Appendix G2: Scaling Habitat Restoration

Introduction

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This appendix presents the data and methods used to develop estimates of fish production in wetland habitats for wetland-dependent species lost to impingement and entrainment (I&E) in the Great Lakes region and estimates of the scale of wetland restoration required to offset I&E losses at the J.R. Whiting facility. EPA relied on quantitative information on fish species abundances in Green Bay to estimate the expected increase in fish production in Great Lakes wetlands as a result of restoration (Brazner, 1997). Use of abundance as a proxy for production was necessary because of a lack of quantitative information on fish productivity in wetlands in this region. EPA's analysis assumes that, when restored wetland acres have reached their full potential, they will produce additional age-1 fish in the same mix of species and at the quantities observed in undisturbed habitats.

G2-1 Calculating Age 1 Fish Abundance in Great Lakes Wetlands to Estimate Increased Production from Restoration

After examining the data from the Brazner (1997) study and discussing them with the author, a match was found between I&E species and species captured at the southern sites in the Brazner (1997) study. Table G2-1 presents information on the species caught by Brazner (1997) that were paired with species lost to I&E at the J.R. Whiting facility.[1]

EPA developed wetland abundance estimates for each species using aggregate sampling results from 5 sampling efforts by Brazner for each of four lower Green Bay sites (J. Brazner, U.S. EPA, Duluth Lab, personal communication, 2001). In the first step of this process, capture data for the four lower Green Bay locations were averaged. Second, to convert the sampling data to an estimate of fish abundance per acre of wetland habitat, EPA assumed that each sampling event of 100 m of linear coastal wetland frontage corresponded to an average of 100 m of perpendicular width of connected coastal wetlands (i.e., each sampling event included fish from an assumed 100 m x 100 m area of wetlands) based on discussions with Brazner about the likely perpendicular width of the sampled wetlands (J. Brazner, U.S. EPA, personal communication, 2001). Third, based on discussions with Brazner, the capture data were increased by a factor of 100 (1/0.01), to account for sampling efficiency reflecting the assumption that only 1 percent of the fish present were actually captured in the sampling event. Finally, the capture data were divided by 5 to reflect an average abundance per sampling effort and scaled to account for the difference in the presumed area effectively sampled (10,000 m^2) and the size of an acre (4,047 m^2).

Brazner (1997) reported capturing young-of-year fish (younger than age 1), age-1 fish, and adult fish (older than age 1) in Green Bay wetlands. For simplicity, EPA assumed that all captured fish were age 1, eliminating the need to apply an adjustment to express all ages of sampled fish as age 1 equivalents. Because Brazner (1997) reports a high percentage of young-of-year fish captured in the sites he sampled, this assumption most likely results in a slight overestimation of age-1 equivalent fish abundances.

[1] The species listed in Table G2-1 represent only a fraction of the species caught in the southern locations in the Brazner study).

Table G2-1: I&E Species and Losses at J.R. Whiting and Corresponding Species from the Brazner (1997) Study

Species with I&E Losses at J.R. Whiting	Average Annual Age 1 Equivalent I&E at J.R. Whiting	Corresponding Species Caught in Sampling of Green Bay Coastal Wetlands (Brazner, 1997)
Alewife	3	Alewife
Bluntnose minnow	2,762	Bluntnose minnow
Bullhead spp.	161	Sum of values for black, brown, and yellow bullheads
Carp	48,717	Carp
Channel catfish	1,833	Channel catfish
Crappie	5,533	Black crappie
Emerald shiner	2,593,094	Emerald shiner
Freshwater drum	19,950	Freshwater drum
Gizzard shad	6,450,915	Gizzard shad
Logperch	8,147	Logperch
Other Forage Species	36,348	Not considered
Rainbow smelt	865	Rainbow smelt
Shiner spp.	542,890	Sum of values for spottail, spotfin, common, and golden shiners
Sucker spp.	3,903	White sucker
Sunfish	355,396	Green sunfish
Walleye	268	Walleye
White bass	43,278	White bass
White perch	1,725	White perch
Yellow perch	21,558	Yellow perch
Total	10,137,346	

Table G2-2 provides a summary of the capture data by species for the 5 sampling trips conducted in each of the lower Green Bay wetlands (J. Brazner, U.S. EPA, Duluth Lab, personal communication, 2001), along with the adjusted estimates of abundance per wetland acre after accounting for the number of sampling trips, sampling efficiency, and the size of the effective wetland area being sampled.

Table G2-2: Green Bay Wetland Capture Data and Estimates of Age-1 Equivalent Abundance per Acre of Wetland Habitat

Species	Assumed Number of Age-1 Equivalent Fish Captured in Sampling of Lower Green Bay Wetlands[a]				Estimated Age-1 Equivalent Abundance per Acre of Wetland Habitat
	Long Tail Point Wetland	Little Tail Point Wetland	Atkinson Marsh	Sensiba Wildlife Refuge	
Yellow perch	3,525	942	333	1,108	11,955
Gizzard shad	384	264	160	137	1,912
Spottail, spotfin, common, and golden shiners (for I&E shiner spp.)	1,089	468	275	545	4,810
Bluntnose minnow	285	116	15	259	1,366
Alewife	265	142	92	124	1,261
Emerald shiner	113	31	251	224	1,253
White bass	52	226	106	9	795
White sucker (for I&E sucker spp.)	14	10	1	103	259
Carp	19	10	3	1	67
Green sunfish (for I&E sunfish)	3	5	22	2	65
Freshwater drum	4	4	7	1	32
Black, brown, and yellow bullheads (for I&E bullhead spp.)	9	4	0	2	30
White perch	0	0	0	7	14
Black crappie (for I&E crappie spp.)	1	2	1	1	10
Channel catfish	0	0	3	0	6
Logperch	0	0	0	1	2
Rainbow smelt	0	1	0	0	2
Walleye	1	0	0	0	2
Other forage	Not addressed with available capture data				

[a] Number captured cumulatively in 5 sampling efforts conducted along 100 meters linear coastal wetland frontage.

G2-2 Scale the Habitat Restoration Alternatives to Offset I&E Losses

To estimate the required scale of wetland restoration to offset the I&E loss of each wetland-dependent species at the J.R. Whiting facility, EPA divided the I&E loss estimates in Table G2-1 by the per-acre abundance estimates for each species in Table G2-2. Results are provided in Table G2-3.

Typically, the estimate for the species requiring the maximum amount of restoration is used to scale the amount of restoration needed to offset losses of all species. However, for the J.R. Whiting scaling, EPA used the estimate for the third highest species, gizzard shad, because gizzard shad account for most of the total loss.

Table G2-3: I&E Losses at J.R. Whiting and the Corresponding Species whose Capture Data from Green Bay Wetland Sampling Was Used by EPA to Estimate Wetland Abundance

Species with I&E Loss Estimates at J.R. Whiting	Estimate of Average Annual Age-1 Equivalent I&E at J.R. Whiting	Estimated Age-1 Equivalent Abundance per Acre of Wetland Habitat (rounded for presentation to nearest whole number of fish)	Required Acres of Wetland Restoration to Offset I&E at J.R. Whiting (rounded to nearest acre)
Other forage species	36,348	Abundance not estimated	n/a
Sunfish	355,396	65	5,489
Logperch	8,147	2	4,026
Gizzard shad	6,450,915	1,912	3,374
Emerald shiner	2,593,094	1,253	2,070
Carp	48,717	67	730
Freshwater drum	19,950	32	616
Crappie	5,533	10	547
Rainbow smelt	865	2	427
Channel catfish	1,833	6	302
Walleye	268	2	132
White perch	1,725	14	122
Shiner spp.	542,890	4,810	113
White bass	43,278	795	54
Sucker spp.	3,903	259	15
Bullhead spp.	161	30	5
Bluntnose minnow	2,762	1,366	2
Yellow perch	21,558	11,955	2
Alewife	3	1,261	0
Acres of wetland required to offset I&E losses for species with abundance estimates (based on gizzard shad)		3,374	