

**Fish Predation and Trapping for Rusty
Crayfish Control on Plum and Star Lakes:
A Commentary**

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Fish Predation and Trapping for Rusty Crayfish Control on Plum and Star Lakes: A Commentary

INTRODUCTORY REMARKS – A series of three meetings were held this summer at the UW-Trout Lake Station (UW-TLS) to examine how best to assess the larger implications of the successful small-scale Sparkling Lake study of fish predation and trapping for rusty crayfish (RC) control on Plum and Star Lakes. Participating in these meetings were representatives of the University of Notre Dame’s Environmental Research Center (UNDERC), the Wisconsin Department of Natural Resources (WDNR), UW’s TLS and Madison Limnology Center, the Vilas County AIS Partnership, and the TPL Lakes Committee [1]. The meetings were organized by the Town of Plum Lake (TPL) Lakes Committee, were hosted by Tim Kratz, UW-TLS Director, and moderated by Bill Sloey, chair of the Lake Monitoring and Management Subcommittee of the TPL Lakes Committee. There follows a list of initial discussion points:

1. RCs were introduced to both Plum and Star Lakes some 30 to 40 years ago.
2. Both lakes have provided ideal habitat for RCs to establish robust high-density communities.
3. Little Star and Star Lakes are interlinked with Plum Lake by Star Creek.
4. There are no apparent signs of biotic (up-down) cycling of RC densities in either Star or Plum Lakes.
5. There is anecdotal evidence that both Star and Plum lakes supported ‘good’ panfishing prior to RC invasions.
6. WDNR creel surveys since the early 1990s do not support #5.
7. There is anecdotal evidence, based on old guide maps and accounts by long-time riparian owners and fishing guides, that both lakes have suffered a sharp loss of aquatic plants and macroinvertebrates.
8. Riparians and other stakeholders share a strong feeling that the RCs have impaired the quality of the lakes and their lake experience – water quality (turbidity), fishery, and RC-human contacts.
9. Water quality measurements taken during a 1997 Lake Planning Grant study conducted by Blue Water Science as well as more recent Secchi disc measurements of 17 feet taken by riparian volunteer Gerry Kurth do not support the water impairment comment in #8.

The history of initial RC invasions on Plum and Star Lake is instructive. These invasions took place decades ago (in the 1960s -1970s) when the lakes were in a healthy reference state with respect to macrophytes, macroinvertebrates, historically abundant Walleye, Musky, Perch, and anecdotally (but unlikely) abundant *Lepomis* (panfish) fisheries.

These supposedly healthy lakes were still not able to resist rusty crayfish invasions that were followed by classic booming population growths that upset the lake’s ecological balance. The upset took the form of dramatic reductions in the amount and kinds of aquatic plants and invertebrates, displacement of native crayfish, and reduction of *Lepomis* and Perch populations due to reduction of likely sparse pre-invasion *Lepomis* and young Perch habitats. To date, these lakes have not exhibited any signs of a “boom-bust” in RC population such as seen on Kentuck Lake in the 1970s and 1980s.

This commentary aims to provide the reader with a sense of what's going on in potential RC control mechanisms as well provide a realistic notion of what might be done to reduce the impact of RCs – restoring a measure of ecological balance to large RC infested lakes.

THE SPARKLING LAKE EXPERIMENT: HOPE FOR THE FUTURE? – The Sparkling Lake Study on RC control indicates that it is possible to achieve a good measure of RC population control via a combination of intensive trapping of adult crayfish and increased predation of young crayfish. The latter was accomplished by virtue of enhanced SMB fish population via fishing restrictions and a rebound of *Lepomis* associated with macrophyte recovery [2, 3].

According to articles in the Vilas County News-Review and the Milwaukee Journal-Sentinel, [4, 5], Steve Carpenter, UW-Madison Limnology Center, says: “The big hope is that the experiment will expose a "tipping point," where the combination of trapping and pressure from predator fish pushes the rusty crayfish population to crash, with the lake ecosystem returning to its pre-rusty crayfish state.

"What we are wondering is whether we will reach a tipping point where the fish alone can keep up the pressure," said Carpenter, an authority on such ecological change. "We haven't seen it yet, but we're not prepared to admit there isn't a tipping point."

TRAPPING HELPS BUT PREDATION IS THE KEY – The Vilas County News-Review reported that intensive trapping would be implemented on Michigan's Lake Ottawa by Notre Dame researchers who have been working on the RC issue with employees of the Ottawa National Forest for the past five years [6]. Commercial crayfish traps are being used in an effort to eliminate the crayfish remaining in the lake after a small-scale 2005 effort to trap via trawling nets. According to the report: “The project, which began again July 6, will continue throughout the rest of the summer until all of the rusty crayfish have been destroyed.” Trapping alone will not “destroy” the RCs.

Given sufficient resources, it should be possible to drive a given lake's RC population to near extinction by a “top-down” tactic – removal of almost all small, sexually immature RCs via extensive fishery predation. The so-called "tipping point" would occur when the predation capacity exceeds the RC breeding capacity.

Since the RC life span is less than five years, significant results could be observed in about five years after increasing the predation capacity of the lake system to the point where it far exceeds the lake's RC breeding capacity. The RC breeding capacity can be reduced by trapping adult, sexually-mature RCs, thereby accelerating the RC-population-reduction process. A combination of trapping and increased predation of the diminished but still existing RC population could make it possible to observe significant results inside of five years. However, what is possible may very well be infeasible because of the enormity of requisite resources for intensive trapping in lakes much larger than Sparkling Lake, not to mention greater numbers of riparian and other lake users.

WHAT HAPPENS UPON CESSATION OF INTENSIVE TRAPPING? – The use of intensive trapping gives rise to the question: What happens when the intensive trapping

ceases? In reference 3, the authors state that: "In coming years, we will examine whether sustained trapping efforts are required to reduce impacts of rusty crayfish." This statement is followed by brief discussions of several mechanisms that may maintain low abundance of rusty crayfish after the intensive trapping regime.

It is Bill Sloey's view that "Based upon what we are currently seeing in Plum Lake, it appears as though both Perch (P) and Northern Pike (NP), and, likely, Smallmouth Bass (SMB), Rock Bass (RB) and Sunfishes, are aggressively feeding on young RCs. This is probably because their traditional food supplies have been greatly diminished by the removal of the littoral vegetation by the RCs and the associated macroinvertebrates and forage fishes." Sloey believes that there is still an unanswered question involving long-term recovery, to wit: "If these predators shift back away from the crayfish once the vegetation recovers, will they resort back to intense RC feeding if the RCs come back? Continued studies in Sparkling Lake may give us a clue in the next few years."

As noted above, the history of initial rusty crayfish invasions on Plum and Star Lake tells us that these healthy lakes were still not able to resist rusty crayfish invasion followed by classic booming population growths. Notwithstanding the cited maintenance mechanisms, a persuasive argument could be made that it is most likely that long-term control in Plum and Star Lakes would involve a continuation (although perhaps only on a periodic basis) of large-scale intensive trapping, a continuation of fishing restrictions, and more. It all depends on the predation capacity of the lake system.

Perhaps the situation was best summarized by Jake Vander Zanden of the UW-Center for Limnology, who said: "that when the crayfish invaded these lakes, Lepomis and bass were being harvested – thus, they were likely well below densities that you will see if you were to control bass/leporomis harvest and let them 'recover'. So, this will certainly work in your/our favor. Still, we can model the system all we want, but we won't know what the system does when we stop trapping until we try in on Sparkling. And how this translates to the very different lakes Plum and Star is unknown" [7].

IS THE SPARKLING LAKE EXPERIMENT UPWARD SCALABLE? – Sparkling Lake is relatively small-scale (2.3-mile perimeter) and simple compared to lakes having much greater littoral-zone lengths such as Plum (14.5-mile perimeter or 6.3xSparkling) and Star (11.7-mile perimeter or 5xSparkling), as well as having different morphologies, and vastly more complex structures. Consequently, the generality of the conclusion as well as the feasibility of the approach needs to be carefully scrutinized when consideration is given to these and other lake systems [8].

If we assume for the sake of argument that the Sparkling Lake study is an accurate predictor of the possibility of similar success on Plum, Star, and other larger lakes, would other factors preclude feasibility? Among these factors would be the size differentials (5-6 times the # of traps to be set, baited, and managed during the trapping season and beyond, and crayfish to be counted and disposed of) as well as regulatory hurdles (increase in size and decrease in bag limits of SMB with potential for negative impact on

WE fishery and visa versa, as well as fishing restrictions for other predatory species) and the likelihood of "lost" seed banks and other macrophyte regenerative mechanisms [9].

The practical day-to-day problems associated with large-scale intensive trapping on larger, more populated lakes loom large. In addition to the legal/insurance implications re: the navigational hazards posed by the traps and floats, operating costs associated with the traps, boats and motors, off-season storage of traps, disposal of trapped RCs must be considered. Intensive trapping on these larger lakes would require close to 2000 traps rather than the 200 or so traps used on Sparkling Lake. Also to be considered is the difficulty of finding people to perform the daily duties over a long period of time – perhaps five years or more. All things considered, rehabilitating a large, RC infested lake system to near its pre-invasion tropic status would be no easy task.

UNDERC's Brett Peters will be working to develop ballpark estimates of the funds needed to conduct a large-scale removal and scientific analysis on the Star-Plum Lake System.

INCREASING PREDATION CAPACITY – All of the above calls attention to the potential long-term benefits of enhancing predation capacity. That is to say in the event resource limitations dictate less intensive trapping, a commensurate increase in predation capacity would be required. This increased predation capacity can be implemented via fishing regulations [10], relocation of RC predators (SMB, NP, P, and Lepomis) from nearby water bodies along with intensive transition-phase habitat enhancement (shoreline tree falls, brush piling, and artificial plants) – would then work to drive the RC population to much less harmful levels than exist today.

Put another way, ecological balance can be restored over time if the predators can significantly reduce the RC population to the point where natural fishery habitat in the form rooted aquatic plants are capable of being reestablished, and most importantly, to the point where the likelihood of a blowback in the form of exponential growth of the RC population triggered by residual colonizers is remote at best.

We know that "catch and release" fisheries do lead to more abundant, larger SMB. However, absent intensive stocking of SMB fingerlings to compensate for the high mortality of YOY from predation by dominant WE fisheries, the odds are that it will be difficult at best to evolve significant predation by SMB on Star Lake even with the SMB regulation change (operative in 2008) of the 18-inch-minimum size limit, 1-fish bag limit proposed by Steve Gilbert, WDNR Fishery Biologist – Vilas County. This change was made effective at Plum Lake in 1996 – resulting in an enhanced SMB population according to Gilbert.

The emergence of the Black Bass Virus in southern Wisconsin has made the WDNR extremely reluctant to stock either LMB or SMB from hatcheries [11]. Relocation of a portion of the SMB fishery from area water bodies such as Palette or Nebish Lakes would certainly be a step in the right direction. If this is not possible, heavy stocking of Perch and a diverse array of other predatory fish, coupled with recovered macrophyte

beds (due to intensive trapping) could provide an alternative long-term predation control mechanism [12].

The aim of the control would be to restore the littoral ecozone with a view toward avoiding massive comebacks instigated by residual populations of rusty crayfish that would most assuredly be much larger in density and spatial distribution than the initial colonizers. It is assumed that the predators will, for the most part, continue to feed on the young RCs even when their traditional foods return. If not, there could be difficulty in dealing with potential compensatory RC reproduction triggered by the population knock down [13]. Since the residual RC population would be much larger than that of the original colonizers that did not succumb to predation, the post-trapping predator capacity will likely need to be much greater than it was before the RC invasion [14].

CONCLUDING REMARKS – Fish predation and trapping to control RC populations will most likely be a lake-dependent, iterative process. For example, Plum Lake appears to be recovering a bit due in part to the 1996 SMB fishing regulation change, but it is still linked to RC-rich Star Lake via Star Creek. Therefore, Plum Lake may still require a modest increase in predation and trapping to help accelerate recovery and maintain equilibrium. However, the larger the trapping effort that can be mobilized, the sooner the recovery. Here caution must be exercised lest the use of (currently unregulated) commercial trappers could lead to the introduction of additional plant and animal exotics via trapping gear contaminated by other infested lakes.

On the other hand, Star Lake shows no signs of recovery, as it appears to be at or near its RC carrying capacity [15]. A SMB regulation change (operative in 2008) and very low intensity private and commercial trapping are the only mitigating forces at this time. It would seem that Star Lake would benefit from as much trapping as can be mobilized as well as by the array of predation-capacity-enhancing mechanisms outlined above. This, in turn, would require a radical paradigm shift for this high-density RC infested lake as well as for other lakes of its kind – short-term fishery management for predation as opposed to angling. It may well be that short-term restrictions on harvesting of all panfish (as defined in the WDNR Fishing Regulations) and SMB will be required to enhance the predation on RCs.

Finally, the role of Little Star Lake is unmeasured and unknown at this time.

Bottom line, restoring the Star-Plum Lake System to its near its pre-invasion tropic status poses a daunting challenge – requiring substantial human, financial resources, and time, as well as the close cooperation of the WDNR and other government bodies, local businesses, riparian and other lake users.

Frank G. Splitt
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This March 2007, posting reflects reformatted NOTES and APPENDICES. In the latter, permission to use the Vilas County News Review articles is indicated while access to Susanne Rust's Milwaukee Journal Sentinel article via the given hyperlink is permitted.

NOTES:

1. Participants in these meetings included: Brett Peters, UNDERC; Steve Gilbert, WDNR; Tim Kratz UW-TLS; Jake Vander Zanden, UW-Madison Limnology Center; Ted Ritter, Vilas County AIS Partnership, Jim and Vicki Haberle, Gerry Kurth, Bill Sloey, Frank Splitt, and Chris Wise, TPL Lakes Committee.
2. Catherine Hein et al, "Fish Predation and Trapping for rusty crayfish (*orconectes rusticus*) control: a whole lake experiment," Published on the NRC Research Press Web site at <http://cjas.nrc.ca>, Jan. 14, 2006.
3. _____, "Intensive trapping causes population decline of an invasive crayfish," *Freshwater Biology*, Draft copy for review, June 2006.
- 4.
5. "The rusty crayfish, a voracious, bullying exotic that has visited ecological havoc on numerous Wisconsin lakes, may have finally met its match. *Vilas County News-Review*, August 2, 2006, Appendix 1.
6. Susanne Rust, "Scientists claw back at invaders: Lake's rusty crayfish decimated by trapping, boosting fish numbers," *Milwaukee Journal-Sentinel*, <http://www.jsonline.com/story/index.aspx?id=480420>, Aug. 6, 2006, Appendix 2..
7. "Rusty crayfish being removed from Lake Ottawa," *Vilas County News-Review*, July 26, 2006, Appendix 3.
8. Personal communication via 7/26/06 e-mail Re: rusty reprints and more.
9. Some additional thoughts on "other lakes" via a personal communication from Bob Young, WDNR Fishery Biologist for Forest and Florence Counties, follow.

"It may be useful in your discussion of crayfish impacts to separate lakes into general lake types, i.e., deep clear rocky systems like Plum and Butternut, intermediate ones like Kentuck having more extensive littoral zones (and a more diverse fishery), and even more shallow, fertile systems with mostly littoral area. You may be better able to assess impacts and potential for control if analyzed in this way.

It seems to me the first type would be the most difficult in which to control crayfish numbers due to the abundance of rocky habitat for crayfish and the general lack of panfish numbers to help with predatory control. Not to mention the relatively low numbers of SMB some of the more infertile systems are capable of supporting.

An exercise to similarly classify all area lakes where rusty crayfish currently exist, along with some (trusted) knowledge of the historical crayfish and fish population dynamics, could be helpful in assessing chances in a control program."
10. According to UNDERC's Brett Peters, the seed banks in Plum and Star Lakes may not be "lost" at all as both lakes have areas with diverse macrophytes which have the capability of seeding areas now lacking macrophytes. Although there has been a loss of local seed banks within areas of the lakes that have lacked macrophytes for many years, the fact that there are still macrophytes thriving in some areas of both lakes gives hope for natural propagation in areas of the lakes which currently do not have macrophytes. Personal communication, August 30, 2006
11. Fishing regulation changes to protect and enhance RC predators are necessary even if a highly intensive trapping program is used. Brett Peters, personal communication, August 30, 2006.
12. Traci D. George, "Bass Virus: A Cause for Concern?"
<http://www.outdooralabama.com/fishing/freshwater/fish/bassblack/virus.cfm>.
13. Anecdotal evidence indicates that enhancement of Perch populations via intensive stocking would provide a substantial predation benefit. During the course of a mid July telephone interview with Gary

Kittleson, Plum Waters Resort, and a September 6 interview with Roger Soletske, past president of the Big Bearskin Lake Association, they expressed their conviction that Perch are voracious RC predators. Their conviction is based on personal experience with Plum and Big Bearskin Lakes respectively.

Of particular interest is the input from Soletske who began trapping RCs in 1981. His association did extensive stocking of SMB and Perch while lake residents continue to trap RCs with some measure of success. Soletske said he went from a take of 25 gal./day from 25 traps in the mid 1980s to today's take of 8-10 gal./day with 25 "better" traps. Also, aquatics now occupy an estimated 30% of the 400-acre lake compared to 7-10% before their restoration efforts. Soletske's remarks backed up Plum Lake Water's Gary Kittleson's observations re: Perch predation that was mentioned at our second meeting at UW-TLS. Subsequent to my conversation with Soletske, my attention was called to the existence of a March 2002 update of the Comprehensive Lake Management Plan for Plum Lake. The updated report contains the following "new ideas" on Rusty Crayfish Projects from Blue Water Science's Steve McComas:

"There are two crayfish projects the Plum Lake Riparian Association could consider. The first is to use fish to control the smaller crayfish. Yellow perch can be good crayfish predators. Catch and release tactics would be helpful. Signs and informational materials could be distributed to lake residents and at public landings to encourage catch and release fishing. The idea is to maximize the impact of fish predation on crayfish. The second project area is to set traps to remove crayfish.... It would take a substantial effort for several years to have a significant impact.

Big Bearskin Lake (Oneida Co.) has been harvesting crayfish for a number of years. They should be contacted for harvesting techniques and ideas [Roger Soletski (sic) is the president].

For Plum Lake, at least 200 traps should probably be set for 5 to 6 years. This may be a project area that Lake Association volunteers could participate in."

13. For a tutorial on this natural phenomenon, see Greg Laslo's article in the June 2006, issue of Dive Training, "A Natural Selection: How Evolution Works in the Marine World." (Reference courtesy of Nils Holmgren, holmgren@ezwebtech.com). The article centers on the 20+ years of research studies by UC-Riverside professor David Reznick on native guppies. "It seems that when guppies live in low-predatory environments, the fish, well, slow down. Conversely, in high predatory environments, they reach maturity faster, swim faster, have more, smaller babies, and live longer than their happy-go-lucky cousins. You could say that it's as if the fish have developed some sort of ability to survive in the more hostile environment."

Nils believes that "because crayfish in Star seem to be, on average, much larger in size than those in other lakes, the reference to work by David Conover struck a note. David Conover notes that depending on which size is allowed to survive in a population, it follows as to what the average size will be. While this may seem to be obvious, it is interesting that the average size then goes on to be self sustaining. In any case, I found the web sites, <http://www.msrb.sunysb.edu/pages/Lab/DOC/index.html>, and <http://www.seagrant.sunysb.edu/Pages/ConoverPR070502.htm> that will lead to the research he has done. The question I came up with was that if the larger crayfish or other predators prey on the smaller members, has the average crayfish size been altered to match the larger population that is left and to that end become self sustaining? I am going to call Mr. Conover and put this question to him."

14. It could very well be that there was a more robust form of initial colonization than just a few RCs introduced via cast off bait. Some local residents hold to the view that Star Lake was heavily seeded with RCs by those having commercial crabbing interests – with Plum Lake becoming infested by RC migration via Star Creek. This remains but one of several possible scenarios.

15. Comments by Nils Holmgren on the September 11, 2006 commentary distributed by Ted Ritter: "I have read the Rusty Crayfish report and found many of the comments interesting. As I read through the report a few things came to mind, largely tied to the extensive diving we have done in Star Lake and Kentuck, both lakes noted in the report. Please keep in mind that my comments regarding Star are anecdotal, I am not a biologist, and are limited in large to the area of Star that once was home to the sawmill that operated around the turn of the century. We do not spend much time in Star other than this bay. Therefore, our comments are heavily weighted to what we have observed in this bay. Other areas of Star may differ. We are familiar with all areas of Kentuck so those comments are valid for the entire lake. For what it is worth, our observations on Kentuck are the result of over a decade of observations

When in Star, we spend the majority of our dive time around the pilings, and copious supply of sunken timber that covers the bay near the Town of Star Lake. The bottom is covered with hundreds of very large

logs under which there reside thousands of crayfish. If the sun is out, the crayfish remain hidden, but on overcast days or toward evening things change, the crayfish emerge and the bottom is crawling with the crayfish.

There is no vegetation. By this I do not mean the vegetation is sparse, but that none exists. Years back I attributed this to the tannin left behind from the bark that covers much of the bottom, but now believe the crayfish are eating any organic matter they can find. The bottom is sandy with a light cover of coarse silt which seems to contain a large component of old pine bark.

There are many very large bass in the area. Based on our observations over 4 or 5 years, their number has increased. There are also many Rock Bass and Walleyes. In fact, Star is the only lake I dive where we can count on seeing schools of Walleyes. The schools contain a wide variety of sizes from the small cigars to those I would consider mounting.

The crayfish we observe in Star are large, in fact the largest of any lake I know. They are larger (my opinion) than those we were familiar with in Sparkling Lake. We see numerous crayfish skeletons, probably to be expected considering the large population. We see few if any small crayfish and have wondered if they remain hidden or are just on the wrong end of the food chain. Considering the bottom, it is difficult to envision what food is available to support the large robust crayfish population.

Living on Kentuck Lake, I am very familiar with the changes that have taken place. During the 80's, if one were to take a light down to our pier and observe the bottom at night, this bottom was crawling with crayfish. The crayfish were not as large as those in Star, but they were plentiful. As the bass population thrived, the crayfish population plummeted. By that I mean it is no longer possible to observe the bottom at night and see any crayfish. That said, there still are many Rusty Crayfish in Kentuck, but they are under the rocks and those that emerge can measure their life expectancy in milliseconds. Bass love the crayfish, especially the smaller ones, those that are maybe less than 2" long. Large crayfish are very aggressive and are fully capable of standing off a bass or other fish. All bass are not equal and there are some Rambos among them.

While not common, some bass will take on the larger crayfish and seem to have adopted a method of attacking them from the rear so as to avoid the claws. None seem interested in taking them head on. We can, and do observe this behavior regularly in the waters in front of our property. In fact we make a game of turning over rocks, exposing the crayfish for bass that wait for us to do so. You may have seen some pictures in the New Review of us doing this. (We are easy to entertain).

I tell you this because I do not believe anyone can expect the bass in Star to prey on the crayfish we observe. The crayfish in Star are just too large. We have watched bass observe and follow a crayfish, but never attack. Now, the bass may be going after the smaller crayfish, but again we have never observed this action. I question if this is happening or if it is, how effective the bass are at chopping off the smaller and I assume younger crayfish. As the report states the life of a crayfish is 5 years, if bass eating smaller crayfish was effective you would expect a decrease in the number of larger specimens. Maybe there are just more young (small) crayfish than even the bass can deal with.

I believe the bass in Kentuck are an important component to keeping the crayfish in check. I also believe the crayfish have adopted a method of staying alive in the presence of the predators that are more than happy to serve them up as a meal. When diving Kentuck it is rare to see a crayfish in the open; they are all under the rocks or other cover. The crayfish are obviously a preferred meal for the bass and occasionally other species. This is supported anecdotally by our observations which indicate that no matter how many crayfish we expose, the fish continue to eat. As you know, Kentuck is fished very heavy. It is not unusual to watch several boats fish the area in front of our property and have little to no luck. In spite of this, I can guarantee and demonstrate that following this we can start to turn rocks and numerous bass will come to feast on the crayfish.

I cannot tell you or speculate what impact other fish species have on the crayfish as we have limited contact with them. Bass being unique and very friendly are those we observe on a regular basis. I am confident the behavior I have discussed above is unique to the bass and one that is learned. For example, we dive Stormy Lake extensively. Stormy has few crayfish. When we catch crayfish to feed to bass on Stormy it takes them some time for the bass to connect the dots and realize the crayfish are good chow. After some repetition of the process, the bass learn and are in your face expecting more handouts. In contrast we can dive any shore of Kentuck where the bass demonstrate they are familiar with and prefer crayfish.

Another point is that even though there is more than enough vegetation in Kentuck, it seems the bass have not developed some other preferred food source. If small crayfish are available they will eat them. I

know this is a question that is raised in the report, so put this observation in the, 'for what it is worth column.'

As I recall, there was little or no impact on Kentuck due to trapping. The impact as I have stated seems to be tied to the increase in bass population. A friend of mine and I recently set traps in Star Lake. After the traps were set with fish as bait, it took no longer than 2 minutes for previously hidden crayfish to emerge and home in on the traps. Their sense of smell must be highly developed. The photo I sent you was of a crayfish from this venture. Even knowing the number of crayfish in this area I was impressed with the number that attacked the traps. Since we're diving we found the most efficient way to trap the crayfish was to grab them by hand and shove them into the traps. In my opinion, the traps are not that efficient. Because the bait lies on the bottom the crayfish attack that area and find the entrance primarily by accident. I think a better trap design would yield much better results. That design should entice the crayfish toward the openings.

As I stated, the previous comments are based on accumulated observations on our part. They may not be of much value, but I wanted to share them with you. I hope some of them may help us to battle this invasive species." – Nils Holmgren

APPENDICES: REFERENCE NEWSPAPER ARTICLES

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1. The rusty crayfish, a voracious, bullying exotic that has visited ecological havoc on numerous Wisconsin lakes, may have finally met its match.

Vilas County News-Review, August 2, 2006

Since its introduction to Wisconsin waters sometime in the 1950s, the aquatic invasive has spread to thousands of lakes and streams, clear-cutting the underwater forests that are critical fish habitat, evicting the native crayfish from one body of water after another and scooping up fish eggs like so much caviar.

But the clawed invader, the early results of a long-term UW-Madison study suggest, may be vulnerable to a "double whammy" of intensive trapping and predator fish manipulation to the point where it may actually be possible to rid lakes of an animal that has vexed scientists, anglers and conservation agencies alike for decades.

"They pretty much wipe out all of the rooted aquatic plants, they eat fish eggs, they either eat or compete with native invertebrates and, in general, raise havoc with the near-shore community of a lake," said Stephen Carpenter, a UW-Madison professor of limnology and zoology involved in the study on Sparkling Lake in Vilas County. Supported by the National Science Foundation (NSF), the long-term study of the feasibility of evicting the rusty from the 110-acre lake is now in its sixth year. It holds the promise of a rare victory in the war against introduced invasive species.

Since 2001, the UW-Madison researchers, aided by a small army of undergraduate students and the Wisconsin Department of Natural Resources (DNR), have succeeded in significantly reducing the population of rusty crayfish in Sparkling Lake through a program of intensive trapping and manipulating fishing regulations to favor the smallmouth and rock bass that dine on juvenile crayfish. The two-pronged attack, says Carpenter, has yielded very promising results. "It seems to be working. The aquatic plants are back. That's good because that's fish habitat, and the fish populations are returning to what they were before the rusty got into the lake sometime in the 1980s," said Carpenter.

The two-pronged approach to ridding Sparkling Lake of its rusty crayfish is the key, notes Jake Vander Zanden, a UW-Madison professor of limnology who is helping oversee the experiment.

"One important message is that trapping alone will not do it. There's a synergistic effect with the fish playing an important role," he said. Smallmouth bass and rock bass, says Vander Zanden, are the primary predators of juvenile crayfish, and to some degree bluegills and pumpkinseeds pitch in by eating the smallest crayfish.

The Wisconsin DNR, by manipulating the bag and size limits for anglers fishing Sparkling Lake, has helped establish an optimal population of the fish that routinely dine on the crayfish.

The trapping on Sparkling Lake, however, has been intensive during six years with 280 traps seeded around the lake. Baited with beef liver, the traps snare both native and rusty crayfish, but the natives, Carpenter explains, are returned to the lake. The trapping targets the largest crayfish, those that may be too big for the lake's predators.

The big hope, says Carpenter, is that the experiment will expose a “tipping point,” where the combination of trapping and pressure from predator fish pushes the rusty crayfish population to crash, with the lake ecosystem returning to its pre-rusty crayfish state.

“What we are wondering is whether we will reach a tipping point where the fish alone can keep up the pressure,” said Carpenter, an authority on such ecological change. “We haven’t seen it yet, but we’re not prepared to admit there isn’t a tipping point.”

Vander Zanden says the rusty crayfish infestation in Sparkling Lake, like most lakes where it is found, was probably sparked by a small pioneer group that somehow got into the lake.

At one time, rusty crayfish were used as bait. Misguided attempts years ago to establish the rusty in Wisconsin for commercial purposes also contributed to the spread of the exotic species to 50% of Wisconsin lakes and streams.

The practical upshot of the experiment and the real hope, say Vander Zanden and Carpenter, is that the experimental techniques used on Sparkling Lake can be transferred to other lakes with the help of the many lake associations in Wisconsin. The Wisconsin scientists have addressed lake associations and found a receptive audience.

“We have talked to lake associations,” said Carpenter. “If everyone was willing to run half a dozen traps off their dock, it could be very effective.”

And one of the best parts of the study, according to the Wisconsin scientists, is that the rusty crayfish is edible.

“The students up at our Trout Lake Research Station have been eating a lot of crayfish,” said Carpenter.

2. Scientists claw back at invaders

Milwaukee Journal Sentinel, Posted: Aug. 5, 2006

By Susanne Rust, rust@journalsentinel.com

Lake's rusty crayfish decimated by trapping, boosting fish numbers. For more go to URL <http://www.jsonline.com/story/index.aspx?id=480420>

3. Rusty crayfish being removed from Lake Ottawa

Vilas County News-Review, July 26, 2006

The Ottawa National Forest, in cooperation with the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources, has been working on a project to remove rusty crayfish from the waters of Lake Ottawa, located about five miles west of Iron River, Mich., in the Ottawa National Forest.

Rusty crayfish are a non-native aquatic invasive species that have caused damage to lakes across the Midwest and have been introduced into the waters of Michigan’s Upper Peninsula by anglers coming to the area and releasing live bait.

The native crayfish are unable to compete with the rusty crayfish, resulting in the loss of native crayfish, reducing diversity and stripping the lakes of much of its aquatic vegetation.

An investigation of the impact of the rusty crayfish on Lake Ottawa has shown that the aquatic vegetation of the lake has been reduced from 12 submersed and three floating-leaved species to four submersed and two floating-leaved species. The rusty crayfish have also destroyed all native crayfish in this lake.

In 2005, a decision was implemented to remove more than 10,000 rusty crayfish from the lake using trawling nets. This was only a fraction of the invaders and it was determined that this year, intensive trapping would be implemented using commercial crayfish traps in an effort to eliminate the remaining crayfish in the lake.

The 38 traps that have been set up will be checked about twice a week by Notre Dame researchers who have been working on the rusty crayfish issue with employees of the Ottawa for the past five years. The project, which began again July 6, will continue throughout the rest of the summer until all of the rusty crayfish have been destroyed. The project will continue to be monitored to evaluate its effectiveness.