<u>Lake Michigan Salmon Stocking Strategies</u>: Collaborative Process, Current Findings, and Proposed Stocking Policies and Options

BACKGROUND

Lake Michigan is a dynamic ecosystem that is changing rapidly due to the introduction of exotic species. Quagga and zebra mussels have shifted most of the productivity to the bottom of the lake leaving few nutrients for the production of plankton and zooplankton. This shift in productivity has contributed to reduced and sporadic prey fish production, which then results in variable growth and survival of salmon and trout. The most sensitive species in this prey and predator relationship are the alewife and Chinook salmon.

Chinook salmon management was fairly simple through the 1980s. As managers increased Chinook stocking, angler catch and harvest increased. Eventually, the amount of Chinook salmon exceeded the available prey and the fish became stressed. This then led to an outbreak of Bacterial Kidney Disease (BKD) that caused large die offs of Chinook salmon in the late 1980s. Studies in the 1990s confirmed the relationship between predator-prey balance and susceptibility to disease, which led to the first major reduction in Chinook stocking in 1999. As Lake Michigan's productivity continued to decrease because of invasive mussels, managers continued to see signs of low prey biomass and over-abundance of Chinook and again reduced stocking in 2006.

The Lake Michigan Committee (LMC) consulted with angling groups, general public, and federal agencies to make the stocking reductions in 1999 and 2006. An additional outcome of the 2005 stocking meeting (2006 stocking reduction) was that a lakewide study of Chinook salmon natural reproduction should be implemented to better estimate the abundance of predators. It was also decided that agencies would bring this information back to the public along with an evaluation of the 2006 stocking reduction and current status of the fishery. It is time again to review the state of Lake Michigan and develop a stocking strategy that will meet our objectives for the lake.

COLLABORATIVE PROCESS

The stocking decisions made in 1999 and 2006 involved the public once evaluations and proposals were developed by the LMC. The LMC is comprised of fishery management agency representatives from Michigan, Indiana, Illinois, Wisconsin, and Tribal interests represented by the Chippewa-Ottawa Resource Authority. An enhanced collaborative process that involved the public early in the evaluation and strategy development processes was developed by the LMC. A stakeholder group with key representatives from each state was established to develop management goals and objectives; to learn, question, and understand the current information on the State of Lake Michigan; to develop various stocking scenarios to run through a structured decision analysis computer model; and to recommend stocking policies and options to present to the general public for comment.

IDENTIFICATION OF THE CORE STAKEHOLDER GROUP

Each management agency chose individuals to serve on the Core Stakeholder Group that have good knowledge of the Lake Michigan ecosystem and fishery, represent large sport fishing or conservation organizations, and have the ability to network. This group participated in two full day workshops and provided recommendations for the proposed stocking strategies. The Core Stakeholder Group was comprised of the following individuals:

- Jeff Sadula, Calumet Harbor Sport Fish Association (Illinois)
- Ed Makauskas, Trollers Unlimited (Illinois)
- Bill Meier, Salmon Unlimited; North Point Charter Captains Assoc. (Illinois)
- Mike Ratter, Salmon Unlimited (Indiana)
- Mike Ryan, Great Lakes Fishery Commission Advisor (Indiana)
- Jeff Guerra, Michiana Steelheaders (Indiana)
- John Robertson, Michigan United Conservation Clubs (Michigan)
- Denny Grinold, Great Lakes Fishery Commission Advisor (Michigan)
- Dennis Eade, Michigan Steelheaders (Michigan)
- Todd Pollesch, Great Lakes Fishery Commission Advisor (Wisconsin)
- John Hanson, Great Lakes Sport Fish Federation (Wisconsin)
- Duane Nadolski, Great Lakes Sport Fish Federation (Wisconsin)

STAKEHOLDER AND AGENCY GOALS AND OBJECTIVES

Stakeholders from Illinois, Indiana, Michigan and Wisconsin first met with fishery managers in the spring of 2011 to discuss goals and objectives for the Lake Michigan fishery. Meetings were held in Michigan and Wisconsin in April and June, respectively.

<u>Agency Goals and Objectives</u>

- Maintain acceptable catch rates (8-12 fish/100 hrs)
- Maintain a diverse fishery (>50% Chinook; >25% other species)
- Maintain good salmon growth (Age 3 Chinook > 7 kg [15.4 lbs], in late summer)
- Maintain alewife at or below undesirable levels
- Maintain adequate spawning stock biomass for lake trout.

<u>Stakeholder Goals and Objectives</u>

- Maintain ecosystem balance
- Maximize harvest and catch rates (catch per effort)
- Maximize sport fish potential
- Maximize sustainable benefits
- Protect forage biomass
- Minimize collapse of the forage base (alewives)
- Avoid loss of native species
- Provide larger Chinook (16-18 lbs range for age 3+)
- Maintain a stable fishery
- Maintain a diverse fishery

CURRENT FINDINGS

Chinook Salmon Abundance

Lake Michigan has been stocked with Chinook salmon by the state agencies since 1967. From the start of stocking until 1990, there was a direct relationship between the number of Chinook salmon stocked and the angler harvest – higher stocking levels meant higher harvest (Figure 1). Chinook salmon harvest crashed in 1988 and bottomed out in 1995 due to the loss of adult Chinook salmon due to bacterial kidney disease (BKD). The rapid decline in harvest even with increased stocking was our first warning sign that something was changing in Lake Michigan. Prey abundance was decreasing at the same time. So in 1999 and then again in 2006 Chinook salmon stocking numbers were decreased to bring predator numbers into better balance with available prey. Harvest rebounded through 2008 but has been decreasing since.

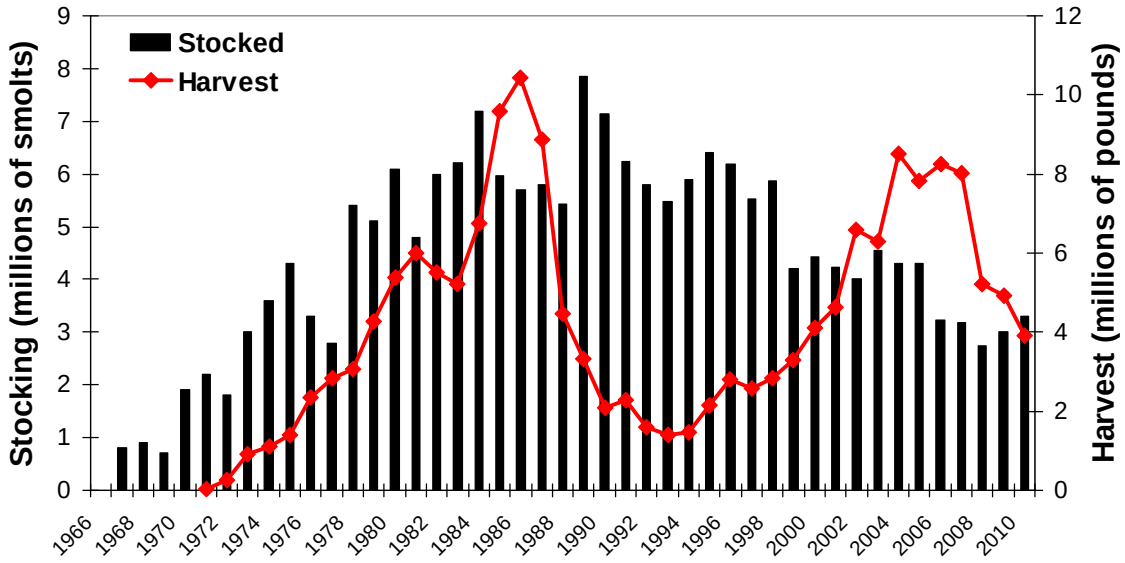

Figure 1. Lake Michigan Chinook salmon stocking and harvest from 1966 to 2010 (Source: Salmonid Working Group).

Objectives for the fishery (e.g., harvest and fish health) have become less predictable with declining and variable prey abundance and with increasing natural reproduction. From 1967 through the early 1980s, hatcheries were the source of most of the Chinook salmon in the lake. Even with the 1999 and 2006 stocking reductions, Chinook salmon numbers have remained high due to an increase in natural reproduction through time (Figure 2). This increase in natural reproduction can be attributed to increased water quality in rivers, increased connectivity to spawning habitat, and movement of wild fish from Lake Huron. The planned benefit of the two stocking reductions (i.e., predator-prey balance) has been virtually lost due to increasing natural reproduction.

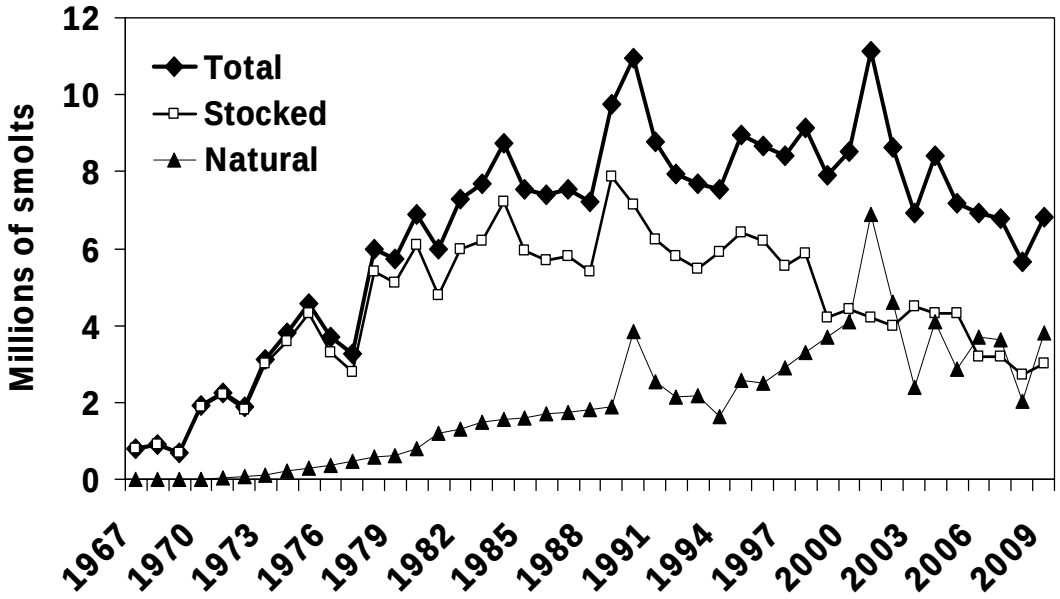

Figure 2. Total, stocked, and natural abundance of Chinook salmon smolts in Lake Michigan (Source: Salmonid Working Group).

Chinook Salmon Health

The BKD era lead to more studies related to fish health and growth. Currently, 98% of Chinook salmon inspected during egg take show no signs of disease (Figure 3). One theory as to the decline in disease incidence is that selecting eggs from healthy fish over several years resulted in a natural (genetic) predisposition for immunity. In addition, disease surveillance at hatcheries has increased and led to stocking healthier fish. Growth of fish typically goes up or down when prey abundances or environmental conditions change in the lake. Weight of age-3 Chinook salmon from harvest weirs is one of the growth indicators used by managers. The size of age-3 fish peaked at over 22 pounds in the early 1990s, during the BKD die-off. Less adult fish in the lake resulted in higher portions of available forage for the fish that survived the disease. Growth declined steadily from 2001 to 2007 and bottomed out at 11 pounds for age-3 Chinook in 2007. Since then, growth has increased to 16 pounds for age-3 Chinook in 2011, which is attributed to the strong 2010 alewife year class. Changes in alewife abundance are likely responsible for the recent changes in Chinook salmon growth.

Prey Fish Abundance

The total prey fish biomass in 2011 was 17.5 kt, which is the lowest on record for the USGS bottom trawl survey (Figure 5). Low bloater recruitment compared to the 1980s and 1990s; reduced productivity due to invasive zebra and quagga mussels; and Chinook salmon predation on alewife contribute to low prey fish biomass. Bottom trawl gear is more effective at catching larger and older alewife. An acoustic survey is also completed by Michigan DNR and USGS and is more effective at sampling younger alewife and fish in the water column than the trawl survey. The 2005 and 2010 year classes of alewife were the strongest in the last tens years, but they were still only half as much as the 1995 year class (Figure 6). With such low prey abundance, the risk of depleting the alewife population in Lake Michigan continues to increase.

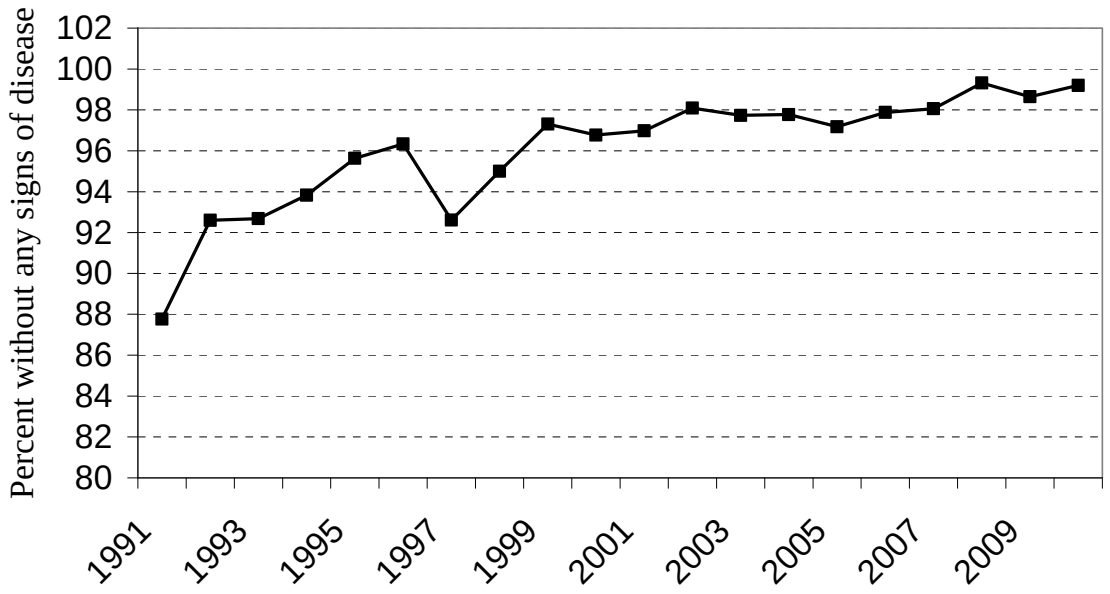

Figure 3. Percent of Chinook salmon from Lake Michigan without visual signs of disease (Source: Salmonid Working Group).

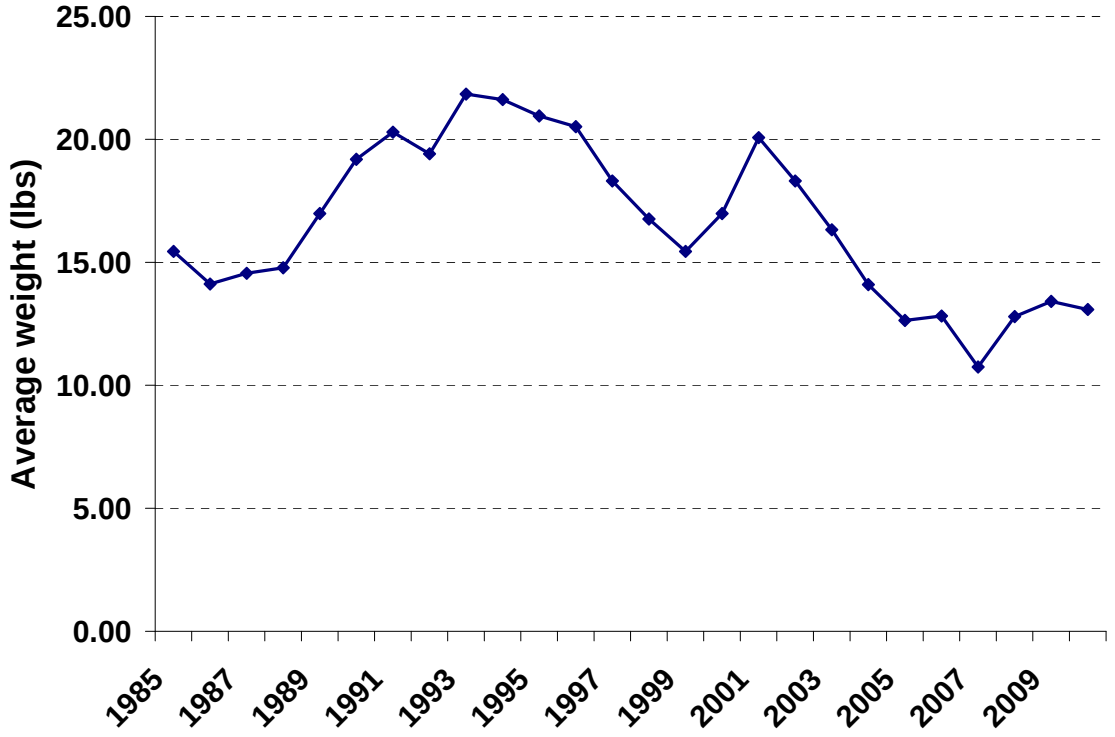

Figure 4. Average weight of age-3 Chinook salmon caught at Strawberry Creek Weir in Wisconsin (Source: Wisconsin DNR).

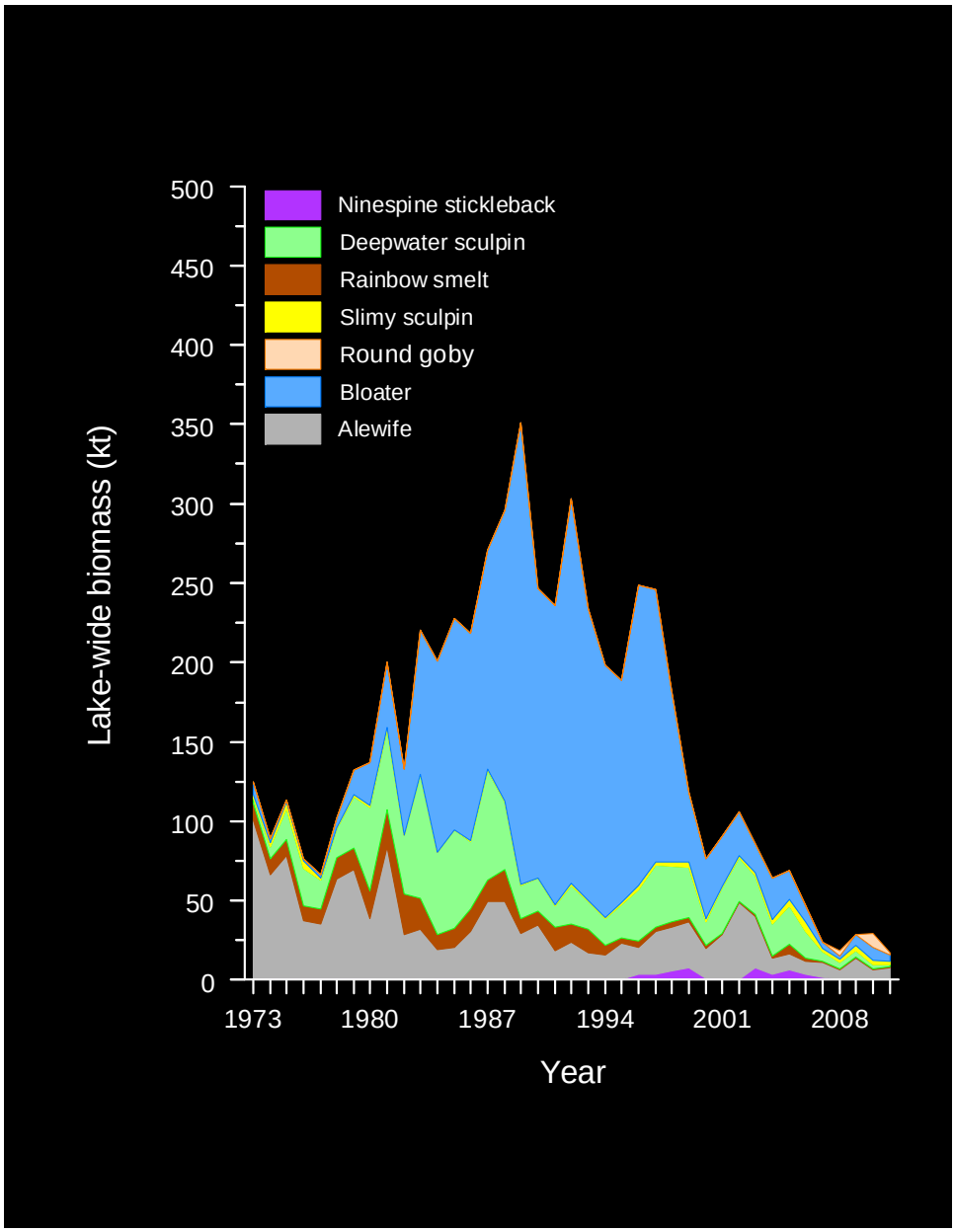

Figure 5. Bottom trawl biomass of Lake Michigan prey species (Source: USGS Great Lakes Science Center).

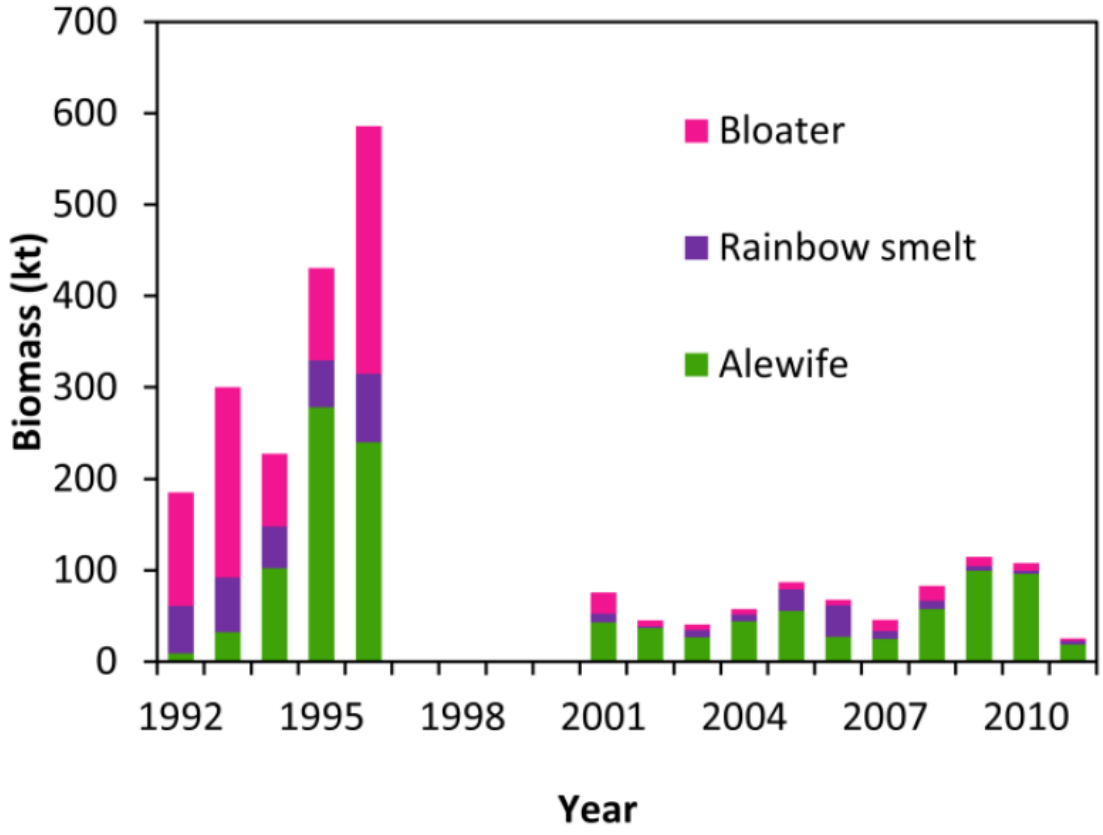

Figure 6. Acoustic estimates of total prey fish biomass in Lake Michigan 1992-2011 (Source: Michigan DNR and USGS Great Lakes Science Center).

STRUCTURED DECISION ANALYSIS

Structured decision analysis is simply a process used to inform a decision. In this case the process is being used to help managers and stakeholders make decisions regarding stocking strategies for Lake Michigan salmon. The process began with the identification of objectives for the fishery. Stocking options were then collaboratively identified. These options were evaluated through a complex quantitative computer model to see how alewife abundance and Chinook harvest would change by employing different stocking options. A key component of the computer model is that it accounts for the uncertainty in the existing population by providing a range of potential outcomes. An example of a uncertainty is the variability in alewife recruitment. The computer model produced outcomes that were evaluated by managers and stakeholders to help rank preferred options and evaluate risk. An example of risk evaluation is identification of an individual's comfort with a strategy that threatens alewife abundance. Too much predation could cause an alewife collapse and too little predation could cause unhealthy increases in the alewife population. The tradeoffs of each option were thoroughly reviewed and discussed collaboratively to come up with a suite of acceptable options to move forward for public review.

STOCKING POLICY REVIEW

The Lake Michigan Committee reviewed 26 potential stocking options that included increases, decreases, or no change in stocking as well as policies that evaluated stocking changes annually to every five years. These options were reduced to 16 with outcomes of 20% or less risk of low alewife abundance, which was a stated risk tolerance of the stakeholders. The Lake Michigan Technical Committee and Core Stakeholder Group participants were given the opportunity to provide feedback on these 16 options. Based on their comments, options that reduced the risk of low alewife abundance and that involved a policy that incorporated changes more frequently than every five years were preferred.

PROPOSED STOCKING POLICIES AND OPTIONS

The Lake Michigan Committee at their March 19th meeting agreed to move the four options listed below forward for public comment. Option 1 follows the same stocking policy implemented in the 1999 and 2006 stocking reductions. That is, a change in stocking is made and then evaluated after five years. Options 2-4 represent feedback policies where a stocking change is made, evaluated, and then adjustments (increases or decreases) may be made more frequently than a 5-year interval. Given the logistics of hatchery operation, it is anticipated that these adjustments could be enacted every 3 years. The proposed stocking options are larger reductions in stocking compared to 1999 and 2006 because prey abundance continues to decline and stakeholders expressed a low risk tolerance for low alewife abundance. Options 3 and 4 lower the risk of low alewife abundance by stocking reductions of a mix salmon and trout species (Table 1).

1. **Reduce Chinook salmon stocking lake-wide by 50% and evaluate after five years**.
   - This option follows our existing policy to make a change, evaluate the results over five years, and come back to the public for future changes.

2. **Reduce Chinook salmon stocking lake-wide by 50% and make additional reductions to stocking if weight of age-3 Chinook salmon is below 7 kg (15.4 lbs) or increase stocking if weight of age-3 Chinook salmon is above 8 kg (17.6 lbs).**
   - This option uses Chinook salmon weight as an indicator of forage abundance and fish health to determine when stocking changes are necessary. Agencies would make changes more often than every five years (i.e., changes could occur after 2, 3 or 4 years).

3. **Reduce Chinook salmon stocking lake-wide by 30% and a mix of coho salmon, steelhead, and brown trout by 10% and make additional reductions to stocking if weight of age- 3 Chinook salmon is below 7 kg (15.4 lbs) or increase stocking if weight of age-3 Chinook salmon is above 8 kg (17.6 lbs).**
   - This option uses Chinook salmon weight as an indicator of forage abundance and fish health to determine when stocking changes are necessary. Agencies would make changes more often than every five years (i.e., changes could occur after 2, 3 or 4 years). Only the 3 year outcomes are presented in Table 1.
   - Reducing the stocking of other species reduces predation and maintains higher Chinook abundance while protecting lake trout for rehabilitation purposes.

4. **Reduce Chinook salmon stocking lake-wide by 30% and a mix of other salmon and trout species (coho salmon, steelhead, brown trout, and lake trout) by 10% and make additional reductions to stocking if weight of age-3 Chinook salmon is below 7 kg (15.4 lbs) or increase stocking if weight of age-3 Chinook salmon is above 8 kg (17.6 lbs).**
   - This option uses Chinook salmon weight as an indicator of forage abundance and fish health to determine when stocking changes are necessary. Agencies would make changes more often than every five years (i.e., changes could occur after 2, 3 or 4 years). Only the 3 year outcomes are presented in Table 1.
   - Reducing the stocking of other species reduces predation and maintains higher Chinook abundance.

Table 1. Potential alewife biomass and Chinook salmon weight, harvest, and catch rate with each stocking option.

	Status quo	Option 1 **No feedback**	Option 2 **3 yr feedback**	Option 3 **3 yr feedback**	Option 4 **3 yr feedback**
Chinook reduction	None	50%	50%	30%	30%
Coho, Steelhead, Brown reduction	None	None	None	10%	10%
Lake Trout reduction	None	None	None	None	10%
Risk of low alewife biomass (<100 kt)	*23%*	14%	12%	4%	3%
Risk of low Chinook weight (<13.2 lbs)	*35%*	23%	20%	12%	11%
Risk of low Chinook harvest (<200k fish)	*20%*	21%	21%	10%	7%
Risk of low Chinook catch rate (<8 fish/100 angler hrs)	*20%*	19%	19%	9%	6%

PUBLIC COMMENT PROCESS

Following the April 14th Public Meeting in Benton Harbor, stakeholders will continue to have the opportunity to provide comments through an online survey or in writing to an agency representative. The preferred method is through an online survey available on the Michigan Sea Grant web site at:

http://www.miseagrant.umich.edu/fisheries/stocking/index.html

Comments will be received until May 15th, 2012.

As an alternative, written comments may be submitted directly to agency contacts at the mailing address listed below:

CORA
Tom Gorenflo
179 W. 3 Mile Road
Sault Ste. Marie, MI 49783

MICHIGAN
Jay K. Wesley
Fisheries Division
Dept. of Natural Resources
621 N. 10th Street
Plainwell, Michigan 49080

ILLINOIS
Steve R. Robillard
Illinois Dept. of Natural Resources
Lake Michigan Program
9511 Harrison Street
Des Plaines, IL 60016

WISCONSIN
Bradley T. Eggold
600 E. Greenfield Avenue
Milwaukee, WI 53204

or

David Boyarski
110 S. Neenah Avenue
Sturgeon Bay, WI 54235

INDIANA
Jeremy Price
Dept. of Natural Resources
Northeast Regional Office
1353 South Governors Dr.
Columbia City, IN 46725