Status of the Hornyhead Chub (*Nocomis biguttatus)* in Minnesota

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Author's Note: The following report was prepared in 2008 with the field assistance and editing input of Barry Thoele, owner of Lincoln Bait (Staples, MN). At that time, I was the Minnesota Department of Natural Resources (DNR) Nongame Fish Biologist. In November 2008, this report was discussed with DNR Fisheries Section Managers. Barry Thoele participated via conference call. At the minimum, I believed these results would assure a commitment from the DNR to study the problem in greater detail. However, the meeting ended with the decision to table the issue indefinitely despite the role that the Hornyhead Chub performs as a keystone species. The desired outcome would have been a temporary harvest ban during the spawning season in the watersheds I had identified with populations in poor condition.

Sometime in 2012, the DNR will be finalizing species for Endangered, Threatened or Special Concern status. The Hornyhead Chub is currently not under review. I believe Special Concern status is warranted for this species even though this designation does not afford protection. However, special regulations prohibiting harvest can be imposed in watersheds where populations require protection. This is not unprecedented. For example a Special Concern species, Slender Madtom (*Noturus exilis*), only occurs in the Cedar River system of southern Minnesota. The demand for madtoms (aka willow cats) in the bait industry has likewise skyrocketed (Cochran and Zoller 2009) in recent decades and current regulations for the Cedar and its tributaries ban bait harvest in Mower County south of Interstate 90.

While editing this report for *American Currents*, I contacted Barry Thoele in November 2011 to provide an update and his comments are paraphrased below:

"I would reiterate the results stated in the 2008 status report and add that the harvest this year may have been the worst yet. It is becoming increasingly difficult to obtain sufficient broodstock for propagation. However, I personally find it difficult to justify removing any Hornyhead Chubs even for the sole purpose of aquaculture if this may further hurt wild populations. Ironically, I'm coming to believe the only salvation for Hornyhead Chub populations may be exotic Zebra Mussels *(Drissena polymorhpa)* as they spread into new watersheds. Under current regulations, Zebra Mussel infested waters are closed to bait harvest from May 15 through October 16, which will provide protection for Hornyhead Chubs through their spawning season. I have observed a "modest recovery" in two infested streams (Mississippi and Pine Rivers), but the drought will undoubtedly drive another nail in the coffin, not only for Hornyhead Chubs, but also Common Shiners *(Luxilus cornutus)*."

Most importantly, Barry emphasizes if there is going to be a future for wild populations of Hornyhead Chubs and also sustainable to bait industry demand there must be a monumental shift to aquaculture--not closure of streams to harvest.

Abstract

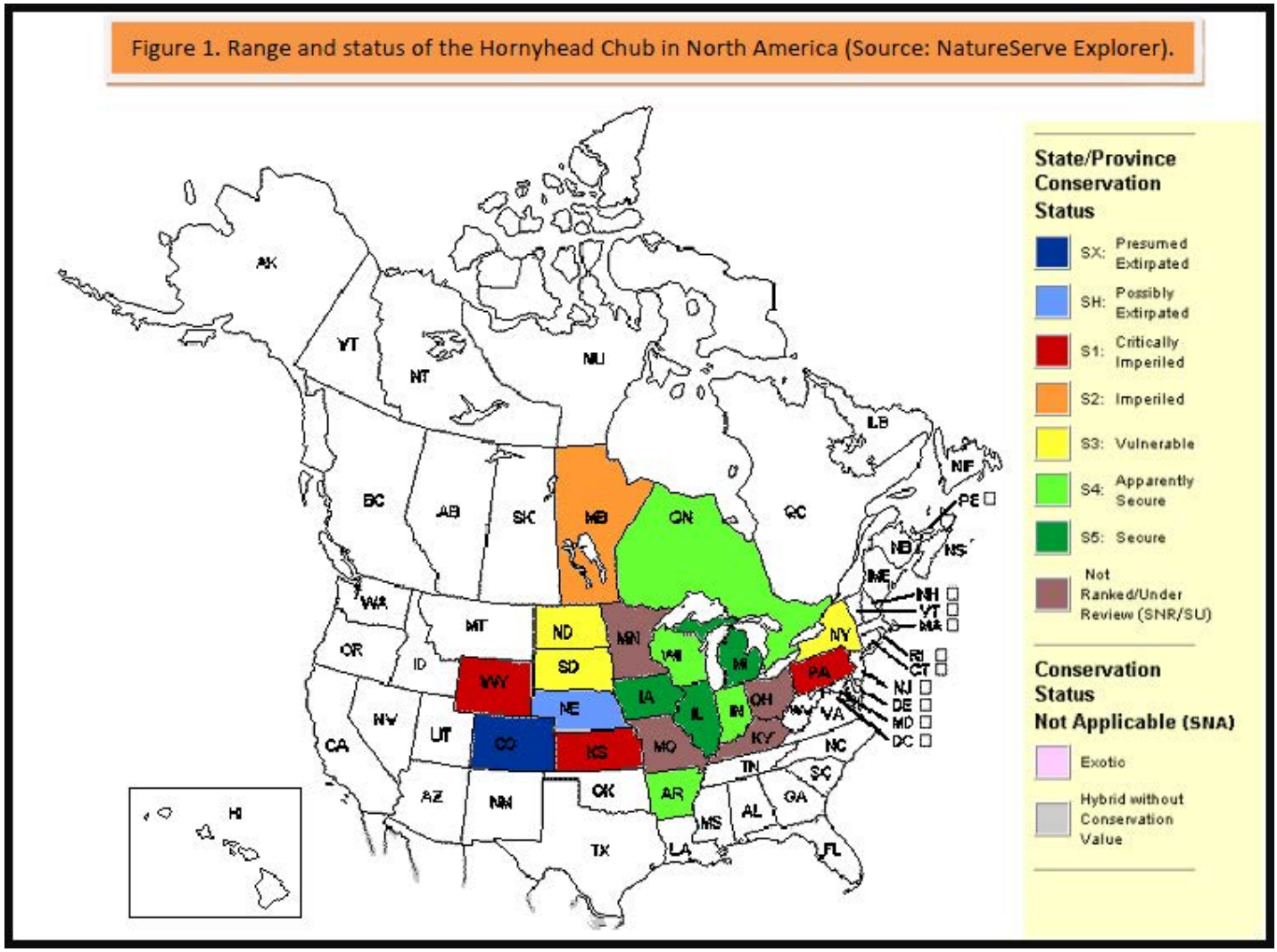
In recent decades there have been many reports of drastic declines of Hornyhead Chubs (aka redtail chub) in streams primarily in north-central Minnesota. The primary cause of this observation is believed to be increasing harvest pressure from the bait industry to meet angler demand. However, supporting information has been anecdotal and declines have not been scientifically confirmed. This report discusses the limited abundance data available on the species, identifies critical research needs and recommends actions to consider if the species is to be properly managed for continued commercial harvest on a long-term sustainable basis.

Introduction

Distribution and Status: The range of the Hornyhead Chub in North America includes 18 states and 2 Canadian provinces (Figure 1). It is extirpated from Colorado and possibly Nebraska and ranked critically imperiled in Kansas, Pennsylvania and Wyoming. In the Upper Midwest, the species' status has not been determined in Minnesota, but ranked imperiled in Manitoba and vulnerable in North and South Dakota. Its status is secure or apparently secure in Iowa, Wisconsin and Ontario (NatureServe 2008).

The Hornyhead Chub has been reported from all drainages in Minnesota, but is not evenly distributed. The species is absent or rare in the Des Moines, Missouri, Superior; southern Upper Mississippi; northern and southern Red; and eastern Lower Mississippi, Minnesota and Rainy River drainages (Figure 2).

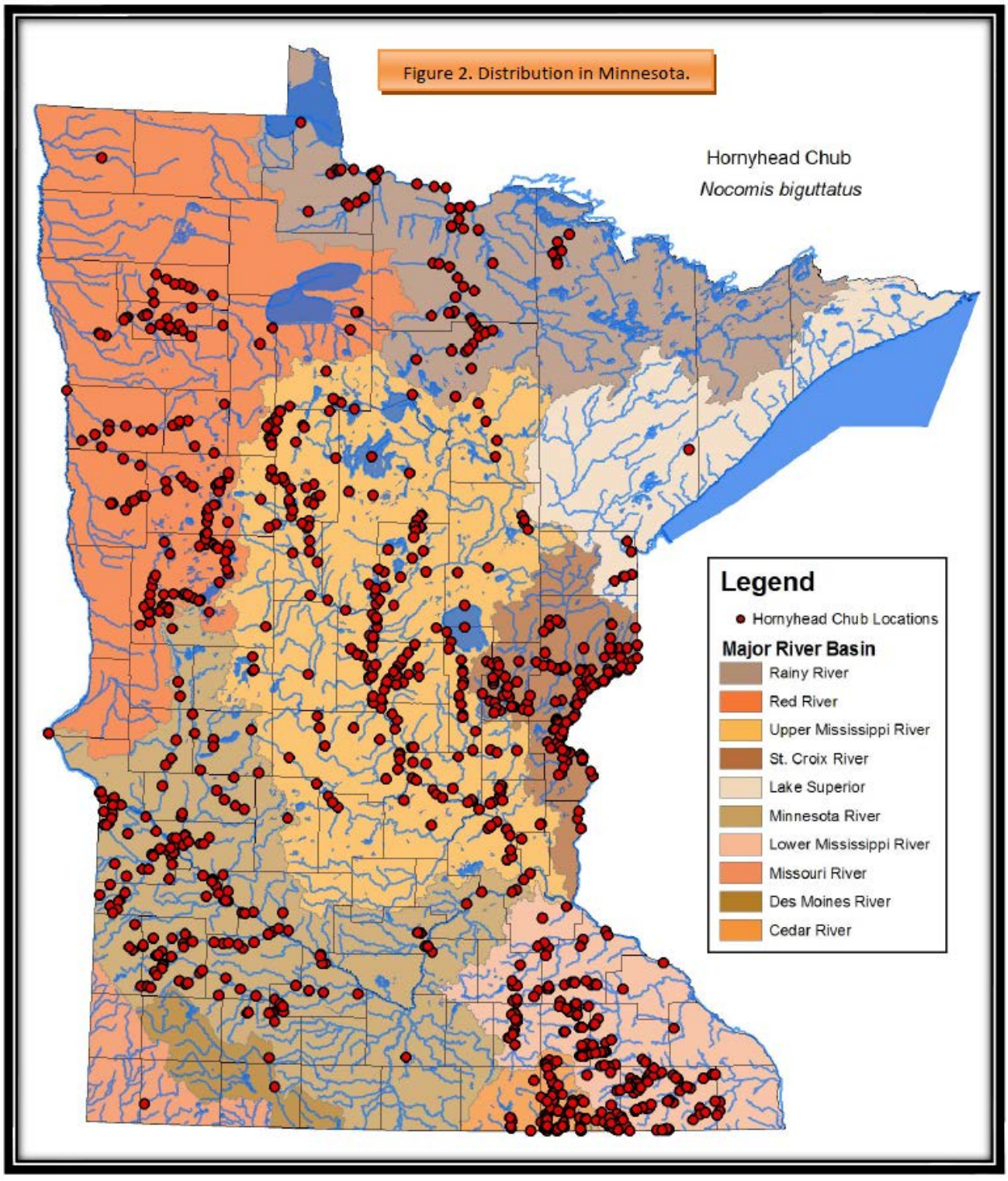
Natural History: The majority of information available on the Hornyhead Chub in the upper Midwest has been reported in *Fishes of Wisconsin* (Becker 1983). At that time, there was concern the species was generally declining across its range because of intensive agriculture, which caused increased siltation and greater frequency of intermittent stream flows. In Wisconsin, Hornyhead Chubs prefer clear medium sized streams, but its abundance declines as turbidity increases. The species occurred most often over gravel and sand in streams up to 24 m (26 yd) wide. Spawning begins in May when water temperatures reach 18.3º C (65º F) and continues through July when males prepare and defend large nests of pebbles. Several fishes utilize the Hornyhead Chub nest for spawning or egg predation and include: Blacknose Dace, Blackside Darter, Bluntnose Minnow, Carmine Shiner, Common Shiner, Johnny Darter, Rainbow Darter, South-



ern Redbelly Dace and stonerollers. Male Common Shiners often share the nest-guarding responsibilities with the Hornyhead Chub which must constantly leave in search of more pebbles. Because of the high number of fishes dependent on Hornyhead Chub nests it is considered a keystone species, which if lost in a stream community, many other species will likely decline or disappear (Hatch et al. *in prep*). The Common Shiner is an example of one species that seems to be experiencing a similar decline due to the reduction or loss of the mutualistic nest association with the Hornyhead Chub. In Wisconsin, the Hornyhead Chub has a maximum lifespan of 4 years and the largest specimen reported was 225 mm (8.9 in) in total length. In Iowa (Harlan and Speaker 1956) and Minnesota (Eddy and Underhill 1974), the species once reached a length of about 305 mm (ca 12 in).

Redtail Chub Demand and Harvest: For decades, Hornyhead Chubs have been commercially harvested for the "redtail chub" bait trade where there has been great demand from Walleye and Northern Pike anglers, especially for larger specimens. However, smaller chubs are marketable down to about 3.5 in (89 mm) long (Barry Thoele, pers. comm.). At one time, 15-20 gallons of redtail chubs could be harvested per day from some stream reaches where lengths up to 8 inches were not uncommon. However, recently the maximum catch per day has dropped to 1-2 gallons per day and large specimens are extremely rare. While the supply has decreased, the demand has not and redtail chubs have recently sold for as much as $150.00/gallon wholesale and $15.00/dozen retail. However, as larger wild-caught individuals have declined some bait harvesters have attempted to market redtail chubs as small as 64 mm (2.5 in) long. Commercial harvesters are required to submit reports to the DNR listing the gallons of minnows sold each year. However, the "chub" category includes other species besides Hornyhead Chubs. In 1998, chub harvest peaked at 10,297 gallons, fell to 3,796 in 2004 and rebounded to 7,838 in 2006.

Reports of Decline in Abundance and Size: Most of the reports relative to Hornyhead Chub population characteristics



prior to 2008 are anecdotal and claims of widespread decline have never been confirmed. In 2000 and 2001, several resident anglers and some commercial harvesters in north-central Minnesota expressed concerns to Pollution Control Agency (PCA) and DNR stream survey crews that redtail chubs had either vanished from streams or the once common large chubs were now extremely rare. In 2005, a DNR committee reviewed the Hornyhead Chub for designation as a Species in the Greatest Conservation Need (SGCN) because of commercial exploitation and anecdotal reports of decline. The designation does not provide legal protection, but SGCN are eligible for federal and state funding to conduct research studies and implement projects that enhance populations. However, the review committee concluded that there was insufficient data to list the Hornyhead Chub. Barry Thoele reported his first observation of Hornyhead Chub decline to DNR Fisheries in 2000. His follow-up reports suggesting worsening conditions raised the level of concern within the DNR prompting limited surveys in 2008.

Methods and Materials

In September 2008, surveys were conducted at 5 stations on the Crow Wing (4) and Otter Tail (1) Rivers. Barry Thoele selected the sites based on where he had harvested Hornyhead Chubs for many years. Our sampling gear consisted of a seine (35 feet long and 6 feet deep with ¼-inch mesh). Hornyhead Chubs were "chummed" into the stations using two net bags filled with chicken livers. Five seine hauls were made at each station; however, new schools of minnows were allowed sufficient time to move up on the bags between hauls. The catch was graded into three sizes (small, medium and large). For each size, data recorded included minimum and maximum total lengths (TL) in millimeters (mm) and batch weights in grams (g). Associated fish species were not tallied, measured or weighed, but noted as present.

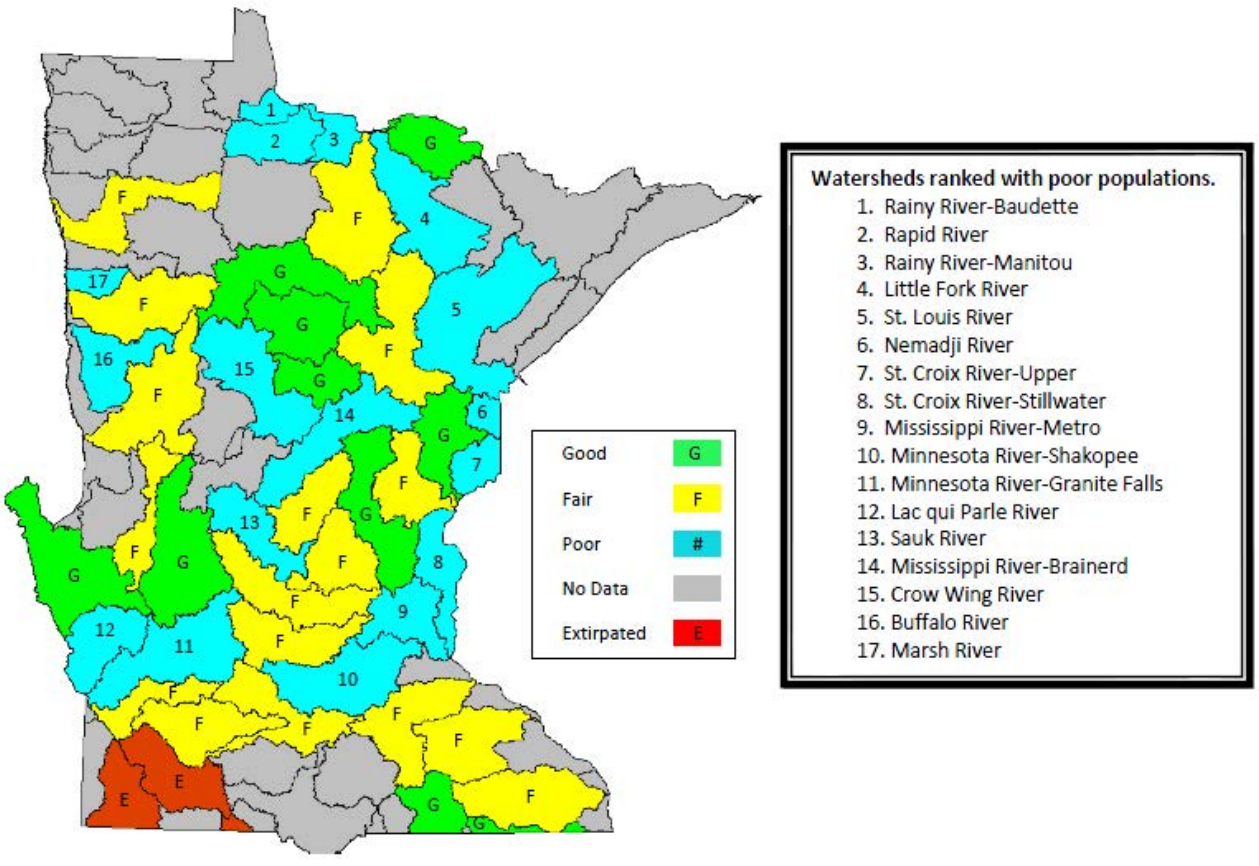
Historical data for Hornyhead Chub population structure is virtually nonexistent. However, the PCA has compiled statewide data from community stream surveys providing means and ranges of population structure meristics by watershed. However, the bulk of this data was collected from 1990-2007 and is limited to very few records for some watersheds. Survey sites should be revisited to gather additional data for improved assessments. Nevertheless, an attempt has been made to rank the status of all populations as good, fair or poor based on structure metrics of statewide averages.

Results and Discussion

Fish Data: In the 2008 surveys, the longest Hornyhead Chub collected was 128 mm (5.0 in) at age 3 (Table 1). The longest specimens at the other four stations ranged from 116-118 mm (4.6-4.7 in) and were between 2-3 years old. Only Station 1 (of the five stations) had a commercially harvestable population where approximately 39% (132 individuals) of the sample were at least 89 mm (3.5 in) long. However, 82 Hornyhead Chubs were two years old (maximum TL: 109 mm/4.3 in) and the largest individual of the remaining 50 was three years old (117 mm/4.6 in). The average weight of individuals at the five stations ranged from 4-9 g and an overall average of 7 g. The minimum harvestable size Hornyhead Chub (89 mm) weighed an average of 8 g. Catch/haul ranged from 25-55 individuals (mean=41.9). Ironically, the Otter Tail River station in the Hubbel Pond Wildlife Management Area had been closed to harvest for a number of years and the population structure appeared no better than the Crow Wing River stations.

Habitat Data: In 2008, all stations were in a moderate to severe drought. In the Crow Wing River, stream flows below the daily mean at USGS gauges ranged from 21-57%. Water transparencies were all greater than 1.2 m. Riffles and runs were the dominant habitats with lightly to moderately embedded substrates of sand, gravel and cobble. Pools were rare, but when present were often mostly covered with sand. Submergent vegetation was spotty to dense and diverse. Emergent vegetation included wild rice and reed canary grass. There were no stream gauges near the Otter Tail station, but Barry Thoele estimated the flow to be about 1/3 of normal for September. The water was moderately turbid (transparency tube=0.4 m). Dominant habitats included runs and pools having substrates of sand and gravel. Submergent vegeta-

Figure 3. Hornyhead Chub Population Status in Minnesota Watersheds.



tion was spotty but diverse and emergents included reed canary grass and rush. There were no obvious environmental impacts or pollution sources at any of the stations.

Additional Fish Data: A query of the PCA database returned 590 records of Hornyhead Chubs in 43 major watersheds. The data have been analyzed and summarized to report the status of several populations on a watershed basis (Figure 3 and Appendix 1).

Watershed surveys were conducted in 1999 and 2000 in the Crow Wing River where Hornyhead Chubs were sampled at 12 stations. The population structure was below statewide averages in 7 areas (highlighted in gray) and the watershed was ranked poor. However, the average weight (9 g) was at the statewide average and there were some fish entering their fourth year of life (maximum TL: 150 mm/5.9 in). In contrast, the Rum River watershed was at or above statewide averages and ranked good. On the drainage basin level, the Upper Mississippi River populations ranked fair. The Lake Superior and Red, Rainy and St. Croix River drainages were poor, but the Minnesota and Lower Mississippi Rivers ranked good. The longest Hornyhead Chub sampled in the PCA dataset was 224 mm (8.8 in) from the Wild Rice River watershed (Red River of the North drainage) in 1994. The second longest specimens were 181 mm (7.1 in) from the Pomme de Terre River (Minnesota River drainage) in 2007 and Cedar River (Lower Mississippi River) in 2002. The recent take of large specimens is encouraging; however, no historical data exist to determine if the large size class occurred in an absence or presence of commercial harvest.

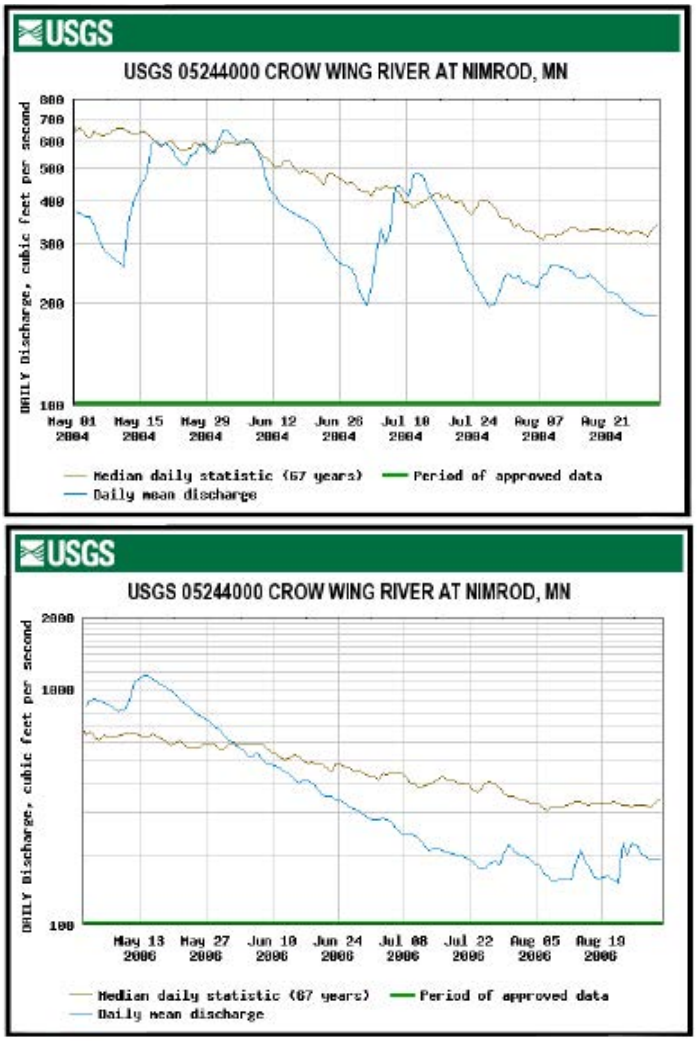
Drought and Changes in Habitat Usage: As suitable habitat is lost, fish species will migrate out of smaller tributaries to larger rivers during extended periods of below normal stream flows. Since 2004, low flow conditions in the Crow Wing River have coincided with the Hornyhead Chub spawning period in 4 out of 5 years: the two worst were 2004 and 2006 (Figure 4). Barry Thoele has observed during drought periods the absence of Hornyhead Chubs in smaller streams where they normally spawn and found them utilizing large rivers with little cover where they are far more vulnerable to predation and harvest.

Additional Factors Causing Decline: At this time, the primary factors *suspected* of causing the decline in abundance and size of Hornyhead Chubs appears to be the *combination* of extended drought and harvest during the spawning season. Although data are not readily available, other factors may have also affected abundance and size of this species including predation, diseases, competition due to increased abundance of associated species or rising water temperatures resulting from climate change.

Recommendations

Short-term: Where poor populations of Hornyhead Chubs occur, harvest bans during the spawning period should be implemented. However, scheduling optimum dates for such bans in advance can be problematic. Depending on water temperatures, the date Hornyhead Chubs begin to spawn each year can vary up to a month (Barry Thoele, pers. comm.). In 2007, during an unusually early and warm spring, spawning began on May 20th, but in 2008 (a late and cold spring), spawning was not observed until June 16. If harvest seasons must be published or announced earlier, Barry Thoele recommends a ban from June 15 through August 1 which should cover 90% of the species' spawning period.

Figure 4. Crow Wing River 2004 and 2006 Stream Flows.



An effective monitoring program must be developed and implemented to document trends in populations. Nest abundance could be a practical surrogate measure instead of standardized fisheries stream surveys. Nest counts or fish surveys could be coordinated, conducted or contracted through area fisheries offices on an annual basis. Another vital monitoring component would be to require commercial harvesters to submit detailed and accurate annual reports. Currently, "chubs" is the only category listed in annual reports which lumps several chub-like species into a single category. At a minimum, Hornyhead Chubs should be listed separately and gallons reported as cultured versus wild with the latter listing harvest localities by watersheds (e.g., Crow Wing).

To assure there will be sound, science-based management in the future, basic research should be undertaken to better understand the ecology of the Hornyhead Chub. Information on life history, nest associates, genetic analysis of populations and water quality and habitat assessment are needed. Funding opportunities must be explored for graduate students to conduct research. One possible funding source could come from license fees commercial harvesters annually pay. Other options could be adding a surcharge only to those who harvest Hornyhead Chubs or permit an annual quota (e.g., 100 gallons). Exceeding the

quota would require purchasing additional licenses or surcharges. A final avenue would be listing the Hornyhead Chub a Species in the Greatest Conservation Need which would provide eligibility for state and federal funding. However, this could eventually result in listing the Hornyhead Chub a State Threatened or Endangered species if the research supports and warrants protective status. This designation would prohibit all harvest of the species.

Long-term: If the demand for Hornyhead Chubs continues, the emphasis on harvesting wild populations eventually must shift to aquaculture. Preliminary research has already proven the species can be reared profitably and sold at competitive prices paid for wild harvest sources (Gunderson et al 2008). Funding for research to refine aquaculture techniques that boost production and reduce the rearing period to marketable size should be a high priority.

Acknowledgements

The field data collected for this report could not have been accomplished without the assistance of Barry Thoele who took time off from his business to serve as a guide to former Hornyhead Chub hotspots. He also provided invaluable input and information for the report based on his 20 years of experience as a commercial bait harvester. Other contributors to this report include Nick Proulx (DNR) who produced the Minnesota range map, Mike Feist (PCA) who provided the dataset used to create Appendix 2, Matt Haworth (DNR) who assisted in the surveys and Robert Hrabik (Missouri Department of Conservation) who reviewed and provided editorial comment for this adaption to the *American Currents* article.

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Table 1. 2008 Hornyhead Chub Survey Data

Sation	Stream	Location	County	Watershed	Basin	Date	Graded Catch	% Composition	Hauls	Ave #/Hauls	Min Length (mm)	Max Length (mm)	Age Class Range	Batch Weight (g)	Ave Weight (g)
1	Crow Wing	Anderson Crossing	Wadena	Crow Wing	Upper Mississippi	9/12/2008	17	5.0	10		39	47	0	13	0.8
							25	7.3			45	65	0-1	53	2.1
							59	17.3			45	75	0-2	333	5.6
							16	4.7			60	71	1	59	3.7
							49	14.3			67	81	1-2	343	7.0
							44	12.9			72	92	1-2	385	8.8
							79	23.1			92	97	2	864	10.9
							3	0.9			95	109	2	34	11.3
							50	14.6			97	117	2-3	750	15.0
Station Summary							342			34.2	39	117	0-3	2834	8.3
2	Crow Wing	Nimrod	Wadena	Crow Wing	Upper Mississippi	9/12/2008	42	33.1	5		41	71	0-1	201	4.8
							57	44.9			72	83	1-2	540	9.5
							28	22.0			85	128	1-3	310	11.1
Station Summary							127			25.4	41	128	0-3	1051	8.3
3	Crow Wing	Little White Dog	Wadena	Crow Wing	Upper Mississippi	9/22/2008	103	37.7	5		38	67	0-1	128	1.2
							119	43.6			61	93	1-2	617	5.2
							51	18.7			80	116	1-3	446	8.7
Station Summary							273			54.6	38	116	0-3	1191	4.4
4	Crow Wing	Sylvan Dam	Morisson	Crow Wing	Upper Mississippi	9/22/2008	16	7.5	5		38	58	0-1	26	1.6
							100	47.2			69	84	1-2	758	7.6
							91	42.9			82	99	1-2	1105	12.1
							5	2.4			106	118	2-3	87	17.4
Station Summary							212			42.4	38	118	0-3	1976	9.3
5	Otter Tail	Hubbel Pond	Becker	Otter Tail	Red River of the North	9/23/2008	11	4.2	5		45	47	0	13	1.2
							197	74.6			66	87	1-2	958	4.9
							48	18.2			80	101	1-2	363	7.6
							8	3.0			103	118	2-3	124	15.5
Station Summary							264			40.6	45	118	0-3	1458	5.5
Overall						Sum	1218		30		min=38	max=128	0-3	8510	
Summary						Average	244			41.9				1702	7.0

Harvest Size: >3.5 in/89 mm

Age classes based on Becker (1983)

Appendix 1. Population Status in Minnesota Drainages and Watersheds. (Data Source: MPCA).

Drainage Basin	Major Watershed	Sampling Period	Records	Average Catch	Range	Average #/100 m	Range	Average #/hour	Range	Average Batch Weight (g)	Range	Average Individual Weight (g)	Range	Ave Min Length (mm)	Range	Ave Max Length (mm)	Range	Ave Max Age Class	Max Age Class
Upper Mississippi	Crow River [F]	1996-2007	21	84	1-398	30	1-205	72	1-328	740	1-4142	7	1-16	49	24-86	114	59-161	2	>3
	Crow Wing [P]	1999-2000	12	33	2-150	8	<1-30	28	2-103	258	7-590	9	2-17	44	25-75	109	44-150	2	>3
	Leech Lake [G]	2000	1	297		59		182		2735		9		25		147		>3	>3
	Miss-Brainerd [P]	1998-2000	5	15	1-41	4	<1-11	11	1-24	113	2-336	5	1-12	49	31-80	89	45-159	1-2	>3
	Miss-Grand Rapids [F]	1998-2000	5	51	2-219	21	<1-95	54	2-236	245	4-1159	4	1-7	45	25-81	83	46-139	1-2	>3
	Miss-Headwaters [G]	1999-2000	2	129	11-246	25	3-47	86	5-167	1092	84-2099	8	8-9	38	36-39	153	140-166	>3	>3
	Miss-Metro [P]	1999-2007	6	9	1-26	4	<1-14	17	1-58	46	2-143	5	2-9	54	25-67	93	56-142	2	>3
	Miss-Sartell [F]	1996-2003	13	29	2-110	7	<1-30	38	4-177	243	44-556	11	5-24	52	29-110	126	96-148	3	>3
	Miss-St. Cloud [F]	1999-2007	3	52	5-94	32	1-58	131	4-205	201	4-488	3	1-5	36	25-51	87	46-137	1-2	>3
	Pine [G]	1999-2000	2	82	40-123	16	8-25	64	54-73	626	81-1170	6	2-10	42	33-50	137	121-152	>3	>3
	Rum [G]	1997-2000	9	34	2-118	12	1-38	43	3-125	415	14-1330	14	7-20	57	29-90	129	78-147	3	>3
	Sauk [P]	2000-2007	4	7	1-19	2	1-4	6	1-14	263	3-165	10	3-14	72	64-85	105	66-130	2	3
Drainage Summary [F]		1996-2007	83	50	1-398	16	<1-205	49	1-328	426	1-4142	8	1-24	49	24-110	113	44-166	2	>3
Superior	Nemadji [P]	1990-1997	3	9	1-20	2	1-4	14	5-23	65	58-71	8	4-12	65	35-94	99	91-107	2	2
	St. Louis [P]	1998	1	111		29		154		238		2		20		113	20-113	2	2
Drainage Summary [P]		1990-1998	4	34	1-111	9	1-29	61	5-154	122	58-238	6	2-12	50	20-94	104	91-113	2	2
Red River	Buffalo [P]	1994-2007	7	17	1-40	8	1-16	37	2-115	98	18-295	8	3-18	52	25-111	109	74-142	2	>3
	Otter Tail [F]	1991-2005	10	29	1-176	5	<1-19	36	10-45	247	31-601	8	1-15	36	25-46	144	126-161	>3	>3
	Marsh [P]	1994	1	2		1		6		2		1		47		54		1	1
	Red Lake [F]	1976-2007	43	22	1-181	8	<1-41	23	1-193	246	1-1267	8	1-23	45	20-95	116	28-159	2-3	>3
	Wild Rice [F]	1994-2007	24	35	1-173	14	<1-36	37	1-108	232	2-1243	6	2-14	34	21-61	119	57-224	2-3	>3
Drainage Summary [P]		1976-2007	85	21	1-181	7	<1-41	28	1-196	222	1-1267	6	1-18	40	20-111	112	28-224	2	>3
Rainy	Big Fork [F]	2005-2006	9	21	1-52	4	<1-10	15	1-41	128	10-389	9	3-24	67	26-121	114	96-136	2	>3
	Little Fork [P]	2005	1	1		<1		1		2		2		60		60		1	1
	Rapid [P]	2005	5	6	1-10	2	<1-4	6	1-10	30	2-105	4	2-11	46	34-55	80	49-132	1-2	>3
	Rainy-Rainy Lake [G]	1998-2005	2	66	48-83	26	23-29	66	44-88	472	383-561	7	7-8	31	25-36	135	125-145	>3	>3
	Rainy-Manitou [P]	2002-2006	6	3	1-5	<1	<1-1	2	1-5	22	5-65	7	4-13	66	38-81	81	63-123	1-2	3
	Rainy-Baudette [P]	2005	2	13	2-24	4	1-6	10	3-16	148	11-285	9	6-12	55	51-59	106	64-147	2	>3
Drainage Summary [P]		1998-2006	25	18	1-83	6	<1-29	17	1-88	111	2-561	6	2-24	54	25-121	96	49-147	2	>3
Minnesota	Chippewa [G]	1990-2007	13	105	1-707	44	1-295	185	1-1287	1156	1-5203	9	1-17	55	25-91	130	38-159	3	>3
	Cottonwood [F]	1990-2007	19	17	1-68	10	<1-33	39	1-117	154	8-498	9	2-22	62	40-127	116	61-152	2-3	>3
	Lac qui Parle [P]	1990-2003	10	14	1-72	6	<1-47	25	1-131	120	2-495	13	<1-49	65	25-135	112	31-175	2	>3
	Minn-Headwaters [G]	2001-2003	3	82	46-132	22	13-34	79	52-125	691	322-1167	8	7-9	57	42-78	131	109-145	>3	>3
	Minn-Granite Falls [P]	1990-2004	8	7	1-32	4	<1-11	17	1-60	32	1-120	7	1-24	61	39-83	96	41-152	2	>3
	Minn-Mankato [F]	1991-2007	11	21	3-67	9	1-32	20	3-59	226	59-696	17	11-28	57	25-116	137	105-148	>3	>3
	Minn-Shakopee [P]	1990-2007	7	5	1-17	2	<1-12	10	1-53	27	1-105	6	1-15	71	45-107	90	45-137	1-2	>3
	Pomme de Terre [F]	2003-2007	5	19	1-47	9	<1-24	30	1-60	243	33-506	17	6-33	90	28-136	143	95-181	>3	>3
	Redwood [F]	1990-2007	43	17	1-121	9	<1-51	29	1-159	135	2-834	9	2-22	61	24-114	118	50-170	2-3	>3
	Yellow Medicine [P]	1990-2003	5	29	1-91	11	1-30	44	2-115	188	2-474	6	2-11	47	40-52	105	52-147	2	>3
Drainage Summary [G]		1990-2007	124	32	1-707	13	<1-295	48	1-1287	272	1-5203	10	<1-49	63	24-136	118	31-181	2-3	>3

Appendix 1 Continued. Population Status in Minnesota Drainages and Watersheds.

Drainage Basin	Major Watershed	Sampling Period	Records	Average Catch	Range	Average #/100 m	Range	Average #/hour	Range	Average Batch Weight (g)	Range	Average Individual Weight (g)	Range	Ave Min Length (mm)	Range	Ave Max Length (mm)	Range	Ave Max Age Class	Max Age Class
St. Croix	Kettle [G]	1967-2006	14	51	1-210	12	<1-41	53	1-197	502	55-1880	11	5-23	56	20-94	130	96-148	3	>3
	Snake [F]	1987-2007	69	52	1-491	17	<1-133	57	1-569	403	1-3353	9	<1-38	48	17-152	114	25-168	2	>3
	St. Croix-Upper [P]	1966-2006	65	15	1-73	5	<1-35	19	1-102	107	1-485	7	1-20	43	20-125	107	25-145	2	>3
	St. Croix-Stillwater [P]	1989-2007	57	19	1-121	6	<1-38	20	1-140	199	1-1739	10	<1-61	55	20-134	103	25-161	2	>3
Drainage Summary [P]		1966-2007	205	34	1-491	10	<1-133	37	1-569	268	1-3353	9	<1-61	50	20-152	114	25-168	2	>3
Lower Mississippi	Cannon [F]	2000-2007	12	23	1-140	5	<1-33	26	1-207	114	6-373	11	2-31	54	25-98	121	71-163	3	>3
	Cedar [G]	2002-2007	23	83	1-400	28	<1-175	98	1-502	637	1-2406	11	1-34	53	25-125	137	46-181	>3	>3
	Root [F]	2002-2004	11	24	1-83	8	<1-27	24	1-59	245	3-1133	9	1-16	58	25-110	124	72-168	3	>3
	Upper Iowa [G]	2002-2004	3	118	50-225	26	3-61	89	46-155	887	530-1356	9	6.0-11	38	25-61	155	134-171	>3	>3
	Zumbro [F]	2002-2007	10	25	1-85	11	<1-33	24	1-58	289	8-1221	10	1-21	61	25-114	133	92-176	>3	>3
Drainage Summary [G]		2000-2007	59	55	1-400	16	<1-175	52	1-502	411	1-2406	10	1-34	53	25-125	134	46-181	>3	>3
Statewide Summary		1966-2007	590	34	1-707	12	<1-295	43	1-1287	296	1-5203	9	<1-61	52	20-152	115	25-224	2-3	>3
Population Status		Good (0-2) [G]	Fair (3-5) [F]	Poor (6-8) [P]		Below Statewide Average				Harvest Size: >3.5 in (89 mm)				Age classes based on Becker (1983)