Contaminant transport by introduced Pacific salmon to Great Lakes tributaries

Illinois-Indiana Sea Grant
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David Janetski

Department of Biological Sciences
University of Notre Dame
Notre Dame, IN 46556

Project Summary

Funds from Illinois-Indiana Sea Grant (IISG) were used to fill gaps in my research regarding contaminant transport by introduced Pacific salmon to Great Lakes tributaries. My research through the end of 2009 had been limited to the northern half of Lake Michigan, leaving the more densely populated southern half of Lake Michigan unevaluated. I felt this was an omission that should be rectified because prey fish in the southern half of Lake Michigan may be more contaminated than in the northern half owing to the strong industrial legacy in areas such as Chicago, IL and Gary, IN. Close proximity to contaminant sources may lead to higher contaminant bioaccumulation by salmon in the southern portion of Lake Michigan, which could increase the quantity of contaminants transported to streams during spawning runs. Thus my IISG project aimed to build on my previous research by quantifying contaminant levels in salmon and stream-resident fish at three sites at the southern end of Lake Michigan.

Significant findings, accomplishments, and impacts

In fall 2010, I sampled three tributary streams to the southern Lake Michigan basin: Juday Creek (IN), Trail Creek (IN), and Root River (WI). These three sites were selected based on the availability of resident fish and presence of salmon spawners. Chinook and coho salmon were collected from each site, as well as creek chub, brown trout, sculpin, blacknose dace, white sucker, and/or shiners. Contaminant levels in resident fish from stream reaches receiving spawning salmon were compared to upstream reaches inaccessible to salmon (i.e., control reaches). Data are summarized in Tables 1 and 2 of the accompanying manuscript draft.

Key findings were that biological transport varies by lake basin in the Upper Great Lakes, with Lake Michigan streams receiving relatively high loads of contaminants, followed by Lake Huron then Lake Superior. Chinook salmon were overall more contaminated than coho salmon. Resident fish in Trail Creek and Root River contained high levels of contaminants relative to our other sites (Table 1), and Juday Creek had relatively low contaminant levels. We attribute this to the abundance of salmon spawners, which, based on personal observation, was very low in Juday Creek relative to Trail Creek and Root River.

The additional information collected using funds provided by IISG substantially strengthened our dataset that will be submitted in a manuscript to Environmental Science & Technology within six weeks.

I also plan to present my findings in an oral presentation at the annual meeting of the American Fisheries Society in Seattle, WA in September, 2011. I will present a summary of biological transport across our study sites and compare/contrast the three lake basins, as well as describe the model we developed for predicting resident fish contaminant burdens from salmon biomass and salmon PCB (polychlorinated biphenyl) levels. I anticipate this research will have implications for human health, such as for establishing consumption advisories for stream-resident brook trout, and wildlife conservation, such as by giving managers a tool for roughly predicting PCB transport by salmon following dam removal.

Students supported

Funds from IISG were used to fund my PhD dissertation project, and I anticipate graduation in December, 2011. Two undergraduates, one other graduate student, and a lab technician also participated in sample collection.

Table 1. Mean contaminant levels in salmon spawners and resident fish sampled from reaches with (salmon) and without salmon (no salmon) in each stream. Values represent means of all individuals of all fish species collected and analyzed in 2008 and 2009 (salmon = chinook and/or coho; resident fish = brook trout, sculpin, blacknose dace, creek chub, and/or white sucker). Salmon biomass is the mean of 2008 and 2009. Note that three streams were sampled only in 2010 (see footnote).

Basin	Stream	Salmon biomass (kg m^{-2})	Salmon contaminant levels (ug·kg^{-1} wet weight)			Mean resident fish contaminant levels (ug·kg^{-1} wet weight)					
						PCB		DDE		PBDE	
			PCB	DDE	PBDE	Salmon	None	Salmon	None	Salmon	None
Michigan	Thompson Creek, MI	0.785	327.5	90.8	33.0	97.9	6.0	18.5	2.3	7.4	1.1
	Pine Creek, MI	0.305	393.7	107.0	37.3	245.1	4.0	65.8	1.4	19.1	0.8
	Root River, WI*	0.199	443.6	81.9	34.6	125.5	8.8	35.7	14.2	9.8	1.8
	Kids Creek, MI	0.160	456.4	113.1	54.1	31.4	4.0	14.4	6.6	4.0	1.0
	Deer Creek, MI	0.008	198.7	41.3	23.6	8.7	2.3	2.5	1.8	2.3	1.6
	Trail Creek, IN*	NA	323.9	51.3	22.0	197.5	6.8	46.3	18.2	21.1	0.4
	St. Joseph River, IN*	NA	158.8	30.5	16.2	15.2	11.1	3.5	5.9	2.2	2.4
	Boyne River, MI	NA	-	-	-	160.2	2.7	19.1	1.2	13.9	1.0
	MEAN	**0.291**	**328.2**	**76.2**	**30.3**	**138.9**	**4.8**	**35.3**	**4.3**	**11.8**	**1.2**
Huron	Elliott Creek, MI	0.080	164.9	48.2	18.5	47.3	-	14.7	-	5.2	-
	Garden River, ON	0.042	180.0	47.9	20.8	31.0	2.5	6.0	0.9	7.4	0.7
	Crystal Creek, ON	0.003	51.5	14.7	10.6	18.4	3.3	3.1	1.0	3.8	1.0
	MEAN	**0.041**	**154.4**	**42.9**	**18.4**	**33.7**	**2.9**	**8.9**	**1.0**	**5.0**	**0.8**
Superior	Pendills Creek, MI	0.006	46.0	13.5	13.0	4.4	2.0	1.0	0.7	0.9	0.4
	Mosquito River, MI	0.002	36.9	9.2	8.4	3.8	3.9	0.6	1.1	1.1	1.1
	Miners River, MI	NA	30.5	8.9	7.6	-	-	-	-	-	-
	Sevenmile Creek, MI	NA	26.8	6.6	7.2	-	-	-	-	-	-
	MEAN	**0.004**	**36.0**	**9.7**	**9.5**	**4.3**	**3.0**	**0.9**	**0.9**	**1.0**	**0.8**

*Sampled only in 2010