Attachment 5

Traffic Forecasts and Fish Impacts

26th Meeting of the NECC
July 20,1999

Presented by

Steve Bartell

Cadmus Group

UMS-IWWS Navigation Study Modification 1 "Ecological Model Application, Risk Assessment and Interpretation In Support of the Upper Mississippi River- Illinois Waterway System Navigation Study" (DACW25-99-C-0009)

Annual Number of Tows by Pool **EXHIBIT ONE REVISED JULY 1 1999/BARR**

Scenario Without Project

Upper Mississippi River

Year	USA	LSA	P1	P2	P3	P4	P5	P5A	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P24	P25	P26	P27	LGR	PEO	STR	MAR	DRS	BRD	LPT	OBN	UMRS
1992	1,321	1,326	1,333	1,277	1,273	1,267	1,251	1,251	1,463	1,385	1,536	1,536	1,848	1,901	2,119	2,179	3,055	2,828	3,116	2,958	3,013	3,101	3,317	3,354	3,310	3,457	3,454	7,461	9,136	3,330	3,655	2,919	2,773	2,739	3,135	3,119	2,784	100,280
2000	1,313	1,327	1,315	1,327	1,322	1,322	1,305	1,305	1,536	1,454	1,609	1,610	1,969	2,025	2,289	2,361	3,339	3,083	3,405	3,232	3,298	3,404	3,646	3,676	3,636	3,796	3,792	8,589	10,512	3,955	4,219	3,205	2,977	2,872	3,292	3,276	3,034	109,626
2010	1,376	1,374	1,370	1,333	1,329	1,335	1,318	1,319	1,553	1,470	1,630	1,631	2,018	2,075	2,367	2,445	3,396	3,135	3,469	3,300	3,374	3,499	3,753	3,782	3,742	3,907	3,904	9,310	11,404	4,461	4,710	3,520	3,241	3,101	3,557	3,539	3,305	115,351
2020	1,409	1,393	1,399	1,304	1,300	1,311	1,295	1,296	1,525	1,443	1,602	1,605	2,003	2,059	2,367	2,447	3,422	3,156	3,498	3,331	3,410	3,545	3,805	3,831	3,790	3,958	3,955	9,806	12,029	4,829	5,072	3,760	3,445	3,287	3,777	3,756	3,541	118,760
2030	1,461	1,428	1,447	1,273	1,269	1,286	1,271	1,271	1,492	1,412	1,570	1,580	1,989	2,046	2,366	2,448	3,448	3,178	3,527	3,365	3,448	3,590	3,856	3,878	3,838	4,007	4,004	10,287	12,647	5,175	5,414	3,996	3,648	3,478	4,009	3,985	3,769	122,155
2040	1,540	1,493	1,528	1,242	1,238	1,260	1,246	1,246	1,456	1,378	1,536	1,554	1,973	2,032	2,364	2,448	3,475	3,199	3,555	3,397	3,484	3,632	3,905	3,924	3,883	4,051	4,048	10,711	13,210	5,454	5,679	4,190	3,814	3,645	4,220	4,193	3,959	125,163
2050	1,636	1,582	1,631	1,214	1,210	1,236	1,223	1,224	1,423	1,347	1,505	1,532	1,960	2,022	2,365	2,451	3,507	3,224	3,586	3,431	3,524	3,678	3,957	3,971	3,930	4,091	4,088	11,033	13,656	5,633	5,837	4,327	3,932	3,779	4,400	4,369	4,114	127,630

Scenario B: Mooring Cells 12,18,20,22,24 Guidewalls 20 - 25

Upper Mississippi River

Year	USA	LSA	P1	P2	P3	P4	P5	P5A	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P24	P25	P26	P27	LGR	PEO	STR	MAR	DRS	BRD	LPT	OBN	UMRS
1992	1,321	1,326	1,333	1,277	1,273	1,267	1,251	1,251	1,463	1,385	1,536	1,536	1,848	1,901	2,119	2,179	3,055	2,828	3,116	2,958	3,013	3,101	3,317	3,354	3,310	3,457	3,454	7,461	9,136	3,330	3,655	2,919	2,773	2,739	3,135	3,119	2,784	100,280
2000	1,313	1,327	1,315	1,327	1,322	1,322	1,305	1,305	1,536	1,454	1,609	1,610	1,969	2,025	2,289	2,361	3,339	3,083	3,405	3,232	3,298	3,404	3,646	3,676	3,636	3,796	3,792	8,589	10,512	3,955	4,219	3,205	2,977	2,872	3,292	3,276	3,034	109,626
2010	1,432	1,444	1,426	1,454	1,449	1,453	1,434	1,434	1,693	1,603	1,774	1,766	2,178	2,235	2,546	2,629	3,731	3,445	3,809	3,617	3,698	3,841	4,119	4,162	4,118	4,299	4,295	9,744	11,879	4,467	4,718	3,530	3,251	3,113	3,569	3,550	3,308	122,213
2020	1,490	1,494	1,478	1,480	1,475	1,482	1,463	1,463	1,728	1,636	1,812	1,802	2,237	2,295	2,629	2,718	3,776	3,486	3,862	3,673	3,762	3,926	4,215	4,263	4,220	4,409	4,405	10,305	12,572	4,835	5,080	3,771	3,457	3,300	3,791	3,770	3,547	127,108
2030	1,547	1,535	1,531	1,460	1,455	1,469	1,450	1,450	1,712	1,621	1,798	1,792	2,243	2,302	2,654	2,746	3,840	3,543	3,932	3,745	3,841	4,022	4,322	4,372	4,330	4,525	4,521	10,855	13,268	5,180	5,422	4,008	3,662	3,495	4,026	4,002	3,775	131,449
2040	1,623	1,590	1,604	1,428	1,423	1,443	1,425	1,426	1,680	1,591	1,768	1,770	2,235	2,296	2,665	2,759	3,888	3,585	3,984	3,802	3,904	4,102	4,413	4,462	4,421	4,621	4,617	11,331	13,890	5,457	5,685	4,203	3,829	3,663	4,238	4,211	3,964	134,995
2050	1,718	1,666	1,698	1,401	1,396	1,421	1,404	1,404	1,649	1,561	1,738	1,749	2,226	2,289	2,671	2,768	3,928	3,618	4,025	3,848	3,957	4,168	4,489	4,536	4,496	4,696	4,692	11,691	14,380	5,634	5,840	4,338	3,946	3,795	4,416	4,386	4,117	137,754

Scenario E: Mooring Cells 12,18,20,22,24 Guidewalls 14 - 18 Locks 20 - 25

Upper Mississippi River

Year	USA	LSA	P1	P2	P3	P4	P5	P5A	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P24	P25	P26	P27	LGR	PEO	STR	MAR	DRS	BRD	LPT	OBN	UMRS
1992	1,321	1,326	1,333	1,277	1,273	1,267	1,251	1,251	1,463	1,385	1,536	1,536	1,848	1,901	2,119	2,179	3,055	2,828	3,116	2,958	3,013	3,101	3,317	3,354	3,310	3,457	3,454	7,461	9,136	3,330	3,655	2,919	2,773	2,739	3,135	3,119	2,784	100,280
2000	1,313	1,327	1,315	1,327	1,322	1,322	1,305	1,305	1,536	1,454	1,609	1,610	1,969	2,025	2,289	2,361	3,339	3,083	3,405	3,232	3,298	3,404	3,646	3,676	3,636	3,796	3,792	8,589	10,512	3,955	4,219	3,205	2,977	2,872	3,292	3,276	3,034	109,626
2010	1,376	1,374	1,370	1,333	1,329	1,335	1,318	1,319	1,553	1,470	1,630	1,631	2,018	2,075	2,367	2,445	3,396	3,135	3,469	3,300	3,374	3,499	3,753	3,782	3,742	3,907	3,904	9,310	11,404	4,461	4,710	3,520	3,241	3,101	3,557	3,539	3,305	115,351
2020	1,597	1,626	1,583	1,703	1,697	1,701	1,677	1,678	1,988	1,882	2,081	2,053	2,535	2,594	2,965	3,064	4,337	4,007	4,434	4,205	4,303	4,487	4,812	4,877	4,825	5,034	5,030	10,999	13,334	4,841	5,089	3,783	3,471	3,315	3,806	3,785	3,553	138,749
2030	1,665	1,680	1,646	1,709	1,703	1,711	1,687	1,688	2,001	1,894	2,096	2,071	2,575	2,637	3,029	3,133	4,461	4,120	4,568	4,339	4,447	4,659	5,003	5,077	5,027	5,250	5,245	11,655	14,146	5,185	5,430	4,021	3,677	3,511	4,042	4,019	3,780	144,586
2040	1,770	1,770	1,746	1,735	1,728	1,742	1,718	1,719	2,038	1,930	2,138	2,116	2,649	2,713	3,135	3,245	4,531	4,182	4,649	4,427	4,547	4,791	5,153	5,239	5,193	5,428	5,423	12,215	14,859	5,460	5,691	4,216	3,844	3,682	4,258	4,231	3,970	149,880
2050	1,859	1,837	1,833	1,709	1,703	1,722	1,699	1,700	2,016	1,908	2,118	2,104	2,654	2,721	3,163	3,277	4,607	4,247	4,733	4,516	4,647	4,922	5,302	5,397	5,355	5,601	5,597	12,675	15,459	5,634	5,844	4,354	3,964	3,818	4,441	4,411	4,124	153,672

Scenario F: Mooring Cells, Guidewalls 14-18 and LaGrange & Peoria, Locks 20-25

Upper Mississippi River

Year	USA	LSA	P1	P2	P3	P4	P5	P5A	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P24	P25	P26	P27	LGR	PEO	STR	MAR	DRS	BRD	LPT	OBN	UMRS
1992	1,321	1,326	1,333	1,277	1,273	1,267	1,251	1,251	1,463	1,385	1,536	1,536	1,848	1,901	2,119	2,179	3,055	2,828	3,116	2,958	3,013	3,101	3,317	3,354	3,310	3,457	3,454	7,461	9,136	3,330	3,655	2,919	2,773	2,739	3,135	3,119	2,784	100,280
2000	1,313	1,327	1,315	1,327	1,322	1,322	1,305	1,305	1,536	1,454	1,609	1,610	1,969	2,025	2,289	2,361	3,339	3,083	3,405	3,232	3,298	3,404	3,646	3,676	3,636	3,796	3,792	8,589	10,512	3,955	4,219	3,205	2,977	2,872	3,292	3,276	3,034	109,626
2010	1,376	1,374	1,370	1,333	1,329	1,335	1,318	1,319	1,553	1,470	1,630	1,631	2,018	2,075	2,367	2,445	3,396	3,135	3,469	3,300	3,374	3,499	3,753	3,782	3,742	3,907	3,904	9,310	11,404	4,461	4,710	3,520	3,241	3,101	3,557	3,539	3,305	115,351
2020	1,597	1,626	1,583	1,703	1,697	1,701	1,677	1,678	1,988	1,882	2,081	2,053	2,535	2,594	2,966	3,064	4,338	4,007	4,434	4,205	4,303	4,488	4,813	4,877	4,826	5,036	5,032	11,063	13,401	4,909	5,158	3,821	3,503	3,341	3,832	3,811	3,571	139,191
2030	1,664	1,680	1,645	1,709	1,703	1,711	1,687	1,688	2,001	1,894	2,096	2,072	2,575	2,637	3,030	3,133	4,462	4,120	4,569	4,340	4,448	4,660	5,004	5,078	5,028	5,253	5,248	11,764	14,259	5,299	5,547	4,085	3,730	3,554	4,086	4,062	3,812	145,333
2040	1,769	1,769	1,745	1,734	1,728	1,742	1,718	1,719	2,038	1,930	2,138	2,116	2,649	2,713	3,136	3,245	4,531	4,182	4,651	4,428	4,548	4,792	5,155	5,240	5,195	5,433	5,428	12,412	15,066	5,667	5,906	4,329	3,937	3,756	4,333	4,306	4,023	151,208
2050	1,863	1,841	1,837	1,709	1,703	1,723	1,700	1,701	2,016	1,909	2,119	2,105	2,655	2,722	3,164	3,278	4,608	4,248	4,734	4,517	4,648	4,923	5,303	5,398	5,357	5,610	5,605	13,187	16,002	6,173	6,400	4,626	4,180	3,986	4,612	4,581	4,250	155,698

Scenario H: Guidewalls 14-18, Locks 20-25 and LaGrange & Peoria

Upper Mississippi River

Year	USA	LSA	P1	P2	P3	P4	P5	P5A	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P24	P25	P26	P27	LGR	PEO	STR	MAR	DRS	BRD	LPT	OBN	UMRS
1992	1,321	1,326	1,333	1,277	1,273	1,267	1,251	1,251	1,463	1,385	1,536	1,536	1,848	1,901	2,119	2,179	3,055	2,828	3,116	2,958	3,013	3,101	3,317	3,354	3,310	3,457	3,454	7,461	9,136	3,330	3,655	2,919	2,773	2,739	3,135	3,119	2,784	100,280
2000	1,313	1,327	1,315	1,327	1,322	1,322	1,305	1,305	1,536	1,454	1,609	1,610	1,969	2,025	2,289	2,361	3,339	3,083	3,405	3,232	3,298	3,404	3,646	3,676	3,636	3,796	3,792	8,589	10,512	3,955	4,219	3,205	2,977	2,872	3,292	3,276	3,034	109,626
2010	1,376	1,374	1,370	1,333	1,329	1,335	1,318	1,319	1,553	1,470	1,630	1,631	2,018	2,075	2,367	2,445	3,396	3,135	3,469	3,300	3,374	3,499	3,753	3,782	3,742	3,907	3,904	9,310	11,404	4,461	4,710	3,520	3,241	3,101	3,557	3,539	3,305	115,351
2020	1,591	1,619	1,577	1,691	1,685	1,689	1,666	1,667	1,974	1,869	2,067	2,039	2,519	2,578	2,948	3,046	4,314	3,985	4,410	4,182	4,279	4,462	4,785	4,848	4,797	5,006	5,002	10,994	13,328	4,871	5,118	3,799	3,484	3,326	3,816	3,795	3,561	138,386
2030	1,658	1,672	1,639	1,696	1,690	1,698	1,675	1,676	1,986	1,880	2,081	2,057	2,558	2,619	3,010	3,113	4,435	4,095	4,541	4,313	4,420	4,629	4,970	5,042	4,993	5,217	5,212	11,786	14,281	5,366	5,614	4,120	3,759	3,577	4,110	4,086	3,829	145,100
2040	1,761	1,760	1,738	1,719	1,713	1,727	1,703	1,705	2,021	1,913	2,120	2,099	2,629	2,693	3,112	3,221	4,501	4,154	4,618	4,396	4,514	4,753	5,112	5,193	5,148	5,386	5,381	12,459	15,113	5,772	6,012	4,383	3,981	3,790	4,368	4,341	4,049	151,058
2050	1,855	1,831	1,828	1,692	1,686	1,706	1,684	1,685	1,996	1,890	2,098	2,085	2,632	2,698	3,137	3,250	4,572	4,216	4,695	4,479	4,607	4,872	5,247	5,335	5,293	5,543	5,539	13,065	15,871	6,120	6,347	4,600	4,161	3,971	4,597	4,566	4,239	155,686

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Scenario

1 Mooring Cells 12,18,20,22,24 Guidewalls 20-25
2 Mooring Cells 12,18,20,22,24 Guidewalls 14 - 18 Locks 20 - 25
3 Mooring Cells, Guidewalls 14-18 and LaGrange & Peoria, Locks 20-25

Tows/Year

UMR 04

Year	W/O Project	Scenario 1	(%)	Scenario 2	(%)	Scenario 3	(%)
1992	1,267	1,267	0.0	1,267	0.0	1,267	0.0
2000	1,322	1,322	0.0	1,322	0.0	1,322	0.0
2010	1,335	1,453	8.8	1,335	0.0	1,335	0.0
2020	1,311	1,482	13.0	1,701	29.7	1,701	29.7
2030	1,286	1,469	14.2	1,711	33.1	1,711	33.1
2040	1,260	1,443	14.5	1,742	38.2	1,742	38.2
2050	1,236	1,421	14.9	1,722	39.3	1,723	39.3

UMR 08

Year	W/O Project	Scenario 1	(%)	Scenario 2	(%)	Scenario 3	(%)
1992	1,536	1,536	0.0	1,536	0.0	1,536	0.0
2000	1,609	1,609	0.0	1,609	0.0	1,609	0.0
2010	1,630	1,774	8.9	1,630	0.0	1,630	0.0
2020	1,602	1,812	13.1	2,081	29.9	2,081	29.9
2030	1,570	1,798	14.5	2,096	33.5	2,096	33.5
2040	1,536	1,768	15.1	2,138	39.2	2,138	39.2
2050	1,505	1,738	15.5	2,118	40.7	2,119	40.8

UMR 13

Year	W/O Project	Scenario 1	(%)	Scenario 2	(%)	Scenario 3	(%)
1992	2,179	2,179	0.0	2,179	0.0	2,179	0.0
2000	2,361	2,361	0.0	2,361	0.0	2,361	0.0
2010	2,445	2,629	7.5	2,445	0.0	2,445	0.0
2020	2,447	2,718	11.1	3,064	25.2	3,064	25.2
2030	2,448	2,746	12.2	3,133	28.0	3,133	28.0
2040	2,448	2,759	12.7	3,245	32.6	3,245	32.6
2050	2,451	2,768	12.9	3,277	33.7	3,278	33.7

UMR 26

Year	W/O Project	Scenario 1	(%)	Scenario 2	(%)	Scenario 3	(%)
1992	7,461	7,461	0.0	7,461	0.0	7,461	0.0
2000	8,589	8,589	0.0	8,589	0.0	8,589	0.0
2010	9,310	9,744	4.7	9,310	0.0	9,310	0.0
2020	9,806	10,305	5.1	10,999	12.2	11,063	12.8
2030	10,287	10,855	5.5	11,655	13.3	11,764	14.4
2040	10,711	11,331	5.8	12,215	14.0	12,412	15.9
2050	11,033	11,691	6.0	12,675	14.9	13,187	19.5

IWW LaGrange

Year	W/O Project	Scenario 1	(%)	Scenario 2	(%)	Scenario 3	(%)
1992	3,330	3,330	0.0	3,330	0.0	3,330	0.0
2000	3,955	3,955	0.0	3,955	0.0	3,955	0.0
2010	4,461	4,467	0.1	4,461	0.0	4,461	0.0
2020	4,829	4,835	0.1	4,841	0.3	4,909	1.7
2030	5,175	5,180	0.1	5,185	0.2	5,299	2.4
2040	5,454	5,457	0.1	5,460	0.1	5,667	3.9
2050	5,633	5,634	0.0	5,634	0.0	6,173	9.6

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UMR Pool 04 **Year 2030**	**Fish Larvae Entrainment** **Percent Difference Between Without- and With-Project Traffic**		
Species	**Mooring cells: 12,18,20,22,24; Guidewalls 20-25**	**Mooring cells: 12,8,20,22,24; Guidewalls 14-18, Locks 20-25**	**Mooring cells; Guidewalls 14-18, Lagrange, Peoria; Locks 20-25**
Channel catfish	0.12	0.28	0.28[a]
Freshwater drum	0.15	0.33	0.33
Emerald shiner	0.11	0.27	0.27
Mooneye	0.02	0.05	0.05
Gizzard shad	0.14	0.33	0.33
Walleye	0.08	0.18	0.18

[a]Pool 4 traffic differences between second two traffic scenarios are negligible.

UMR Pool 08 **Year 2030**	**Fish Larvae Entrainment** **Percent Difference Between Without- and With-Project Traffic**		
Species	**Mooring cells: 12,18,20,22,24; Guidewalls 20-25**	**Mooring cells: 12,8,20,22,24; Guidewalls 14-18, Locks 20-25**	**Mooring cells; Guidewalls 14-18, Lagrange, Peoria; Locks 20-25**
Channel catfish	1.26	2.90	2.90[a]
Freshwater drum	1.42	3.26	3.26
Emerald shiner	1.23	2.82	2.82
Mooneye	0.21	0.47	0.47
Gizzard shad	1.39	0.32	0.32
Walleye	0.80	1.81	1.81

[a]Pool 8 traffic differences between second two traffic scenarios are negligible.

Attachment 5

UMR Pool 13 **Year 2030**	**Fish Larvae Entrainment** **Percent Difference Between Without- and With-Project Traffic**		
Species	**Mooring cells: 12,18,20,22,24; Guidewalls 20-25**	**Mooring cells: 12,8,20,22,24; Guidewalls 14-18, Locks 20-25**	**Mooring cells; Guidewalls 14-18, Lagrange, Peoria; Locks 20-25**
Channel catfish	0.8	2.0	2.0[a]
Freshwater drum	1.0	2.4	2.4
Emerald shiner	1.0	2.3	2.3
Mooneye	0.1	0.3	0.3
Gizzard shad	0.9	2.2	2.2
Walleye	0.8	1.9	1.9

[a]Pool 13 traffic differences between second two traffic scenarios are negligible.

UMR Pool 26B **Year 2030**	**Fish Larvae Entrainment** **Percent Difference Between Without- and With-Project Traffic**		
Species	**Mooring cells: 12,18,20,22,24; Guidewalls 20-25**	**Mooring cells: 12,8,20,22,24; Guidewalls 14-18, Locks 20-25**	**Mooring cells; Guidewalls 14-18, Lagrange, Peoria; Locks 20-25**
Channel catfish	0.4	1.0	1.1
Freshwater drum	0.4	1.1	1.1
Emerald shiner	0.6	1.2	1.2
Mooneye	0.5	1.4	1.5
Gizzard shad	0.5	1.1	1.2
Walleye	0.3	0.7	0.7

Attachment 5

IWW LaGrange Year 2030	**Fish Larvae Entrainment Percent Difference Between Without- and With-Project Traffic**		
Species	**Mooring cells: 12,18,20,22,24; Guidewalls 20-25**	**Mooring cells: 12,8,20,22,24; Guidewalls 14-18, Locks 20-25**	**Mooring cells; Guidewalls 14-18, Lagrange, Peoria; Locks 20-25**
Channel catfish	0.09	0.09	0.35
Freshwater drum	0.07	0.07	0.34
Emerald shiner	0.10	0.10	0.37
Mooneye	0.01	0.01	0.42
Gizzard shad	0.11	0.11	0.36
Walleye	0.03	0.03	0.20

Attachment 5

Preliminary Assessment of UMR-IWW Species Potentially at Risk

UMR 04	UMR 08	UMR 13	UMR 26	LaGrange
None	Bigmouth buffalo	Bigmouth buffalo	Bigmouth buffalo	Bigmouth buffalo
	Bluegill			Bluegill
	Carp	Carp	Carp	Carp
	Channel Catfish			Channel Catfish
	Freshwater drum	Freshwater drum		Freshwater drum
	Emerald Shiner	Emerald Shiner	Emerald Shiner	Emerald Shiner
	Goldeye		Goldeye	Goldeye
			Mooneye	Mooneye
	River Carpsucker	River Carpsucker	River Carpsucker	River Carpsucker
	Gizzard shad	Gizzard shad		Gizzard shad
	Smallmouth buffalo	Smallmouth buffalo	Smallmouth buffalo	Smallmouth buffalo
	Spotted Sucker	Spotted Sucker	Spotted Sucker	Spotted Sucker
	Shorthead Redhorse	Shorthead Redhorse	Shorthead Redhorse	Shorthead Redhorse
	White bass	White bass	White bass	White bass

Effects of the Incremental Increase in Commercial Traffic on Fish Spawning Habitat

Steven M. Bartell and Kym Rouse Campbell
The Cadmus Group, Inc.
Oak Ridge, Tennessee

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		Physical Forces*			
Fish Species	HSI Model Developed	Water Level Fluctuation	Scour Depth	Tow Velocity	Substrate Size
Lake Sturgeon	x				x
Paddlefish	x			x	x
Northern Pike					
Emerald Shiner	x			x	
Bullhead Minnow					
Bigmouth Buffalo	x				
Channel Catfish					
Largemouth Bass	x	x		x	x
Spotted Bass	x			x	x
Black Crappie	x		x	x	x
Sauger	x		x	x	x
Walleye	x	x			x
Freshwater Drum					

*Also includes ambient water depth and current velocity

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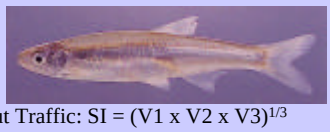
Emerald Shiner Spawning Index (SI)



Without Traffic: SI = $(V1 \times V2 \times V3)^{1/3}$

Modified by Each Tow Passage: SI(MOD) = SI x V4
SI Recovery Rate = SI/7.0

V1 = Water Depth (ft)
V2 = Substrate Size (mm)
V3 = Ambient Current (ft/s)
V4 = Velocity Disturbance Modifier (ft/s)

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Paddlefish Spawning Index (SI)

Without Traffic: SI = $(V1 \times V2 \times V3)^{1/3}$

Modified by Each Tow Passage: SI(MOD) = SI x V4
SI Recovery Rate = SI/7.0

V1 = Substrate Size (mm)
V2 = Ambient Current (ft/s)
V3 = Water Depth (ft)
V4 = Velocity Disturbance Modifier (ft/s)

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Sauger Spawning Index (SI)

Without Traffic: SI = $(V1 \times V2 \times V3)^{1/3}$

Modified by Each Tow Passage: SI(MOD) = SI x V4 x V5
SI Recovery Rate = SI/6.0
V1 = Substrate Size (mm)
V2 = Ambient Current (ft/s)
V3 = Water Depth (ft)
V4 = Velocity Disturbance Modifier (ft/s)
V5 = Scour Disturbance Modifier (inches)

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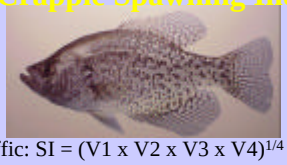
Black Crappie Spawning Index (SI)



Without Traffic: SI = $(V1 \times V2 \times V3 \times V4)^{1/4}$

Modified by Each Tow Passage: SI(MOD) = SI x V5 x V6
V1 = Structure
V2 = Ambient Current (ft/s)
V3 = Water Depth (ft)
V4 = Substrate Size (mm)
V5 = Scour Disturbance Modifier (inches)
V6 = Velocity Disturbance Modifier (ft/s)

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Results for Emerald Shiner
Emerald Shiner Spawning HSI
1
0.8
0.6
0.4
0.2
0
3264
May 16
3268
3272
3276
3280
Hours
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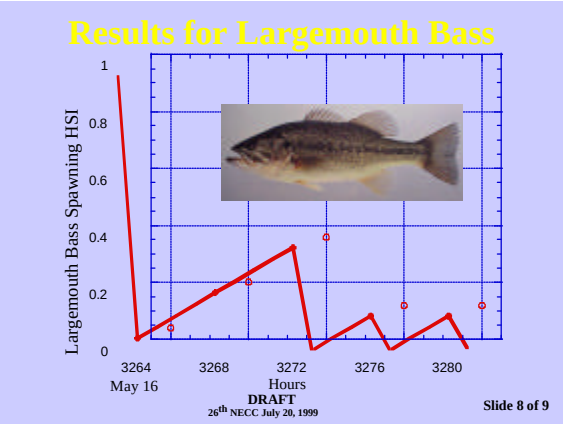
Results for Largemouth Bass
Largemouth Bass Spawning HSI
1
0.8
0.6
0.4
0.2
0
3264
May 16
3268
3272
3276
3280
Hours
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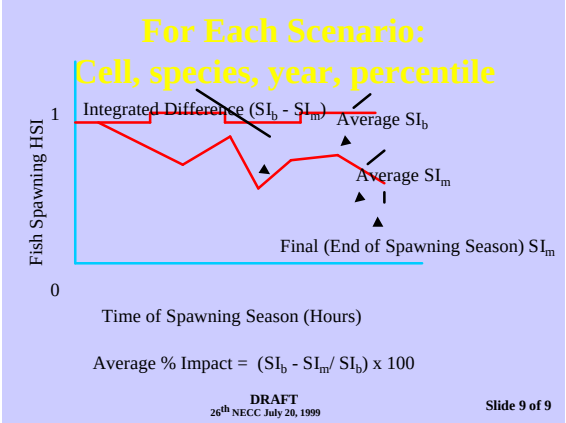
For Each Scenario:
Cell, species, year, percentile
Fish Spawning HSI
1
0
Integrated Difference (SI_b - SI_m)
Average SI_b
Average SI_m
Final (End of Spawning Season) SI_m
Time of Spawning Season (Hours)
Average % Impact = (SI_b - SI_m/ SI_b) x 100
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