Cover photos: Landsat 7 satellite image of western Lake Erie Basin and Detroit River corridor provided by USGS Landsat Project; Upper left: angler with walleye (*Sander vitreus*) by Jim Barta; Middle left: lake sturgeon (*Acipenser fulvescens*) by Glenn Ogilvie; Lower left: *Hexagenia* by Lynda Corkum; Center: lake whitefish (*Coregonus clupeaformis*) by James Boase/U.S. Fish and Wildlife Service; Lower right: juvenile peregrine falcon (*Falco peregrinus*) by Craig Koppie/U.S. Fish and Wildlife Service; Bottom left: bald eagle (*Haliaeetus leucocephalus*) by Steve Maslowski/U.S. Fish and Wildlife Service.

State of the Strait

Status and Trends of Key Indicators

Edited by: John H. Hartig, Michael A. Zarull, Jan J.H. Ciborowski, John E. Gannon,
Emily Wilke, Greg Norwood, and Ashlee Vincent

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STATE OF THE STRAIT
STATUS AND TRENDS OF KEY INDICATORS

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Edited by:

John H. Hartig, U.S. Fish and Wildlife Service
Michael A. Zarull, Environment Canada
Jan J.H. Ciborowski, University of Windsor
John E. Gannon, International Joint Commission
Emily Wilke, Southwest Michigan Land Conservancy
Greg Norwood, U.S. Fish and Wildlife Service
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www.StateoftheStrait.org
www.epa.gov/med/grosseile_site/indicators/index.html

5.0 Appendix A

State of the Strait Conference Program and Session Summaries

5.1 State of the Strait Conference Program

STATE OF THE STRAIT CONFERENCE PROGRAM
December 5, 2006
Flat Rock Community Center, Flat Rock, Michigan

8:00-8:30	**Registration and Breakfast**
8:30-8:35	**Welcome –** Canadian Consulate General Robert Noble and Flat Rock Mayor Richard Jones
8:35-8:45	**History of State of the Strait and Overview of Detroit River-Western Lake Erie Indicator Project –** Ms. Emily Wilke and Dr. John Hartig, U.S. Fish and Wildlife Service-Detroit River International Wildlife Refuge
8:45-10:00	**Land Use and Transportation/Population/Human Health Indicators Session** *Session Convenor -* Mr. John Nasarzewski, Southgate Anderson High School and Downriver Stream Team *Panelists* Mr. Matthew Child, Essex Region Conservation Authority Mr. Eric Foster, Michigan Department of Community Health Mr. Jim Rogers, Southeast Michigan Council of Governments
10:00-10:15	**Coffee Break**
10:15-11:30	**Fish/Invertebrate Indicators Session** *Session Convenor -* Dr. John Gannon, International Joint Commission *Panelists* Dr. Lynda Corkum, University of Windsor Mr. Bob Haas, Michigan Department of Natural Resources Fisheries Division Dr. Bruce Manny, U.S. Geological Survey-Great Lakes Science Center Mr. Stewart Thornley, Ontario Ministry of Environment
11:30-1:00	**Lunch and Poster Session**
1:00-2:15	**Wildlife and Habitat Indicators Session** *Session Convenor -* Mr. Bruce Szczechowski, Southgate Anderson High School and Downriver Stream Team

Panelists
Ms. Julie Craves, Rouge River Bird Observatory
Mr. Paul Cypher, Southeastern Michigan Raptor Research
Mr. Dan Lebedyk, Essex Region Conservation Authority
Mr. Phil Roberts, Essex County Field Naturalists
Dr. Chip Weseloh, Canadian Wildlife Service

2:15-3:30 **Contaminant Indicators Session**

Session Convenor - Ms. Melanie Coulter, Detroit River Canadian Cleanup

Panelists
Mr. Mike Alexander, Michigan Department of Environmental Quality
Mr. Charlie Bristol, Bristol Technical Services
Dr. Ken Drouillard, University of Windsor-Great Lakes Institute for Environmental Research
Dr. Chris Marvin, Environment Canada

3:30-3:45 **Coffee Break**

3:45-4:10 **Summary Talk on State of the Strait**
Dr. Jan Ciborowski, University of Windsor; Dr. John Hartig, U.S. Fish and Wildlife Service; and Dr. Michael Zarull, Environment Canada

4:10-4:55 **Facilitated Panel Discussions on "Where do we go from here?"**
Mr. Ted Briggs, Ontario Ministry of Environment
Ms. Rose Ellison, U.S. Environmental Protection Agency
Ms. Sandra George, Environment Canada
Dr. Russ Kreis, U.S. Environmental Protection Agency
Dr. Don Scavia, Michigan Sea Grant

4:55-5:00 **Concluding Remarks**
Dr. John Hartig, U.S. Fish and Wildlife Service
Dr. Michael Zarull, Environment Canada

5.2 State of the Strait Conference Session Summaries

On December 5, 2006, a State of the Strait Conference was convened in Flat Rock, Michigan to review available trend data, develop key findings, and discuss possible management actions and research needs. This State of the Strait Conference laid the foundation for a comprehensive and integrative assessment of the state of the Detroit River and western Lake Erie ecosystem. Presented below are the summaries from the individual conference sessions.

Land Use, Transportation, Population and Human Health Session Summary (prepared by John Nasarzewski)

There is a wide range of indicators being developed by the Detroit River-Western Lake Erie Indicator Project. It is important to understand the effects of land use changes, transportation patterns, and population trends on the ecosystem. Further, it is important to recognize that humans are a part of the ecosystem and that human health trends are an important part of assessing the state of the strait.

Once known as the "Paris of the Midwest," Detroit initially experienced dramatic population growth, followed by urban sprawl and associated disinvestment in the inner city. The growth of Detroit from 1910 to 1930 is similar to the growth of Las Vegas, Nevada today, a city growing rapidly in population and investment. What makes it more dramatic is that the same amount of growth in Detroit was achieved when the population of the United States was just over 100 million versus 300 million today! Even when the rapid growth slowed during the Great Depression, Detroit was still one of the fastest growing cities in the United States. Detroit's population was just under two million residents in 1950 and there are approximately 900,000 today.

What was not envisioned at that time was the enormous changes that were about to transform the well-functioning, centralized urban center of Detroit. It suffered from rapid suburban growth and subsequent urban decline. Even today, that trend continues; the Southeast Michigan Council of Governments estimates that southeast Michigan's population will grow by 10%, but consume 30% more land over the next 25 years. Furthermore, two-thirds of the region's growth will take place in 32 communities in the outer suburbs, consuming 250,000 acres of rural land instead of reclaiming land near existing city centers.

These changes impact the quality of life for everyone who lives in the region. It is clear that human population growth and, more importantly, urban sprawl can:

- increase impervious surface and lead to storm water runoff problems;
- decrease wildlife habitat;
- increase susceptibility to biological invasions;
- increase water and air pollution;
- increase herbicide and pesticide use; and
- adversely affect human health.

This growth itself is encouraged by the transportation management policies at the state and federal levels. Instead of discouraging new road construction into green space and encouraging reclamation of existing areas in established communities, policies favor green space consumption. Such sprawl then further reduces the likelihood of improvements in a mass transportation system, which is much needed for the daily commutes of residents. In cities such as Chicago and Boston, mass transit is a more efficient option for all residents, thanks to higher population density and farsighted policies. Instead, since the 1950s, fewer and fewer people in southeast Michigan are using mass transportation and more individuals are driving greater distances to work.

Urban sprawl and its subsequent increase in vehicle use is one source of the region's air pollution. The Detroit metropolitan area is not considered in compliance with the National Ambient Air Quality Standards for both ozone and particulates, and these two pollutants are most closely linked to triggering symptoms of asthma. Even as the pollution per kilometer or mile driven has decreased from our vehicles, more cars and trucks on the road and more kilometers driven has contributed to the continued problems with air quality in southeast Michigan. Rates for hospitalization due to asthma in Wayne County average over 75% higher than in the state of Michigan as a whole and have remained this high since 1990. This may be an underreported figure because in the United States, the number of individuals without health care has increased and individuals who suffer breathing problems may be going untreated or at least unreported.

Along with the air quality problems most commonly associated with urban sprawl, there is also an increase in electric power usage associated with the increase in average size and number of housing units. Data from the National Association of Home Builders show that the average home built in 1970 (with larger families) was 1,400 square feet in comparison with 2,330 square feet in 2004. These new homes are often positioned on the lot without consideration for the natural cycles of the sun, wind and vegetative cover to allow nature to help heat and cool the home. Rather, they are built to be either heated or air-conditioned using traditional energy resources. Both of these factors create increased demand for electrical power, which then contributes to the air pollution problem. Most residents in northeastern North America and the Great Lakes region remember the August 2003 blackout when 100 coal-fired plants were shut down. What is not widely known is that a study by a University of Maryland research team revealed how large a role our need for electrical power has in these emissions problems. The Maryland team sent up two light aircraft over the affected areas the day after the blackout started. The data were then compared to similar tests from the previous year that had the same atmospheric condition. The day after the blackout, sulfur dioxide dropped by 92% and ozone by more than 50%, along with other air pollutant reductions.

In summary, southeast Michigan faces some enormous challenges that directly impact the quality of life of all residents. The indicators of changing land use and transportation are linked to adverse effects on the ecosystem. Other models and examples of community development exist that encourage green space preservation and redevelopment in city-center space. Once urban sprawl is decreased and population density increased, mass transit becomes more viable. This, in turn, reduces traffic congestion, reduces pollution, reduces human health effects and increases our quality of life. While such changes do not happen overnight, many other communities have shown that it can be done.

Wildlife and Habitat Session Summary (prepared by Bruce Szczechowski)

Conserving and restoring habitat is the best way to protect and increase biodiversity in the Detroit River and western Lake Erie. From an inauspicious start of 123 hectares (304 acres) in 2001, the Detroit River International Wildlife Refuge has grown to 2,042 hectares (5,047 acres) in just six years, with a targeted goal of 4,856 hectares (12,000) acres of marshes, wetlands, islands, shoals and upland habitats in the Detroit River-western Lake Erie corridor.

In order to support diverse ecological communities in this region, it is imperative that wetlands along the Detroit River be protected and restored. Two hundred years ago, coastal wetlands were extensive along the Detroit River. Today, only 3% of the original wetlands remain along the Detroit River, resulting in the loss of many fish spawning and nursery grounds, and wildlife nesting, foraging and shelter habitats. Communities must be encouraged to protect and restore wetlands for fish and wildlife habitat, and for improvement of water quality and flood control. Wetland protection laws must be enforced, and volunteer restoration efforts and soft engineering projects must be encouraged and supported in areas with high likelihood of success (e.g., Grosse Ile's Gibraltar Bay project).

Reestablishment of suspended/submersed aquatic macrophytes in western Lake Erie is important, since increasing plant diversity will lead to more diverse and stable ecosystems. In 1898, a western Lake Erie survey recorded 40 species of aquatic macrophytes. By 1967, 50% of the aquatic macrophytes had disappeared as a result of algal blooms and subsequent reduced light availability. As light availability improved, macrophyte diversity began to rebound between 1968 and 1995. In recent years, two more pondweed species (*Potamogeton nodosus* and *P. zosteriformis*) have reestablished themselves and are flourishing. In addition, *P. illinoiensis* may possibly become a reproducing component in the flora of Put-in-Bay and recolonization by other species is not unexpected. However, further research is needed to determine the effects of resurgent *Cladophora* – a green, filamentous alga. It is imperative that monitoring for new invasive organisms be rigorously pursued. Policy changes must be made at the state and national levels to prevent ongoing introductions of invasive species into the Great Lakes.

Wild celery (*Vallisneria americana*) is an aquatic macrophyte of particular importance as a food source for diving ducks. Wild celery growth is also a water quality indicator, as it is sensitive to chemical contaminants. Prior to the 1900s, Detroit River wetlands were up to 1.6 km (1 mile) wide along both Canadian and U.S. coastlines, providing abundant areas for wild celery growth. From 1950 to 1985, oil pollution and filling of wetlands resulted in marked decreases in wild celery beds at several locations. Around the mid-1980s, colonization by zebra mussels brought about changes in water clarity which, along with improved water quality, resulted in increased wild celery abundance. Implementation of pollution abatement programs to improve water quality and clarity, which encourages the continued recovery of wild celery beds, should be a priority, along with preservation of remaining coastal wetland habitats and the rehabilitation of degraded ones to support wildlife populations.

Canvasbacks (*Aythya valisineria*) and other waterfowl use the Detroit River as stopover habitat during spring and fall migrations. The canvasback requires large amounts of food such as wild celery, as well as pondweeds, sedges and other aquatic plants during migration to and from its central Canadian breeding grounds. The population of canvasbacks declined drastically from 100 years ago to the mid-1970s as a result of droughts, market hunting, development, industrial/sewage discharges adversely impacting wild celery beds and agricultural conversion of wetland breeding areas. In 1974, the migrating canvasback population in the Detroit River was only 125. The population increased dramatically with effective conservation efforts, rainfall in breeding areas, and the aforementioned recovery of wild celery beds, peaking in 1999 at 79,300. Since 1999, however, there has been a precipitous drop in canvasback numbers surveyed. One reason for the declining trend may be due to delayed migration, resulting in more canvasbacks migrating later in the fall after the November 5th flyover survey. It is also possible that canvasbacks may be undergoing a population shift to other locales in the Great Lakes during their cross-continental migrations. Since southeast Michigan and connecting waters have been one of the most important flyways for migrating canvasbacks, as well as other waterfowl, wetland stopovers in the Lake St. Clair-Lake Erie corridor must be protected and rehabilitated.

The Christmas Bird Count (CBC) in the Detroit River-western Lake Erie region includes the more northerly Detroit River Christmas Bird Count, as well as the more southerly Rockwood Christmas Bird Count. These counts circumscribe areas of 24.1 km (15 miles) in diameter and include parts of the U.S. and Canada. In the Detroit River CBC, 35 species have been observed over the past 27 years, including the Canada goose. Since reintroductory efforts in the 1920s-1930s, the Canada goose population has grown 14% annually. There has also been a steadily increasing trend for mute swans from 1986 to 2004. The mute swan, a nonnative, aggressive, invasive species from north-central Asia and Europe, has been spreading throughout the U.S. since the 1920s, displacing native waterfowl by taking over preferred nesting habitat and damaging beds of submersed vegetation, such as wild celery.

In the Rockwood CBC, low numbers of American crows (average 1975-2001 = 636; 2002-2004 = 35) in recent years likely reflect mortality due to West Nile virus. The ratio of American black duck to mallard now is 1:17, with one reason being that mallards are much more adaptable to urbanization than American black ducks. For future CBCs, use of GPS for more accurate recording of observation locations will help to ensure consistency of areas covered. There is a need for consistency in count hours and efforts by volunteers. Additionally, more attention should be paid to weather conditions, as average weather conditions for the weeks and month preceding the count day may affect waterfowl counts.

Though the double-crested cormorant (*Phalacrocorax auritus*) is not believed to have established a presence in the Great Lakes until the early 1900s, it has undergone a population explosion in recent years throughout the Great Lakes, including western Lake Erie and the Detroit River. The cormorant is a colonial-nesting waterbird that feeds on small fish, mainly forage fish such as alewife and gizzard shad, but they also consume sport fish. The cormorant population slowly increased until the mid-1950s (to approximately 1,000 pairs), at which time a sharp decline in reproductive success ensued, caused by adverse reproductive effects of DDT and its metabolite, DDE, as well as PCBs. Banning or limiting use of these persistent toxic substances in the 1970s and 1980s was followed by an exponential growth of the cormorant population in the Great Lakes in the 1980s and early 1990s. Today, with populations at an all-time high (in excess of 30,000 pairs), concerns are mounting over the cormorant's potential impact on fisheries, degradation of native Carolinian forest vegetation from its fecal waste, and its displacement of co-occurring species from nesting habitat, such as egrets and herons. Monitoring and research are needed on the double-crested cormorant and its effects on fish, wildlife and vegetation in western Lake Erie and the Detroit River.

Another colonial-nesting waterbird is the common tern (*Sterna hirundo*), which is fast-disappearing from Michigan waters everywhere, particularly the Detroit River, where populations plummeted from over 4,000 pairs in the 1960s to less than 300 pairs today. Reasons for the decline are thought to include sensitivity to contaminants, vegetative overgrowth of habitat, human development on islands formerly used for nesting, and competition for nesting sites with ring-billed gulls. After extensive observations during the past four years of common terns nesting on man-made bridge structures in the Trenton Channel (Grosse Ile Free and Toll Bridges), it has become apparent that this state-threatened species is being impacted by black-crowned night heron predation. It is imperative that predator control structures be erected at current nesting sites, as well as restoring more nesting areas for common terns with predator controls installed at the outset. The latest habitat restoration effort took place at the DTE Energy River Rouge Power Plant in the fall of 2006, with Southgate Anderson High School students helping to move 73 meters (80 yards) of sand and gravel onto abandoned mooring cells. The site was retrofitted with a predator control structure in the spring of 2007. Other potential sites for nesting habitat include BASF's Hennepin Point property, Mud Island, Humbug Marsh, inside Pointe Mouillee's banana dike and possibly Belle Isle.

Another avian species decimated by toxic chemicals is the national symbol of the United States, the bald eagle (*Haliaeetus leucocephalus*). At the top of the food web, eagles nesting near Great Lakes shorelines have historically been more adversely affected by toxic contaminants in the Great Lakes food web than eagles nesting further inland. Coincident with reduction of toxic chemicals, such as DDT and PCBs, the population of bald eagles in the western Lake Erie and Detroit River region has seen an upward trend from the early to mid-1980s to the present time, with Ohio bird populations faring much better than populations in Michigan and Ontario. The bald eagle was recently removed from the federal endangered species list. Though it is apparent that the bald eagle is recolonizing former Great Lakes habitats, including western Lake Erie and the Detroit River, they remain extremely vulnerable to human disturbance, contaminants and habitat loss. Therefore, continued monitoring is essential for gauging the contaminant levels and reproductive status of the bald eagle.

The peregrine falcon (*Falco peregrinus*) is globally rare and another raptor residing at the top of the food web that has been hit especially hard by toxic contaminants, such as DDT. After the population crashed in the 1950s, the peregrine falcon was listed as endangered in 1970; no birds were observed east of the Mississippi River at that time. Reintroduction efforts began in 1982, including urban areas. Reintroductions in Michigan began in 1991, with the raising and release of 139 peregrine falcons. The number of nesting pairs and sites has been slowly increasing in southeast Michigan. Currently there are six nesting pairs of peregrine falcons in the Detroit River corridor with the goal of at least ten nesting pairs. The peregrine falcon was removed from the endangered list in 1999, but there is a need in the Detroit River corridor to continue protecting and enhancing habitat and monitoring its reproductive success and population recovery.

Fish and Invertebrate Session Summary (prepared by John Gannon)

A newspaper reporter once called me a "physician of lakes" because I was assessing the ecological health of inland lakes in the northern Lower Peninsula of Michigan. So, just as a medical doctor uses certain tests (e.g., blood sample, blood pressure, pulse, etc.) as indicators of your health, aquatic ecologists use indicators of the ecological health of rivers and lakes. In the Detroit River and western Lake Erie, as in water bodies elsewhere, invertebrates (plankton and benthos) and fish make particularly good indicators because of their importance in the food web. Many species of plankton (i.e., free-floating or free-swimming organisms) and benthos (i.e., bottom-dwelling organisms) form the base of the food web that supports the fish community. Fish, of course, are important in river and lake ecology, and provide economically valuable fisheries.

Studies of Detroit River and western Lake Erie phytoplankton (i.e., microscopic plants or algae) and zooplankton (i.e., microscopic animals) communities date back to the late nineteenth and early twentieth centuries, but they have been sporadic. Therefore, it is often difficult to determine status and trends over time using the available data. In some cases, observational information is useful in the absence of data collected consistently over time using comparable methods (an essential requirement of a good indicator). For example, a "picture is worth a thousand words" when observing high concentrations called "blooms" of blue-green algae (cyanobacteria) on or near the water surface and heavy growths of the macro-alga, *Cladophora*, smothering nearshore habitats and forming stinking, rotting mats on beaches. Both blue-green blooms and extensive *Cladophora* growths, once prominent in the 1960s and 1970s, became much less prevalent in the 1980s in response to water quality improvements, especially reductions in phosphorus. In the 1990s, blue-green algal blooms reappeared and are continuing into the 2000s while nuisance growths of *Cladophora* reoccurred in the 2000s. These are possible indicators of declining water quality in recent years, but factors involved with infestations of zebra and quagga mussels may be at least partially responsible also. In any case, the resurgence of algal blooms and excessive *Cladophora* growths is a concern and monitoring and research need to be continued on these likely indicators of declining ecosystem quality.

Sometimes, individual species of plankton can be used as an indicator, but more often, attributes of the entire plankton community can indicate ecological health. One such plankton community indicator, the Planktonic Index of Biological Integrity (P-IBI), has recently been developed to describe the offshore waters of Lake Erie. It is based on five measures of the abundance and kinds of phytoplankton and zooplankton. The index is especially designed to indicate the response of the plankton community to nutrient pollution, especially phosphorus. The P-IBI values are lower for the 2000s in comparison with the mid-1990s, indicating a possible decline in water quality in recent years.

Perhaps the best benthic indicator in the Detroit River and western Lake Erie is the burrowing mayfly, *Hexagenia*. It is a sensitive indicator of water and bottom sediment (mud) quality, and many fish species feed on *Hexagenia*. It was formerly abundant, but was extirpated in the early 1950s because of pollution. Ecologists heralded the reappearance of *Hexagenia* in the early 1990s as an indicator of improved water and sediment quality in the Detroit River and western Lake Erie.

The density of oligochaetes (worms) and chironomids (midge larvae) in bottom sediments is also a useful indicator of pollution and ecosystem health. Excessively high densities are often an indicator of nutrient pollution, and excessively low densities an indicator of toxic pollution. In addition, deformities of teeth in the head capsule of chironomids are used as an indicator of pollution. The distribution and density of oligochaetes and chironomids in the Detroit River corridor is a function of sediment type, as well as pollution. In general, pollution, as indicated by these benthic communities, is historically worse in the Trenton Channel and continues today.

Observations have been made of lake whitefish spawning and increases have occurred in the lake sturgeon population in the Detroit River and walleye and yellow perch populations in western Lake Erie. In general, these indicators collectively represent a "good news" story of improving ecosystem quality and sound fishery management. During the late nineteenth and early twentieth centuries, lake whitefish entered the Detroit River from Lake Erie in spectacularly large fall spawning runs. These spawning runs practically disappeared in the early 1900s due to habitat loss (especially the loss of spawning habitat due to construction of the Livingstone Channel), habitat degradation, overfishing, and pollution. Lake whitefish numbers were at an all-time low in the 1960s and 1970s in Lake Erie, started a modest recovery in the 1980s, and the recovery has continued into the 1990s and 2000s. The first confirmed spawning and successful reproduction of lake whitefish in the Detroit River since 1916 was documented in 2006.

The lake sturgeon story in the Detroit River closely parallels that of the lake whitefish. The lake sturgeon population was abundant in Lake Erie and the Detroit River in the 1800s and the Detroit River was one of the most productive sturgeon spawning grounds in North America. The population declined from a combination of the above-mentioned factors in the early 1900s and remained at extremely low numbers throughout most of the twentieth century. In the 1990s, lake sturgeon began a modest recovery and the first reported sturgeon spawning in the Detroit River in over three decades occurred in 2001.

Walleye live and breed in Lake Erie and the Detroit River. As adults, walleye are top predators in Lake Erie and Detroit River food webs and this position makes them good indicators of ecosystem health. Walleye populations generally declined through the mid-twentieth century, and in 1970 a legal walleye harvest was prohibited due to mercury contamination coming from the St. Clair and Detroit rivers. The industrial source of mercury contamination was eliminated and a limited legal harvest was renewed in 1972. Through a combination of harvest quota management and improving water quality, the walleye population increased in the 1980s and developed into a fishery of enormous economic importance. However, in the late 1980s a decline in the walleye population occurred. The last five years has seen variability, yet an increase to a rating of "high quality" in 2005. Fishery managers are adjusting harvest quotas and monitoring walleye populations and their food base in an effort to maintain and sustain the walleye population for commercial and recreational use and its keystone position as Lake Erie's and the Detroit River's top predator fish.

The yellow perch is lower in the food web than walleye, and its population normally fluctuates more widely than walleye in Lake Erie and the Detroit River. It is highly prized as a sport and commercial fish and on the dinner table. The catch peaked in the late 1880s and decreased substantially thereafter, reaching a population low in the early 1990s, possibly due to the invasion of zebra and quagga mussels. Since the late 1990s, yellow perch populations are once again increasing, coinciding with the return of *Hexagenia*, an important food source.

In summary, the public has long held the perception that the Detroit River and western Lake Erie are polluted. Although there is need for further improvement, the fish and invertebrate indicators show overall improvement in ecosystem quality over recent decades in response to water quality and habitat improvements and sound fishery management. Some indicators are showing recent (past 5-10 years) declines in ecosystem quality. This emphasizes the importance of continuing the monitoring of fish and invertebrate indicators to assist with science-based resource management and policy decisions in the Detroit River and western Lake Erie.

Contaminants Session Summary (prepared by Melanie Coulter)

Over the past century, contaminants of various sorts have caused a variety of problems in the Detroit River and western Lake Erie. These range from DDT (which causes bald eagle eggshell thinning and mortality) to oil spills (which cause large bird die-offs) to mercury (which continues to give rise to fish consumption advisories). Contaminants enter the river and lake in several ways, including point source discharges from industry and sewage treatment plants, nonpoint source runoff from urban and agricultural areas, airborne deposition, and from upstream sources which travel through the Detroit-St. Clair corridor. Some of the contaminants in the river are not from current sources, but are the residue of historical contaminants that have settled into the river bottom sediments. They can be released from those sediments during storm events or dredging activities, or they may be ingested by bottom-dwelling organisms.

It is difficult to give a clear answer as to whether the indicators demonstrate an overall improvement or deterioration in the contaminant situation. Some of the indicators show an improvement, while others do not. An accurate assessment would be to characterize the results as mixed, with generally improving trends.

Discharges of liquid and solid waste from agricultural and domestic sources have introduced toxic substances into the waters of western Lake Erie. Over the years, these contaminants have accumulated in successive layers at the bottom of the lake, providing a historical record of natural and anthropogenic events. The ongoing goal is to see a reduction in the levels of contamination in these sediments, and research demonstrates that levels are decreasing. Research on Lake Erie in 1971 found that the highest total mercury and DDT concentrations occurred in the western basin near the mouth of the Detroit River, while the highest PCB concentrations were found along the southern shore of Lake Erie, particularly the western half. Fifty of the original 259 sites were revisited by Environment Canada in 1995. On that occasion, researchers found that the levels of PCBs and organochlorides in sediments had decreased considerably, although they were still highest in the western basin of Lake Erie. Further research in 1997 found that although the levels of contaminants in western Lake Erie sediments were decreasing, they still exceed Canadian Threshold Effect Level guidelines and U.S. Threshold Effect Concentrations. In addition, levels of mercury, PCBs, dioxins, and furans still exceed the Ontario Lowest Effect Level.

All of the Areas of Concern around Lake Erie have some areas of contaminated sediment, which have been an obstacle to the full restoration of beneficial uses. However, efforts have been made in the Detroit River to clean up some of these contaminated sites. Between 1993 and 2006, almost one million cubic meters of sediment have been remediated at twelve project sites at a cost of $154 million. Some of these sites include

Elizabeth Park Marina, Conners Creek, and Ellias Cove (formerly Black Lagoon). Unfortunately, these projects only represent 33% of the total contaminated sediments in the basin. The Michigan Department of Environmental Quality estimates that approximately 2.3 million cubic meters of contaminated sediments remain, particularly in the Trenton Channel, Rouge River, and River Raisin.

In the 1970s, phosphorus was identified as the primary nutrient limiting algal growth in the Great Lakes. As a result, the Ontario Ministry of the Environment began analyzing untreated water samples taken from the Union Water Treatment Plant intakes at Kingsville, Ontario on a weekly basis. During the years since the program began, there have been three detectable periods of trends. An increase was noted in the years from 1976 to 1983, and a decrease from 1983 to 1994. Since 1994, the mean total phosphorus has again been increasing, but the pattern is not consistent with loadings from point or nonpoint sources. Additional research is required to determine the causes of this increase, as well as to what degree these nearshore intake samples are representative of the western basin of Lake Erie as a whole.

The Detroit Wastewater Treatment Plant (WWTP) was constructed in 1940, and treats the waste of over three million people (over 2.6 billion liters or 700 million gallons of wastewater) every day. For years, the plant had the dubious distinction of being the largest single phosphorus contributor to Lake Erie. However, between 1966 and 2003, there was a reduction of more than 90% in phosphorus concentrations and loadings from the Detroit WWTP to the river. Although the plant is still a major point source contributor to Lake Erie, nonpoint phosphorus sources are now a major factor as well. Ongoing management to continue to reduce levels is required, as well as better estimates of phosphorus loadings to Lake Erie to accurately assess the current situation.

Chlorides (in small amounts) are required for normal cell functions in plants and animals. However, at high concentrations, chloride is toxic to aquatic biota. Lake Erie has a chloride concentration at least three times that of Lake Huron because of its shallowness and relatively small water volume, and because of significant urban and industrial inputs of chloride. Chloride levels have been monitored in western Lake Erie for the past century, and during that time there have been three detectable trend periods. Although there is seasonal and year-to-year variability, there was an increase noted from the early 1900s through the 1960s, followed by a decreasing trend from 1968 to 1985 which can be attributed to reduced point source loadings to the Detroit River when industries ceased operations. From the late 1980s to the present, there appears to be an increase in chloride concentrations. That rise may be attributable to increases in nonpoint sources, such as agricultural runoff, highway deicing, and streambank erosion.

The Detroit River is an essential resting and feeding ground for migrating waterfowl, and is generally a good habitat for waterbirds. However, when oil spills occur, they can be devastating to wildlife. External oil causes loss of buoyancy, elimination of the insulation properties of feathers, and reduced swimming ability. Oil contamination of eggs will decrease their hatchability, and the ingestion of oil by birds causes sickness and mortality. Unfortunately, between 17% and 40% of all reported oil spills in Michigan occur in the Detroit and Rouge rivers. A major spill in 1948 resulted in the death of 11,000 ducks in the Detroit River. However, there was a 97.5% reduction in oil discharges between the late 1940s and the early 1960s, and an additional 80% decrease in discharges between 1963 and 1976. Spills such as the one in 1948 have not occurred since that time. However, there are still years in which the volume of oil spilled is comparable to 1961 values, including a 378,540 liter (100,000 gallon) spill in the Rouge River in 2002, which resulted in a $7.5 million cleanup of 43 kilometers (27 miles) of shoreline and the death of at least ten waterfowl. In addition to these reported spills, there are many unreported spills and releases through combined sewer overflows that are not counted.

In 1977, the Canada Department of Fisheries and Oceans began monitoring the contaminant burdens of representative top predator and forage fish species from western Lake Erie to measure the success of remedial actions. Unfortunately, it is difficult to draw many conclusions from the results because invasive species are exerting pressure and causing changes in chemical cycling and energy flows, although the overall results seem to be demonstrating a downward trend. In rainbow smelt, concentrations of mercury were variable, while concentrations of PCBs and DDT declined over the period. However, levels of all three contaminants show a spike in 2002 which could not be explained. In walleye over the same time frame, there was more variation among contaminants. Mercury showed a rapid decline from 1977 to 1983, a leveling off, and then increases in 1999, 2003, and 2004 (although with less variability than levels in smelt). Total PCB levels were lower in the 1980s and 1990s compared to the late 1970s, although concentrations have fluctuated (as they have for smelt). DDT levels have declined by an order of magnitude since 1977, with the 2003 concentration being the lowest measured since the program began. The key element in the reduction of these contaminants in fish is to control the contaminants at their source.

Herring gulls (*Larus argentatus*) are an ideal species with which to track contaminants because they are year-round residents of the Great Lakes, easy to study and locate, tend to return to the same nest sites, and are a top food web predator. Environment Canada's Canadian Wildlife Service has monitored herring gull eggs for decades, and this study provides a good, ongoing dataset with which to assess trends. Herring gulls in western Lake Erie and the Detroit River have been studied on Middle Island and Fighting Island. There was a significant decrease in levels of PCBs from the mid- to late 1970s to the early 1990s, followed by a nonsignificant decreasing trend from the early 1990s to the early 2000s. This represents an 83% decline on Fighting Island, and a 75% decline on Middle Island during the study period. For dioxin, there is a general pattern of lower concentrations in the late 1990s and early 2000s when compared to the period from the mid-1980s to the mid-1990s, with the exception of an elevated dioxin concentration on Fighting Island in 2003. Other positive indications are that, in addition to reductions in levels of persistent toxic contaminants, reproductive success has improved and visual abnormalities are now seldom seen.

In its elemental form, mercury is not regarded as a major contaminant in water because it is almost completely insoluble. However, in sediments, it can be transformed by microorganisms into a more soluble and toxic form. There are currently fish consumption advisories in western Lake Erie and the Detroit River due to elevated mercury levels. Mercury problems reached their peak during the Mercury Crisis of 1970 when elevated mercury levels forced the closure of the fisheries from southern Lake Huron to Lake Erie. However, research has demonstrated that the mercury content in Lake St. Clair walleye has decreased by more than 80% during the period from 1970 to 2004; a similar reduction is also evident in other fish species. Currently, the primary sources of mercury are contaminated sediments from historic discharges and airborne deposition. In addition to other steps required to remediate sediments contaminated with mercury, the control of mercury emissions at their sources remains an imperative.

At the State of the Strait Conference, two key steps were identified as necessary to adequately deal with issues related to contaminants. First, better loading and ecosystem models and monitoring are needed to help assess where the contaminants originate and how they are influencing species and ecosystem health. Secondly, funding is required to address known problems, including the remediation of contaminated sediments, elimination of point sources, and prevention of nonpoint source loadings. Contaminant loadings and contaminated sediment are long-standing issues in the Detroit River that will take a cooperative effort by governments, industries, and surrounding communities to resolve. However, it is clear that such efforts are already underway and seem to be making a difference in some of the indicators.