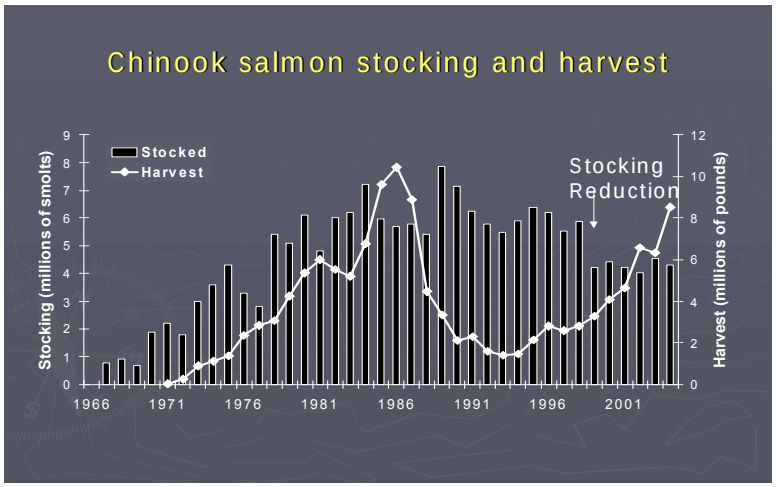
# The Lake Michigan Fishery: Balancing the Future

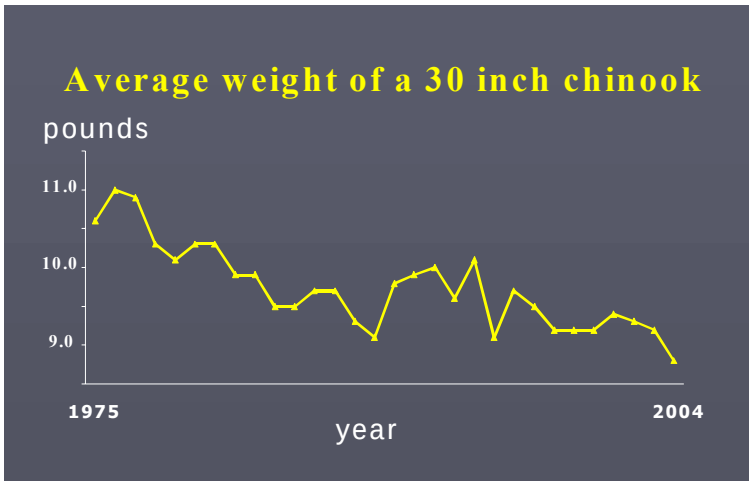
**Overview**. Predator and prey interactions play a key roll in balancing the abundance of fishes in every aquatic system, and Lake Michigan salmon and trout fisheries are no different. Over the past several years Chinook salmon fishing on Lake Michigan has been exceptional, approaching 8.5 million pounds of total harvest in 2004, which is the highest level since 1986. This harvest level suggests either there are many more salmon in the lake than can be explained by stocking, or there is not enough food and Chinook are hungry and biting everything in sight, or more likely a combination of both. Through extensive sampling fisheries managers have also identified a declining trend in the prey or forage base coupled with this rise in Chinook harvest. A similar trend was identified in Lake Michigan in the late 1990s and more recently in Lake Huron. In 1999 the Lake Michigan management agencies, in consultation with interested stakeholders, reduced lake-wide stocking of Chinook salmon by 27% from 6,000,000 to 4,400,000 fish in an effort to better balance predator and prey populations. The reduction was partially justified because of concerns that high density of Chinooks could lead to an epizootic recurrence caused by bacterial kidney disease (BKD), which significantly reduced the Chinook population in the late 1980s. Despite the stocking reduction in 1999 and the subsequent increase in harvest, it appears that the forage base may still be at risk. Therefore, it is likely prudent to make further stocking reductions at this time to maintain a favorable balance of predators and their prey.

The Lake Michigan management agencies will sponsor a conference on September 24, 2005 in Kenosha, Wisconsin to discuss the question of whether or not to implement stocking reductions, starting in 2006. **The thoughts, advice, and opinions of all interested users of Lake Michigan will be appreciated**. If you cannot attend the meeting, you are invited to reply to the agencies directly using the address found at the end of the document.



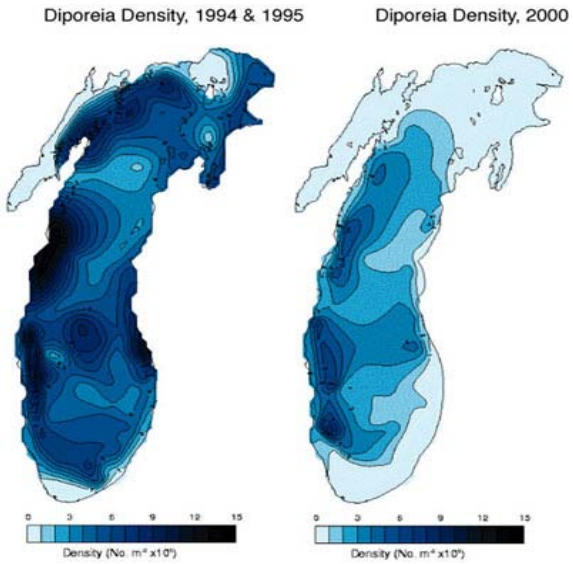

**Chinook Stocking History.** The chart at right illustrates a nearly 40-year history of stocking Chinook salmon and harvest in Lake Michigan. For the first 20 years stocking levels steadily increased as agencies developed hatchery capacity and expertise, and the harvest increased almost every year. An outbreak of BKD in the late 1980s caused a severe decline in the Chinook population and caused the management agencies to question stocking policies. BKD incidence may have been provoked by conditions similar to what we have observed in Lake Michigan today, which is lower prey abundance and high numbers of predators. By the early 1990s Chinook fishing started to improve, but believing that substantial cuts were necessary to assure the long-term stability of the forage base the agencies reduced

Chinook salmon stocking by 27% in 1999. Since then Chinook salmon fishing has been outstanding.




**Recent Concerns.** A number of indicators suggest that the great fishing anglers are currently experiencing will not last. Fisheries research scientists on Lake Michigan have developed a series of indicators that are now referred to as "red flags". These indicators provide managers long term trend information necessary to make decisions on when management practices need to be adjusted in order to meet objectives. First among these is the decline in size-at-age of Chinook salmon. As shown in the chart, the average weight of a 30-inch Chinook salmon returning to Wisconsin's Strawberry Creek Weir has declined over two pounds since the late 1970s, and almost one full pound between 2001 and 2004.

The number of salmon that Lake Michigan can sustain may change over time as new species and habitat alterations affect the ecosystem. Scientists with the Great Lakes Science Center (USGS, Ann Arbor) have documented a 14% decline in the condition (weight at a given length) of alewife in Lake Michigan since the mid 1990s, the primary prey utilized by Chinook. Similar declines in the estimated abundance and biomass of alewife have also been documented over the last three years. These declines may be a consequence of underlying ecosystem changes reflected in the rapid disappearance of bottom dwelling amphipods known commonly as scuds and scientifically as *Diporeia*. Scientists with the NOAA's Great Lakes Environmental Research Laboratory have studied the distribution and abundance of *Diporeia* in Lake Michigan and other lakes, and documented the reduction illustrated in the accompanying figure. Significantly lower densities of *Diporeia* may partially explain the decline in condition of alewives. These observations and long-term trend data showing decreasing abundance of prey species suggest that the ability of Lake Michigan to support top predators, including Chinook salmon, may have changed.



**Lake Michigan Management Goals.** The Lake Michigan fishery is managed through a cooperative process that is outlined in the "Joint Strategic Plan for Management of Great Lakes Fisheries" (Great Lakes Fishery Commission 1980, revised 1997). The plan outlines the goal of securing fish communities, based on foundations of stable, self-sustaining stocks, supplemented by stocking of hatchery-reared fish with the objective of providing an optimum contribution of fish, fishing opportunities and associated benefits to meet the needs identified by society for food, recreation, employment and income, and a healthy human environment.

Ten guiding principles for Lake Michigan exist to provide a decision-making framework for rehabilitating and maintaining the integrity of Lake Michigan's fish communities. They include:

- ✓ Recognize the limits on lake productivity.
- ✓ Preserve and restore fish habitat.
- ✓ Preserve native species.
- ✓ Enhance natural reproduction of native and desirable introduced fishes.
- ✓ Acknowledge the role of planted fish.
- ✓ Recognize naturalized species.
- ✓ Adopt the genetic stock concept.
- ✓ Recognize that fisheries are an important cultural heritage.
- ✓ Prevent the unintentional introduction of exotic species.
- ✓ Protect and enhance threatened and endangered species.

Within these goals are defined objectives to guide management decisions better know as "fish community objectives" or FCOs (Eshenroder et. al. 1995). Within that framework, there are additional specific objectives to guide the current stocking discussion, including:

- ✓ Maintain salmonid catch rates of 15-20 fish per 100 hours.
- ✓ Maintain a diversity of fishing opportunities.
- ✓ Promote lake trout rehabilitation and fishing.
- ✓ Maintain alewives at levels that minimize negative effects on native species while supporting the other objectives.
- ✓ Minimize the risk of disease outbreaks.
- ✓ Reduce reliance on stocking to sustain the fishery.
- ✓ Maintain a fishery in which Chinook salmon make up around 50% of the total salmon and trout harvest by weight.

**Two Approaches: "Red Flags" and "Decision Analysis".** To evaluate the need for changes to the stocking policy for Lake Michigan, the agencies have pursued two approaches. Biologists have tracked a number of indices of the condition of this particular predator-prey community. They have identified a number of variables to be examined, of which the six most important are presented here: salmon abundance, reproduction, growth, ration, and health, as well as forage abundance (primarily alewife). These variables are collectively known as the "Red

**Red Flags Summary Table**

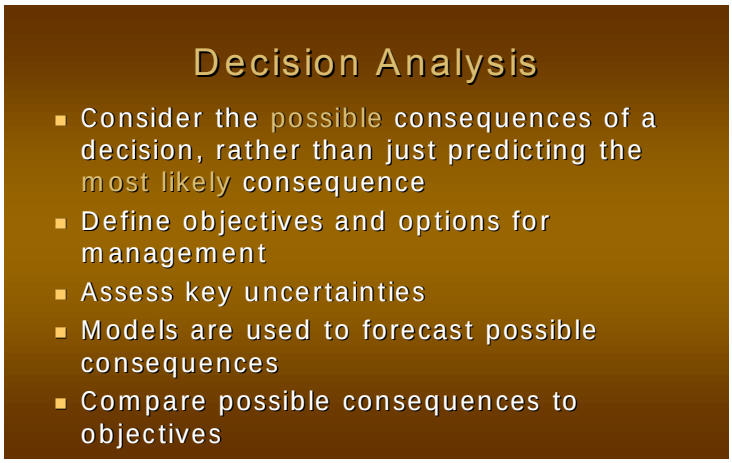
| Variable | Index | Level I | Level II |
|---|---|---|---|
| Abundance | Harvest | No | No |
| | Catch rate | Yes | Yes |
| Reproduction | Total Recruits | No | No |
| Growth & ration | Wt Age 2 | No | No |
| | Wt Age 3 | Yes | No |
| | Age 2 ration | No | No |
| | Age 3 ration | Yes | No |
| Forage | Bottom trawl | Yes | No |
| | Acoustics | Yes | No |
| Fish health | Survey visual | No | No |
| | Weir visual | No | No |
| | SC DFAT | No | No |

Flags". For each variable, fisheries biologists have set a standard to denote a healthy population of Chinook salmon. If a Level I flag is triggered, this indicates a variable has exceeded the standard for one year. If a Level II flag s triggered, this indicates a variable has exceeded the standard for three of the last five years. While all the data for 2005 are not yet available for review, it does appear that many of the variables under observation will continue to cause triggering of many flags again this year.

Using data analyzed through 2004, the red flags table shows that over 40% of the index's Level I rating was triggered as red flags. This is an increase from 2003 and it was significant enough to warrant consideration of investigation into management direction. Level II red flags were only triggered in the catch rate index. If these trends continue in 2005 reaching a balance between predators and prey is unlikely, especially if stocking remains status quo.

Estimating the amount of naturally produced salmon plays a significant role in our analysis and modeling. The agencies understand that a Chinook population that is comprised of 70% wild fish (fish not from hatcheries) can have dramatic impacts to the prey base if stocking continues at its present pace. Fisheries managers are unclear on the actual amount of wild fish in Lake Michigan, but they are comfortable with estimates near 50% and understand that recent trends indicate increasing amounts of wild fish in the population. These recent increases are most likely fish produced in Lake Huron.

Decision analysis involves the use of mathematical models to project possible future states of the salmon and alewife populations. These models incorporate uncertainty about future events and force us to realize that desirable future conditions cannot be guaranteed. They also allow us to see the trade-offs between different management objectives.




An in-depth discussion of both the "Red Flags" and "Decision Analysis" process will be presented at the conference.

**Stocking Options.** How many salmon should be stocked? We believed in the past that more stocking lead to more harvest, but we now know that too much stocking can lead to poor feeding conditions and increased mortality of Chinook salmon. Conversely, too little stocking may lead to negative effects of alewife on other native species. Management agencies explicitly reviewed strategic stocking options in the context of meeting the seven specific objectives of the FCOs listed above. This review included discussions on 12 separate scenarios that encompassed many stocking strategies. There was no investigation into increasing stocking rates for any species.

Management agencies on Lake Michigan have narrowed the strategic options for public consideration to the following:

- ✓ status quo, maintaining current stocking levels for all salmonids;
- ✓ reduce Chinook salmon stocking by 25%;
- ✓ reduce Chinook salmon stocking by 50%; or
- ✓ reduce stocking of all salmon and trout by 25%, except lake trout.

It is the goal of the management agencies to balance predator and prey populations, and deliver the best outcomes in relation to the fishery objectives. This can occur in different ways or combinations if stocking strategies are viewed in relation to forage consumption. We can conserve valuable forage by reducing the primary forage consumer (Chinook) or by reducing combinations of all stocked salmonids. Anglers have clearly indicated the desire to maintain diverse fisheries and because of this it makes sense to reduce only Chinook salmon.

We evaluated the 4 strategic options shown above in relation to the established objectives. Given our latest and best information at this time, the agencies have agreed to recommend a preferred option of reducing Chinook salmon stockings by 25% starting in 2006. The public at this time is now invited to discuss with the agencies this recommendation and help in a decision making process to decide if we move forward with this specific recommendation or a modification. It is the job of professional fishery managers to ensure that management actions are proactive rather than reactive, and that thoughtful responses to changes observed in the lake are implemented in a timely manner.

For further information or to provide written comment on this proposal:
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For information about the conference, call 920-683-4697 or visit www.seagrant.wisc.edu/Fisheries/ and click on "**Salmon Stocking Conference**".

References:
Eshenroder, R. L., M. E. Holey, T. K. Gorenflo, and R. D. Clark, Jr. 1995. Fish-community objectives for Lake Michigan. Great Lakes Fish. Comm. Spec. Pub. 95-3. 56p.

Great Lakes Fishery Commission. 1997. A Joint Strategic Plan for Management of Great Lakes Fisheries. Ann Arbor, Mi.

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