Before The State of Wisconsin
Department of Natural Resources

PETITION BY CITIZENS FOR THE ADOPTION OF RULES TO GOVERN MERCURY EMISSIONS TO THE AIR AND SPECIFICALL Y REQUIRING REDUCTIONS FROM THE LARGEST SOURCES OF MERCURY EMISSIONS WHICH CONTRIBUTE TO MERCURY DEPOSITION TO WISCONSIN LAKES AND RIVERS

Citizen Petition for Rules Docket No. _____

TO: Secretary of the Department of Natural Resources, and the
Natural Resources Board
P.O. Box 7921
Madison, Wisconsin 53707

The undersigned citizens of the State of Wisconsin hereby petition the Wisconsin Department of Natural Resources (WDNR) and the Natural Resources Board to conduct rulemaking to adopt administrative rules which require the reduction of mercury emissions to the air, which are subsequently deposited in surface waters and bioconcentrate in game fish, from the largest known sources of such emissions under the authority given to the Department in section 285.11 (9) Wis. Stats.

This petition is filed pursuant to the provisions of 227.11 (2) (a) and 227.12 (1) and (2), Wis. Stats., and Wisconsin Administrative Code NR 2.05. A petition for rulemaking must state the substance or nature of the rule requested, the reason for the request, the petitioners' interest in the requested rule, and a reference to the agency's authority to promulgate the requested rule, 227.12 (2), Wis. Stats. This petition fulfills these requirements and describes why rules are urgently needed.

PETITIONERS

Petitioner Phil Emmling joins in this petition as an angler and as the Vice President of the Great River Council of the Federation of Fly Fishers, whose membership is 800. Many anglers within the group fish for species that are not frequently affected by mercury, such as trout. However, largemouth and smallmouth bass are fished often, and also appear on every page of the Wisconsin fish consumption advisory for mercury. The group feels strongly that mercury reduction is essential to protect the health of people and fisheries.

Petitioner Sandy Lyon joins in this petition as Executive Director of Anishinaabe Niijii/Protect The Earth's W.A. T.E.R. Campaign, whose mission it is to bring together the Native and Non-Native communities to protect the earth for Seven Generations yet to come. Sandy is concerned that poor people are significantly more threatened by mercury poisoning because of their reliance on fresh fish for food. Specifically, Sandy has seen the Anishanaabe in Northern Wisconsin and the Lake Superior region eating a great deal of large game fish, like walleye, that are associated with high mercury levels. She feels that mercury warnings are inadequate, and that it is unjust to delay action that will make fish a healthy food source for all.

Petitioner John Durben joins in this petition as President of the Green Bay Area Great Lakes Sport Fishermen (GBABLSF) and individually as an angler spanning a period of over 45 years. John as well as members of GBAGLSF have serious concerns about the poisoning of Wisconsin's lakes through the emission of mercury contaminants. They are concerned about the affects of the consumption of mercury-laced fish both for this generation and generations to come. They believe that now is the time to reverse the current trend and adopt rules that will have a positive affect on our environment.

Petitioner Ron Vander Loop joins in this petition individually as a Wisconsin fisherman and as president of the Brown County Conservation Alliance (BCCA). A special concern is what the results of mercury contamination will be on the reproductive capacity in fish, wildlife and humans in the future. Myself and the twelve member clubs of the BCCA strongly support the requested rules recognizing that they are critical to making sport fish safe for consumption.

Petitioner Pete Petrouske joins in this petition individually as a longtime Wisconsin angler with young grandchildren and in my capacity as a Wisconsin Department of Natural Resources Certified Angling Instructor who has taught fishing classes at two different schools in Green Bay. I am very concerned with the mercury contamination of fish in Wisconsin's waters. Sport fish must be made safe for consumption by our young anglers.

Petitioner Kerry Schumann joins in this petition as the Director of the Wisconsin Public Interest Research Group (WISPIRG). WISPIRG is a nonpartisan, nonprofit public interest organization advocating for a safe and healthy environment. WISPIRG is concerned about the impact mercury has on Wisconsin's environment and the health of Wisconsin's citizens. With a known 853 river miles and 117,000 lake acres under mercury advisory 1 Wisconsin is in need of strong rules to eliminate more mercury entering our environment. WISPIRG is particularly concerned with addressing the largest source of mercury contamination -coal-fired power plants. WISPIRG has about 15,000 members across the state of Wisconsin.

Petitioner Todd Ambs joins in this petition as an angler and as Executive Director of the River Alliance of Wisconsin, which has a membership of 1500 individuals and businesses that believe a healthy river is the heart of a healthy community. Segments of major rivers, such as the Wolf and Wisconsin, have mercury warnings for certain fish. Additionally, many of the rivers on the Impaired Waters List are so designated because of mercury. Reducing mercury emissions from the largest sources, coal-burning power plants, would help restore the health of these rivers while protecting others from future mercury pollution.

II. NATURE OF THE REQUESTED RULES

The petitioners request Wisconsin DNR and the Natural Resources Board to promulgate the following:

1) A rule which creates a comprehensive program in the DNR for addressing mercury in the environment including:

--mercury deposition and monitoring activities --other mercury research
--public information and education outreach in coordination with the Health Dept. --technical assistance for stationary sources of mercury
--cooperative mercury reduction activities with neighboring states and federal government
--activities to reduce mercury emissions from small (purposeful use) sources --activities to address problems associated with long-term storage of mercury --activities to address the effectiveness of this program for reducing mercury in the environment
--activities to minimize the release of mercury into the environment from coal ash and other solid waste streams
--any other component identified by the Department

2) A rule which requires the Department to appoint a mercury control council of up to 12 members, including representatives from environmental and sport fishing organizations, Native American tribes, health and industry professionals, for the purpose of advising the department on mercury reduction strategies and activities.

3) A rule which requires the Department to determine a baseline mercury emission level for each regulated source by averaging the annual mercury emissions in 1997, 1998 and 1999.

4) A rule which requires the Department to place a cap on 1999 emissions from each regulated and non-regulated source and not allow any new sources of mercury or modifications at existing sources which result in increased emissions unless that source obtains mercury emission reductions equal to 150% of the annual mercury emission increase.

5) A rule which requires the Department to require a 90% reduction in mercury emissions by the year 2010 from:

--all utility boilers with more than 10 pounds of mercury emissions in a year
--all government-owned boilers with more than 10 pounds of mercury emissions in a year
--all municipal waste incinerators --all medical waste incinerators --all chlor-alkali plants
--other sources of mercury air emissions the Department determines to be significant and reasonably (in terms of technology and cost-effectiveness) regulated. (Utility and government-owned boilers would not be required to reduce below 10 pounds of mercury emissions in a year.)

6) A rule which requires the Department to set any interim reduction requirements for regulated sources above that it deems useful including at least a 25% reduction by the year 2006.

7) A rule which requires fines and other disincentives for non-compliance with the caps and reductions required above.

8) A rule which allows that if the department, in conciliation with the Public Service Commission, determines that compliance with any of the reduction requirements is not technically feasible, would jeopardize electric reliability or cause unreasonable hardship, the department may issue a variance for up to 2 years from part or all of the requirement as long as the variance will not result in undue harm to human health or the environment.

III. REASONS FOR THE REQUEST

1) The Wisconsin Department of Natural Resources (DNR) and the Wisconsin Department of Health and Social Services (DHSS) jointly release an annual fish consumption advisory (Important Health Information For People Eating Fish From Wisconsin Waters) which currently warns anglers and their families to not eat certain fish from 341 lakes and rivers (approximately one out of every three tested) due to unsafe levels of mercury contamination. This list will continue to grow as the Department continues to test additional lakes. Approximately one out of every three lakes tested ends up on the advisory .

2) The Health Department warns pregnant women not to eat certain large game fish from all Wisconsin lakes that have not been tested. -

3) The most common fish species listed on the health advisory is walleye which is also one of the most sought after game fish for eating.

4) Mercury is a neuro-toxin which means that it adversely impacts the brain and nervous system making small children and pregnant women and their fetuses particularly susceptible to mercury poisoning.

5) Mercury stays In the body for a relatively long period of time (half life of 30 to 120 days) so that mercury contaminated fish meals eaten prior to pregnancy can impact the fetus.

6) Chronic exposure to mercury contaminated fish prior to or during pregnancy can result in infants and children with lower I.Q.s, reduced attention span, reduced memory capacity, reduced motor skills, and other mental and physical impairments.

7) Acute exposure to mercury contaminated fish prior to or during pregnancy can result in infants with severe mental and physical retardation.

8) Acute exposure to mercury contaminated fish in Wisconsin has lead to at least one case of acute mercury poisoning where the individual, Henry Henk (Hayward), lost 100 pounds of weight, lost the use of his legs, suffered severe dementia (didn't recognize his own wife), and nearly died.

9) Fish consumption is the route of human exposure to mercury of greatest concern and there are currently no regulations of mercury emissions which take this route of exposure into account.

10) The presence of mercury in combination with other contaminants found in Wisconsin fish, such as PCBs, increases the likelihood of adverse health impacts at lower levels of mercury contamination.

11) Levels of mercury found in commercially sold fish in stores or restaurants (e.g canned tuna) are, on average, about half of what they are in fish caught from Wisconsin waters listed on the health advisory .The fish consumption advisory assumes no consumption of commercially sold fish, underestimating the risk for anyone who does eat fish from the store or a restaurant.

12) The Department of Natural Resources sells over 1 million fishing licenses but only publishes 40,000 fish consumption advisories. The vast majority of anglers and their families never see the fish consumption warnings for mercury contamination.

13) The Environmental Protection Agency and Wisconsin DNR have identified coal-fired power plants as the largest sources of mercury emissions nationwide and in Wisconsin respectively. Yet, mercury emissions from coal-fired power pla-nts are not meaningfully regulated.

14) The U.S. Environmental Protection Agency (EPA), Northeast States for Coordinated Air Use Management (NESCAUM) and other government agencies have identified numerous mercury removal control technologies currently available for electricity generating boilers including coal cleaning, wet scrubbers, dry scrubbers, fabric filters, combined ESP/baghouse and other combinations of existing technologies.

15) Studies have linked mercury contamination to impaired reproduction in wildlife, particularly loons and other fish-eating species.

16) In at least one DNR research project, reduced hatching success and reduced survival of embryos were associated with high mercury concentrations in walleye eggs from two northern Wisconsin lakes.

17) Nearly two million people fish in Wisconsin and spend nearly $1 billion each year. In 1996, fishing license sales alone totaled $26 million. More than 30,000 jobs in the state depend on sport fishing; sport fishing in Wisconsin depends on clean lakes, clean rivers and clean fish.

18) Certain cultures are at greater risk of adverse health impacts resulting from consumption of mercury contaminated fish due to their tendency to engage in semi- subsistence fishing. Certain Native American tribes, for example, rely heavily on game fish as a food source, as do certain Hmong communities.

19) More than 100 organizations have passed resolutions (see attached) supporting a policy to reduce mercury emissions in Wisconsin, including more than 40 sport fishing organizations, numerous lake associations, environmental groups, resort owners, Native American tribes and other groups representing communities of color which are disproportionately impacted by mercury contaminated fish.

20) Until states with the greatest mercury contamination in lakes and fish (e.g. Wisconsin), and therefore extensive fish consumption advisories, take action to reduce the:ir own mercury emissions, there is little hope of receiving cooperation from upwind states with few, if any, fish consumption advisories (e.g. Illinois, Missouri, Texas, etc.).

IV. AGENCY AUTHORITY TO ADOPT REQUESTED RULES

The Department of Natural Resources is provided with direct and clear authority to promulgate the rules requested in this petition under 285.11 (9) Wis. Stats., which instructs the Department to "Prepare and adopt minimum standards for the emission of mercury compounds or metallic mercury into the air." The bill which created this law was 1971 Assembly Bill 556, introduced by (then) Representative Tommy G. Thompson and two other legislators. The bill was clearly in response to high levels of mercury in Wisconsin River fish which prompted Governor Warren Knowles to close 40 miles of the Wisconsin River to fishing for two months in 1970.

The law created by this bill, Chapter 272, Laws of 1971, had three components: one restricting mercury discharges to the water, one requiring a materials balance sheet for purposeful use of mercury (addressing disposal), and a third (section l' 144.422) requiring that the department "prepare and adopt minimum standards for the emission of mercury compounds or metallic mercury into the air." This requirement creates clear and direct authority for the DNR to promulgate the rules requested in this citizens' petition.

The Department did adopt mercury air emission standards in response to the passage of this law. However, the current air toxics standards are intended, by design, to only address health impacts resulting from direct air inhalation of mercury, in fact, have resulted in no reductions of mercury air emissions. The Department has had the authority to promulgate mercury air emission rules addressing mercury contamination in fish for the last 29 years, but has failed to do so. This is not entirely surprising given the difference in the state of researchers' understanding of mercury in the environment between then and now. In 1971, researchers and policy makers alike had little idea of the role mercury deposition played in the contamination of fish. The fact that a mercury limit addressing inhalation has already been established by the Department in no way prevents the Department from establishing a stricter standard addressing air deposition and the fish consumption route of exposure. The Department clearly must address air deposition in order to protect human health, fish and wildlife since fish consumption is the exposure route of greatest concern on the part of state health officials.

Assembly Bill 556 (of 1971) as introduced, only addressed direct mercury discharges to the water. However, the Assembly Natural Resources Committee adopted a substitute amendment (which became law) which broadened the bill to include solid waste disposal and air emissions, recognizing, to some extent, that all mediums (water, air and land) are connected and affect each other. The substitute amendment was introduced by Representatives T. Thompson and L. Mittness.

The crux of the authority issue is that the law was clearly intended to reduce mercury levels in fish and clearly gave the department the authority to do this by regulating both water discharge and air emission sources of mercury .And, in fact, water discharge sources of mercury. whether from industries or from municipalities, have been, in a relative sense, greatly reduced; while air emission sources have gone completely unchecked. The fact that mercury levels in Wisconsin lakes and rivers have remained high (i.e. unsafe to the extent described in the state's fish consumption advisory) for the past 30 years is consistent with what we have learned about the role and importance of mercury deposition.

The DNR has clear, unquestionable statutory authority to adopt the requested rules For the reasons set forth above, Petitioners urge that the requested rules be promulgated with all due expedience.

Dated this 18th day of September, 2000.

Respectfully submitted:

Sandy Lyon, Executive Director
Anishinaabe Niijii/Protect the Earth
W.A.T.E.R. Campaign

Pete Petrouske, Volunteer
W.D.N.R. Safety Instructor

Phil Emmling, Vice President
Great River Council of Wisconsin
Of the Federation of Fly Fishers

Ron Vander Loop, President
Brown County Conservation Alliance

John Durben, President
Green Bay Area Great Lakes
Sport Fishermen

Todd Ambs, Executive Director
River Alliance of Wisconsin

Kerry Schumann, Director
Wisconsin Public Interest Research Group

Appendix B
December 2000 Natural Resources Board Resolution

STATE OF WISCONSIN
NATURAL RESOURCES BOARD
RESOLUTION

WHEREAS, on May 18, 2000, a petition was submitted to the Department of Natural Resources requesting the adoption of administrative rules governing mercury emissions to the air from the largest sources of emissions which contribute to mercury deposition to Wisconsin lakes and rivers;

WHEREAS, the petition was amended on September 15, 2000 changing a requested rule provision from requiring a 90% reduction in mercury emissions by the year 2015 to requiring a 90% reduction in mercury emissions by the year 2010;

WHEREAS, the petition was signed by representatives of environmental organizations, conservation groups, sporting clubs, lake associations and several state legislators;

WHEREAS, the Department of Natural Resources has been monitoring mercury in the environment since the 1970's, including sampling mercury in the tissue of fish and other forms of wildlife and has found elevated levels of mercury in fish in one out of every three water bodies tested;

WHEREAS, there are 341 water bodies in Wisconsin that are currently listed by the Department with mercury health advisories restricting human consumption of fish;

WHEREAS, studies have shown that the major pathway for mercury to enter water bodies and ultimately fish and wildlife is atmospheric deposition;

WHEREAS, the predominant source category of unregulated mercury emissions to the air in Wisconsin is the combustion of coal for energy production;

WHEREAS, the Department of Natural Resources has the authority to regulate mercury emissions to the air under s. 285.11(9), Wis. Stats.

THEREFORE, BE IT RESOLVED that the Natural Resources Board grants the petition and directs the Department of Natural Resources to present proposed rules, with a request for public hearing authorization, at the Board's March 2001 meeting.

BE IT FURTHER RESOLVED that the Natural Resources Board directs the Department to incorporate the following items in the administrative rules:

1. The percentage reductions and a phased schedule for achieving the reductions.
2. A methodology for determining baseline emissions levels.
3. An emissions trading and banking system.

4. A provision to allow for alternative compliance options, such as projects that achieve voluntary mercury emission reductions from sources not covered by the rules.
5. A provision that would allow the Department to grant variances, such as deadline extensions and alternative emission limits, if it determines that compliance with the reduction requirements is not technologically feasible, would jeopardize electric reliability or would cause unreasonable hardship as long as the variance would not result in undue harm to human health or the environment.
6. A provision that the Department submit a report to the Board by the end of 2007 that:
   a. Evaluates the mercury reduction requirements in light of electric reliability, scientific and technology developments, and federal regulatory activity, and recommends adjustments to the reduction requirements, if appropriate, and
   b. Assesses the impacts of emissions trading on localized water quality and recommends corrective actions if needed.

Appendix C
Alternatives to the Proposed Rules Offered at Public Hearing

Alternatives

Amount and Schedule of Mercury Reductions	Growth in Mercury Emissions	Evaluation Report	Other Comments
2006 – 25% **2010 – 90%** • With trading require 90% mercury reductions by 2008. • Reduction requirement applies to all utilities and government owned boilers with more than 10 pounds of mercury emissions in one year including chlor-alkali plants, medical waste incinerators, municipal waste incinerators and other significant sources. • Include a provision for the virtual elimination of mercury 20 years after rule promulgation.	**Offsets 1.5 : 1.0** Require mercury emission reductions equal to 150% of the annual mercury emission increase from any new source or modification of an existing source. Applies without a lower mercury emission threshold of 10 pounds.		• Propose that an alternative should be the eight rule elements in the citizen petition. This includes a comprehensive mercury program, appointment of a mercury control council, establishment of baseline emissions for sources, setting emission caps and a 1.5:1.0 offset for any new emission sources, reductions from utilities and other major sources in two-phases, establishment of fines and disincentives for non-compliance and a variance provision that could provide a two-year suspension of rule requirements. • Additionally propose that a mercury containing product reduction program not be included and that the ability to meet emission reduction requirements by obtaining emission reductions from others be limited to 20%.

Amount and Schedule of Mercury Reductions	Growth in Mercury Emissions	Evaluation Report	Other Comments
2007 – 10% **2012 – 40%** or **Multi-pollutant Reduction Program Alternative** Addition of a compliance alternative that would allow a major utility the opportunity to propose a multi-pollutant reduction program instead of achieving the mercury reduction requirements in the rules. Mercury reductions would still need to be an element of the proposal, which would also require a commitment to provide other environmental benefits beyond existing laws and rules. The proposal would also need to include a schedule to accomplish the alternative program. The alternative program would be subject to a public hearing.	**Latest Available Control Technology** Instead of emission offsets establish a mercury control technology requirement for new sources and modifications of existing sources with substantial mercury emissions.		

Amount and Schedule of Mercury Reductions	Growth in Mercury Emissions	Evaluation Report	Other Comments
Voluntary Program	**Latest Available Control Technology with Determination of Environmental Benefits** Require mercury control technology based on a finding that resources benefit from the reductions that would be achieved.		• Clearly state in rules that the requirements i.e. caps, offsets do not apply to sources covered by a MACT standard. • Eliminate or substantially increase threshold of caps for major sources. If there are major source caps apply them on a unit, not facility basis. • Do not set limits on the use of certified emission reduction credits. • Include rule language that mandates that the state proposal be consistent and no more stringent than the federal MACT for utilities.

Appendix D
Presentations to the Committee

Lloyd Eagan

Wisconsin Department of Natural Resources
Director, Bureau of Air Management

Presentation: Controlling Mercury Emissions – Viewpoint of Wisconsin DNR

Date: January 9, 2002

Controlling Mercury Emissions

Viewpoint of Wisconsin DNR
presented to Mercury CAC
by Lloyd Eagan - January 9, 2002

Why Propose NR 446?

- Very important issue from an environmental standpoint
- Human health effects well documented historically and currently
- CDC data shows 10% of U.S. woman have blood levels that would harm unborn
- Ecological data also shows persistent environmental impacts.

Why Propose NR 446

- We believe prompt action is vital!
- Economic interests are impacted too.
- Wisconsin has as much at stake in this issue as anybody.
- We can influence national efforts.
- Wisconsin did something similar with S02 and Acid Rain which worked well.

History of NR 446

- Mercury reduction efforts have been considered for 11 years.
- We have known for some time that emissions of mercury are a significant contributing factor to the presence of mercury in aquatic life and human beings.

History Continued:

- DNR has had a long term mercury advisory process:
  - The Mercury Stakeholders Group met in 1999
  - State Legislation considered 2000-2001
  - NRB acted upon citizen petition in 2000
  - Current citizen review and recommendations in process

Why Propose NR 446?

- Federal Approach to mercury is limited - may only cover 1/2 of WI emissions
- Federal MACT cannot consider trading and other flexible approaches to emissions reductions
- Federal interest in multi-pollutant legislation is strong and would greatly impact utilities
- Ensure early reductions are credited

Why Propose NR 446?

- Need to reduce emissions comprehensively.
- Reasonable phased mercury emissions reductions from an established baseline
- Include flexibility with banking and trading
- Respond to electric reliability concerns
- Periodically re-evaluate and adjust rule if needed for industry or environmental issues

Where Do We Go From Here?

- Need for constructive input to make our mercury reduction effort effective and feasible.
- Must make credible mercury emissions reduction progress
- Must be economically viable
- March 2002 -target to deliver recommendations to Secretary Bazzell

Where Do We Go From Here?

- Consider the Precautionary Principle
- When we have some information about harm, even though the science is uncertain we should act.
- DNR will act but would like recommendations to make a better rule

Where Do We Go From Here?

- Agree on approach to "Value Issues"
  - Share viewpoints
  - Document areas of difference
  - Provide measurement of intensity of difference
- Agree on approach to "Technical Issues"
  - What is known and what TAG will do
  - What is unknown
  - Recommendations from CAC

Opportunities

- Opportunity: Provide a "cutting edge" model for the country & drive meaningful regulations
- Opportunity - Your input will affect the WAY in which DNR prepares regulation.

Constraints

- Time: Dragging out the CAC process out will compromise the opportunities
- The DNR Secretary will advance Mercury Emission Reduction Rules with or without CAC input
- The scientific understanding of Mercury emissions and their public health and environmental impacts isn't perfect

Lynda Knobeloch, Ph.D.

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Presentation: Health Effects of Methyl-Mercury

Date: February 13, 2002

Lynda Knobeloch is a Senior Toxicologist with the Wisconsin Division of Public Health

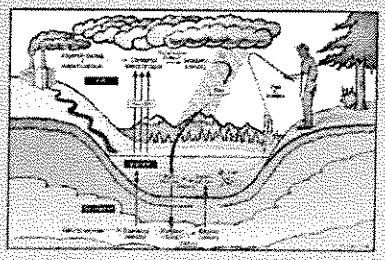
Health Effects of Methylmercury

Lynda Knobeloch, Ph.D.
Senior Toxicologist
WI Division of Public Health

Mercury Species

- Inorganic Mercury
  - Elemental - Hg^0
  - Ionic - Hg^{+2}
- Organic
  - Methylmercury - CH_3Hg
  - Ethylmercury, thimerosal - CH_3Hg

The Mercury Cycle



Case Studies

Minamata Disease
Iraqi Poisonings
New Zealand Study
Finnish Fishermen Study
Faroes Island and Seychelles studies

Minamata, Japan - 1956

- >1,000 people affected
- Numbness, slurred speech, unsteady gait, tunnel vision, & behavioral changes
- Many children were born with cerebral palsy and severe mental retardation
- 'Cat dancing disease' in domestic cats

Minamata Disease

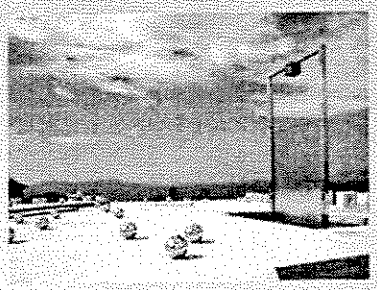
- Illnesses linked to mercury contaminated fish
- Chisso Corporation discharged tons of mercury into the Minamata Bay between 1930-1960
- Japan banned the sale of fish from the bay
- Chisso Corp diverted waste to the Minamata river
- Within months illnesses began to occur in the river town of Hachimon.

Features of Minamata Disease

- All patients lived near Minamata Bay
- Most were fishermen and their families
- All ages affected except infants
- Men affected more than women
- No regular interval between onset within a home
- Death rate was high
- Vegetables and water ruled out
- Every patient had eaten fish and seafood
- Many cats with same symptoms

Victim of Minamata Disease

Memorial to Minamata Victims



Monument to the cats of Minamata Japan

Methylmercury Poisoning in Iraq

by Bakir, et al.

"The primary signs and symptoms of methylmercury poisoning result from damage to the nervous system and are characterized by loss of sensation at the extremeties of the hands and feet and in areas around the mouth (paresthesia), loss of coordination in gait (ataxia), slurred speech (dysarthria), diminution of vision and loss of hearing."

Bakir et al. – continued

- "Severe poisoning can cause blindness, coma and death."
- "There is a latent period of weeks or months between exposure and the development of .. symptoms."
- "Ataxia may decrease, but general recovery is poor."
- "Prenatal exposure … has resulted in mental retardation and cerebral palsy."

Bakir, et al. continued

- "This epidemic is the most catastrophic ever recorded in terms of its extent and its ensuing morbidity and mortality."
- "6,530 cases were admitted to hospitals and there were 459 hospital deaths"
- Rural families were exposed when they ate bread made with fungicide-treated wheat.

Science magazine, July 29, 1973

New Zealand Study

Smaller study of 237 children

Ethnically diverse study population

Maternal hair mercury levels associated with lower test scores in children

Seychelles Study

Study of 779 mother/infant pairs

No effects seen. Why?

- Chance? 70% power to see an effect
- Test methods might be less sensitive
- Timing of maternal hair collection
- Age of children at testing
- Healthy population/excellent medical care
- Diet rich in antioxidants and other nutrients

Faroes Islands Study

Ongoing study of 900 children

Developmental delays and blood pressure changes associated with cord blood Hg

Possible confounding by PCB exposure among families that consumed whale blubber

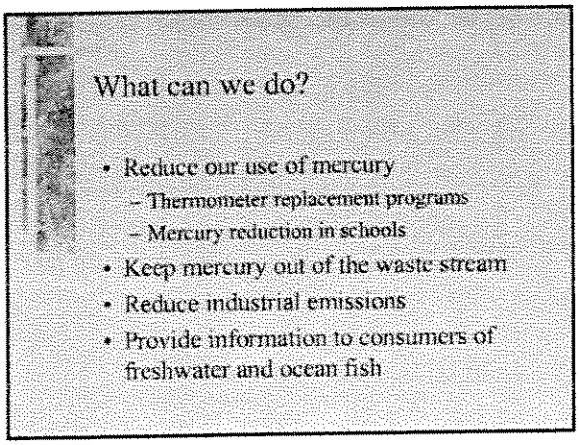
Finnish Fisherman Study

- Study of 1,833 fishermen aged 42-60
- *"These data suggest that a high intake of mercury from non-fatty freshwater fish and the consequent accumulation of mercury in the body are associated with an excess risk of AMI as well as death from CHD, CVD, and any cause in Eastern Finnish men..."*

Salonen, et al. Circulation, 1995

Conclusions of the National Academy of Sciences

- Prenatal exposure to mercury can cause developmental delays
- The effects on the aging nervous, cardiovascular, immune and endocrine systems should be evaluated
- EPA and FDA should take action to reduce Hg exposure in the U.S.


What can we do?
• Reduce our use of mercury
– Thermometer replacement programs
– Mercury reduction in schools
• Keep mercury out of the waste stream
• Reduce industrial emissions
• Provide information to consumers of freshwater and ocean fish

Bill Maxwell

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Presentation: The MACT Process – And the Industrial Boiler and Utility Industry Sectors

Date: February 26, 2002.

Bill Maxwell is with the EPA OAQPS Combustion Group and is currently working with utility air toxics and the utility MACT standard.

THE MACT PROCESS – AND THE INDUSTRIAL BOILER & UTILITY INDUSTRY SECTORS

Wisconsin Department of Natural Resources
Mercury Citizen's Advisory Committee
Madison, Wisconsin
February 26, 2002

Presentation Outline

- Overview of section 112 of the Clean Air Act
- Outline the MACT development process
- Utility MACT development and schedule
- Industrial Boiler MACT development and schedule
- Possible mercury controls

Section 112 - General

- Contains list of 188 hazardous air pollutants (HAP)
- Requires EPA to publish a list of major sources that emit HAP
- Requires EPA to establish emission standards (NESHAP) for each category of major sources
- Allows EPA to establish work practice requirements
- MACT standards must include compliance date no later than 3 years after promulgation

Section 112 - MACT

- Mandates that EPA develop standards for HAP
- Standards are based on the use of maximum achievable control technology (MACT)
- Sets minimum stringency criteria (MACT floor)
- MACT may differ for new and existing sources
- Allows for subcategorization

Format of Section 112 Rule

- Emissions standard applicable to each source
- Trading not allowed in any consideration of the level(s) of control at the floor
  - Trading among units at given facility allowed

Major Source

- ".. Any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants..."

MACT Development Process

- Conduct an industry study
- Establish MACT floor/subcategories
- Develop control options
- Assess impacts of options
- Propose standards
- Receive public comments
- Respond to comments
- Promulgate final standards

MACT Floor

- For existing sources
  - "The average emission limitation achieved by the best performing 12 percent of existing sources..."
- For new sources
  - "The emission control achieved in practice by the best controlled similar source..."
- Recent court decisions will be examined for impact on how floors are established

Utility MACT

Background – Mandate

- Section 112(n)(1)(A) of Clean Air Act (CAA): EPA must perform study of, and report to Congress on, the hazards to the public health of HAP emissions from fossil fuel-fired electric utility steam generating units
- Based on the results of the study, Administrator must determine whether HAP regulations for such units are necessary and appropriate

Background – Study

- Report to Congress issued in February 1998
  - HAP of greatest concern -- mercury from coal-fired units
  - Some concern from other HAP from coal-fired units and from oil-fired units

Background – ICR

- Information collection request
  - Intended to inform electric utility regulatory determination along with health studies (e.g., National Academy of Sciences report), control option analyses, etc.
  - Intended to improve overall estimate of the amount and species of mercury being emitted from coal-fired utility units

Background – ICR (conc.)

- Identified all coal-fired units meeting CAA definition and their control configuration
- Required all coal-fired units to analyze coal mercury content during calendar year 1999
- Required ~85 coal-fired units to test for speciated mercury emissions

Background – Determination

- EPA announced finding on 12/14/2000
  - Regulation necessary for oil- and coal-fired boilers
  - Regulation not necessary for gas-fired boilers
  - Based on
    - Public health concerns
    - Mercury emissions from power plants
    - Information that mercury from power plants can be controlled

Section 112 Focus

- Most of attention has been on mercury from coal-fired units
- Also concerned about
  - Other HAP from coal-fired units
  - Nickel from oil-fired units
- Listing decision triggers section 112(g) case-by-case MACT determinations for new coal- and oil-fired sources

MACT Process

- Clean Air Act Advisory Committee Working Group
  - Representatives of industry, environmental groups, State/Local/Tribal organizations
  - Sally Shaver, EPA, and John Paul, Dayton Regional Air Pollution Control Agency, Co-Chairs
  - Bimonthly meetings for approximately 1 year
    - Meetings held August, November, December 2001; February 2002
    - Next meeting – March 4/5 in Washington, D.C.
  - Information to be provided on website
  - Outreach and stakeholder communication

MACT Activities

- Continuing ICR data analyses for the purpose of establishing section 112 MACT standards
  - Potential subcategories
    - Boiler type
    - Coal type
    - Control device type
    - Other -?
  - Floor determination
  - Best performing technology ("new source" MACT)
  - Adequacy of data

Coordination Activities

- Coordination with ORD, DOE, EPRI, UNDEERC, etc. on current mercury control research
  - More testing on existing control devices and enhancements
  - More testing on SCR/SNCR installations
  - Coal combustion residue issues
  - Control device cost analyses
  - Hg CEM activities
    - Long-term demonstrations on 1-2 units
    - Short-term demonstrations on multiple units

Ongoing Research Areas

- DOE field test program
  - PowerSpan - multi-pollutant removal system
  - ADA - ESP retrofit (4 sites)
    - Alabama Power E.C. Gaston - completed
    - Wisconsin Electric Pleasant Prairie - completed
  - B&W - wet scrubber reagent (Endicott, Zimmer)
  - UNDEERC - hybrid electrified FF w/activated carbon
  - Apogee - ESP tests w/sorbent injection (2-3 sites)
  - CONSOL - cooling system w/calcium sorbents
  - Southern Co. - multipollutant sorbents
  - USR Radian - oxidation catalysts
- Also research on impact of SCR/SNCR

DOE Program Information

- Further information on the DOE program may be found on the following websites
  - http://www.fe.doe.gov/coal_power/existingplants/index.shtml
  - http://www.fe.doe.gov/coal_power/existingplants/mercurycontrol_fs.shtml
  - http://www.fe.doe.gov/techline/tl_mercurycontrol_1.html
- Additional information, including technical papers, are available on the linked company webpages

Additional Activities

- More sophisticated deposition analyses using REMSAD and new mercury emissions data
- Analyses using IPM looking at the costs and market impacts of a variety of potential levels of mercury control

Timing

- Settlement agreement provides for
  - Proposal of section 112 regulations by 12/15/2003
  - Promulgation of section 112 regulations by 12/15/2004
- Compliance date of 12/15/2007

Website

- Utility MACT information located at:
  - www.epa.gov/ttn/uatw/combust/utiltox/utoxpg.html
    - Announcements of new postings, upcoming activities
    - Background material
    - Coal data for 1999
    - List of plants
    - Speciated mercury emission test reports
    - Summary analyses of speciated emission data

Utility MACT Contact

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Industrial Boiler MACT

Status of Industrial Boiler MACT

- Source categories included:
  - Industrial boilers
  - Institutional/commercial boilers
  - Process heaters
- Major source MACT only
- Subcategorizing by fuel type, size, and use

What is a Process Heater?

- An enclosed device using controlled flame and the unit's primary purpose is to transfer heat indirectly to a process material, instead of generating steam
- Process heaters are devices in which the combustion gases do not directly come into contact with process gases in the combustion chamber

Industrial Boilers Plus Process Heaters?

- Boilers and "indirect-fired" process heaters are similar combustion devices
  - Combust similar fuels to heat water (steam) or other materials
  - Both transfer heat indirectly
  - Fuel-related emissions are the same

Potential Affected Existing Sources

- Total: 57,000 units (42,000 boilers, 15,000 process heaters)
  - 2,500 coal-fired units
  - 46,800 gas-fired units
  - 700 wood-fired units
  - 6,000 oil-fired units
  - 1,200 mixed fuel-fired units
- Based on size or co-location

Projected Affected New Sources

- Based on DOE fuel consumption forecasts
- Based on existing population data
- Total: 4,500 boilers (fifth year)
  - 250 coal-fired boilers
  - 100 wood-fired boilers
  - 260 oil-fired boilers
  - 3,900 gas-fired boilers

Emission Controls

- Various controls and combination are used
- Metals and particulate matter
  - Fabric filters, ESP, scrubbers
- Acid gases (HCl)
  - Scrubbers (wet or dry)
- Mercury
  - Fabric filters
- Organic HAP (dioxins, formaldehyde)
  - CO monitoring and limit

Databases

- Inventory database (fossil fuel)
- Survey database (nonfossil fuel)
- Emission database
- Can be downloaded from EPA's website at:
  - www.epa.gov/ttn/atw/combust/iccrarch/iccrarch.html
  - Microsoft ACCESS is the database software

What Units Will the MACT Cover?

- All industrial boilers located at major sources
- All commercial and institutional boilers located at major sources
- All process heaters located at major sources

What Units Will the MACT Not Cover?

- Fossil fuel-fired electric utility boilers
- Boilers burning municipal waste
- Boilers burning hazardous waste
- Boilers burning medical waste
- Black liquor recovery boilers
- Hot water heaters
- Waste heat boilers

Preliminary Baseline Emissions

- HCl = 66,000 tpy
- Lead = 175 tpy
- Chromium = 200 tpy
- PAH = 580 tpy
- Formaldehyde = 3,850 tpy
- Mercury = 14 tpy
- Particulate Matter = 1,000,000 tpy

Preliminary Subcategories

- Main subcategories selected based on fuel type
  - Solid, liquid, gaseous fuel-fired units
- Subcategories to analyze impacts on small businesses
  - Subcategories based on size
    - Large (greater than 10 MMBtu/hr heat input)
    - Small (less than 10 MMBtu/hr heat input)
  - Subcategories based on use
    - Limited-use (less than 10% capacity factor)
- Total of 9 subcategories

MACT Floor - Existing Units

- Preliminary MACT floors based on control technologies for existing sources
  - For solid fuel boilers
    - Large units -- Baghouse (metals)/scrubber (HCl)
    - Small units -- No demonstrated emission reduction
    - Limited-use units -- ESP
  - For liquid fuel units -- No demonstrated emission reduction
  - For gaseous fuel units -- No demonstrated emission reduction
- MACT floors are actually emissions levels

MACT Floor - New Units

- Based on control technologies, State regulations, and new source performance standards (NSPS)
- Solid fuel units
  - Large units -- Baghouse/scrubber/CO limit
  - Small units -- Baghouse/scrubber
  - Limited-use Units -- Baghouse/scrubber/CO limit

MACT Floor - New Units (more)

- Liquid fuel units
  - Large units -- Baghouse/scrubber/CO limit
  - Small units -- Baghouse/scrubber
  - Limited-use units -- Baghouse/scrubber/CO limit
- Gaseous fuel units
  - Large/limited use units -- CO limit
  - Small units -- No demonstrated emission reduction
- MACT floors are actually emissions levels

Preliminary MACT Floor Levels

- Based on review of emission database
- Existing large solid fuel-fired units
  - PM -- about 0.065 lb/MMBtu
  - HCl -- about 0.048 lb/MMBtu (45 to 50 ppm)
  - Hg -- ?
- New large solid fuel-fired units
  - PM -- about 0.04 lb/MMBtu
  - HCl -- about 0.016 lb/MMBtu (15 to 20 ppm)
  - CO -- 200 ppm @ 3% oxygen
  - Hg -- ?

Beyond the Floor Control Options

- For solid fuel boilers -- fuel switching (Hg)/CO limit
- For liquid fuel boilers -- ESP (metals)/CO
- For gaseous fuel boilers -- CO limit

Provisions Being Considered

- Alternate metal standard
  - Minimize impacts on small businesses
  - Sensitive to sources burning fuel with little metals, but emitting PM which would require control
  - Sum of 8 selected metals: arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, and selenium
  - Will be based on review of emission database
    - About 0.001 lb/MMBtu

Issues

- Court opinion from National Lime Association litigation on the Cement Kiln MACT
  - Opinion was that material substitution (pollution prevention [i.e., fuel switching]) should be considered in the MACT floor analysis
  - Fuel switching is not considered an appropriate MACT floor technology for industrial boilers because
    - Uncertain benefits
      - Decrease in some HAP (metals, HCl)
      - Increase in some HAP (organic HAP)
    - Potentially lower efficiency
    - Fuel availability concerns

Schedule

- Proposal Summer 2002
- Promulgation Summer 2003
- Compliance date Summer 2007

Information

- Information on the MACT rulemaking for industrial, commercial, and institutional boilers and process heaters is available at:
  - www.epa.gov/ttn/atw/combust/boiler/boilerpg.html

Industrial Boiler MACT Contact

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Fax: 919-541-5450

Possible Mercury Controls

Mercury Capture

- Hg(p) easily captured by ESP and FF units
- Hg^{2+} exhibits high to low solubility and can generally be captured in scrubbers
- Hg° is insoluble; must be adsorbed on to solids or converted to Hg^{2+} for capture by scrubbing
- Hg^{2+} is generally easier to adsorb than Hg°
- Adsorption highly dependent on flue gas composition and temperature
- Typical Hg^{2+}:Hg° in flue gas: bituminous coal > subbituminous coal > lignite

Major Conclusions of Determination Studies

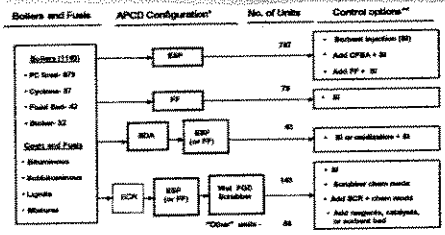
- 48 tons of Hg emitted from coal-fired units in 1999
- Capture by existing equipment ranges from 0 to >90%
- Moderate to good capture for bituminous
- Poor capture for subbituminous and lignite
- Best capture for dry and wet FGD scrubbers
- Capture associated with PM controls:
  FF > ESPs > PM scrubbers & mechanical collectors
- NOx controls (particularly SCR/SNCR) may enhance ability to capture Hg

Mean Mercury Emission Reductions for Existing PC-Fired Units[a], %

Add-on Controls	Type of Coal		
	Bituminous	Subbituminous	Lignite
PM Only			
CS-ESP	29	3	3
HS-ESP	11	0	NT
CS-FF	89	73	NT
PM Scrubber	12	0	33
Dry FGD Scrubbers			
SDA+ESP	45	0	NT
SDA+FF	93	23	37
Wet FGD Scrubbers			
CS-ESP+Wet FGD	78	16	42
HS-ESP+Wet FGD	39	0	NT
CS-FF+Wet FGD	97	NT	NT

a. Based on OH train data. NT - not tested.

Mercury Control Retrofit Options



Estimated Feasible Levels of Near- and Long-Term Control*

PERCENT REDUCTION FROM INLET CONCENTRATION

Existing Technology	Current Bit	Current Sub	Near-Term Bit	Near-Term Sub
ESP	29	3	70	45
FF	89	73	90	85
SDA + ESP	45		80	70
SDA + FF	93	23	90	80
ESP + wet FGD	78	0	90	50
FF + Wet FGD	97		90	85

Long-term control ranges from 85 to 95 % depending on coal and control technologies

* Mercury control for pulverized coal-fired boilers and units with cold-side ESPs or FFs. Current control from ICR data; Near-term control (2007-2008) is based on use of PAC.

The Future – Activated Carbon

- Existing DOE program yielding results on what may be possible in the near- to long-term
  - Activated carbon injection tests conducted on two facilities to date
    - Alabama Power E.C. Gaston - low sulfur bituminous coal w/hot-side ESP and COHPAC unit
    - Wisconsin Electric Pleasant Prairie - subbituminous coal w/cold-side ESP
  - Two additional facilities to be tested
    - PG&E NEG Salem Harbor - low sulfur bituminous coal w/cold-side ESP and SNCR
    - PG&E NEG Brayton Point - low sulfur bituminous coal w/cold-side ESP and carbon/ash separation

The Future – SCR/SNCR

- Tests conducted at seven units
  - Four with SCR
    - One subbituminous coal-fired
    - Three bituminous coal-fired
  - One with SNCR
    - Bituminous coal-fired
  - Two with ammonia injection
    - One subbituminous coal-fired
    - One bituminous-subbituminous coal blend

The Results -- Activated Carbon

- E.C. Gaston tests indicated that mercury removals as high as 90% were achieved on the bituminous coal
- Pleasant Prairie tests indicated that mercury removals as high as 70% were achieved on the subbituminous coal but at a higher "cost" than was observed for 40-60% mercury removal
  - Impacts on potential to sell fly ash
  - Higher mercury removals greatly increased use of activated carbon and cost

The Results -- SCR/SNCR

- Preliminary results
  - Oxidation of mercury enhanced with SCR use on two of the bituminous coals
  - No significant mercury oxidation enhancement with SCR use on one bituminous coal or the subbituminous coal
  - Ammonia injection and SNCR did not appear to enhance mercury oxidation

What More Could be Done?

- Further tests are yet to be conducted that will address some of the issues
- Modifications that could be considered to lower costs, preserve fly ash value, etc.
  - Use of COHPAC unit for activated carbon injection as done at E.C. Gaston - preserves fly ash in ESP
  - Use of ash/carbon separation techniques as will be investigated at Brayton Point - preserves both
  - Activated carbon modifications to make it more "mercury friendly" - more "reactive" sorbent

And...

- More work yet to be done
  - Different coal types
  - Different control configurations
  - Applications to other processes (e.g., industrial boilers)
  - Different catalysts and catalyst system designs
- There are some promising signs

Dr. Carl J. Watras

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Presentation: Mercury Trends in Little Rock Lake, Wisconsin

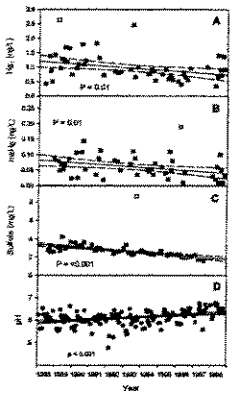
Date: April 10, 2002

Carl Watras is an Advanced Research Scientist with the DNR and has a Doctorate degree in Zoology/Limnology

Recent Trends in Little Rock Lake 1988-1999

Mercury in Lake Water

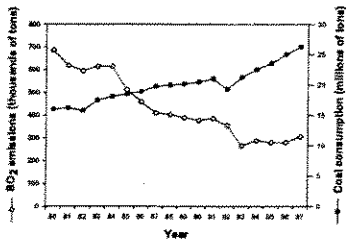
Acid Rain Fingerprints In Lake Water



Summary of changes observed in Little Rock Lake during recent years

	Time Period	Average Rate of Change (% per year)
Atmospheric Sulfate Deposition	1988-2000	-4
Lake Water Sulfate Concentration	1988-2000	-5
Atmospheric Hg Deposition	1995-1999	-10
Lake Water Hg Concentration	1995-1999	-5
Yellow Perch Hg	1994-2000	-5

Recent Trends in Sulfur Dioxide Emissions and Coal Consumption In Wisconsin



Source: WDNR PUBL-AM -290-99

Recent Trends In Mercury Emissions

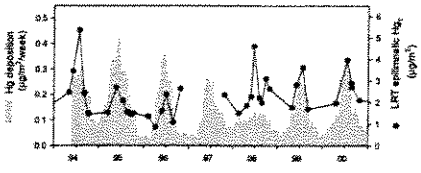
????

Ban on Mercury in House Paint

Removal of Mercury from Batteries

Closure of White Pine Smelter

Seasonal Cycle of Mercury in Lake Water Compared to Seasonal Cycle of Atmospheric Mercury Deposition



Summary

Lakes have responded positively to declines in Acid Rain over the past 3 decades. This positive response has been observed in many regions of the northern hemisphere where controls on SO2 emissions are in effect.

Evidence from Little Rock Lake indicates that lakes may respond even more rapidly to changes in atmospheric mercury deposition.

Dr. Michael W. Meyer

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Presentation: Assessing the Ecological Risk of Mercury Exposure to Piscivores

Date: April 10, 2002

Mike Meyer is an Ecological Toxicologist with the DNR and has a Doctorate degree in Wildlife Ecology

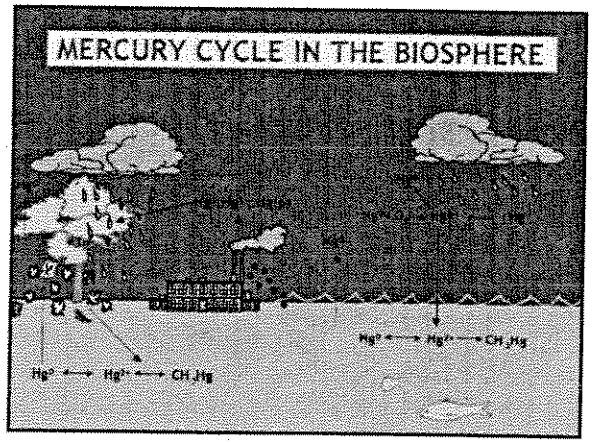
Assessing the ecological risk of mercury exposure to piscivores

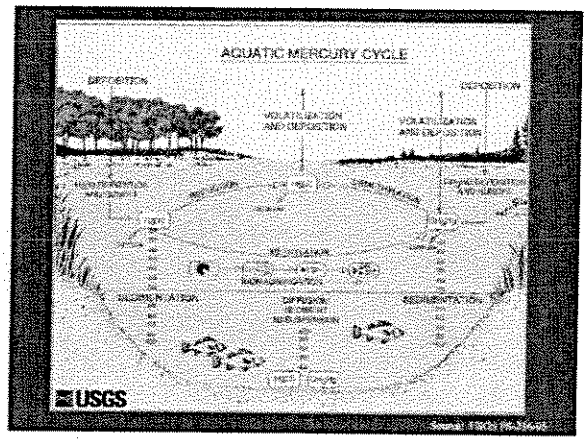
- Persistent and highly mobile toxicant, bioaccumulates in top predators, compromises productivity
- Current risk assessment models inadequate for producing regulatory endpoints

State plan aims to cut mercury pollution

USGS

MERCURY CYCLE IN THE BIOSPHERE





Common Loon/Mercury Risk Assessment

US Geological Survey, Wisconsin Department of Natural Resources, University of Wisconsin

Why Common Loon?

- Sensitive to effects of mercury
  - altered behavior, increased chick mortality
- At risk species
  - high trophic level
  - long-lived
  - obligate piscivore

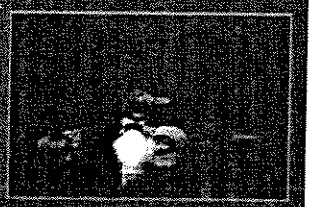


Photo by Woody Hagge

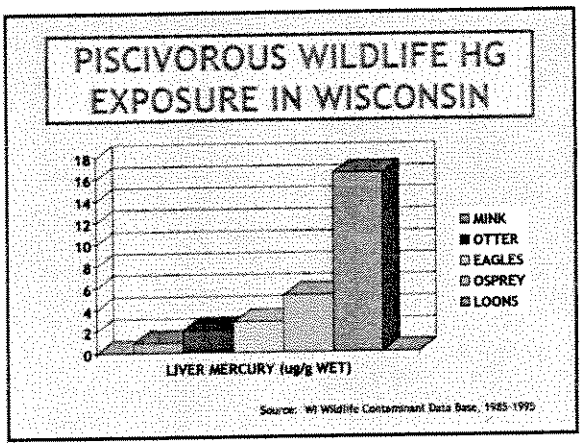
USGS

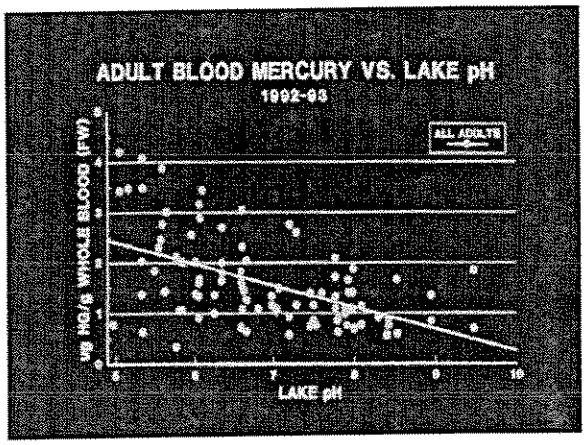
Relative Rates of Fish Consumption

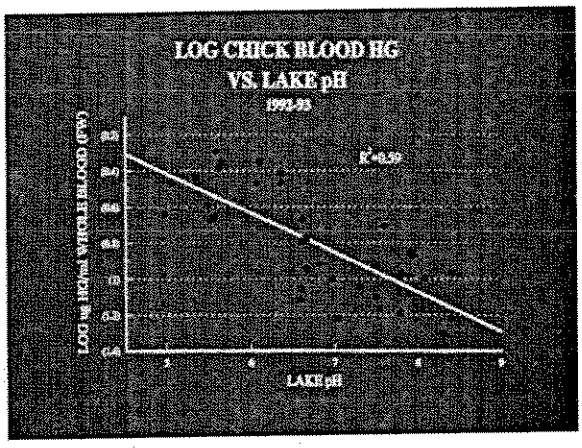
Organism	Daily consumption of fish g/individual	g/individual/kg
Adult female human (U.S.)[a]		
Median	31	0.6
95th percentile	110	2.2
Common loon[b]		
Chick (first 11 weeks)	400	220-410
Adult	960	190

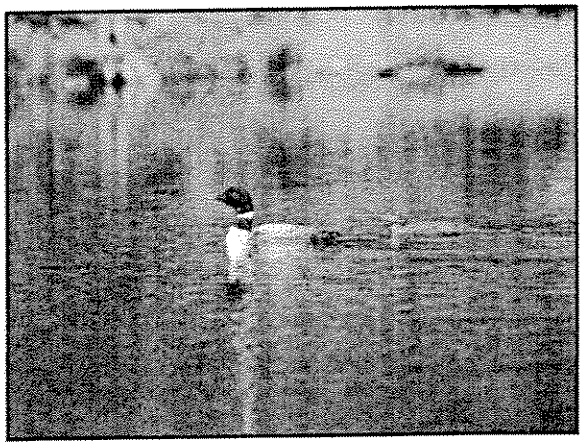
[a]USDA Continuing Surveys of Food Intake by Individuals (1989-1991).
[b]Barr 1996.

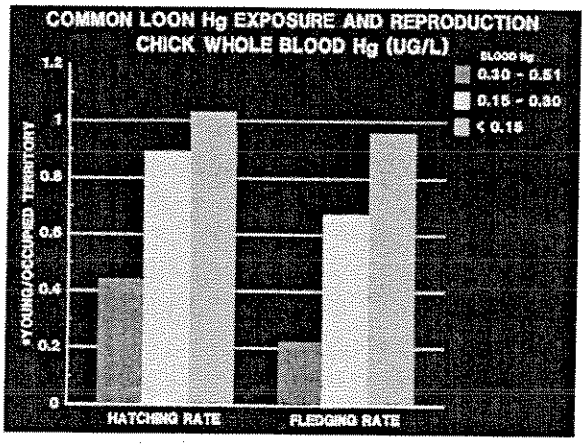
USGS

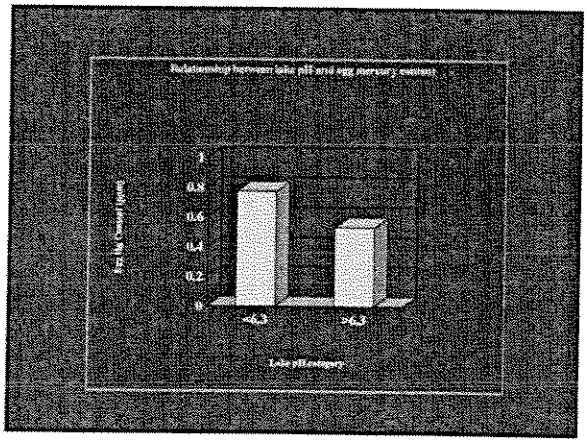

PISCIVOROUS WILDLIFE HG
EXPOSURE IN WISCONSIN
18
16
14
12
10
8
6
4
2
0
MINK
OTTER
EAGLES
OSPREY
LOONS
LIVER MERCURY (ug/g WET)
Source: WI Wildlife Contaminant Data Base, 1985-1995

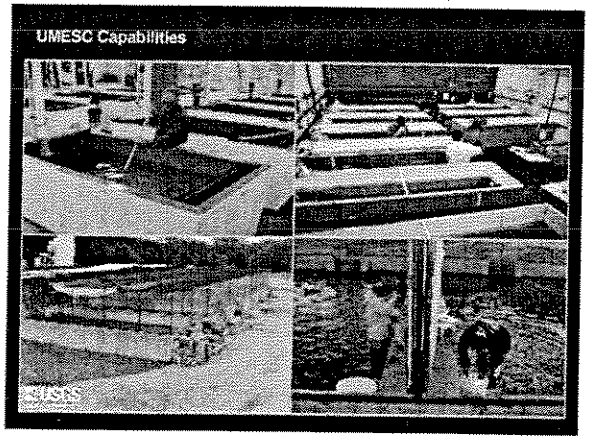

ADULT BLOOD MERCURY VS. LAKE pH
1992-93
ALL ADULTS
UG HG/g WHOLE BLOOD (FW)
LAKE pH


LOG CHICK BLOOD HG
VS. LAKE pH
1992-93
LOG BLOOD MERCURY (ug/g)
LAKE pH





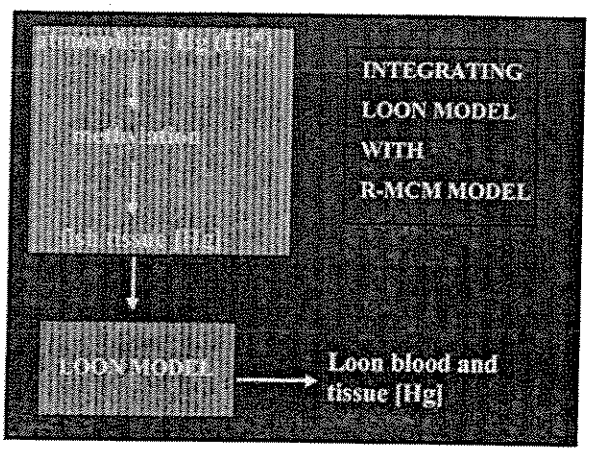


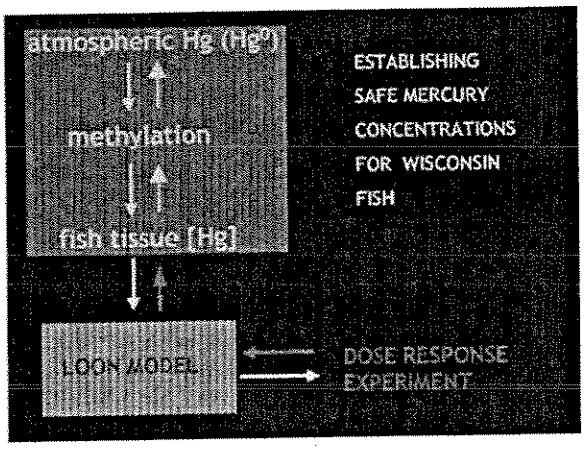


General objectives

1. develop a mechanistic model to predict tissue concentrations as a function of dietary exposure.

2. quantify mercury exposure associated with negative effects on loon chick survival and fitness.





Objective 1: mechanistic model

- mercury uptake
- mercury assimilation
- mercury excretion

"Black box"

- rate of food intake } field
- mercury content of food
- assimilation of mercury } laboratory
- rate of excretion
- tissue partitioning

Rate of food intake

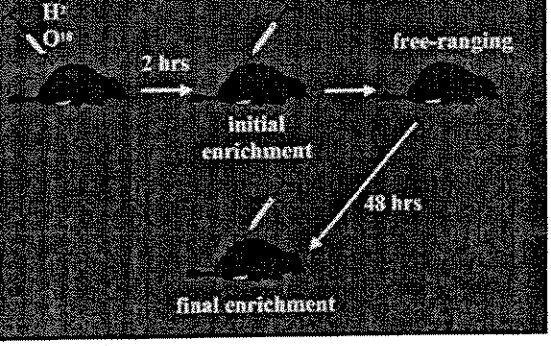
intake = respiration + production

- based on total energy budget
- measured with doubly labeled water

Doubly labeled water (HH^2O^{18})

- label the body water pool
- H leaves the body as water
- O leaves the body as water and CO_2
- the ratio of turnover of H and O gives the amount of CO_2 produced

Doubly labeled water

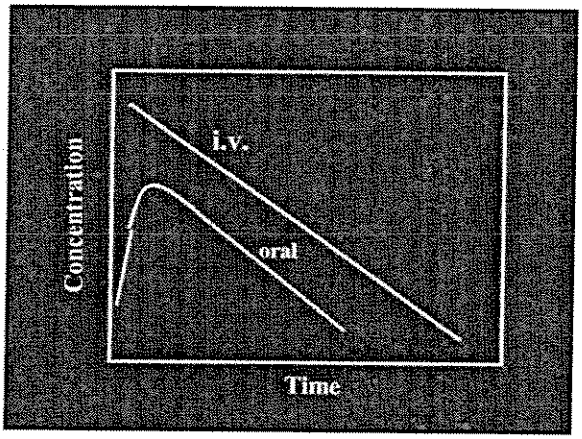


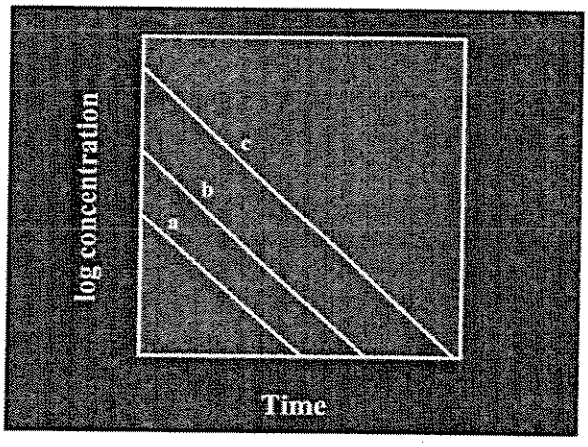
Bioavailability and excretion

- administer single pulse dose
- intravascular and oral routes
- monitor concentration in blood over time
- determine bioavailability and excretion

Methods

- collect eggs from nests (n = 8)
- incubate and hatch at UMESC
- assign chicks to groups (4/group)
- blood collection





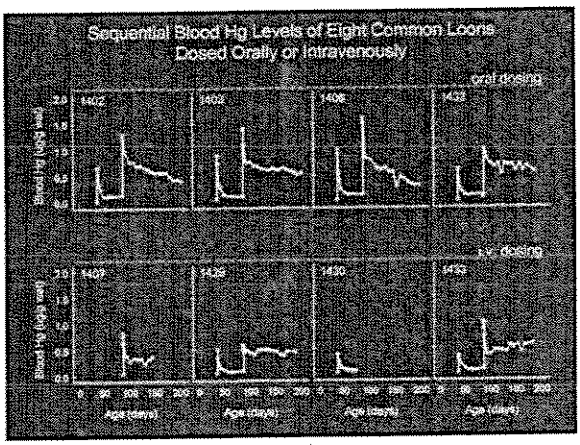
Bioaccumulation model

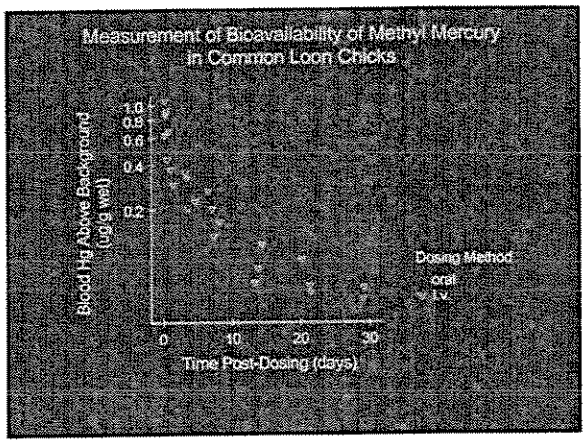
$$C_t = \frac{\alpha R C_f}{k_e}\left(1 - e^{-k_e t}\right) + C_0 e^{-k_e t}$$

C_t = total body burden (µg/g)
α = bioavailability
R = daily rate of food intake (g food/g loon x day)
C_f = mercury content of food (µg/g)
k_e = excretion rate constant (day^{-1})
C_0 = initial body burden (µg/g)

Energy and Food Requirements

Chick Age (d)	DEE (kJ/d)	Food intake (g/d)
10	645	144
21	721	160
35	1819	406



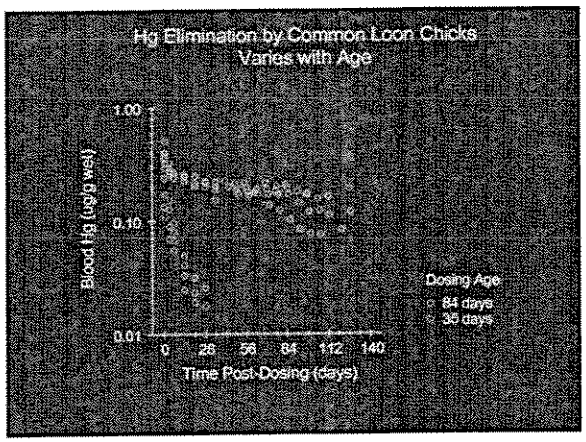


Bioavailability

$$f = \frac{AUC_{oral}}{AUC_{iv}}$$

AUC = (area under the curve)

81% MeHg Bioavailability



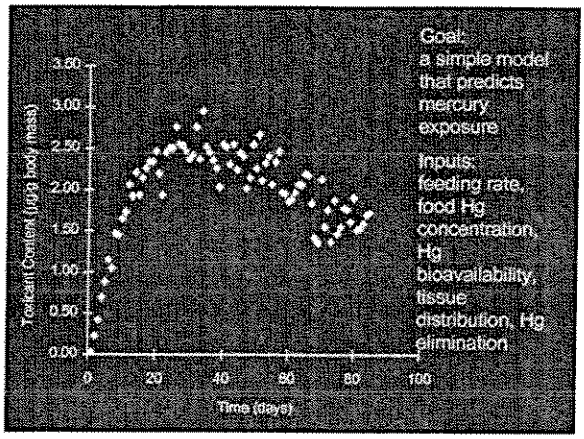
Major Findings on Absorption and Elimination of Methyl mercury

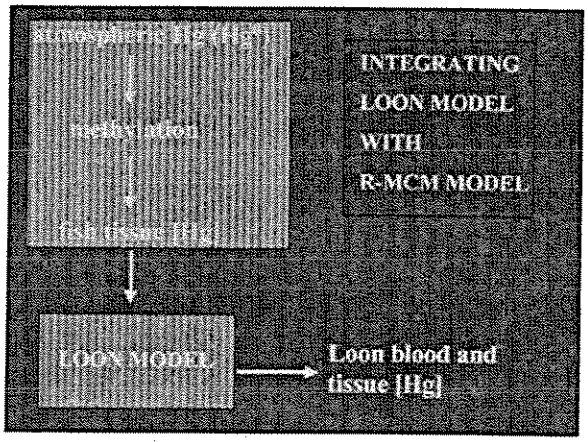
- 81% of ingested methyl mercury is absorbed
- during feather growth the half-life for elimination is 3-10 days
- after completion of feather growth, half-life for elimination is >100 days

Bioaccumulation model

$$C_t = \frac{\alpha R C_f}{k_e}\left(1 - e^{-k_e t}\right) + C_0 e^{-k_e t}$$

C_t = total body burden (µg/g)
α = bioavailability
R = daily rate of food intake (g food/g loon x day)
C_f = mercury content of food (µg/g)
k_e = excretion rate constant (day^{-1})
C_0 = initial body burden (µg/g)



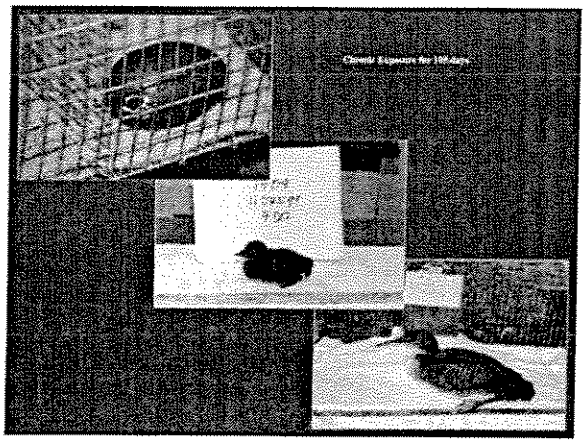


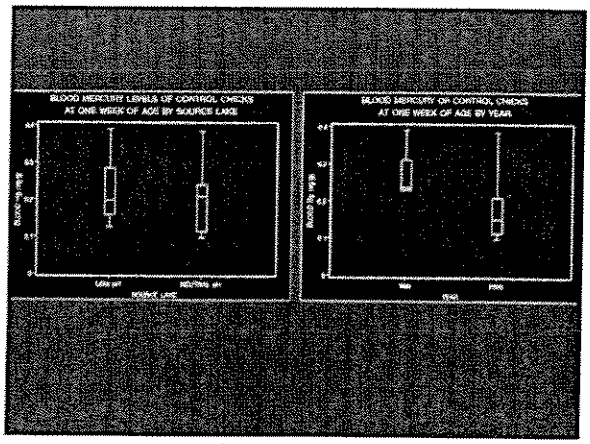
Objective 2: dose-response

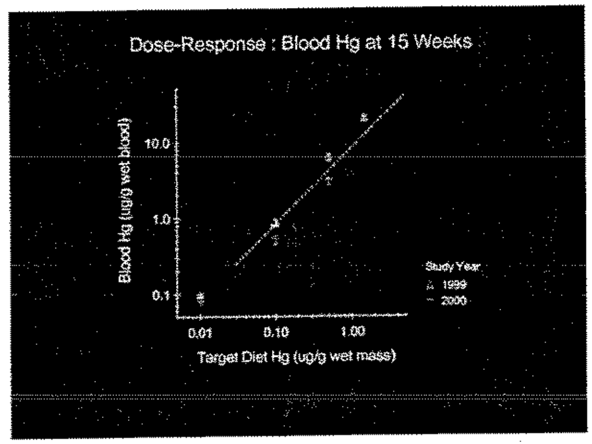
- level of MeHg that reduces survival and fitness
- chronic exposure experiment
- physiological and histological endpoints
- behavioral assays

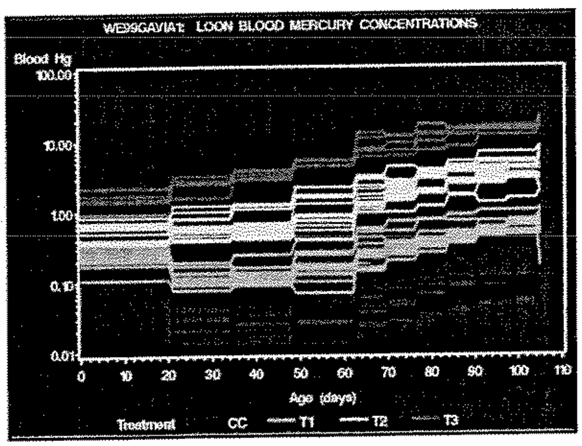
Methods

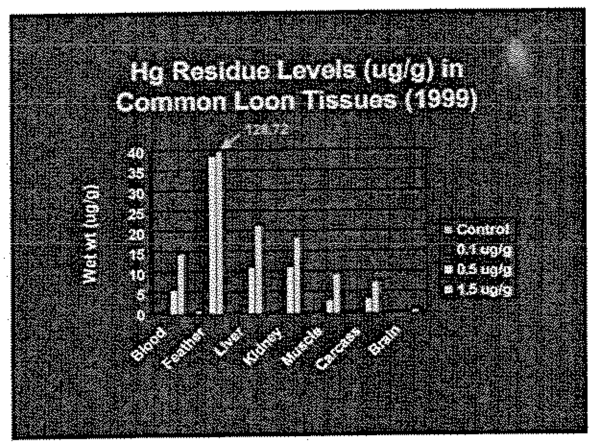
- collect eggs from 2 lake classes
- incubate and hatch at UMESC
- assign to 4 groups (4/raceway)
- daily dosing
- blood collection
- euthanize birds and collect organs and tissues

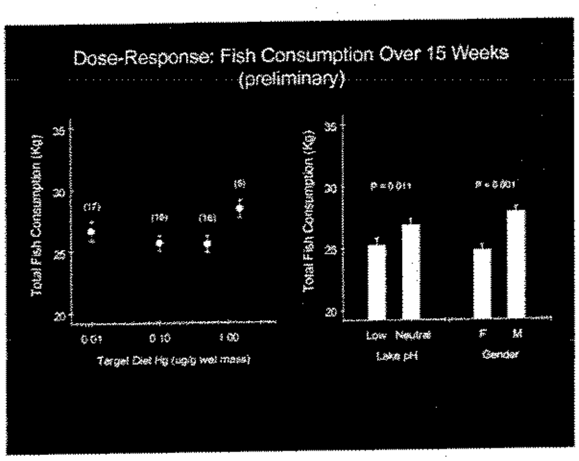


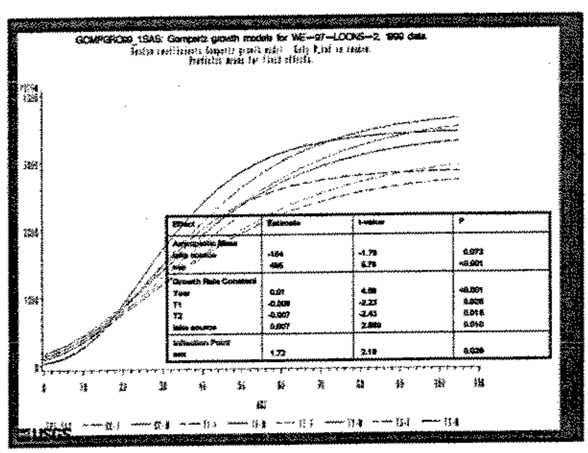



Dose-Response : Blood Hg at 15 Weeks
Blood Hg (ug/g wet blood)
10.0
1.0
0.1
0.01
0.10
1.00
Target Diet Hg (ug/g wet mass)
Study Year
1999
2000


LOON BLOOD MERCURY CONCENTRATIONS
Blood Hg
100.00
10.00
1.00
0.10
0.01
0
10
20
30
40
50
60
70
80
90
100
110
Age (days)
Treatment
CC
T1
T2
T3


Hg Residue Levels (ug/g) in Common Loon Tissues (1999)
128.72
Wet wt (ug/g)
40
35
30
25
20
15
10
5
0
Blood
Feather
Liver
Kidney
Muscle
Carcass
Brain
Control
0.1 ug/g
0.5 ug/g
1.5 ug/g

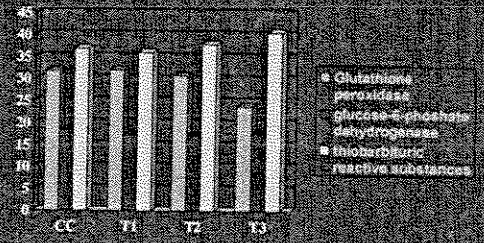

Dose-Response: Fish Consumption Over 15 Weeks (preliminary)
Total Fish Consumption (Kg)
35
30
25
20
(17)
(16)
(16)
(9)
0.01
0.10
1.00
Target Diet Hg (ug/g wet mass)
Low
Neutral
Lake pH
F
M
Gender



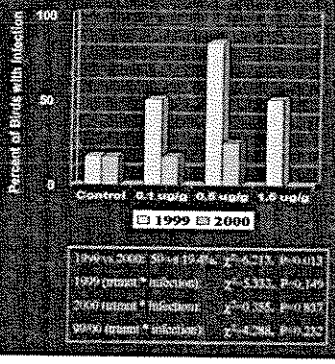
Physiological Endpoints

- Blood and tissue residue levels
- Blood and tissue oxidative stress
- DNA damage
- Immune function

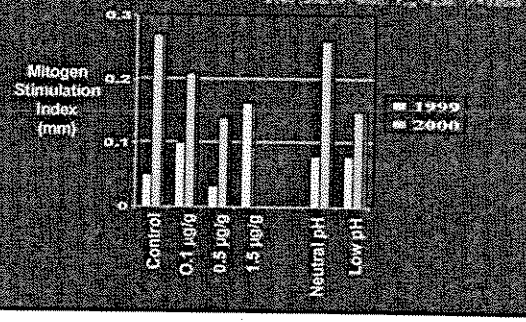
Mean Oxidative Stress Enzyme Levels: Brain (1999)



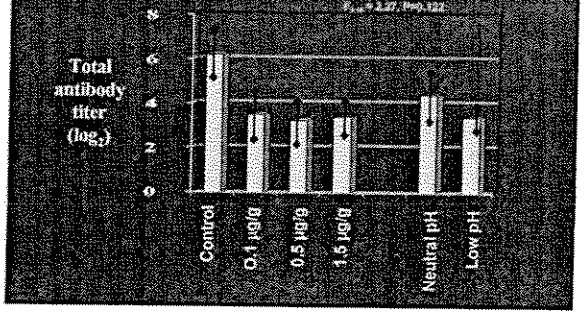
Incidence of Bacterial Infection



Mean PHA-P Skin Response

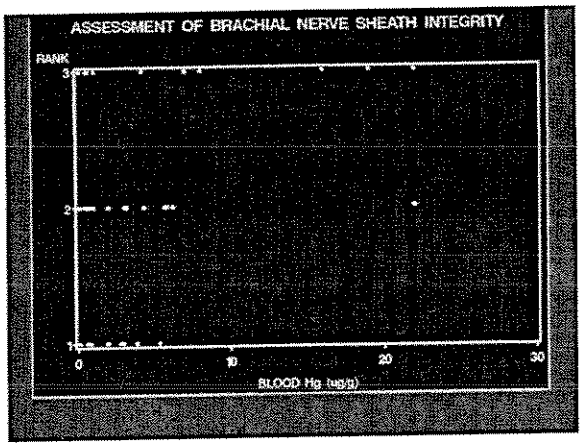


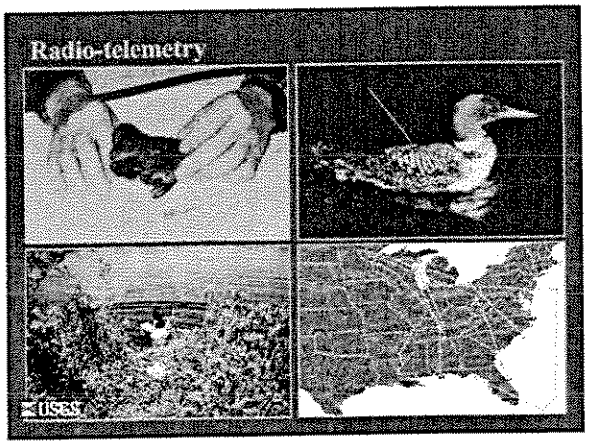
Mean Primary Antibody Response (1999)

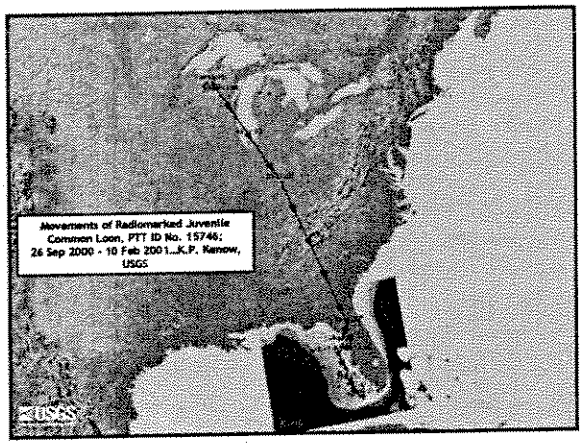


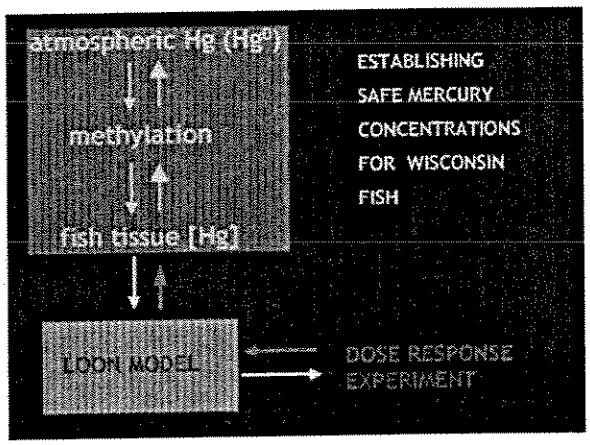
Histological Endpoints

- liver
- spleen
- bone marrow
- bursa
- thymus
- adrenal gland
- thyroid
- gonad
- pancreas
- muscle
- CNS
- brachial nerve
- sciatic nerve
- brain
- lung
- kidney









Summary: Common loons & Hg

- Kinetics of Hg absorption and elimination have been described
- In conjunction with field feeding rates and fish Hg levels, we should be able to predict exposure
- Dose-response studies should enable us to predict effects over ecologically relevant exposure levels
- Because of dosing irregularities, we have yet to establish an accurate relationship between mercury intake and blood mercury exposure

- Results of the dose-response work so far are inconclusive with respect to whether the current exposure levels in WI negatively impact loon chick health
  - No impact on survival and no overt signs of neurotoxicity
  - Suppression of instantaneous growth rate at lower treatments but not at high treatment level
  - No indication of behavioral effects with Hg exposure
  - No convincing negative physiological or histological findings
  - Analytical power associated growth and immune function measures may be insufficient to detect differences at the resulting sample sizes
- Lake pH is an important ecological confounding factor that may cause effects correlated with Hg exposure

Proposed Workplan 2002

- Establish accurate relationship between Hg intake and blood Hg exposure
- Validate predictions of the pharmacokinetic model
- Integrate loon model with R-MCM
- Additional tissue partitioning data
- Increase sample size to increase power of analyses of growth and immune function assays
- WDNR/USGS budget - $ 200k
- Tetra-Tech, Inc. budget - ?

Collaborators

- Wisconsin DNR
- USGS/BRD UMESC
- UW-Madison Dept. of Wildlife Ecology
- Tetra Tech Inc.
- USGS/BRD PWRC
- Texas A&M Univ.
- Wright State Univ.
- University of Florida

Funding Sources

- Electric Power Research Institute
- Wisconsin Utilities Association
- Wisconsin DNR
- USGS/BRD UMESC
- University of WI
- Water Environmental Resource Foundation

USGS

Appendix E
Committee Retreat Issue Briefs

CITIZEN ADVISORY COMMITTEE RETREAT
ISSUE A - BASELINE DETERMINATION

How should a mercury emission baseline be established for utility units or other mercury emitting sources that may be affected by requirements to cap and reduce mercury emissions?

ALTERNATIVES:

1. Select the current year fuel mercury content and emission rate data and apply to historic coal throughput during the identified baseline years.
2. Real time baseline – mercury in fuel compared to stack emissions out.
3. Use the baseline determination procedure in the proposed rules.
4. Use mercury emissions data from a recent year(s) or year(s) after the proposed rules are promulgated.

COMMITTEE DISCUSSION:

Committee members recognized that it was likely that obtaining accurate historical emissions data and fuel mercury content information may be difficult. Alternative 1. received significant support as an appropriate adjustment to the proposed rules that maintained the fundamental approach of a historic baseline but allowed for the use of more accurate estimates of fuel content and emission data. Several committee members believed that USEPA's Information Collection Request data and related stack emission testing should be used as part of the method for determining the baseline under this alternative. Under a multi-pollutant strategy some utilities favor use of the baseline approach expressed in Alternative 2.

PROVISIONS IN THE PROPOSED RULE:

NR 446.03 Baseline mercury emissions. This section outlines the requirements for establishing baseline mercury emissions for major electric utilities and major industrial sources. This section also includes the procedures for newly affected sources to establish their baseline mercury emissions. These are sources that become major after the promulgation date of the rules. For major utilities baseline mercury emissions set the level from which reductions are required. The presumptive baseline is the average of annual mercury emissions for 1998, 1999 and 2000. There is an opportunity to request an alternative baseline if the presumptive baseline is felt to be not representative of normal operations. Baseline mercury emissions would become effective 4 years after promulgation of rules.

For the purpose of this rule, a major utility has annual mercury emissions of 100 pounds or more and a major stationary source has annual mercury emissions of 10 pounds or more.

NR 446.04 Procedures for determining baseline mercury emissions. This section outlines the procedures for determining baseline mercury emissions from utility and industrial combustion units and process units. For utility and industrial combustion units mercury emission determinations require knowledge of mercury in the fuel used, the quantity of fuel fired and performance test results to determine the mercury removal efficiency of air pollution control equipment. For process units a mass balance approach is required.

ADDITIONAL BACKGROUND:

The Natural Resources Board in their resolution authorizing development of administrative rules directed that a methodology for determining baseline emission levels be included in the proposed rules.
The Technical Advisory Group (TAG) has drafted a brief on this issue. Their draft brief identifies concerns with the procedure included in the proposed rules and identifies alternatives. Remaining work involves a comparison of the proposed rules and alternatives.

The TAG suggests the following alternatives:

1. Select current year fuel mercury content and emission rate data and apply to historic coal throughput during the identified baseline years.
2. Use mercury emissions data from a recent year(s) or year(s) after the proposed rules are promulgated.
3. Set a baseline using historic or current fuel and consumption information.

SUMMARY OF PUBLIC COMMENT:

Wisconsin Public Service Corporation – Baseline provisions pose problems for one of their units which has recently undergone a significant change in pollution control equipment.

Sierra Club – When setting the baseline consider the amount of mercury emitted before control as the baseline. Establish a panel including public interest for approving any alternative baseline.

Wisconsin Paper Council – It is not clear why DNR picked 1998-2000 as the baseline period. Significant mercury reductions have occurred since 1990 and other states have used 1990 as a baseline. DNR should work with the Technical Advisory Group to evaluate alternative baseline periods.

Alliant Energy – Expressed concern that more time is needed to implement an emission cap then is provided in the proposed rules, that the provision for setting an alternative baseline is vague, that establishing a historical baseline using the procedures in the proposed rules is difficult and that the procedure for non-utility sources is preferred over the utility baseline procedure.

Wisconsin Electric – Opposed to the procedure in the proposed rules because there is a more accurate alternative. The proposed procedures do not account for any coal or emission control changes since the historic baseline period. Recommend a current year baseline, updated annually, set on mercury fuel content and coal consumption. A compromise position is to set a historic baseline that represents the total mercury fuel content. Baseline of mercury fuel content is more consistent with a multi-emissions controls approach, and avoids the inaccuracy of historic estimates of mercury emissions.

Stora Enso – Concerned about the quality of historical emission data to set a baseline.

COMMITTEE MEMBER INTERESTS:

Marc Looze - WED
We are open to looking at the best method for baseline determination.