IOWA'S WATER

Ambient Monitoring Program

Bouncing Back: Recovery of Fish Populations

Background

Follow-up fish sampling in Crabapple Creek, Linn County.

Fish kills occur when toxic amounts of pollutants such as animal waste, fertilizers, pesticides, and sewage are released into surface waters. Natural environmental circumstances, such as dissolved oxygen depletion and extreme water temperature fluctuation can also cause fish kills. Since the Iowa Department of Natural Resources (IDNR) began to compile reports in 1981, there has been no overall trend in the reported number of fish kills (Figure 1). However, record numbers of stream fish kills were recorded in 1997 and 1998, and several large and highly publicized recent fish kills have raised concerns about water quality and aquatic ecosystem damages.

Until recently, the IDNR lacked information to evaluate long-term impacts of fish kills. To address this need, follow-up sampling was conducted in 23 streams that were impacted by 20 major fish kills (Table 1). The primary sampling goals were to assess stream biological health and evaluate recovery of fish populations. The streams chosen for follow-up sampling represent a broad range of fish kill causes, severities, and recovery times.

Standard electrofishing methods were used to sample recovering fish communities. Data analysis focused on three aspects of the fish community: abundance, community integrity, and species composition. The Fish Index of Biotic Integrity (FIBI), developed specifically for Iowa's streams, was used to quantify fish community health/integrity. Sampling results were compared with fish kill assessment reports and results from stream ecoregion reference sites. Reference sites represent least-disturbed stream conditions within different ecological regions of the state. Fish community impairment thresholds were set equal to the 25th percentile levels of fish abundance and fish community integrity (FIBI) measured at reference sites. A follow-up stream was considered impaired if either the fish sample abundance level or FIBI level ranked below the applicable reference thresholds.

Table 1. *Stream fish kill segments selected for 1999-2001 follow-up sampling.*

Stream Name - County	Kill Type / Kill Cause	Fish Kill Date	Total Fish Kill Estimate	Kill Length (Miles)	Follow-up Sampling - Months After Fish Kill
Buck Cr.-Delaware	Ag Run-off / Animal Wastes	07/20/1998	92,404	4.0	37
Buffalo Cr. - Jones	Spill / Animal Wastes	08/21/1996	5,850	6.4	60
Crabapple Cr. - Linn	Ag Run-off / Animal Wastes	08/06/1998	26,481	3.2	36
Crane Cr. - Howard	Spill / Animal Wastes	07/26/1997	109,168	8.5	39
Deer Cr. - Worth	Spill / Fertilizer	04/06/2000	59,087	6.5	17
E. Big Cr. / Big Cr. - Linn	Spill / Industrial Chemical	04/23/1997	11,013	2.0	51
Farmers Cr. - Jackson	Ag Run-off / Animal Wastes	09/22/1997	133,134	13.0	23
Floyd R. - O'Brien	Spill / Animal Wastes	05/17/1997	5,558	6.5	28
Heather Branch - Henry	Sewage / Municipal	07/23/1997	7,175	2.2	51
Horton Cr. - Bremer	Unknown / Unknown	08/16/1997	12,724	1.6	47
Indian Cr. - Linn	Urban Run-off / Pesticides	08/25/1998	43,367	2.3	25
No. Buffalo Cr. / Buffalo Cr. - Kossuth	Spill / Animal Wastes	09/06/1996	586,881	22.6	48
North Fork Maquoketa R. – Dubuque	Ag Run-off / Animal Wastes	07/22/1998	34,326	4.2	13
Prairie Cr. - Jackson	Spill / Animal Wastes	09/18/1997	93,403	5.1	47
Prairie Cr. - Palo Alto	Spill / Animal Wastes	08/18/1998	10,997	2.4	38
Silver Cr. - Jones	Ag Run-off / Animal Wastes	07/26/1999	64,104	6.0	24
Sixmile Cr. - Sioux	Ag Run-off / Animal Wastes	06/15/1998	1,152	16.1	26
Tipton Cr.-Hamilton / Hardin	Spill / Animal Wastes	07/20/1998	93,180	10.8	13
Unn.Tributary / Yellow R. – Allamakee	Unknown / Unknown	03/17/2000	4,860	3.1	5
West Branch Floyd R. – Sioux	Spill / Animal Wastes	07/08/1998	7,978	5.0	38

Findings

Fish abundance was extremely variable among follow-up streams and compared to fish kill estimates and reference stream thresholds (Figure 2). Abundance levels ranged from very low (17 fish/500 ft.) to very high (2506 fish/500 ft.). Fish community integrity (FIBI) levels also differed greatly among follow-up streams and compared to reference thresholds. FIBI levels ranged from 2 (very poor) to 73 (excellent). Fish community assessment ratings for follow-up streams ranged from not impaired to severely impaired (Figures 3 and 4). Twelve (52%) follow-up streams had levels of fish abundance and/or fish community integrity that were lower than reference thresholds.

Exploratory statistical tests were performed using data from a subset of follow-up streams. Analysis results must be viewed cautiously since the sample population was small and not obtained from a scientific experimental design. Eight streams were sampled both inside and outside of the fish kill segment. As a group, fish abundance levels within kill segments were not lower, but actually ranked higher than levels outside kill segments. Fish kills produce a void in the stream that fish respond to quickly after adverse conditions subside. The number of fish, particularly small, short-lived species, may temporarily increase as the stream void is filled through fish migration and reproduction.

Figure 1. *Fish kill causes from reports compiled by the IDNR: 1981 - 2003.*

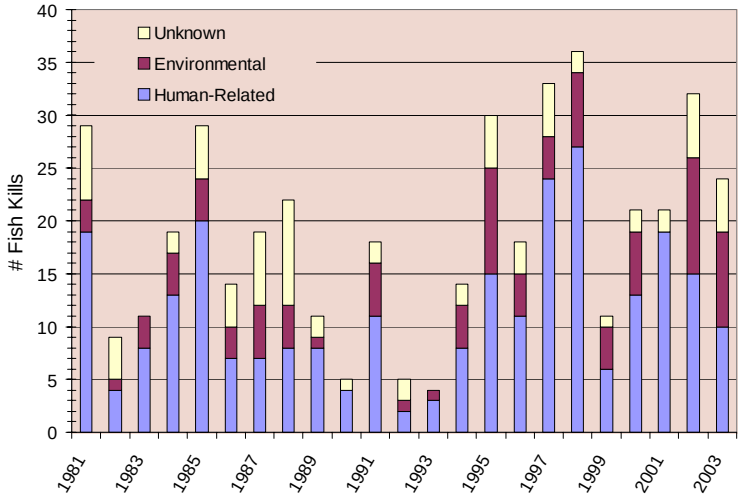
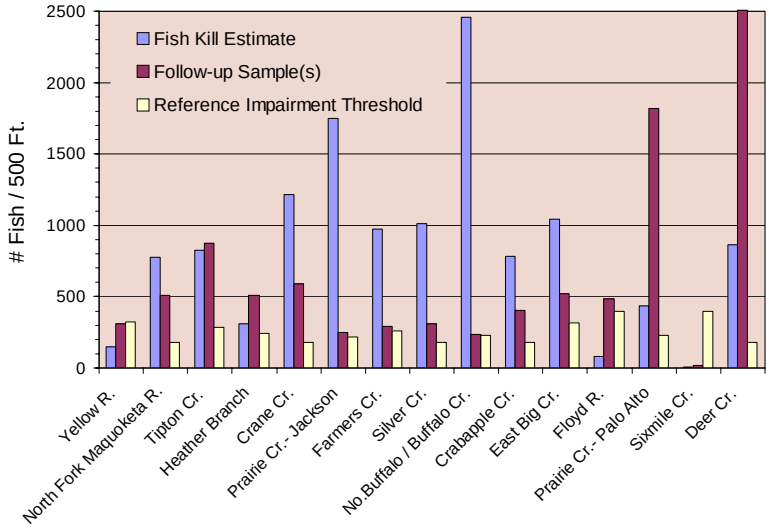


Figure 2. *Estimated fish killed and sampled fish abundance levels in 15 stream fish kill segments.*



Levels of fish community integrity (FIBI) did not differ significantly between kill and non-kill segments. Among 15 streams with kill segment sampling data, FIBI levels were inversely correlated with fish kill length. That is, low FIBI levels tended to occur in streams that had long affected areas. The length of time between a fish kill and follow-up sampling (recovery time) was not correlated with fish abundance or FIBI levels.

Conclusions

Follow-up sampling results indicate that significant recovery of fish abundance and community integrity does occur in many streams within several months to a few years after a major fish kill. Recovery in other streams, however, might not occur as quickly or completely. Several follow-up streams were missing one or more fish species that were part of the fish kills. Other follow-up streams had low levels of fish abundance and/or fish

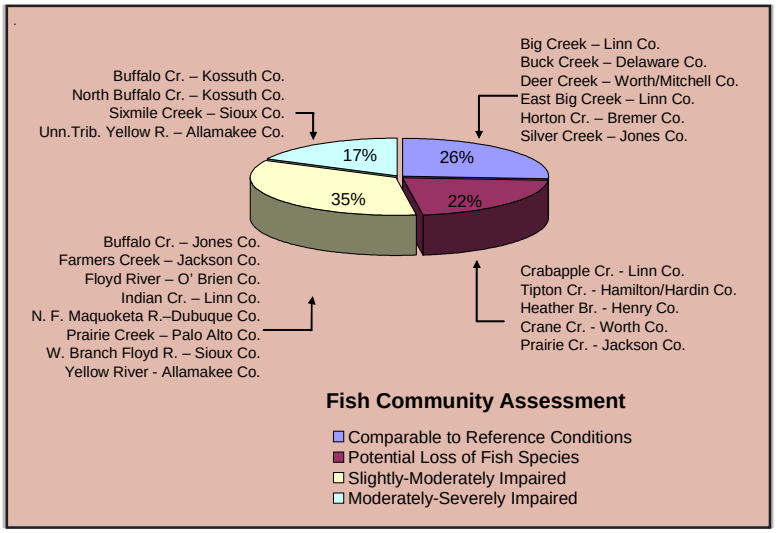


Figure 4. *Percentage of 23 fish kill follow-up streams belonging to each fish community assessment category.*

community integrity. Streams with poor fisheries characteristics in the kill segment tended also to have poor fisheries characteristics outside the kill segment. These streams appear to have widespread water quality and/or habitat problems that contribute to poor fisheries health. Without addressing other sources of stream degradation and pollution in the watersheds, it is unlikely that stream rehabilitation efforts focusing exclusively on the sources of documented fish kills will be successful.

In addition to fish data, IDNR staff evaluated benthic macroinvertebrate, physical habitat, and water quality data for a more complete follow-up assessment of stream conditions. The assessment data were included in the 2002 biennial report on the status of Iowa's water quality. From this assessment, 14 stream segments sampled as part of the fish kill follow-up study were placed on the 2002 list of impaired waters. Additional assessments are needed to accurately define the causes and sources of these stream impairments.

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Water Monitoring Program Web Site – wqm.igsb.uiowa.edu

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