines (total): 10; Dorsal soft rays (total): 11-14; Anal spines: 3; Anal soft rays: 10 - 12; Vertebrae: 30 - 32. Mouth large; maxillary extending beyond the eye. Pelvic fins not joined by a membrane. Green to olive dorsally, milk-white to yellow ventrally, with a black band running from the operculum to the base of the caudal fin. Caudal fin rounded. Caudal fin with 17 rays [Spillman 1961].”

From NatureServe (2019):

“The elongate body is compressed from side to side, the upper jaw extends well beyond the rear edge of the eye in adults, the dorsal fin has two parts that are barely connected (front part is spiny and highest at the middle; rear part has soft rays), and the shortest spine in the dorsal fin is less than half as long as the longest spine. The overall color is silvery to brassy (brown in dark waters), with dark olive mottling; each side has a broad black stripe (continuous or broken into a series of blotches) that extends onto the snout.”

From CABI (2019):

“*M. salmoides* is best distinguished from both smallmouth bass and spotted bass by its upper jaw, which extends past the midpoint of the eye when the jaw is closed. In addition, smallmouth bass display vertical bars along the body length in contrast to the largemouth’s horizontal banding pattern (Trautman, 1957; Scott and Crossman, 1973).”

Biology

From Froese and Pauly (2019a):

“Inhabit lakes, ponds, swamps, and backwaters and pools of creeks, and small to large rivers [Page and Burr 2011]. Usually found over mud or sand and common in impoundments [Page and Burr 1991]. They prefer quiet, clear water and over-grown banks. Adults feed on fishes, crayfish and frogs; young feed on crustaceans, insects and small fishes. Sometimes cannibalistic. They don't feed during spawning; as well as when the water temperature is below 5°C and above 37°C [Billard 1997]. An introduced species in Europe reported to avoid fast-flowing waters and to occur in estuaries with a salinity up to 13 ppt [Kottelat and Freyhof 2007]. […] Preyed upon by herons, bitterns, and kingfishers [Scott and Crossman 1998].”

“The male which becomes aggressive and territorial builds the nest on muddy bottoms of shallow water. A female may spawn with several males on different nests. The male guards and fans the eggs for about 29 days [Gross and Sargent 1985]. Spawning takes place spring to summer or when temperature reaches 15°C. Adults mate between the age of 5-12 years [Terofal 1984].”

“Juveniles feed mainly on invertebrates, plankton and insect larvae [Terofal 1984; Etnier and Starnes 1993]; individuals from 5 cm TL become almost exclusively piscivores but also feed on frogs and some crustaceans. These are dusk and dawn feeders, feeding in schools chasing their prey near the surface and in zones with vegetation.”

From CABI (2019):

“Aquatic vegetation (both emergent and submergent) is usually necessary, as are mud, sand or gravel substrates that provide spawning habitat. The species preferentially occupies the nearshore (littoral) area of lakes due to the abundance of aquatic vegetation and warm temperatures.”

From NatureServe (2019):

“Eggs are laid in shallow cleared depressions (nests) made by males in sand, gravel, or debris-littered bottoms, often at depths of 40-80 inches (1-2 meters) but up to at least 23 feet (7 meters) or as shallow as 8-12 inches (about 20-30 cm). Nests are often next to submerged objects and usually are more than 30 feet (9 meters) apart.”

Human Uses

From Froese and Pauly (2019a):

“Popular game fish in North America. […] Excellent food fish [Scott and Crossman 1998].”

“Appreciated as one of the best food fishes cultured in China [Tan and Tong 1989].”

“[In Mexico:] Average catch from 1985-90 was around 1500 tons live weight [Anonymous 1994]. Regulations: catch season: 1 Jun. - 31 Mar.; closed season: 1 Apr. - 31 May; sport fishery: 10 kg/day and 20 cm TL as minimum size; marketed fresh (whole, fillet) [Anonymous 1994].”

“Highly appreciated and is the subject of a rapidly expanding culture. Presently monocultured in Southern Taiwan and exported to Hongkong [*sic*]; […]. First successful larviculture in Taiwan occurred in 1983 [Liao et al. 2001].”

From GISD (2017):

“The introduction of the species is banned [in Switzerland] since 1994.”

From CABI (2019):

"The species may also be found inadvertently within the aquarium and ornamental trade (Welcomme, 1988; FAO, 1997) and baitfish industry (Litvak and Mandrak, 1993). Economic benefits from aquaculture occur primarily within Cameroon, Costa Rica, Dominican Republic, Argentina, Poland, Yugoslavia and Taiwan (Welcomme, 1988; Liao and Lia, 1989; Holcík, 1991; Lever, 1996; Bussing, 1998)."

"Within their native range, the species may be used as a research laboratory organism and held within zoos or public aquariums."

From NIES (2019):

"Import, transport and keeping are prohibited in Japan by the Invasive Alien Species Act."

Diseases

Infection with *Gyrodactylus salaris*, *Aphanomyces invadans*, spring viremia of carp virus, and viral haemorrhagic septicaemia virus are OIE-reportable diseases (OIE 2019). Poelen et al. (2014) lists *Micropterus salmoides* as a host for *Gyrodactylus* sp.

Truter et al. (2017) report *M. salmoides* as a host of *Acolpenteron ureterocoetes*, *Actinocleidus fergusoni*, *Clavunculus bursatus*, *Onchocleidus dispar*, *O. furcatus*, *O. helicis*, *O. principalis*, and *Syncleithrium fusiformis*.

Vandersea and Litaker (2007) report *Aphanomyces invadans* infection in *M. salmoides.*

Phelps et al. (2012) report detection of spring viremia of carp virus from *M. salmoides* tissue samples.

Kim and Faisal (2010) confirm the ability to infect *M. salmoides* with viral haemorrhagic septicaemia virus.

From Froese and Pauly (2019a):

"Two host-specific parasites: an ancyrocephalid monogean and the trematode *Crepidostomum cornutum* were introduced into Lake Pátzcuaro together with the species [Perez-Ponce de Leon et al. 2000]."

"Eye Infection (*Diplostomum* sp.), Parasitic infestations (protozoa, worms, etc.)
Achtheres Infestation, Parasitic infestations (protozoa, worms, etc.)
Contracaecum Infestation 3, Parasitic infestations (protozoa, worms, etc.)
Edwardsiellosis, Bacterial diseases
Goezia Disease 6, Parasitic infestations (protozoa, worms, etc.)
Rhabdochona Infestation 10, Parasitic infestations (protozoa, worms, etc.)
Largemouth Bass Iridovirus, Viral diseases"

Froese and Pauly (2019b) list *Micropterus salmoides* as a host for *Achtheres micropteri*, *A. pimelodi*, *Acolpenteron ureteroecetes*, *Caecincola septimus*, *C. wakullata*, *Clavunculus bifurcatus*, *Ergasilus caeruleus*, *E. centrarchidarum*, *E. lizae*, *E. luciopercarum*, *E. nerkae*, *E. versicolor*, *Genarchopsis chubuensis*, *G. goppo*, *Goezia sinamora*, *Haplocleidus dispar*, *H. furcatus*, *Huffmanela huffmani*, *Lernaea cyprinacea*, *L. cruciata*, *Ligictaluridus floridanus*, *Multigonotylus micropteri*, *Neoergasilus japonicus*, *Sanguinicola huronis*, and *Thometrema lotzi*.

Poelen et al. (2014) list the following additional diseases and parasites of *M. salmoides*: *Acanthocephalus anguillae*, *A. dirus*, *Actinocleidus mizellei*, *Alloglossidium corti*, *A. kenti*, *Allopodocotyle virens*, *Amphimerus elongatus*, *Ancyrocephalus* sp., *Arthythmorhynchus brevis*, *Azygia angusticauda*, *A. longa*, *Bothriocephalus claviceps*, *B. acheilognathi*, *Bucephalus* sp., *Bunodera luciopercae*, *Caecincola latostoma*, *C. parvulus*, *Camallanus lacustris*, *Capilaria* sp., *Clavunculus* sp., *Cleidodiscus* sp., *Clinostomum marginatum*, *C. complanatum*, *Contracaecum brachyurus*, *C. spiculigerum*, *C. rudolphii*, *C. multipapillatum*, *Crepidostomum cooperi*, *Cryptogonimus spinovum*, *C. chili*, *Dichelyne bonacii*, *Digenea* sp., *Diplostomulum schuringi*, *D. spathaceum*, *Distomum* sp., *Echinochasmus donaldsoni*, *Echinorhynchus vaginatus*, *E. micropteri*, *E. salmonis*, *Epistylus colisarum*, *Ergasilus* sp., *Eustrongylides ignotus*, *Flavobacterium columnare*, *Gnathostoma nipponicum*, *Goezia spinulosa*, *Gordius* sp., *Gyrodactylus* sp., *Hedruris* sp., *Homalometron armatum*, infectious spleen kidney necrosis virus, *Leptorhynchoides thecatus*, *L. nebularosis*, *L. atlanteus*, *L. apoglyphicus*, *L. acanthidion*, *Lernaea* sp., *Leuceruthrus micropteri*, *Llinobdella moorei*, Lymphocystis disease virus, *Microphallus* sp., *Multigonotylus micropteri*, *Myxobolus inorantus*, *M. microcystus*, *M. micropterii*, *Neochasmus umbellus*, *Neoechinorhynchus cylindratus*, *N. prolixoides*, *N. rutile*, *Nocardia seriolae*, *Paradilepis urceus*, *Philometra* sp., *Philometroides aphanonaris*, *P. orbitalensis*, *P. nodulosus*, *Phyllodistomum parvulum*, *Plagioporus siliculus*, *Platybdella* sp., *Polyacanthorhynchus kenyensis*, *Pomphorhynchus lucyi*, *P. rocci*, *Posthodiplostomum minimum*, *Prohemistomum chandleri*, *Proteocephalus ambloplitis*, *P. robustus*, *Proterometra macrostoma*, *Raphidascaris acus*, *Rhabdochona lichtenfelsi*, *Rhynchotalona* sp., *Salmincola* sp., Santee-Cooper ranavirus, *Sebekia* sp., *Spinitectus carolini*, *S. micracanthus*, *Sprioxys contorta*, *Textrema hopkinsi*, *Trichodina nigra*, *T. pediculus*, *Tylodelphys scheuringi*, *Urocleidus dispar*, *U. principalis*, *Valipora minuta*, and *Yersinia ruckeri*.

Threat to Humans

From Froese and Pauly (2019a):

"Potential Pest"

3 Impacts of Introductions

From Ellender et al. (2018):

"One such case is the Blindekloof River, a Swartkops River headwater tributary, where the Eastern Cape redfin *Pseudobarbus afer* (Peters 1864) was isolated in headwater refugia and extirpated from invaded reaches further downstream by black-bass, *M. salmoides* and *M. dolomieu*, predation (Ellender et al., 2011)."

"Surveys under base flow conditions [in the Swartkops River] demonstrated that reaches invaded by black basses (*M. salmoides* and *M. dolomieu*) were devoid of *P. afer* and other small native fishes, a finding consistent with their presence on other headwater streams (Moyle et al., 2003; Kimberg et al., 2014; van der Walt et al., 2017)."

From Truter et al. (2017):

"Five of these eight ancyrocephalid species were sampled from *M. salmoides* in South Africa during the present study. As these parasites are common in centrarchid fishes in their native range, they were most likely co-introduced with *M. salmoides* or the other centrarchid fishes that were introduced into South Africa between 1928 and 1980."

"In conclusion, this study presents the first report of *C. bursatus*, *O. dispar*, *O. furcatus*, *O. principalis*, *S. fusiformis* from introduced alien *M. salmoides* on the African continent. Furthermore, these parasites are all considered as co-introduced with largemouth bass."

From Weyl et al. (2010):

"The abundances of all of large bodied and/or conspicuous macroinvertebrates (Gomphidae, Aeshnidae, Gerridae, Notonectidae, Belostomatidae, Nepidae, Dytiscidae and Gyrinidae) were significantly lower in, or they were even absent from, the sections with *M. salmoides* […]. The abundance of the medium sized aquatic macroinvertebrates was not significantly higher in the presence of *M. salmoides*, with the exception of the Libellulidae which there were significantly more abundant […]. Small aquatic macroinvertebrates were unaffected by the presence of *M. salmoides*, with the exception of the Hydropsychidae which were significantly more abundant […] in the presence of *M. salmoides* […]. The inconspicuous/cryptic taxa (Leptoceridae and Physidae) were significantly more abundant […] in the presence of *M. salmoides* […]."

"Similarly, this study demonstrates that the community structure of the aquatic macroinvertebrates was altered in sections of river where *M. salmoides* was present."

From Tsunoda and Mitsuo (2012):

"The present study showed that a predominance of exotic largemouth bass was the main factor decreasing species richness and altering the species composition of pond-dwelling fish assemblages. […] In the case of largemouth bass, previous studies in small pond systems (<10 000 m^2) of Japan showed that no or few species survived after bass invasion (Maezono and Miyashita 2003; Yonekura et al. 2004; [Sugiyama] and Jinguji 2005; Tsunoda et al. 2010). In addition, Jackson et al. (2001) identified that the coexistence of small cyprinids and centrarchidae piscivores (i.e. the bass) was observed only in large lakes exceeding 1.5–2.0 km^2 of surface area."

"Relative abundances of three cyprinid species, *R*[*hodeus*]. *ocellatus ocellatus*, *P*[*seudorasbora*]. *parva* and *Carassius* sp., were significantly affected by the predominance of bass. […] Some previous studies reported that those species dramatically decreased or were eliminated from lakes

and ponds invaded by bass (Maezono and Miyashita 2003; [Sugiyama] and Jinguji 2005; Tsunoda et al. 2010)."

From Sinohin and Cuaterno (2003):

"*Micropterus salmoides* […] caused disappearance of original fish of Caliraya L., Laguna [Philippines]"

From Froese and Pauly (2019a):

"Its introduction [in Madagascar] coupled with habitat degradation have been implicated in the severely restricted distribution and displacement of the endemic *Paratilapia polleni* [Stiassny and Gertsner 1992]."

"Lake Biwa [Japan] catch for native species has dropped from more than 8000 tons in 1972 to 2174 tons in 2000 while experts estimate catch of exotic species (black bass [*M. salmoides*] and bluegill exceed 3000 tons [Takayama 2002]. Social and ecological problems have been experienced recently pertaining to the 'black bass problem.' [Yodo and Iguchi 2004]. Considered to be one of the most damaging alien species in Japan [Iguchi et al. 2004]."

"Strong predator of all species especially cyprinids in limnophilic habitats [in Italy] [Bianco 2014]. Have caused decline in native *Alburnus alborella*, *Esox lucius* and *Perca fluviatilis* as well as in the introduced *Lepomis* [Welcomme 1988]."

"[In Spain:] Has caused the decline of several species of endemic cyprinids [Kottelat and Freyhof 2007]."

"Destroyed local fish species [in Guatemala]; […]. One of the factors which led to the extinction of the Atitlán grebe (*Podilymbus gigas*), an endemic species [Wittenberg 2005]."

"Two host-specific parasites: an ancyrocephalid monogean and the trematode *Crepidostomum cornutum* were introduced into Lake Pátzcuaro [Mexico] together with the species [Perez-Ponce de Leon et al. 2000]."

From Fuller and Neilson (2019):

"Introduced bass usually affect populations of small native fishes through predation, sometimes resulting in the decline or extinction of such species (Minckley 1973). Species that have suffered such effects include relict dace *Relictus solitarius*, Clover Valley speckled dace *Rhinichthys osculus oligoporus*, Independence Valley tui chub *Gila bicolor lethoporus* (U.S. Fish and Wildlife Service 1985b), a distinct population of Gila chub *G. intermedia*, Monkey Spring pupfish *Cyprinodon* sp. (Minckley 1973), White River springfish *Crenichthys baileyi*, Pahranagat roundtail chub *Gila robusta jordani* (U.S. Fish and Wildlife Service 1985b), Owens pupfish *Cyprinodon radiosus* (Miller and Pister 1971), wild brook trout *Salvelinus fontinalis* (Boucher 2003), and White River spinedace *Lepidomeda albivallis* (U.S. Fish and Wildlife Service 1994e). Jenkins and Burkhead (1994) speculated that introduced Largemouth Bass may

have contributed to the demise of an isolated population of trout-perch *Percopsis omiscomaycus* in the Potomac River in Virginia and Maryland. Introduced predatory centrarchids are likely responsible for the decline of native ranid frogs in California, California tiger salamander *Ambystoma californiense* populations (Hayes and Jennings 1986; Dill and Cordone 1997), and the Chiricahua leopard frog *Rana chiricahuensis* in southeastern Arizona (Rosen et al. 1995). In Squaw Creek Reservoir in northcentral Texas, introduced Florida largemouth intergrade with native northern largemouth (Whitmore and Hellier 1988). Nonnative predators, including Largemouth Bass, have been shown to reduce the abundance and diversity of native prey species in several Pacific Northwest rivers (Hughes and Herlihy 2012). The presence of Largemouth Bass, along with other introduced piscivores, reduced the richness of native minnow communities in Adirondack lakes (Findlay et al. 2000)."

From GISD (2017):

"The introduction of *M. salmoides* is one of the causes of the near extinction of an endemic fish *Galaxia neocaledonicus* and its spread by certain anglers creates a high risk for many endemic aquatic species (Marquet et al., 2003)."

From CABI (2019):

"Predation impacts (reductions, extinctions) [from *M. salmoides*] to small fishes following introduction and establishment have been documented globally (Virginia (Fuller et al., 1999); Japan (Chiba et al., 1989); Mexico (Perez-Ponce de Leon et al., 2000); France (Keith and Allardi, 1998); Italy (Bianco and Ketmaier, 2001); Portugal (FAO, 1997); Fiji (Lewis and Pring, 1986); Cuba (Lee et al., 1983)). Several states within the native range have documented reductions of imperiled species attributed directly to predation from *M. salmoides* (California, Nevada and Arizona (Fuller et al., 1999)), with similar reductions of imperiled species also occurring within introduced ranges (Madagascar (Stiassny and Gertsner, 1992); South Africa (Welcomme, 1988)). Predation impacts suggest that competition for food occur within many introduced waters."

"*M. salmoides* populations may hinder local native sport fisheries by out-competing target fishes, resulting in reduced angling opportunities and their social impacts. Alternatively, introductions may be encouraged locally if *M. salmoides* are favoured for sport, which has been globally popular for nearly two centuries. Introduction into previously fishless waters may provide new or valued angling opportunities. Current estimates of social impacts resulting from *M. salmoides* introductions have not been documented."

4 Global Distribution

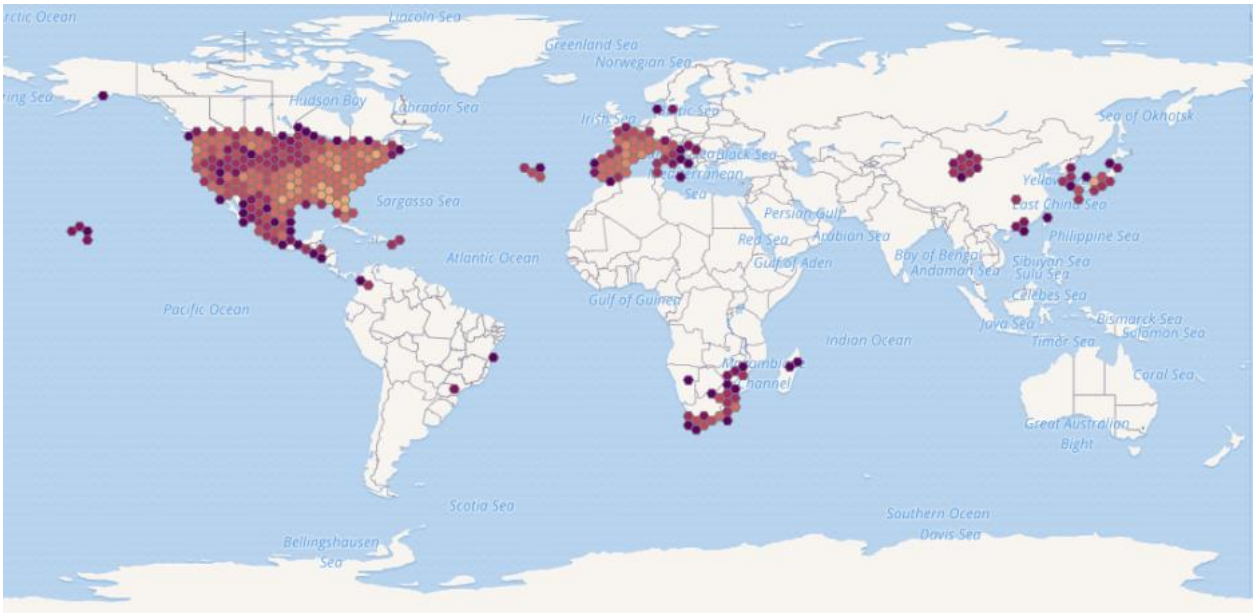

Figure 1. Known global distribution of *Micropterus salmoides*. Map from GBIF Secretariat (2019). The locations in Denmark and Sweden were not used to select source points in the climate match; there are no established wild populations in those countries.

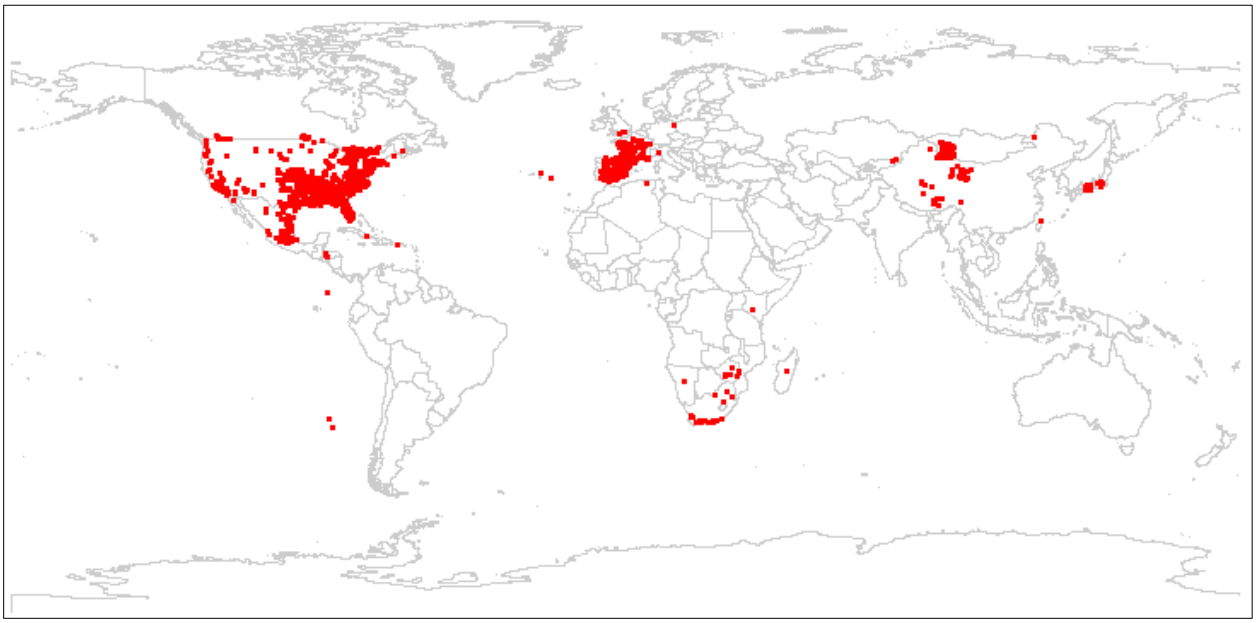

Figure 2. Additional known global distribution of *Micropterus salmoides*. Map from Froese and Pauly (2019). The locations in Germany, Taiwan, and the United Kingdom were not used to select source points for the climate match; there are no established wild populations in any of the three countries. The marine locations were not used to select source points for the climate match. *M. salmoides* is a freshwater species and would not survive in a marine environment.

5 Distribution Within the United States

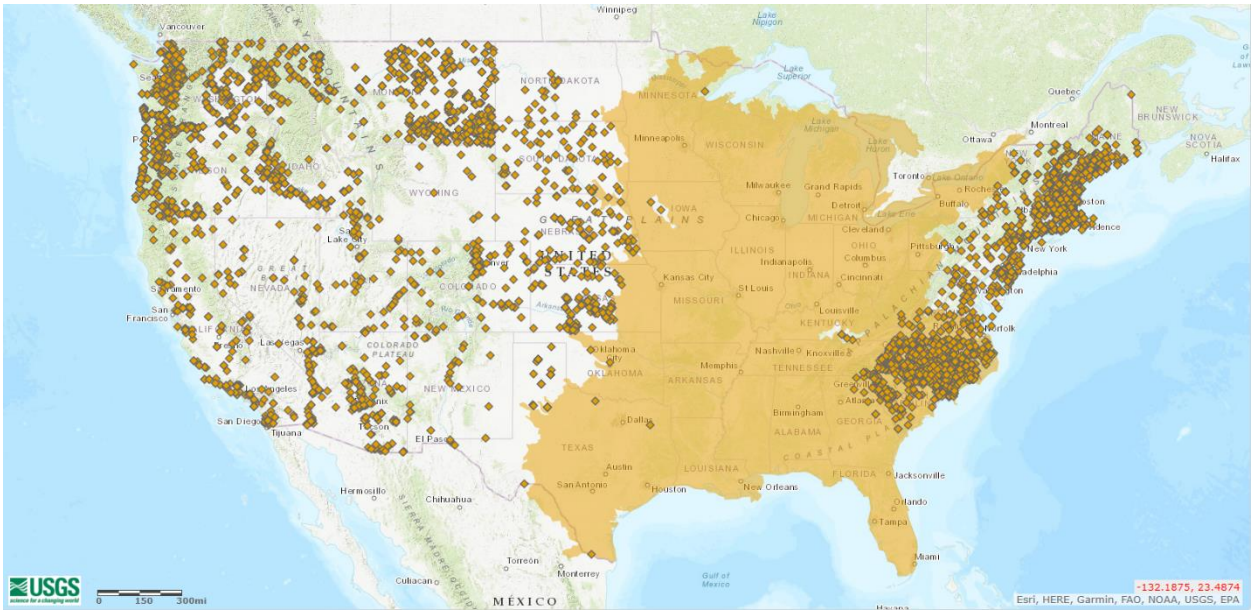

Figure 3. Known distribution of *Micropterus salmoides* in the contiguous United States. Map from Fuller and Neilson (2019).

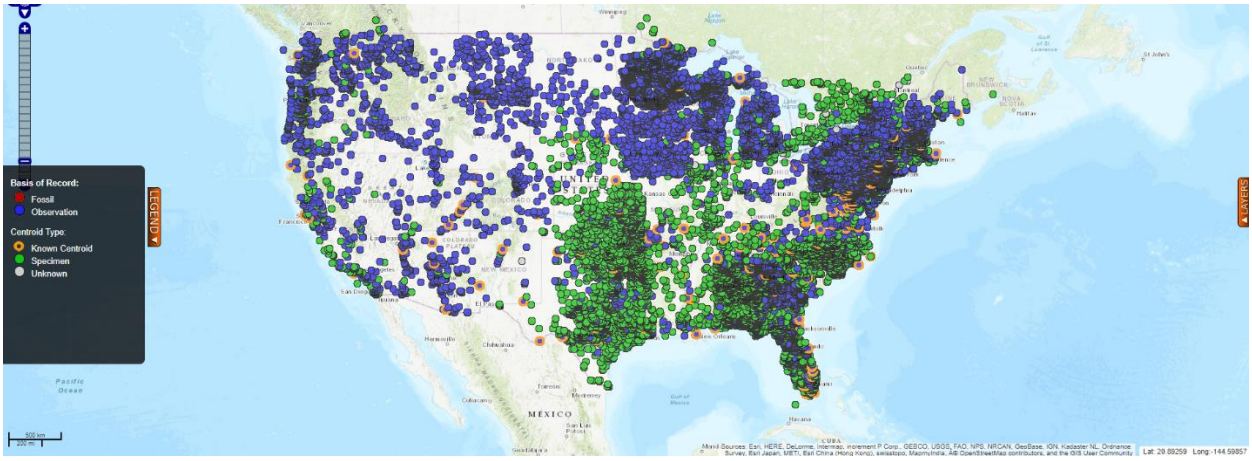

Figure 4. Additional known distribution of *Micropterus salmoides* in the contiguous United States. Map from BISON (2019).

Figure 5. Known distribution of *Micropterus salmoides* in Hawaii. Map from BISON (2019).

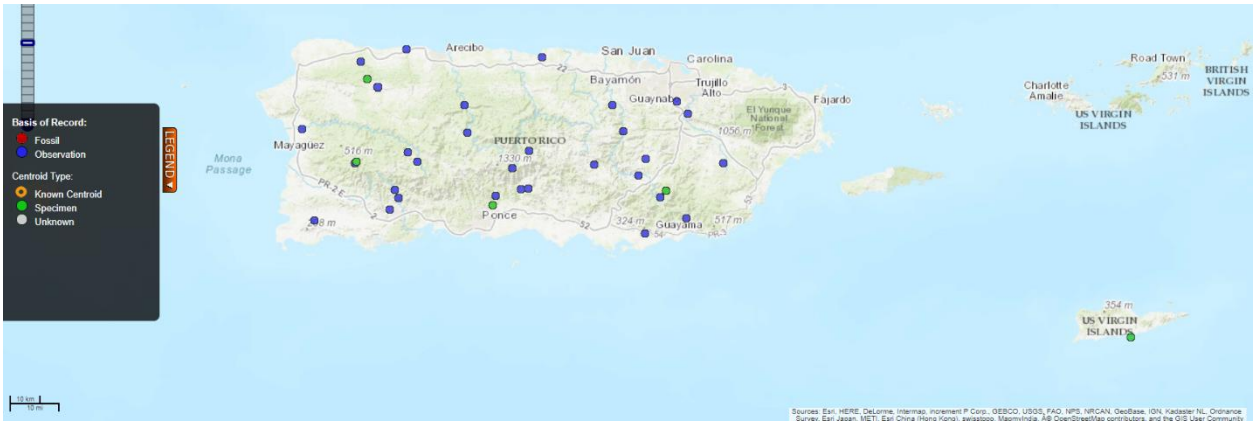

Figure 6. Known distribution of *Micropterus salmoides* in Puerto Rico and the U.S. Virgin Islands. Map from BISON (2019).

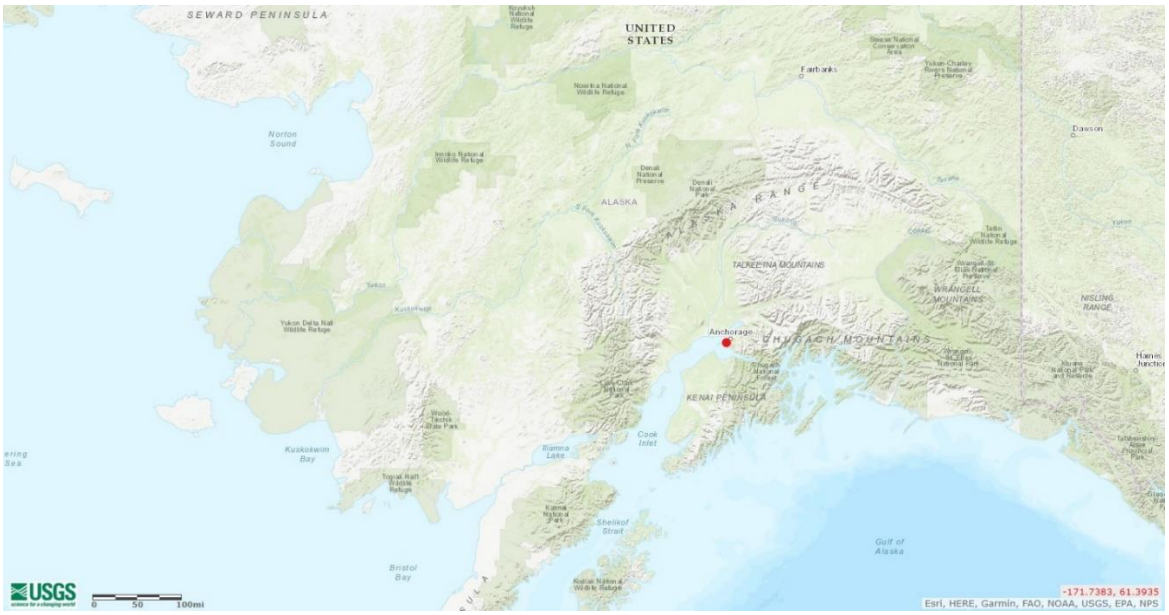

Figure 7. Known collection of *Micropterus salmoides* in Alaska. Map adapted from Fuller and Nielson (2019). The location in Alaska was not used to select source points in the climate match because it represents the collection of a single individual and not an established population.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Micropterus salmoides* was high across the entire contiguous United States. There were no areas of low or medium match. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for contiguous United States was 0.999, high (scores 0.103 and greater are classified as high). All 48 contiguous States had high individual Climate 6 scores.

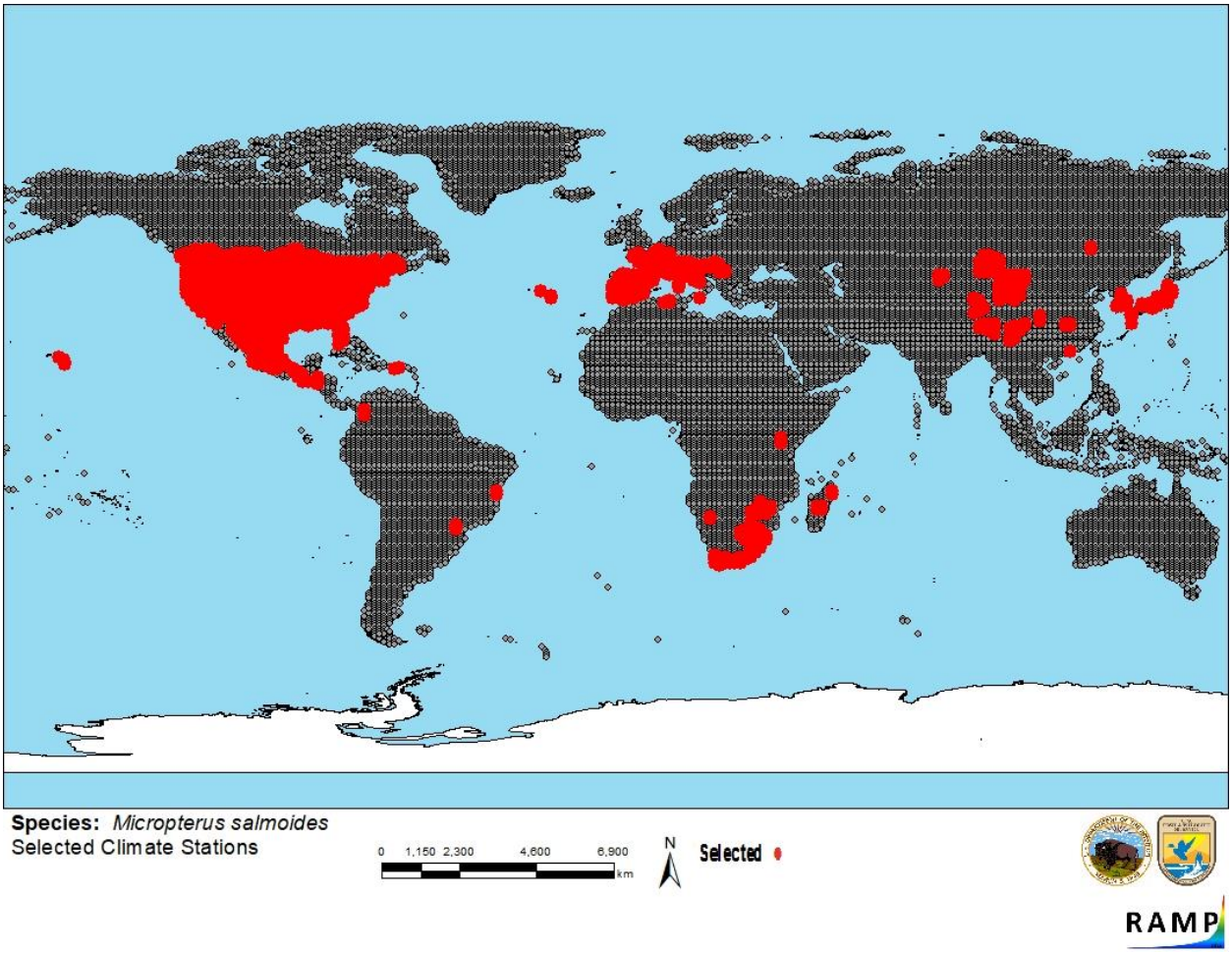

Figure 8. RAMP (Sanders et al. 2018) source map showing weather stations in selected as source locations (red) and non-source locations (gray) for *Micropterus salmoides* climate matching. Source locations from BISON (2019), Froese and Pauly (2019), Fuller and Neilson (2019), and GBIF Secretariat (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

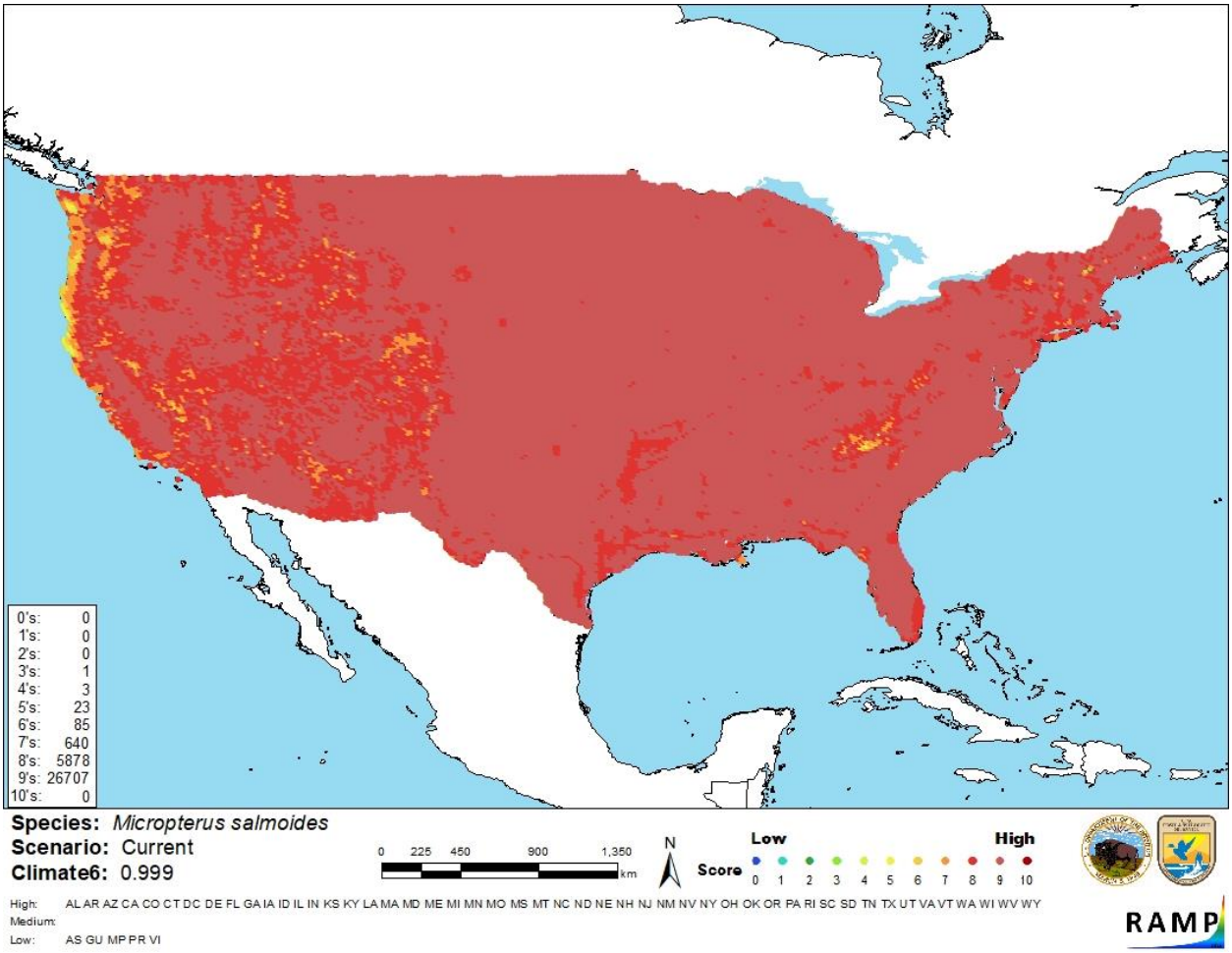

Figure 9. Map of RAMP (Sanders et al. 2018) climate matches for *Micropterus salmoides* in the contiguous United States based on source locations reported by BISON (2019), Froese and Pauly (2019), Fuller and Neilson (2019), and GBIF Secretariat (2019). 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

The certainty of assessment for *Micropterus salmoides* is high. The biology, ecology, introduction history, and impacts of introduction are well documented in the peer-reviewed literature. The distribution is well represented by georeferenced observations.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Largemouth Bass (*Micropterus salmoides*) is a predatory fish native to large areas of eastern North America. It is one of the most popular sport fish and has been transported around the world to increase recreational fishing opportunities. There are multiple recorded diseases of *M. salmoides*, including four OIE-reportable diseases. The history of invasiveness is high. There is a long record of nonnative introductions that have resulted in established populations. Negative impacts of introduction have been documented in many countries. Impacts of introduction include alteration of macroinvertebrate communities, co-introduction of new parasites, and reduction and extirpation of native species. The climate match was very high; *M. salmoides* has established populations in all of the contiguous 48 states. The certainty of assessment is high. The overall risk assessment category is high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information:** Infection with *Gyrodactylus* sp., *Aphanomyces invadans*, spring viremia of carp virus, and viral haemorrhagic septicaemia.
- **Overall Risk Assessment Category: High**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

BISON. 2019. Biodiversity Information Serving Our Nation (BISON). U.S. Geological Survey. Available: https://bison.usgs.gov. (February 2019).

CABI. 2019. *Micropterus salmoides* (Largemouth Bass) [original text by A. Drake]. In Invasive Species Compendium. CAB International, Wallingford, U.K. Available: https://www.cabi.org/ISC/datasheet/74846. (February 2019).

Ellender, B. R., O. L. F. Weyl, M. E. Alexander, A. M. Luger, L. A. J. Nagelkerke, and D. J. Woodford. 2018. Out of the pot and into the fire: Explaining the vulnerability of an endangered small headwater stream fish to black-bass *Micropterus* spp. invasion. Journal of Fish Biology 92:1035–1050.

Fricke, R., W. N. Eschmeyer, and R. van der Laan, editors. 2019. Eschmeyer's catalog of fishes: genera, species, references. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp. (February 2019).

Froese, R., and D. Pauly, editors. 2019a. *Micropterus salmoides* (Lacepède, 1802). FishBase. Available: https://www.fishbase.de/summary/Micropterus-salmoides.html. (February 2019).

Froese, R., and D. Pauly, editors. 2019b. *Micropterus salmoides*. *In* World Register of Marine Species. Available: http://www.marinespecies.org/aphia.php?p=taxdetails&id=151295. (February 2019).

Fuller, P., and M. Neilson. 2019. *Micropterus salmoides* (Lacepède, 1802). U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=401. (February 2019).

GBIF Secretariat. 2019. GBIF backbone taxonomy: *Micropterus salmoides* (Lacepède, 1802). Global Biodiversity Information Facility, Copenhagen. Available: https://www.gbif.org/species/2394563. (February 2019).

GISD (Global Invasive Species Database). 2017. Species profile: *Micropterus salmoides*. Invasive Species Specialist Group, Gland, Switzerland. Available: http://www.iucngisd.org/gisd/speciesname/Micropterus+salmoides. (February 2019).

ITIS (Integrated Taxonomic Information System). 2019. *Micropterus salmoides* (Lacepède, 1802). Integrated Taxonomic Information System, Reston, Virginia. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=168160#null. (February 2019).

Kim, R., and M. Faisal. 2010. Experimental studies confirm the wide host range of the Great Lakes viral haemorrhagic septicaemia virus genotype IVb. Journal of Fish Diseases 33:83–88.

NatureServe. 2019. NatureServe Explorer: an online encyclopedia of life, version 7.1. NatureServe, Arlington, Virginia. Available: http://explorer.natureserve.org. (February 2019).

NIES (National Institute for Environmental Studies). 2019. *Micropterus salmoides*. *In* Invasive species of Japan. National Research and Development Agency, National Institute for Environmental Studies, Tsukuba, Japan. Available: https://www.nies.go.jp/biodiversity/invasive/DB/detail/50330e.html. (February 2019).

OIE (World Organisation for Animal Health). 2019. OIE-listed diseases, infections and infestations in force in 2019. Available: http://www.oie.int/animal-health-in-the-world/oie-listed-diseases-2019/. (February 2019).

Pagad, S., P. Genovesi, L. Carnevali, D. Schigel, and M. A. McGeoch. 2018. Introducing the Global Register of Introduced and Invasive Species. Scientific Data 5:170202.

Phelps, N. B. D., A. G. Armién, S. K. Mor, S. M. Goyal, J. V. Warg, R. Bhagyam, and T. Monahan. 2012. Spring viremia of carp virus in Minnehaha Creek, Minnesota. Journal of Aquatic Animal Health 24:232–237.

Poelen, J. H., J. D. Simons, and C. J. Mungall. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

Sanders, S., C. Castiglione, and M. Hoff. 2018. Risk assessment mapping program: RAMP, version 3.1. U.S. Fish and Wildlife Service.

Schulz, U. H., and M. E. Leal. 2005. Growth and mortality of black bass, *Micropterus salmoides* (Pisces, Centrachidae; Lacapède, 1802) in a reservoir in southern Brazil. Brazilian Journal of Biology 65(2):363–369.

Sinohin, V. O., and W. R. Cuaterno. 2003. Philippines. Pages 80–84 *in* N. Pallewatta, J. K. Reaser, and A. T. Gutierrez, editors. Invasive alien species in Southeast Asia: national reports and directory of resources. Global Invasive Species Programme, Cape Town, South Africa.

Truter, M. I. Přikrylová, O. L. F. Weyl, and N. J. Smit. 2017. Co-introduction of ancyrocephalid monogeneans on their invasive host, the Largemouth Bass, *Micropterus salmoides* (Lacepéde, 1802) in South Africa. International Journal for Parasitology: Parasites and Wildlife 6(3):420–429.

Tsunoda, H., and Y. Mitsuo. 2012. Multiple effects of exotic Largemouth Bass (*Micropterus salmoides*) and environmental factors on species richness and composition of pond-dwelling fishes. Aquatic Living Resources 25:163–171.

Vandersea, M. W., and R. W. Litaker. 2007. *Aphanomyces invadans* and ulcerative mycosis in estuarine and freshwater fish in Florida. Journal of Aquatic Animal Health 19:14–26.

Weyl, P. S. R., F. C. de Moor, M. P. Hill, and O. L. F. Weyl. 2010. The effect of Largemouth Bass *Micropterus salmoides* on aquatic macro-invertebrate communities in the Wit River, Eastern Cape, South Africa. African Journal of Aquatic Science 35(3):273–281.

10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Anonymous. 1994. Atlas pesquero de México. Instituto Nacional de la Pesca.

Anonymous. 1999. Systematic list of Estonian fishes. Online. (January 2000).

Berg, L. S. 1965. Freshwater fishes of the U.S.S.R. and adjacent countries, volume 3, 4th edition. Israel Program for Scientific Translations, Jerusalem. (Russian version published 1949.)

Bianco, P. G. 2014. An update on the status of native and exotic freshwater fishes of Italy. Journal of Applied Ichthyology 30(1):62–77.

Bianco, P. G., and V. Ketmaier. 2001. Anthropogenic changes in the freshwater fish fauna of Italy, with reference to the central region and *Barbus graellsii*, a newly established alien species of Iberian origin. Journal of Fish Biology 59(Supplement A):190–208.

Billard, R. 1997. Les poissons d'eau douce des rivières de France. Identification, inventaire et répartition des 83 espèces. Lausanne, Switzerland, Delachaux and Niestlé.

Blanc, M., J. L. Gaudet, P. Banarescu, and J. C. Hureau. 1971. European inland water fish. A multilingual catalogue. Fishing News (Books), London.

Boucher, D. 2003. Illegal fish stockings threaten Maine lakes and rivers. Available: http://www.state.me.us.

Bussing, W. A. 1998. Peces de las aguas continentales de Costa Rica, 2nd edition. Editorial de la Universidad de Costa Rica, San José.

Chiba, K., Y. Taki, K. Sakai, and Y. Oozeki. 1989. Present status of aquatic organisms introduced into Japan. *in* S. S. de Silva, editor. Exotic aquatic organisms in Asia. Proceedings of the Workshop on Introduction of Exotic Aquatic Organisms in Asia. Asian Fisheries Society, Special Publication 3.

Coppola, S. R., W. Fischer, L. Garibaldi, N. Scialabba, and K. E. Carpenter. 1994. SPECIESDAB: Global species database for fishery purposes. User's manual. FAO Computerized Information Series (Fisheries) 9, Rome, FAO.

Dill, W. A., and A. J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin 178.

Eaton, J. G., J. H. McCormick, B. E. Goodno, D. G. O'Brien, H. G. Stefany, M. Hondzo, and R. M. Scheller. 1995. A field information-based system for estimating fish temperature tolerances. Fisheries 20(4):10–18.

Eccles, D. H. 1992. FAO species identification sheets for fishery purposes. Field guide to the freshwater fishes of Tanzania. United Nations Development Programme, Project URT/87/016, FAO, Rome.

Ellender, B. R., O. L. F. Weyl, and E. R. Swartz. 2011. Invasion of a headwater stream by non-native fishes in the Swartkops River system, South Africa. African Zoology 46:39–46.

Etnier, D. A., and W. C. Starnes. 1993. The fishes of Tennessee. The University of Tennessee Press, Knoxville.

FAO (Food Agriculture Organization of the United Nations). 1997. FAO database on introduced aquatic species. Food and Agriculture Organization of the United Nations, Rome.

Fermon, Y. 1997. Les *Haplochromis* spp. (Teleostei, Cichlidae) des zones rocheuses du Mwanza Gulf, lac Victoria, Tanzanie: Structure des communautes et écomorphologie. Thèse présentée pour l'obtention du Diplôme de Doctorat du Muséum National d'Histoire naturelle. Thèses et Documents Microfichés 157. ORSTOM, Paris.

Findlay, C. S., D. G. Bert, and L. Zheng. 2000. Effect of introduced piscivores on native minnow communities in Adirondack lakes. Canadian Journal of Fisheries and Aquatic Sciences 57:570-580.

Fisheries Management Division of the Shiga Prefecture Agriculture and Fisheries Department. 2007. Shiga's fisheries (Fiscal Year 2007). Pages 77–79 *in* Shiga no Suisan (Heisei 19 Nendo).

Fuller, P. L., L. G. Nico, and J. D. Williams. 1999. Nonindigenous fishes introduced into inland waters of the United States. American Fisheries Society, Publication 27, Bethesda, Maryland.

Gerstmeier, R., and T. Romig. 1998. Die Süßwasserfische Europas: für Naturfreunde und Angler. Franckh-Kosmos Verlag, Stuttgart, Germany.

Godoy, M. P. 1954, Observações sobre a adaptação do Black Bass em Pirassununga, Estado de São Paulo. Revta. Bras. Biol. 14:32–38.

Gross, M. R., and R. C. Sargent. 1985. The evolution of male and female parental care in fishes. American Zoology 25(3):807–822.

Hay, C. J., B. J. van Zyl, F. H. van der Bank, J. T. Ferreira, and G. J. Steyn. 1999. The distribution of freshwater fish in Namibia. Cimbebasia 15:41–63.

Hayes, M. P., and M. R. Jennings. 1986. Decline of ranid frog species in western North America: are bullfrogs (*Rana catesbeiana*) responsible? Journal of Herpetology 20(4):490–509.

Holcík, J. 1991. Fish introductions in Europe with particular reference to its central and eastern part. Canadian Journal of Fisheries and Aquatic Sciences 48(Supplement 1):13–23.

Hubbs, C. L., and D. F. Lagler. 1957. Fishes of the Great Lakes Region. Bulletin of the Cranbrook Institute of Science 26.

Hughes, R. M., and A. T. Herlihy. 2012. Patterns in catch per unit effort of native prey fish and alien piscivorous fish in 7 Pacific Northwest USA rivers. Fisheries 37(5):201–211.

Iguchi, K., K. Matsuura, K. M. McNyset, A. T. Peterson, R. Scachetti-Pereira, K. A. Powers, D. A. Vieglais, E. O. Wiley, and T. Yodo. 2004. Predicting invasions of North American basses in Japan using native range data and a genetic algorithm. Transactions of the American Fisheries Society 133(4):845–854.

International Game Fish Association. 1991. World record game fishes. International Game Fish Association, Florida.

Ismail, G. B., D. B. Sampson, and D. L. G. Noakes. 2014. The status of Lake Lanao endemic cyprinids (*Puntius* species) and their conservation. Environmental Biology of Fishes 97:425–434.

Jackson, D. A., P. R. Peres-Neto, and J. D. Olden. 2001. What controls who is where in freshwater fish communities – the roles of biotic, abiotic, and spatial factors. Canadian Journal of Fisheries and Aquatic Sciences 58:157–170.

Jang, M. H., J. G. Kim, S. B. Park, K. S. Jeong, G. I. Cho, and G. J. Joo. 2002. The current status of the distribution of introduced fish in large river systems of South Korea. International Review of Hydrobiology 87(2-3):319–328.

Jenkins, R. E., and N. M. Burkhead. 1994. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland.

Keith, P. 2002. Revue des introductions de poissons et de crustacés décapodes d eau douce en Polynésie française. Bulletin Français de la Pêche et de la Pisciculture 364:147–160.

Keith, P., and J. Allardi. 1998. The introduced freshwater fish of France: status, impacts and management. Pages 153–166 *in* I. G. Cowx. Stocking and introduction of fish. Bodmin, Cornwall, United Kingdom.

Keith, P., J. Allardi, and B. Moutou. 1992. Livre rouge des espèces menacées de poissons d'eau douce de France et bilan des introductions. Muséum national d'Histoire naturelle, Paris, Secrétariat de la Faune et de la Flore, Conseil Supérieur de la Pêche, CEMAGREF and Ministère de l'Environment.

Keith, P., G. Marquet, P. Valade, P. Bosc, and E. Vigneux. 2006. Atlas des poissons et des crustacés d'eau douce des Comores, Mascareignes et Seychelles. Muséum national d’Histoire naturelle, Paris. Patrimoines naturels 65.

Kimberg, P. K., D. J. Woodford, H. Roux, and O. L. F. Weyl. 2014. Species-specific impact of introduced Largemouth Bass *Micropterus salmoides* in the Groot Marico freshwater ecosystem priority area, South Africa. African Journal of Aquatic Science 39:451–458.

Kottelat, M., and J. Freyhof. 2007. Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland, and Freyhof, Berlin.

Lacepède, B. G. E. 1802. Histoire naturelle des poissons.

Lee, D. S., S. P. Platania, and G. H. Burgess. 1983. Atlas of North American freshwater fishes, 1983 supplement. North Carolina State Museum of Natural History, Occasional Papers of the North Carolina Biological Survey 1983-6, Raleigh.

Lewis, A. D., and C. K. Pring. 1986. Freshwater and brackishwater fish and fisheries of Fiji. Pages 38–59 *in* T. Petr. Reports and papers presented at the Indo-Pacific Fishery Commission Expert Consultation on inland fisheries of the larger Indo-Pacific islands. Bankok, Thailand.

Lever, C. 1996. Naturalized fishes of the world. Academic Press, California.

Liao, I. C., and H. C. Lia. 1989. Exotic aquatic species in Taiwan. Pages 101–118 *in* S. S. De Silva, editor. Exotic aquatic organisms in Asia. Proceedings of the Workshop on Introduction of Exotic Aquatic Organisms in Asia. Asian Fisheries Society, Special Publication 3, Manila, Philippines.

Liao, C. I., H. M. Su, and E. Y. Chang. 2001. Techniques in finfish larviculture in Taiwan. Aquaculture 200:1–31.

Litvak, M. K., and N. E. Mandrak. 1993. Ecology of freshwater baitfish use in Canada and the United States. Fisheries 18(12):6–13.

Losse, G. F. 1998. Lake Kariba and the Gwembe Valley. Pages 22–31 *in* G. F.Losse. The small-scale fishery on Lake Kariba in Zambia. Deutsche Gessellscahft für Technische Zusammenarbeit GmbH, Eschborn, Germany.

Lyons, J., G. González-Hernandéz, E. Soto-Galera, and M. Guzmán-Arroyo. 1998. Decline of freshwater fishes and fisheries in selected drainages of west-central Mexico. Fisheries 23(4):10–18.

Maciolek, J. A. 1984. Exotic fishes in Hawaii and other island of Oceania. Pages 131–161 *in* W. R. Courtenay, and J. R. Stauffer, editors. Distribution, biology and management of exotic fishes. Baltimore, Maryland.

Maezono, Y., and T. Miyashita. 2003. Community-level impacts induced by introduced Largemouth Bass and Bluegill in farm ponds in Japan. Biological Conservation 109:111–121.

Malabarba, L. R., V. A. Bertaco, F. R. Carvalho, and T. O. Litz. 2012. Revalidation of the genus *Ectrepopterus* Fowler (Teleostei: Characiformes), with the redescription of its type species, *E. uruguayensis*. Zootaxa 3204:47–60.

Mamaril, A. C. 2001. Translocation of the clupeid *Sardinella tawilis* to another lake in the Philippines: a proposal and ecological considerations. Pages 137–147 *in* C. B. Santiago, M. L. Cuvin-Aralar, and Z. U. Basiao, editors. Conservation and ecological management of Philippine lakes in relation to fisheries and aquaculture. Southeast Asian Fisheries Development Center, Aquaculture Department, Iloilo, Philippines; Philippine Council for Aquatic and Marine Research and Development, Los Baños, Laguna, and Bureau of Fisheries and Aquatic Resources, Quezon City, Philippines.

Marquet, G., P. Keith, and E. Vigneux. 2003. Atlas des poissons et des crustacés d eau douce de Nouvelle-Calédonie. Paris, Muséum national déhistoire naturelle, Collection Patrimoines Naturels 58.

Mercene, E. C. 1997. Freshwater fishes of the Philippines. Pages 81–105 *in* R. Guerrero III, A. Calpe, and L. Darvin, editors. Aquatic biology research and development in the Philippines. Proceedings of the First National Symposium-Workshop on Aquatic Biology, 1995, Los Baños, Laguna. PCAMRD Book Series 20.

Miller, R. R., and E. P. Pister. 1971. Management of the Owens pupfish, *Cyprinodon radiosus*, in Mono County, California. Transactions of the American Fisheries Society 100(3):502–509.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Fish and Game Department. Sims Printing Company, Phoenix, Arizona.

Monnerjahn, U. 1999. Freshwater fishes of Germany. A checklist compiled from German FischKataster of the Bundesländer and from the German 'Rote Liste'. Provided as Excel spreadsheet for use by FishBase.

Moyle, P. B., P. K. Crain, K. Whitener, and J. F. Mount. 2003. Alien fishes in natural streams: fish distribution, assemblage structure and conservation in the Cosumnes River, California, USA. Environmental Biology of Fishes 68:143–162.

Muchiri, S. M., P. J. B. Hart, and D. M. Harper. 1995. The persistence of introduced tilapia species in Lake Naivasha, Kenya, in the face of environmental variability and fishing pressure. Pages 299–319 *in* T. J. Pitcher, and P. J. B. Hart, editors. The impact of species changes in African Lakes. Chapman & Hall Fish & Fisheries Series 18.

Muus, B. J., and P. Dahlström. 1968. Süßwasserfische. BLV Verlagsgesellschaft, München.

Muus, B. J., and P. Dahlstrøm. 1990. Europas ferskvandsfisk. GEC Gads Forlag, København. (In Danish.)

Okeyo, D. O. 2003a. Taxonomy, common names and distribution of fish in the eastern arm of the Rift Valley drainage, Kenya. Pages 250–266 *in* M. L. D. Palomares, B. Samb, T. Diouf, J. M. Vakily, and D. Pauly, editors. Fish biodiversity: local studies as basis for global inferences. ACP-EU Fisheries Research Report 14.

Okeyo, D. O. 2003b. On the biodiversity and the distribution of freshwater fish of Namibia: an annotated update. Pages 156–194 *in* M. L. D. Palomares, B. Samb, T. Diouf, J. M. Vakily, and D. Pauly, editors. Fish biodiversity: local studies as basis for global inferences. ACP-EU Fisheries Research Report 14.

Page, L. M., and B. M. Burr. 1991. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Company, Boston.

Page, L. M., and B. M. Burr. 2011. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Harcourt, Boston.

Perez-Ponce de Leon, G., L. Garcia-Prieto, V. Leon-Regagnon, and A. Choudhury. 2000. Helminth communities of native and introduced fishes in Lake Patzcuaro, Michoacan, Mexico. Journal of Fish Biology 57:303–325.

Quinn, S. 2001. How long do fish live? In-Fisherman 26(5):15.

Reshetnikov, Y. S., N. G. Bogutskaya, E. D. Vasil'eva, E. A. Dorofeeva, A. M. Naseka, O. A. Popova, K. A. Savvaitova, V. G. Sideleva, and L. I. Sokolov. 1997. An annotated check-list of the freshwater fishes of Russia. Journal of Ichthyology 37(9):687–736.

Rosen, P. C., C. R. Schwalbe, D. A. Parizek, Jr., P. A. Holm, and C. H. Lowe. 1995. Introduced aquatic vertebrates in the Chiricahua region: effects on declining native ranid frogs. Pages 251–261 *in* Biodiversity and management of the Madrean Archipelago: the sky island of the southwestern United States and northwestern Mexico. USDA Forest Service, General Technical Report RM-GTR-264.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Bulletin 184.

Scott, W. B., and E. J. Crossman. 1998. Freshwater fishes of Canada. Galt House Publications, Oakville, Canada.

Seegers, L., L. De Vos, and D. O. Okeyo. 2003. Annotated checklist of the freshwater fishes of Kenya (excluding the lacustrine haplochromines from Lake Victoria). Journal of East African Natural History 92:11–47.

Spillman, C. J. 1961. Faune de France: Poissons d'eau douce. Fédération Française des Sociétés Naturelles, Tome 65, Paris.

Stiassny, M. L. J., and C. L. Gertsner. 1992. The parental care behaviour of *Paratilapia polleni* (Perciformes, Labroidei), a phylogenetically primitive cichlid from Madagascar, with a discussion of the evolution of maternal care in the family Cichlidae. Environmental Biology of Fishes 34(3):219–233.

Sugiyama, T., and H. Jinguji. 2005, Impact and extermination of Largemouth Bass in irrigation pond. Japanese Society of Irrigation Drainage and Rural Engineering 73:797–800. (In Japanese.)

Takayama, H. 2002. Aliens in the palace. Newsweek: December 9.

Tan, Y., and H. E. Tong. 1989. The status of the exotic aquatic organisms in China. Pages 35–43 *in* S. S. De Silva, editor. Exotic aquatic organisms in Asia. Proceedings of the Workshop on Introduction of Exotic Aquatic Organisms in Asia. Asian Fisheries Society, Special Publication 3.

Terofal, F. 1984. Süsswasserfische in europaischen Gewassern. Mosaik Verlag, Munich, Germany.

Trautman, M. B. 1957. Fishes of Ohio. Ohio State University Press, Columbus.

Tsunoda, H., Y. Mitsuo, M. Ohira, M. Doi, and Y. Senga. 2010. Change of fish fauna in ponds after eradication of invasive piscivorous Largemouth Bass, *Micropterus salmoides*, in north-eastern Japan. Aquatic Conservation Marine and Freshwater Ecosystems 20:710–716.

U.S. Fish and Wildlife Service. 1985b. Recovery plan for the Pahranagat roundtail chub, *Gila robusta jordani*. U.S. Fish and Wildlife Service, Portland, Oregon.

U.S. Fish and Wildlife Service. 1994e. White River Spinedace, *Lepidomeda albivallis*, recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon.

van der Walt, K. A., E. R. Swartz, D. J. Woodford, and O. L. F. Weyl. 2017. Using genetics to prioritise headwater stream fish populations of the Marico Barb, *Enteromius motebensis* Steindachner 1894, for conservation action. Koedoe 59:1–7.

Welcomme, R. L. 1988. International introductions of inland aquatic species. FAO Fisheries Technical Paper 294.

Weyl, O. L. F., and T. Hecht. 1999. A successful population of Largemouth Bass, *Micropterus salmoides*, in a subtropical lake in Mozambique. Environmental Biology of Fishes 54:53–66.

Weyl, O. L. F., T. Stadtlander, and A. Booth. 2009. Establishment of translocated populations of smallmouth yellowfish, *Labeobarbus aeneus* (Pisces: Cyprinidae), in lentic and lotic habitats in the Great Fish River system, South Africa. African Zoology 44(1):93–105.

Whitmore, D. H., and T. R. Hellier. 1988. Natural hybridization between largemouth and smallmouth bass (*Micropterus*). Copeia 1988(2):493–396.

Wittenberg, R., editor. 2005. An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape. The environment in practice 0629, Federal Office for the Environment, Bern, Switzerland.

Xie, Y., Z. Lin, W. P. Gregg, and D. Li. 2001. Invasive species in China - an overview. Biodiversity Conservation 10:1317–1341.

Yamamoto, M. N., and A. W. Tagawa. 2000. Hawai'i's native and exotic freshwater animals. Mutual Publishing, Honolulu, Hawaii.

Yodo, T., and K. Iguchi. 2004. A review on the black bass problem referring to the historical background in Japan. Bulletin of the Fisheries Research Board of Argentina 12:10–24.

Yonekura, R., M. Kita, and M. Yuma. 2004. Species diversity in native fish community in Japan: comparison between non-invaded and invaded ponds by exotic fish. Ichthyological Research 51:176–179.