Quota Allocation Strategies

Report of the Standing Technical Committee to the
Lake Erie Committee
03/17/2007

With the recent advent of Geographic Information Systems (GIS) and the development of the Lake Erie GIS, the Standing Technical Committee (STC) of the LEC undertook the task of updating the sharing formulas by jurisdiction for both walleye and yellow perch quota management in Lake Erie. In 2004, the LEC went through an exercise to further define the Lake Erie basin boundaries such that management units and quota sharing formulas could be updated using the more definitive technical data available today, as well as to document the history of sharing formula calculation and quota allocation.

Walleye Quota Allocation Formula

In 1976, the Scientific Protocol Committee (SPC) discussed several quota allocation options, including allocation on the basis of division of total allowable catch among jurisdictions based upon the relative surface area of adult walleye habitat within each jurisdiction, spawning/nursery area within each jurisdiction, or shoreline length within each jurisdiction. They concluded that the simplest and most logical was the division by surface area while postponing the other methods pending acquisition of more definitive data. The SPC defined adult walleye habitat for western basin stocks as lake surface area in Management Units 1 and 2 (Statistical Districts ME-1, OE-1, OE-2, O-1, and O-2) that was inside of the 7 fathom contour (~13 m). The estimated surface area within the 7-fathom contour was calculated for each jurisdiction (MI, ONT, OH), and quotas were allocated based upon these percentages. The SPC (Kutkuhn et al. 1976, Hatch et al. 1987) generated surface area estimates of walleye habitat in each jurisdiction (Table 1).

Table 1. Relative walleye habitat surface area in each Statistical District and Jurisdiction. These estimates were used for quota allocation purposes.

Statistical District	Area[a] (mi^2)	Percentage
ME-1	188.6	8.8%
O-1[b]	663.0	30.9%
O-2	460.5	21.5 %
OE-1	585.6	27.3%
OE-2	246.1	11.5%
Total	**2143.8**	
Michigan	188.6	8.8%
Ohio	1123.5	52.4%
Ontario	831.7	38.8%

[a] Lake surface, inside 7-fathom contour
[b] Includes Sandusky Bay

These surface area percentages were used for allocating harvest quotas by the LEC from the inception of quota management through 1988. Because the walleye stock had increased

through the 1980s, there was a perception that walleye stocks had expanded their distribution further east, into Management Unit 3. In 1988, the Walleye Task Group (WTG) revisited the quota sharing formula and proposed revising this formula to include area within the 7-fathom contour in Management Units 1-3 (Table 2). However, because the revisions resulted in significant changes in the sharing formula, the WTG and LEC agreed to a compromise sharing formula. Unfortunately, no actual surface area estimates existed in the WTG report, only relative surface area estimates (WTG 1988). This formula continues to be used by the LEC for quota allocation purposes currently.

Table 2. Relative walleye habitat surface area in each Statistical District and jurisdiction. Walleye habitat includes area within the 7-fathom contour in Management Units 1-3.

State/Province	**Traditional (MU1-2, within 7-fathom contour)**
Michigan	8.8%
Ohio	52.4%
Ontario	38.8%
	Revised (MU1-3, within 7-fathom contour)
Michigan	1.7%
Ohio	50.5%
Ontario	47.8%
	Compromise (mean of traditional and revised estimates)
Michigan	5.3%
Ohio	51.4%
Ontario	43.3%

More recently, with the advent of Geographic Information Systems (GIS) and the development of the Lake Erie GIS (Geddes and Rutherford 2007), the Standing Technical Committee (STC) of the LEC undertook the task of updating the sharing formulas by jurisdiction for both walleye and yellow perch quota management in Lake Erie. In 2004, the LEC went through an exercise to further define the Lake Erie basin such that management units and quota sharing formulas could be updated using the more definitive technical data available today, as well as to document the history of sharing formula calculation and quota allocation.

Using information contained in the Lake Erie GIS, including the 1:250,000 scale NOAA bathymetric maps (National Geophysical Data Center) and the LEC defined lake limits and Statistical Districts (Figure 1). These datasets, within the confines of the Lake Erie GIS provide much higher accuracy with respect to areal calculations. Estimates from the Lake Erie GIS for surface area by jurisdiction are calculated using the SPC defined extent of walleye habitat (MU1-2, 7-fathom contour), the 1989 WTG defined extent of walleye habitat (MU1-3, 7-fathom contour), and these are compared to historic estimates of surface area by jurisdiction/statistical district (Table 3).

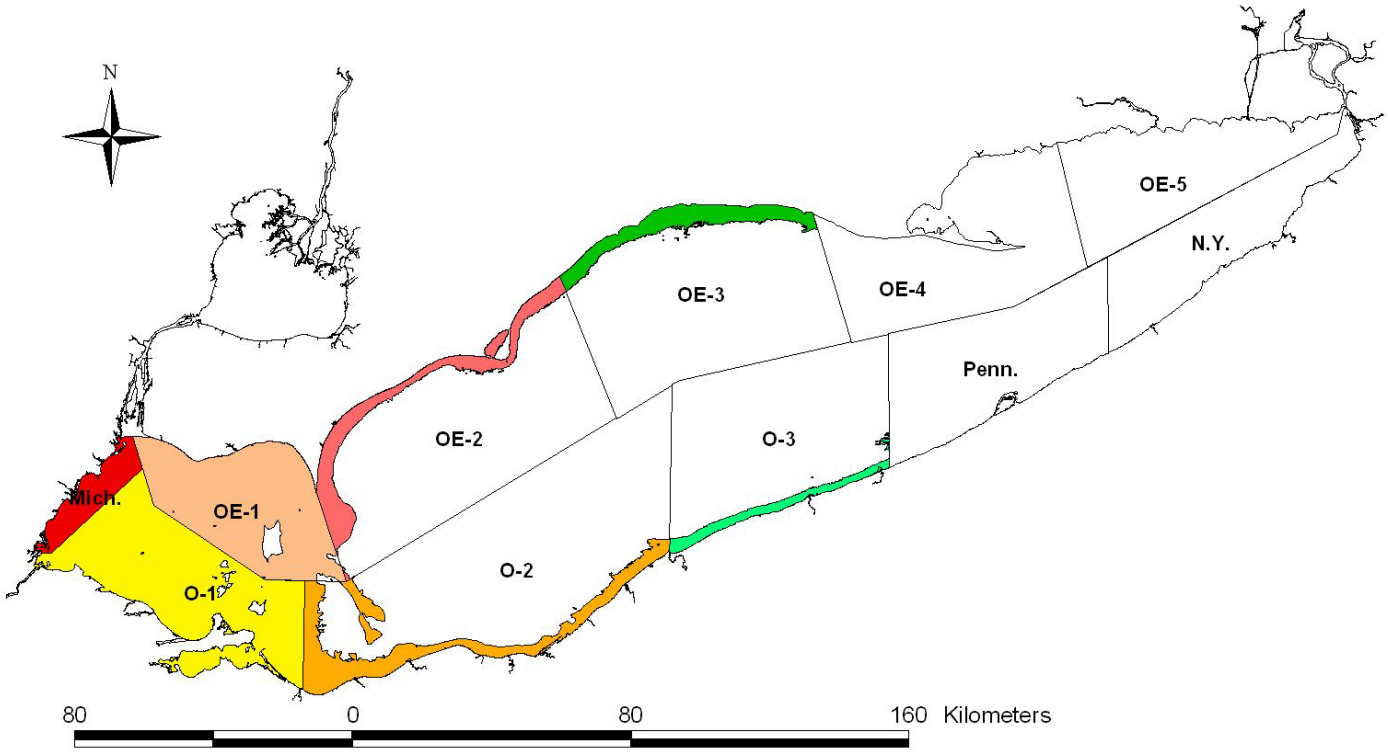

Figure 1. Habitat utilized by the western basin walleye stocks as defined by Kutkuhn et al. (1976) and the Walleye Task Group (1989). Kutkuhn et al. (1976) defined western basin walleye habitat as the area of the lake in Management Units 1 and 2 (Statistical Districts Mich., OE-1, OE-2, O-1, and O-2) while the Walleye Task Group also added area from Statistical Districts OE-3 and O-3.

Table 3. Relative walleye habitat surface area in each Statistical District and jurisdiction as calculated from the Lake Erie GIS. Walleye habitat includes area within the 7-fathom contour in Management Units 1-3. Historical surface area estimates are included for comparison.

		Old Estimates (MU1-2)[a]	New Estimates (MU1-2)[b]	New Estimates (MU1-3)[c]	Current Estimates[d]
Quota Management Area	**Total**	2143.8	1913.1	2124.7	---
Jurisdiction Area (mi^2)	**Michigan**	188.6	123.8	123.8	---
	Ohio	1123.5	1018.4	1086.0	---
	Ontario	831.7	770.8	914.9	---
Jurisdiction percentage	**Michigan**	8.8%	6.47%	5.83%	5.3%
	Ohio	52.4%	53.23%	51.11%	51.4%
	Ontario	38.8%	40.29%	43.06%	43.3%
	Total	100.00%	100.00%	100.00%	100.0%

[a] Estimated in Kuhkuhn et al. (1976) Scientific Protocol Committee on Interagency Management of the Walleye Resource of Western Lake Erie

[b] Estimated using Kutkuhn et al. (1976) definition, Lake Erie boundary definition from LEC and Lake Erie GIS database

[c] Estimated using Kutkuhn et al. (1976) definition, lake Erie boundary definition from LEC, MU1-3 and Lake Erie GIS database

[d] Based on Walleye Task Group Compromise (WTG Report, 1988)

Results of this analysis for walleye indicate that the current estimates of relative surface area, despite being a bit arbitrary (calculated as the mean of the historic and revised estimates from Table 2) are relatively close to the new estimates which include area within the 7-fathom contour in Management Units 1-3. The STC recommends that the LEC adopt the new sharing formulas for walleye quota allocation as these estimates are based upon the most current technical data available. This analysis demonstrates the utility of the GLFC funded Lake Erie GIS, provides more accurate areal estimates of walleye habitat, and can potentially be the springboard for exploring walleye distribution patterns and other allocation strategies based upon the changes seen in Lake Erie over the past several decades. The STC recommends adoption of the new quota sharing allocations in 2008, and suggests that the definition of walleye habitat may need to be revisited in light of changing environmental conditions and walleye abundance in recent years.

Yellow Perch Quota Allocation Formula

In 1981, the Yellow Perch Task Group (YPTG) of the LEC discussed three potential methods for allocating quotas and explored the advantages and disadvantages of each allocation strategy (YPTG 1981). The three methods explored included 1) water surface area within each of the four management units by jurisdiction, 2) historical harvest within each of the four management units by jurisdiction, and 3) a "hybrid" allocation scheme that included aspects of both surface area and harvest. Surface area estimates by jurisdiction and sub-area were presented by the YPTG (1982) (Table 4), but no formal quota allocation strategy was established until 1993. Prior to 1993, the YPTG annually broke down the recommended allowable harvests by jurisdiction in each Management Unit based upon relative total surface area and presented harvest and quota

allocation for comparison purposes (Table 4). In 1993 the LEC agreed to a formal quota allocation strategy that initially used historic harvest by jurisdiction in each of the Management Units for quota allocation. These percentages gradually adjusted from historic percentages to allocations based upon surface area in each Management Unit by jurisdiction over a 12-year period (YPTG 2006).

Table 4. Relative yellow perch habitat by surface area in each Management Unit and jurisdiction as calculated by the YPTG (1982). Yellow perch habitat includes total area within each Management Unit.

Management Unit	Sub-Area	Jurisdiction	Surface Area (km^2)	Relative Surface Area by MU
MU 1	11	Ontario	1532.1	42.3%
	31	Michigan	290.4	8.1%
	21	Ohio	1795.8	49.6%
		Total	**3618.2**	
MU 2	12	Ontario	3333.3	42.5%
	23	Ohio	4501.7	57.5%
		Total	**7835.0**	
MU3	13	Ontario	4769.9	56.1%
	24	Ohio	2714.2	31.9%
	41	Pennsylvania	1014.0	11.9%
		Total	**8498.1**	
MU4	10	Ontario	2935.7	55.2%
	51	New York	1471.1	27.6%[a]
	42	Pennsylvania	915.0	17.2%
		Total	**5321.9**	

[a] YPTG reports (1984-1991) used 29.6% for New York surface area.

More recently, with the advent of Geographic Information Systems (GIS) and the development of the Lake Erie GIS, the Standing Technical Committee (STC) of the LEC undertook the task of updating the sharing formulas by jurisdiction for yellow perch quota management in Lake Erie. In 2004, the LEC went through an exercise to further define the Lake Erie basin such that management units and quota sharing formulas could be updated using the more definitive technical data available today, as well as to document the history of sharing formula calculation and quota allocation.

Using information contained in the Lake Erie GIS, including the medium resolution NOS shoreline data, the 1:250,000 scale NOAA bathymetric maps (National Geophysical Data Center) and the LEC defined lake limits and Management Units (Figure 2). These datasets, within the confines of the Lake Erie GIS provide much higher accuracy with respect to areal calculations. Estimates from the Lake Erie GIS for surface area by jurisdiction are calculated using each jurisdiction's Lake Erie surface area in each of the Management Units. In 2004, some minor changes occurred in some jurisdictions Management Unit boundaries to reconcile catch and effort

reporting with the Management Unit boundaries. These are compared to historic estimates of surface area by jurisdiction/statistical district (Table 5).

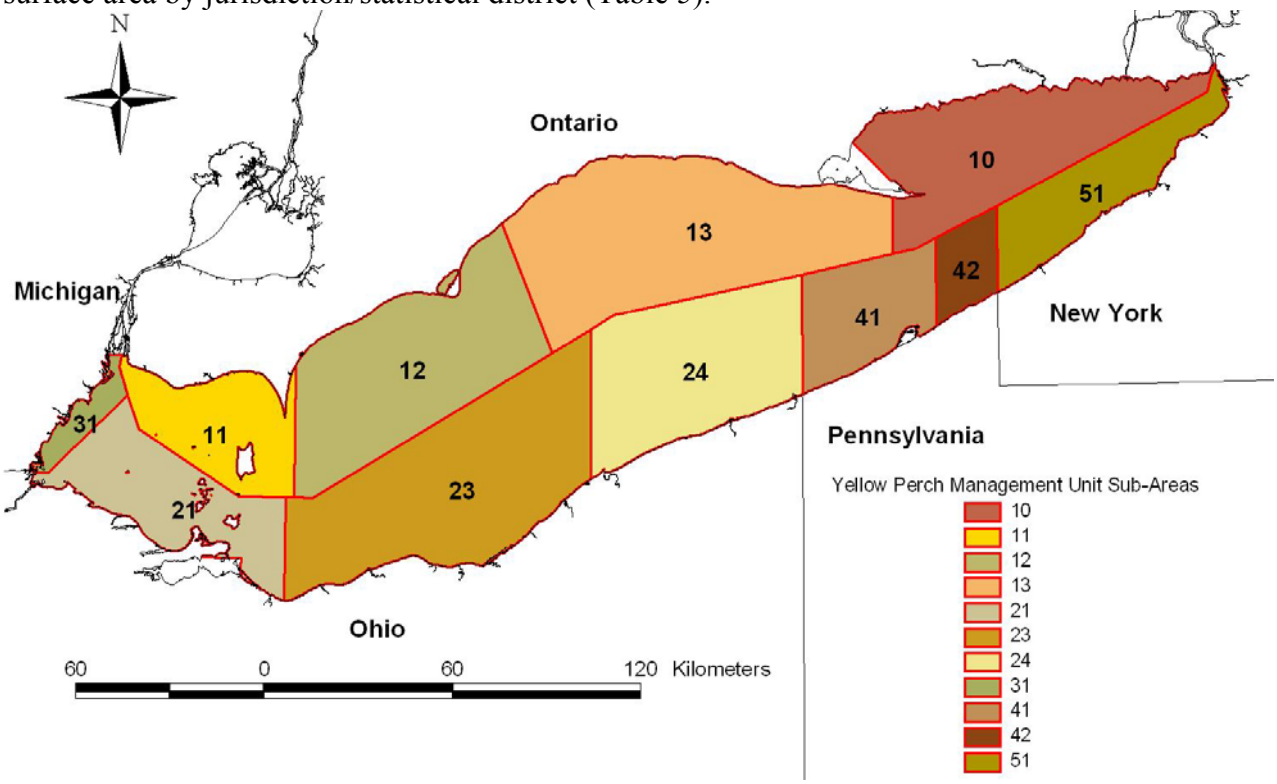

Figure 2. Management Units and sub-areas used for yellow perch quota allocations. Data are contained in the Lake Erie GIS (Geddes and Rutherford 2007)

Table 5. Relative yellow perch habitat by surface area in each Management Unit and jurisdiction as calculated from the Lake Erie GIS. Yellow perch habitat includes total area within each Management Unit. Historical surface area estimates are included for comparison.

Management Unit	Sub-Area	Jurisdiction	New Estimate (km2)	Old Estimate (km2)	New Relative Surface Area	Old Relative Surface Area
MU1	11	Ontario	1537.1	1532.1	40.6%	42.3%
	31	Michigan	344.8	290.4	9.1%	8.1%
	21	Ohio	1905.6	1795.8	50.3%	49.6%
		Total	**3787.5**	**3618.2**		
MU2	12	Ontario	3497.4	3333.3	45.6%	42.5%
	23	Ohio	4175.3	4501.7	54.4%	57.5%
		Total	**7672.7**	**7835.0**		
MU3	13	Ontario	4635.3	4769.9	51.7%	56.1%
	24	Ohio	2946.2	2714.2	32.9%	31.9%
	41	Pennsylvania	1386.8	1014.0	15.5%	11.9%
		Total	**8968.3**	**8498.1**		
MU4	10	Ontario	2937.9	2935.7	59.0%	55.2%
	42	Pennsylvania	535.9	915.0	10.8%	17.25
	51	New York	1508.0	1471.1	30.3%	27.6%
		Total	**4981.8**	**5321.9**		

Results of this analysis for yellow perch indicate that the historic estimates of relative surface area were generally in agreement with the new estimates of relative surface area. Significant changes in relative surface area between jurisdictions were primarily a function of adjusting Management Unit boundaries to line up with catch and effort reporting grids (e.g. Pennsylvania sub-area 42). The STC recommends that the LEC adopt the new sharing formulas for yellow perch quota allocation in 2008 as these estimates are based upon the most current technical data available. This analysis demonstrates the utility of the GLFC funded Lake Erie GIS, provides more accurate areal estimates of walleye and yellow perch habitat, and can potentially be the springboard for exploring yellow perch and walleye distribution patterns/stock delineation and other allocation strategies based upon the changes seen in Lake Erie over the past several decades.

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