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# **Mercury in Fish and Macroinvertebrates from New York's Streams and Rivers: A Compendium of Data Sources**

**Final Report**

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# **Mercury in Fish and Macroinvertebrates from New York's Streams and Rivers: A Compendium of Data Sources**

*Final Report*

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**New York State Energy Research and Development Authority**

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## Notice

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## **Abstract**

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The U.S. Geological Survey has compiled a list of existing data sets, from selected sources, containing mercury (Hg) concentration data in fish and macroinvertebrate samples that were collected from flowing waters of New York State from 1970 through 2014. Data sets selected for inclusion in this report were limited to those that contain fish and (or) macroinvertebrate data that were collected across broad areas, cover relatively long time periods, and (or) were collected as part of a broader-scale (e.g. national) study or program. In addition, all data sets listed were collected, processed, and analyzed with documented methods, and contain critical sample information (e.g. fish species, fish size, Hg species) that is needed to analyze and interpret the reported Hg concentration data. Fourteen data sets, all from state or federal agencies, are listed in this report, along with selected descriptive information regarding each data source and data set contents. Together, these 14 data sets contain Hg and related data for more than 7,000 biological samples collected from more than 700 unique stream and river locations between 1970 and 2014.

## **Keywords**

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Mercury, fish, macroinvertebrate, New York, streams, rivers, consumption advisories

## **Acknowledgments**

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Support for this work was provided by the New York State Energy Research and Development Authority and the U.S. Geological Survey. The authors greatly appreciate assistance from all of the individuals who provided data sets, guided us in interpreting the various data fields, and provided essential background information and insight regarding the purposes, collection methods, and application of the data. We are grateful to Christopher Schmitt (USGS, Columbia Environmental Research Center) and Dorene MacCoy (USGS, Idaho Water Science Center) for their reviews of an earlier draft of this manuscript.

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## Acronyms and Abbreviations List

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MeHg	Methylmercury
NAWQA	National Water Quality Assessment Program
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
THg	Total mercury
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

# 1 Introduction

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Mercury (Hg) is a potent neurotoxin that bioaccumulates to high concentrations through aquatic food webs, affects human health and wildlife health (Evers et al. 2007), and accounts for the majority of fish consumption advisories in New York State (NYS Department of Health 2014). Most of the Hg that affects aquatic ecosystems in New York State comes in the form of inorganic mercury ( $\text{Hg}^{+2}$ ) that is delivered to the landscape in atmospheric deposition from distant sources. The deposited  $\text{Hg}^{+2}$  is subsequently transformed into methylmercury (MeHg), the toxic and bioavailable form of Hg.

Over the years, Hg source reduction policies have led to significant reductions in Hg emissions in the northeastern United States. Reductions in atmospheric Hg concentrations have been observed in recent decades (Wentz et al. 2014). However, a critical need remains to describe resulting changes in Hg concentrations in New York's aquatic resources in order to:

- Determine the spatial extent of Hg contamination throughout the State.
- Improve the understanding of factors that influence Hg cycling and bioaccumulation (such as landscape characteristics, water chemistry, and food web characteristics).
- Help parameterize models of fish Hg concentrations based on more easily-measured chemical, physical, and (or) biological variables, such as specific ultraviolet absorbance (Burns et al. 2013).

Addressing these issues can make future fish monitoring programs more cost effective (for example by focusing on specific geographical regions or water bodies of concern). Analyzing existing data and additional monitoring can accomplish these objectives.

Less is known about the status, distribution, and trends of Hg concentrations in food webs of streams and rivers than is known of these patterns in lakes (Ward et al. 2010). Fundamental differences in Hg cycling and bioaccumulation processes between streams and lakes (Burns et al. 2012, Chasar et al. 2009, Ward et al. 2010) preclude the use of Hg monitoring data from New York's lakes (e.g., Simonin et al. 2006) to monitor or understand Hg patterns and trends in New York's streams. Recent studies have advanced the understanding of Hg cycling and bioaccumulation in streams (e.g., Chasar et al. 2009, Riva-Murray et al. 2011, 2013a, 2013b, Burns et al. 2014, Wentz et al. 2014), but the drivers of broad spatial patterns and temporal trends are still not well understood. To address this gap in understanding, and to inform future monitoring, the U.S. Geological Survey, with funding from NYSERDA, is conducting an



assessment of Hg bioaccumulation in New York State's streams and rivers. A critical part of this project was the compilation and analysis of existing data on Hg concentrations in fishes and macroinvertebrates from streams and rivers across New York State. This report describes methods used to identify data sources, briefly summarizes general information regarding the available data, and presents tables listing data sets and selected basic information regarding the source and content of each. Results of the analysis and interpretation of these Hg data will be presented elsewhere.

## 2 Methods

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Data sets were screened to ensure that each one listed in this report met all of the following criteria:

- Contains fish and (or) macroinvertebrate Hg data.
- Exists in digital form.
- Pertains to New York State's non-haline streams and rivers.
- Covers a broad spatial extent in New York State, represents a long time period, and (or) is part of a larger (e.g., regional or national) coverage.
- Contains data that were collected and analyzed with methods that are documented and available (i.e. published, Web-accessible, or publically-available agency reports).
- Contains information that is necessary to effectively analyze and interpret Hg spatial patterns and trends, such as fish species or macroinvertebrate taxon, organism body part, Hg species analyzed, and Hg weight basis (i.e. wet weight or dry weight).

### 3 Results

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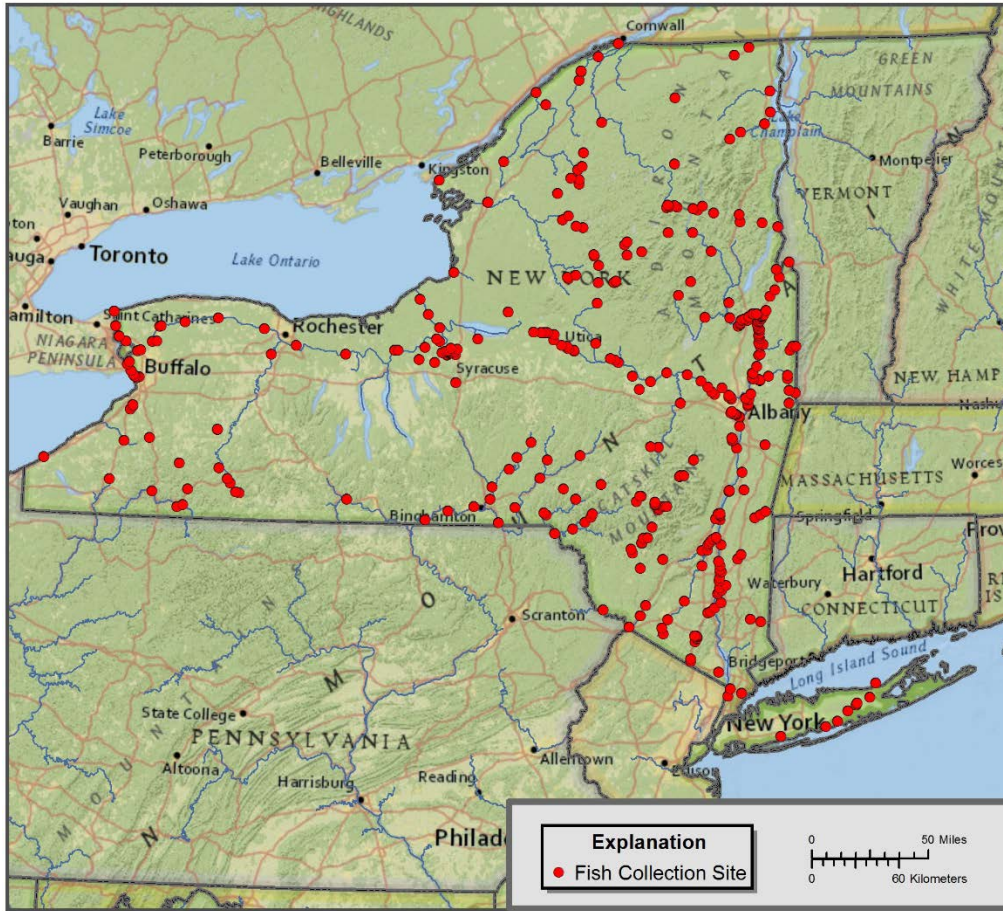
Fourteen data sources met all criteria for listing in this report; all are state or federal data collection programs. The selected data sets (Tables 1-3) represent a total of 7,266 biological samples collected from 765 unique stream and river locations (Figures 1 and 2) between 1970 and 2014, and contain data for 67 fish species (Table 4) and 39 macroinvertebrate taxa (Table 5).

Every effort has been made to be comprehensive in identifying the sources of relevant data sets, and obtaining accurate descriptive information regarding their contents. The data sets listed in this report represent a wide variety of objectives and methods which must be carefully considered prior to combining data from different sources for analysis and interpretation of Hg patterns, trends, and environmental drivers. The information presented in this report is accurate as of November 17, 2014.

# 4 Figures

**Figure 1. Stream and river locations in New York State from which fish mercury data were collected during 1970 – 2014**

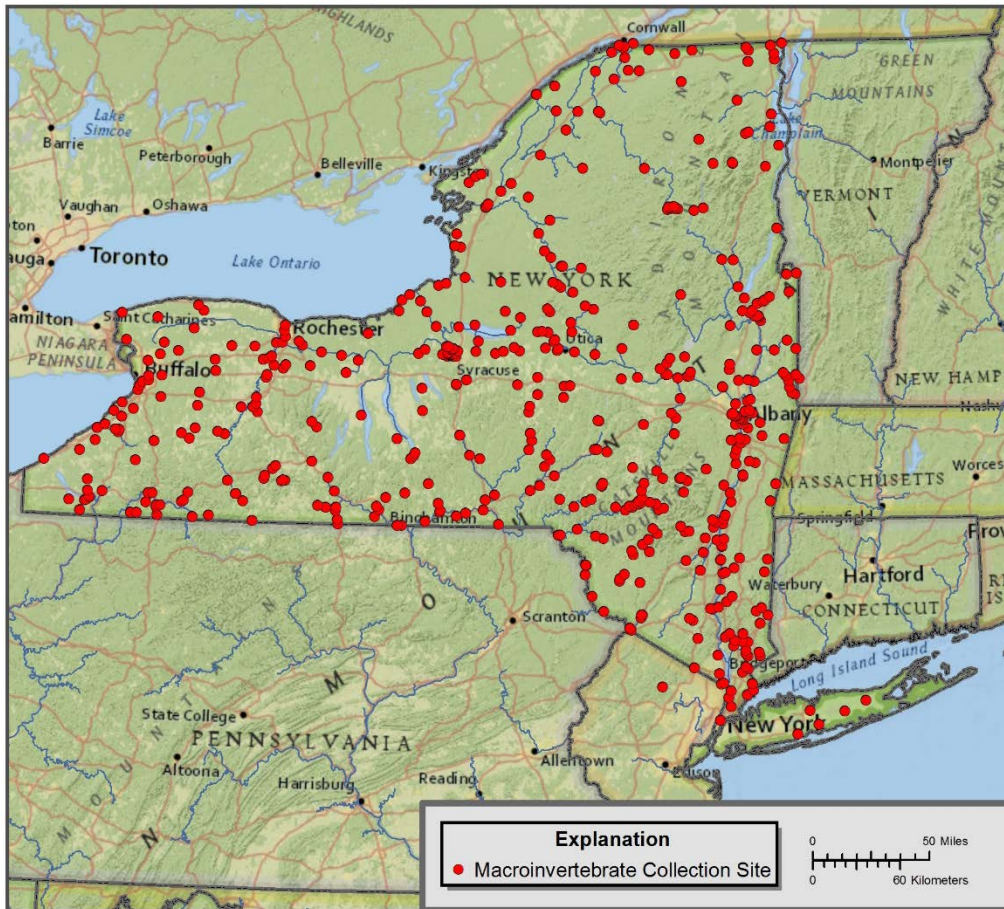
Data sources are listed in Table 1. Salt-influenced sites on the Hudson River (established for the purposes of this compilation from Newburgh Bay downstream) are not included in the compilation or shown on this map.



Base from National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

**Figure 2. Stream and river locations in New York State where macroinvertebrate mercury data were collected during 1970–2014**

Data sources are listed in Table 1. Salt-influenced sites on the Hudson River (established for the purposes of this compilation from Newburgh Bay downstream) are not included in the compilation or shown on this map.



Base from National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

## 5 Tables

**Table 1. Selected sources of fish and macroinvertebrate mercury concentration data collected from streams and rivers in New York during 1970–2014: purpose, contact, website, and references**

<b>Agency or organization; program or project</b>	<b>Purpose</b>	<b>Contact name and email; program, project, or data access Website</b>	<b>References</b>
NYSDEC; Baseline Assessment of Birch Creek	Assessment	Jeffrey Loukmas ( <a href="mailto:jeffrey.loukmas@dec.ny.gov">jeffrey.loukmas@dec.ny.gov</a> )	Loukmas 2009
NYSDEC; Contaminants Database	Monitoring, assessment, establishing fish consumption advisories	Wayne Richter ( <a href="mailto:wayne.richter@dec.ny.gov">wayne.richter@dec.ny.gov</a> ); <a href="http://www.dec.ny.gov/animals/62194.html">http://www.dec.ny.gov/animals/62194.html</a>	NYSDEC 2014a
NYSDEC; Neversink River Watersheds Study	Assessment	Jeffrey Loukmas ( <a href="mailto:jeffrey.loukmas@dec.ny.gov">jeffrey.loukmas@dec.ny.gov</a> )	Loukmas et al. 2006
NYSDEC; Rotating Integrated Basin Studies	Monitoring	Diana Heitzman ( <a href="mailto:diana.heitzman@dec.ny.gov">diana.heitzman@dec.ny.gov</a> ); <a href="http://www.dec.ny.gov/chemical/8517.html">http://www.dec.ny.gov/chemical/8517.html</a>	NYSDEC 2014b
USEPA; National Rivers and Streams Assessment	Assessment	<a href="http://water.epa.gov/type/rsl/monitoring/riversurvey/index.cfm">http://water.epa.gov/type/rsl/monitoring/riversurvey/index.cfm</a>	USEPA 2008; USEPA 2013
USGS; National Contaminants Biomonitoring Program	Monitoring	Christopher Schmitt ( <a href="mailto:cjschmitt@usgs.gov">cjschmitt@usgs.gov</a> ); <a href="http://www.cerc.usgs.gov/data/data.htm">http://www.cerc.usgs.gov/data/data.htm</a>	Schmitt et al. 1999
USGS; National Mercury Study	Assessment	Nancy Bauch ( <a href="mailto:njbauch@usgs.gov">njbauch@usgs.gov</a> ); <a href="http://pubs.er.usgs.gov/publication/ds307">http://pubs.er.usgs.gov/publication/ds307</a>	Bauch et al. 2009
USGS; National Mercury Pilot Study	Assessment	Bill Brumbaugh ( <a href="mailto:bbrumbaugh@usgs.gov">bbrumbaugh@usgs.gov</a> ); <a href="http://water.usgs.gov/nawqa/trace/pubs/setac2000_hg/">http://water.usgs.gov/nawqa/trace/pubs/setac2000_hg/</a>	Bauch et al. 2009; Brumbaugh et al. 2001
USGS; NAWQA Delaware River Basin Regional Survey	Assessment	Robin Brightbill ( <a href="mailto:rabright@usgs.gov">rabright@usgs.gov</a> ); Karen Riva Murray ( <a href="mailto:krmurray@usgs.gov">krmurray@usgs.gov</a> ); <a href="http://pubs.usgs.gov/wri/wri03-4183/">http://pubs.usgs.gov/wri/wri03-4183/</a>	Bauch et al. 2009; Brightbill et al. 2004
USGS; NAWQA Mercury Cycling and Bioaccumulation Study	Research	Karen Riva Murray ( <a href="mailto:krmurray@usgs.gov">krmurray@usgs.gov</a> ); <a href="http://water.usgs.gov/nawqa/mercury/">http://water.usgs.gov/nawqa/mercury/</a> <a href="http://ny.water.usgs.gov/projects/NAWQA/hgtopical.html">http://ny.water.usgs.gov/projects/NAWQA/hgtopical.html</a>	Beaulieu et al. 2012; Riva-Murray et al. 2011, 2013a, 2013b
USGS; NAWQA Status and Trends Study – Delaware River Basin	Assessment	Kristin Romanok ( <a href="mailto:kromanok@usgs.gov">kromanok@usgs.gov</a> ); Karen Riva Murray ( <a href="mailto:krmurray@usgs.gov">krmurray@usgs.gov</a> ); <a href="http://www.waterqualitydata.us/">http://www.waterqualitydata.us/</a>	Romanok et al. 2006
USGS; NAWQA Status and Trends Study – Hudson River Basin	Assessment	Karen Riva Murray ( <a href="mailto:krmurray@usgs.gov">krmurray@usgs.gov</a> ); <a href="http://www.waterqualitydata.us/">http://www.waterqualitydata.us/</a>	Wall et al. 1998
USGS; NAWQA Status and Trends Study - Lake Erie-Lake Saint Clair Drainages Study	Assessment	Jeffrey Frey ( <a href="mailto:jwfrey@usgs.gov">jwfrey@usgs.gov</a> ); <a href="http://www.waterqualitydata.us/">http://www.waterqualitydata.us/</a>	Meyers et al. 2000
USGS; Stream Fish Mercury Monitoring Project (NYSERDA)	Research	Karen Riva Murray ( <a href="mailto:krmurray@usgs.gov">krmurray@usgs.gov</a> ); Douglas Burns ( <a href="mailto:daburns@usgs.gov">daburns@usgs.gov</a> )	USGS National Water Information System <a href="http://dx.doi.org/10.5066/F7P55KJN">http://dx.doi.org/10.5066/F7P55KJN</a>

**Table 2. Selected sources of fish and macroinvertebrate mercury (Hg) concentration data collected from streams and rivers in New York during 1970–2014: geographic extent, time period covered, number of stream and river sites with fish and (or) macroinvertebrate Hg data, and total number of fish and (or) macroinvertebrate Hg data records**

<b>Agency or organization; program or project</b>	<b>Geographic extent</b>	<b>Time period</b>	<b>Number of sites</b>	<b>Number of records</b>
NYSDEC; Baseline Assessment of Birch Creek	Catskills streams: Birch Creek, Esopus Creek, East Branch Delaware River, Batavia Kill	2005-2006	16	133
NYSDEC; Contaminants Database	Statewide	1970-2014	293	5213
NYSDEC; Neversink River Watersheds Study	Upper Neversink River watershed	2003	7	84
NYSDEC; Rotating Integrated Basin Studies	Statewide	1989-2012	490	753
USEPA; National Rivers and Streams Assessment	Allegheny River, Chemung River, Chenango River, Grass River, Hudson River, Indian River, Mohawk River, Olean Creek, Oswegatchie River, Oswego River, Seneca River, Susquehanna River	2008-2009	20	20
USGS; National Contaminants Biomonitoring Program	Hudson River, Genesee River, St. Lawrence River	1969-1987	3	93
USGS; National Mercury Study	Upper Hudson River (Adirondacks)	2005	2	9
USGS; National Mercury Pilot Study	Delaware River, Swan River	1998	2	2
USGS; NAWQA Delaware River Basin Regional Survey	Neversink River; West Branch Delaware River	1999	3	3
USGS; NAWQA Mercury Cycling and Bioaccumulation Study	Upper Hudson River and Fishing Brook watershed, Essex County	2005-2009	10	746
USGS; NAWQA Status and Trends Study – Delaware River Basin	Upper Delaware River Basin	1999	4	4
USGS; NAWQA Status and Trends Study – Hudson River Basin	Hudson River Basin	1992-1997	17	17
USGS; NAWQA Status and Trends Study - Lake Erie-Lake Saint Clair Drainages Study	Cattaraugus Creek	1997	1	1
USGS; Stream Fish Mercury Monitoring Project (NYSERDA)	Adirondack region	2014	34	188



**Table 3. Selected sources of fish and macroinvertebrate mercury (Hg) concentration data collected from streams and rivers in New York State during 1970–2014: organisms collected, body part, Hg species analyzed, associated Hg data available**

Fish species are listed in alphabetical order by common name; macroinvertebrate taxa are listed in alphabetical order by scientific name. Corresponding scientific names (fishes), common names and taxonomic level (macroinvertebrates), and Taxonomic Serial Numbers ([www.itis.gov](http://www.itis.gov)) are provided in Tables 4 and 5. **F**, fish; **M**, macroinvertebrate; MeHg, methylmercury; THg, total mercury.

Agency or organization; program or project	Fish species; macroinvertebrate taxa	Body part	Mercury species	Other Hg data
NYSDEC; Baseline Assessment of Birch Creek	<b>F:</b> Blacknose Dace, Brown Trout, Common Shiner, Cutlips Minnow, Fathead Minnow, Rainbow Trout, Slimy Sculpin, Spottail Shiner <b>M:</b> Cambaridae, Gerridae, Megaloptera	<b>F:</b> whole, standard fillet <b>M:</b> whole	<b>F:</b> MeHg, THg <b>M:</b> MeHg, THg	Riparian spiders
NYSDEC; Contaminants Database	<b>F:</b> Alewife, American Eel, American Shad, Atlantic Salmon, Banded Killifish, black bass species, Black Crappie, Blacknose Dace, Blueback Herring, Bluegill, Bluntnose Minnow, Brook Stickleback, Brook Trout, Brown Bullhead, Brown Trout, bullhead catfishes, Central Mudminnow, Central Stoneroller, Chain Pickerel, Channel Catfish, Common Carp, Common Shiner, Creek Chub, Cutlips Minnow, Eastern Mudminnow, Fallfish, Fantail Darter, Fathead Minnow, Freshwater Drum, Gizzard Shad, Golden Shiner, Goldfish, Lake Sturgeon, Largemouth Bass, Logperch, Longnose Dace, Longnose Sucker, Mirror Carp, Mottled Sculpin, Northern Hog Sucker, Northern Pike, Pumpkinseed, Rainbow Trout, Redbreast Sunfish, Redfin Pickerel, Redhorse, Rock Bass, Round Goby, Rudd, Smallmouth Bass, Striped Bass, Stonecat, tiger muskellunge, Walleye, White Catfish, White Crappie, White Perch, White Sucker, whitefishes, Yellow Bullhead, Yellow Perch <b>M:</b> Amphipoda, Anisoptera, <i>Callinectes sapidus</i> , Cambaridae, <i>Cambarus bartonii</i> , Chironomidae, Gastropoda, Corixidae, Corydalidae, Gerridae, Gyrinidae, <i>Helisoma</i> spp., Hydropsychidae, <i>Lymnaea</i> spp., <i>Macromia magnifica</i> , Nepidae, Odonata, Oligochaeta, Planorbidae, <i>Physa</i> spp., Psidiidae, Tipulidae, Trichoptera, Unionidae, Zygoptera	<b>F:</b> standard fillet (with skin and ribs) for most; also brain, eggs, gallbladder, heart, 'head and viscera removed', kidney, liver, skinless fillet, 'remainder of carcass', right fillet, steak, scute, testes, whole carcass <b>M:</b> whole	<b>F:</b> MeHg (21 samples), THg (most samples) <b>M:</b> THg	Snapping turtle
NYSDEC; Neversink River Watersheds Study	<b>F:</b> Blacknose Dace, Brook Trout, Slimy Sculpin <b>M:</b> Aeshnidae, Cambaridae, Ephemerellidae, Gomphidae, Heptageniidae, Hydropsychidae, Limnephilidae, Perlidae, Perlodidae, Rhyacophilidae, Tipulidae	<b>F:</b> whole, standard fillet (with skin and ribs for most) <b>M:</b> whole	<b>F:</b> MeHg; THg <b>M:</b> MeHg, THg	Bed sediment, water



**Table 3. continued**

<b>Agency or organization; program or project</b>	<b>Fish species; macroinvertebrate taxa</b>	<b>Body part</b>	<b>Mercury species</b>	<b>Other Hg data</b>
NYSDEC; Rotating Integrated Basin Studies	<b>F:</b> none <b>M:</b> Cambaridae, Trichoptera, Megaloptera, Mollusca, 'others'	<b>M:</b> whole	<b>M:</b> THg	Bed sediment, water
USEPA; National Rivers and Streams Assessment	<b>F:</b> Brown Bullhead, Channel Catfish, Largemouth Bass, Rock Bass, Smallmouth Bass, Walleye, Yellow Perch <b>M:</b> none	<b>F:</b> fillet with skin; whole	<b>F:</b> THg	None
USGS; National Contaminants Biomonitoring Program	<b>F:</b> Black Crappie, Common Carp, Goldfish, Largemouth Bass, Northern Pike, Pumpkinseed, Redhorse, Rock Bass, Smallmouth Bass, Walleye, White Sucker, Yellow Perch <b>M:</b> none	<b>F:</b> whole	<b>F:</b> THg	None
USGS; National Mercury Study	<b>F:</b> Largemouth Bass, Smallmouth Bass <b>M:</b> none	<b>F:</b> skinless fillet	<b>F:</b> THg	Bed sediment, water
USGS; National Mercury Pilot Study	<b>F:</b> Redfin Pickerel, Smallmouth Bass <b>M:</b> none	<b>F:</b> skinless fillet	<b>F:</b> THg	Bed sediment, water
USGS; NAWQA Delaware River Basin Regional Survey	<b>F:</b> Brown Trout, Rock Bass, Smallmouth Bass <b>M:</b> none	<b>F:</b> skinless fillet	<b>F:</b> THg	Bed sediment, water
USGS; NAWQA Mercury Cycling and Bioaccumulation Study	<b>F:</b> Blacknose Dace, Blacknose Shiner, Brook Trout, Brown Bullhead, Common Shiner, Creek Chub, Cutlips Minnow, Fallfish, Golden Shiner, Largemouth Bass, Longnose Dace, Northern Redbelly Dace, Rock Bass, Smallmouth Bass, sunfishes <b>M:</b> Aeshnidae, Cambaridae, Heptageniidae, Hydropsychidae, Libellulidae, Limnephilidae, Phryganiidae, Plecoptera, Simuliidae, Tipulidae, Zygoptera	<b>F:</b> skinless fillet, whole <b>M:</b> whole	<b>F:</b> THg <b>M:</b> MeHg, THg	Bed sediment, water
USGS; NAWQA Status and Trends Study – Delaware River Basin	<b>F:</b> White Sucker <b>M:</b> none	<b>F:</b> liver	<b>F:</b> THg	Bed sediment, water
USGS; NAWQA Status and Trends Study – Hudson River Basin	<b>F:</b> Common Carp, White Sucker <b>M:</b> none	<b>F:</b> liver	<b>F:</b> THg	Bed sediment, water
USGS; NAWQA Status and Trends Study - Lake Erie-Lake Saint Clair Drainages Study	<b>F:</b> Northern Hog Sucker <b>M:</b> none	<b>F:</b> liver	<b>F:</b> THg	Bed sediment, water
USGS; Stream Fish Mercury Monitoring Project (NYSERDA)	<b>F:</b> Blacknose Dace, Brook Trout, Brown Bullhead, Central Mudminnow, Creek Chub, Northern Redbelly Dace, Slimy Sculpin, White Sucker <b>M:</b> none	<b>F:</b> whole	<b>F:</b> THg	None

**Table 4. Common and scientific names of fishes in Table 3 listed alphabetically by common name**

TSN, Taxonomic Serial Number from the Integrated Taxonomic Information System ([www.itis.gov](http://www.itis.gov)).

Common name	Scientific name	TSN	Common name	Scientific name	TSN
Alewife	<i>Alosa pseudoharengus</i>	161706	Largemouth Bass	<i>Micropterus salmoides</i>	168160
American Eel	<i>Anguilla rostrata</i>	161127	Logperch	<i>Percina caprodes</i>	168472
American Shad	<i>Alosa sapidissima</i>	161702	Longnose Dace	<i>Rhinichthys cataractae</i>	163384
Atlantic Salmon	<i>Salmo salar</i>	161996	Longnose Sucker	<i>Catostomus catostomus</i>	163894
Banded Killifish	<i>Fundulus diaphanus</i>	165646	Mirror Carp	<i>Cyprinus carpio</i>	163344
black bass species	<i>Micropterus spp.</i>	168158	Mottled Sculpin	<i>Cottus bairdii</i>	167237
Black Crappie	<i>Pomoxis nigromaculatus</i>	168167	Northern Hog Sucker	<i>Hypentelium nigricans</i>	163949
Blacknose Dace	<i>Rhinichthys atratulus</i>	163382	Northern Pike	<i>Esox Lucius</i>	162139
Blacknose Shiner	<i>Notropis heterolepis</i>	163446	Northern Redbelly Dace	<i>Chrosomus eos</i>	913993
Blueback Herring	<i>Alosa aestivalis</i>	161703	Pumpkinseed	<i>Lepomis gibbosus</i>	168144
Bluegill	<i>Lepomis macrochirus</i>	168141	Rainbow Trout	<i>Oncorhynchus mykiss</i>	161989
Bluntnose Minnow	<i>Pimephales notatus</i>	163516	Redbreast Sunfish	<i>Lepomis auritis</i>	168131
Brook Stickleback	<i>Culaea inconstans</i>	166399	Redfin Pickerel	<i>Esox americanus</i>	162140
Brook Trout	<i>Salvelinus fontinalis</i>	162003	Redhorse species	<i>Moxostoma sp.</i>	163927
Brown Trout	<i>Salmo trutta</i>	161997	Rock Bass	<i>Ambloplites rupestris</i>	168097
Brown Bullhead	<i>Ameiurus nebulosus</i>	164043	Round Goby	<i>Neogobius melanostomus</i>	172072
bullhead species	<i>Ameiurus sp.</i>	164034	Rudd	<i>Scardinius erythrophthalmus</i>	163613
Central Mudminnow	<i>Umbra limi</i>	162153	Slimy Sculpin	<i>Cottus cognatus</i>	167232
Central Stoneroller	<i>Campostoma anomalum</i>	163508	Smallmouth Bass	<i>Micropterus dolomieu</i>	550562
Chain Pickerel	<i>Esox niger</i>	162143	Spottail Shiner	<i>Notropis hudsonius</i>	163404
Channel Catfish	<i>Ictalurus punctatus</i>	163998	Striped Bass	<i>Morone saxatilis</i>	167680
Common Carp	<i>Cyprinus carpio</i>	163344	Stonecat	<i>Noturus flavus</i>	164013
Common Shiner	<i>Luxilus cornutus</i>	163836	sunfishes	<i>Lepomis spp.</i>	168130
Creek Chub	<i>Semotilus atromaculatus</i>	163376	Tessellated Darter	<i>Etheostoma olmstedii</i>	168360
Cutlips Minnow	<i>Exoglossum maxillingua</i>	163356	tiger muskellunge	<i>Esox masquinongy X lucius</i>	---
Eastern Mudminnow	<i>Umbra pygmaea</i>	162148	Walleye	<i>Sander vitreus</i>	650173

**Table 4 continued**

Fallfish	<i>Semotilus corporalis</i>	163375	White Catfish	<i>Ameiurus catus</i>	164037
Fantail Darter	<i>Etheostoma flabellare</i>	168394	White Crappie	<i>Pomoxis annularis</i>	168166
Fathead Minnow	<i>Pimephales promelas</i>	163517	White Perch	<i>Morone Americana</i>	67678
Freshwater Drum	<i>Aplodinotus grunniens</i>	169364	White Sucker	<i>Catostomus commersonii</i>	553273
Gizzard Shad	<i>Dorosoma cepedianum</i>	161737	whitefishes	<i>Coregonis spp.</i>	161932
Golden Shiner	<i>Notemigonus crysoleucas</i>	163368	Yellow Bullhead	<i>Ameiurus natalis</i>	164041
Goldfish	<i>Carassius auratus</i>	163350	Yellow Perch	<i>Perca flavescens</i>	168469
Lake Sturgeon	<i>Acipenser fulvescens</i>	161071			

**Table 5. Scientific and common names of macroinvertebrates in Table 3 listed alphabetically by scientific name**

TSN, Taxonomic Serial Number from the Integrated Taxonomic Information System ([www.itis.gov](http://www.itis.gov)).

Scientific name	Common name	taxonomic level	TSN
Aeshnidae	Darner dragonflies	Family	101596
Amphipoda	Amphipods	Order	93294
Anisoptera	Dragonflies	Suborder	101594
Belostomatidae	Giant water bugs	Family	103683
<i>Callinectes sapidus</i>	Blue crab	Species	98696
Cambaridae	Crayfishes	Family	97336
<i>Cambarus bartonii</i>	Appalachian brook crayfish	Species	97343
Chironomidae	Midges	Family	127917
Corixidae	Water boatmen	Family	103364
Corydalidae	Hellgramites	Family	115023
Ephemerellidae	Spiny crawler mayflies	Family	101232
Gastropoda	Snails	Order	69459
Gerridae	Water striders	Family	103801
Gomphidae	Clubtails	Family	101664
Gyrinidae	Whirligig beetles	Family	112653
Heptageniidae	Flat-headed mayflies	Family	100504
<i>Helisoma</i> spp.	Helisomid snails	Genus	76599
Hydropsychidae	Net-spinning caddisflies	Family	115398
Libellulidae	Skimmer dragonflies	Family	101797
Limnephilidae	Northern caddisflies	Family	115933
<i>Lymnaea</i> spp.	Lymnaid snails	Genus	76484
<i>Macromia magnifica</i>	Western river cruiser dragonflies	Species	206628
Mollusca	Molluscs	Phylum	69458
Nepidae	Water scorpions	Family	103747
Odonata	Damselflies, dragonflies	Order	101593
Oligochaeta	Oligochaetes	Subclass	68422
Perlidae	Common stoneflies	Family	102914
Perlodidae	Perlodid stoneflies	Family	102994
Phryganeidae	Large caddisflies	Family	115867
Planorbidae	Ram's horn snails	Family	76591
Plecoptera	Stoneflies	Order	102467
Psidiidae	Pea clams, fingernail clams	Family	81388
<i>Physa</i> spp.	Physid snails	Genus	76677
Rhyacophilidae	Primitive caddisflies	Family	115096
Simuliidae	Black flies	Family	126640
Tipulidae	Crane flies	Family	118840
Trichoptera	Caddisflies	Order	115095
Unionidae	Unionid clams	Family	79913
Zygoptera	Damselflies	Suborder	102042

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