Proposed Keeyask Hydro Facility: Final Report on Concerns Related to Mitigation Plans for Lake Sturgeon

A Report Prepared
by
Stephan Peake, PhD
for
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The following document outlines concerns I have regarding the environmental impact assessment and mitigation plans for the proposed Keeyask facility in northern Manitoba. Although I have reviewed all of the relevant material, my comments are focused on issues related specifically to lake sturgeon.

Issue #1: Expectation management and procedures associated with the use of hatchery-reared fish to bolster lake sturgeon populations in the Keeyask area

General Recommendations:

(1) the Proponents should not expect to attain the consistently high hatchery survival rates reported in southern hatcheries (e.g. Wild Rose Hatchery, Wisconsin USA) , but be prepared for high variability in these rates, as has occurred for many years in Manitoba facilities
(2) the Proponents should not expect to achieve the high survival rates for fingerling sturgeon stocked in the fall as reported for small, productive southern systems, and should instead focus the program on stocking smaller numbers of larger fish in the late spring, when conditions are becoming favourable (rather than difficult) for survival and growth

Specific Recommendations:

(1) the Proponents should consider a program whereby only the largest (perhaps 10%) of fingerlings are stocked in the fall and the rest are kept over the winter to grow out, with stocking of these yearling individuals to occur in late spring or early summer

In general, the overall plan associated with the hatchery rearing and stocking program, as outlined by the Proponents, appears to be reasonable. However, there appears to be a degree of over-confidence with respect to (1) the ability of a Manitoba-based hatchery to successfully rear large numbers of juvenile lake sturgeon in a consistent manner, and (2) in the likelihood that fall-stocked fingerling lake sturgeon will successfully integrate into the existing population. This apparent over-confidence appears to be based on (1) high survival reports made by hatcheries in the northern United States (e.g. the Wild Rose facility in Wisconsin), (2) the belief that technology and research will resolve problems encountered by Manitoba based hatcheries in the past, and (3) on stocking success stories reported by efforts carried out in relatively small productive rivers located outside of Canada. While information and advice from hatchery workers in places like Wisconsin are valuable and should be sought out, experience at several facilities in Manitoba has shown that (for unknown reasons) lake sturgeon rearing is a very difficult endeavour, and consistently high survival rates are a very elusive target. Specifically, and in contrast to those reported at the Wild Rose Hatchery, survival rates in Manitoba facilities (e.g. Whiteshell Fish Hatchery, Grand Rapids Hatchery), and research facilities operated by the University of New Brunswick and Manitoba, have been wildly erratic (ranging from 0 to approximately 60% at the former UNB facility) over the past decade. Furthermore, the exact reasons for this variability have not been determined. There have been good years in all facilities, but there have been at least as many poor ones, and there is no consensus as to why this has been the case and no reason to believe this pattern will change. As such, the Proponents need to bring their expectations of success in terms of consistently high hatchery survival rates into alignment with past experience, and plan for worse case scenarios where sufficient numbers of hatchery fish are only available sporadically.

Once reasonable numbers of hatchery lake sturgeon are available, the next question relates to when they should be stocked and what kind of survival rates should be expected. The Proponents suggest that survival rates of 20 to 40% for stocked fall fingerlings might be expected (Keeyask Lake Sturgeon Stocking Strategy – Appendix 1A Part 2). However, these rates are taken from data on southern stocking programs, where relatively large fish (due to a longer and warmer growing regime) are released into good habitat and productive water in the fall, and are almost certainly optimistic for the Keeyask Project. There is almost no solid data on over-winter survival rates of stocked lake sturgeon in Canada, and the little that exists suggests that these rates might be very low. For example, research aimed at determining survival rates of fall fingerlings stocked in the Winnipeg River from 2009-2011 (Klassen and Peake unpublished data) showed disturbing trends, such as a precipitous (close to 50% in some cases) drop in weight for hatchery fingerlings recaptured within a couple weeks of fall stocking (suggesting an inability to obtain food) and no spring recaptures whatsoever, despite considerable fall stocking (thousands of individuals) and spring fishing effort. While certainly not conclusive, these data suggest that (1) there may not be enough food in northern systems in the fall to support large numbers of hatchery fish and/or (2) the fingerlings may not be able to transition to a wild existence when stocked into conditions of declining productivity. In any case, the Winnipeg River data point to a survival rate much closer to zero than 40%. If the real over-winter survival rate for fall stocked fingerlings is close to zero, this will have dramatic impacts on the proposed stocking strategy. Clearly, there is a desperate need to quantify over-winter survival in fingerling fish stocked in large Canadian rivers in the fall; however, given the results from Winnipeg River studies, and the fact that there is no conclusive data on survival from fish stocked anywhere in Canada, it seems clear that great caution should be used in using survival data from southern fall stocking programs to plan the current one in Manitoba, and that plans and expectations should be managed accordingly.

It should also be noted that Winnipeg River studies, in addition to showing disturbing trends for fall stocked fingerling sturgeon, demonstrated that large, yearling fish stocked in the spring could be recaptured in considerable numbers throughout their first summer in the wild, and that these individuals demonstrated growth rates comparable to those of wild fish. As such, it is suggested that the stocking program at Keeyask release only the largest fingerlings in the fall (perhaps the largest 10% of those available) and keep the rest of the cohort in the hatchery over the winter and stock them in the spring. While it may be argued that keeping fish in the hatchery longer increases their risk of mortality due to disease, it is also clear that larger fish are much more likely to survive, meaning that a small number of yearlings stocked in the spring will potentially have an equivalent (or better) impact as a large number of fingerlings stocked in the fall, especially if survival rates in the latter are low.

Issue #2: Techniques used to mark stocked fish in the Keeyask area

General Recommendations:

(1) the Proponents should plan to **uniquely** mark ALL stocked sturgeon prior to release
(2) all marks should be permanent and their identification should not be subjective
(3) identifying marks should not overly stress, injure, maim or kill the fish
(4) the subsequent monitoring program should evaluate survival, year class strength, and growth in marked hatchery as well as unmarked wild individuals

Specific Recommendations:

(1) yolk sac fry should **never** be stocked into the Keeyask area but should be released in other appropriate areas of the Province when/if they are available
(2) only passive integrated transponders (PIT tags) should be used to mark fish
(3) fingerlings large enough to carry 8 mm PIT tags should be stocked in the fall
(4) smaller fish should be retained in the hatchery, grown out over the winter, tagged with PIT tags and released in the spring

In the plan for bolstering lake sturgeon populations in the Keeyask area by stocking domestic fish, the Proponents have rightly acknowledged that all hatchery fish stocked must be marked for later identification. However, all of the marking techniques discussed in the Keeyask Lake Sturgeon Stocking Strategy (with the exception of passive integrated transponders) represent strategies that cannot reliably and non-invasively provide the important long-term detailed information and critical population parameters (such as hatchery versus wild origins, age/size at the time of stocking, and growth/survival between subsequent recapture events) needed to evaluate and manage the stocking program. These data will provide the best information on the success of the stocking program as well as important ecological data on the domestic and wild fish (and therefore any impacts of one on the other), and must be collected accordingly. Early studies conducted on the Winnipeg River (Cam Barth, University of Manitoba PhD thesis) showed very large numbers of wild juveniles occupying specific nursery areas, which on first glance suggested a normal and healthy population; however, growth data later generated from recapture of uniquely marked fish showed that growth rates were extremely low, indicating over-crowding and habitat was well beyond its carrying capacity. The latter (and more telling and relevant) finding would not have been attainable had fish not been uniquely marked. It is suggested that aspects such as growth rates of sturgeon and carrying capacity of the habitat are extremely important at Keeyask to evaluate the stocking and habitat remediation programs, and should be implemented.

With respect to the effectiveness of various marking techniques, removal of tissue (e.g. scute and/or fin) as described in the Keeyask Lake Sturgeon Stocking Strategy document, was attempted in a stocking program conducted on the Winnipeg River with little success (Klassen and Peake unpublished data). Tissue grows back making identification subjective. More importantly, individual fish cannot be identified using this technique, meaning that important recapture data (e.g. individual growth and survival) cannot be obtained. In addition, maiming fish prior to release invites infection, and may meet with disapproval from First Nations (and others). As such, this technique cannot seriously be considered as a viable way of marking stocked fish in Manitoba. Coded wire tags should also be considered inappropriate because captured fish must be killed to retrieve the tags. Lethal sampling for the sole purpose of evaluating the stocking program should not be considered by the Proponents as it leads to small sample sizes, issues with permits (especially if the species is Sara listed), issues with the public (why are perfectly healthy sturgeon being captured and killed?), the ever present threat of killing wild fish, and an inability to establish growth rates from recaptured individuals.

Visible Elastomer Implants are also not appropriate because they are not unique to specific individuals, and they only last a couple years in sturgeon, after which a hatchery fish, in effect, becomes indistinguishable from an unmarked wild one, making it impossible to generate accurate critical population parameters in older animals, or with respect to the population as a whole. Finally, the proposed use of stable isotopes to mark juvenile lake sturgeon must be considered experimental and not a long term marking technique. Again, such marks only identify a cohort (i.e. individual fish within the cohort cannot be identified) meaning that growth data could not be collected from recaptured fish. In addition, there are no data to show how long such a mark would last, a study looking at this would require a great deal of time, and sampling for this mark would require a very invasive procedure (removing the first fin ray that provides primary support to the pectoral fin) that would never be allowed in a university setting (due to animal care regulations), might raise objections from the First Nations community, and would likely become a problem if the species was listed.

This leaves passive integrated transponders (PIT tags) as the best option for marking stocked fish in the Keeyask area. PIT tags have been used for years to assess the Pacific salmon stocking program. The tags are relatively inexpensive and last indefinitely. More importantly, PIT tags uniquely identify individual fish which allows for the collection of detailed ecological data crucial to population management. Implantation of PIT tags does require a minor surgical procedure; however, this can be done over time in batches within the hatchery, and tagged fish could be held to ensure recovery prior to release. Identifying subsequently captured fish is simply a matter of waving a detector over the animal. Tagged fish will release a unique code that will identify them as hatchery stocked, and the code can be cross referenced with data recorded at the time of release. Fish that do not release a code can reliably be considered wild. The primary drawback of PIT tags is that fish need to be relatively large (approximately 15 cm); however, the use of larger fish in the stocking program has already been argued as the best strategy for maximizing survival and therefore fits well with previous recommendations. It is finally suggested that fish too small to carry an 8-mm PIT tag should not be released into the study area as they would (at some point) become indistinguishable from wild sturgeon. This would make it impossible to accurately monitor changes (positive or negative) that might occur in the natural population due to habitat alteration or improvement, or evaluate the impact stocking might have on wild fish (a stated objective in the mitigation strategy).

Issue #3: Young of the year (YOY) and juvenile habitat

General Recommendations:

(1) the Proponents should lower their expectations with respect to (a) the feasibility of creating stable young of the year and juvenile lake sturgeon habitat, (b) the probability that such habitat will be invaded by the right biota for YOY and juvenile lake sturgeon, and (c) that stocked fish will be able to find and use the engineered habitat

It has been established that the goal of re-establishing a self-sustaining population in the Keeyask Project area will require a successful stocking program AND (i.e. concurrently) a successful habitat remediation program. Habitat for sub-adult and adult lake sturgeon (which are generalists) does not appear to be limiting in the Project area. Furthermore, creation of spawning habitat (as proposed by the Proponents) is a safe strategy as it has been attempted by others with some success in the past. In addition, the fact that this "artificial" spawning habitat consists of large rocky debris means that longevity in the face of highly variable flow conditions can be expected. Finally, there is no biological component to the spawning habitat. It simply must meet the criteria required for egg distribution and survival (requiring only an attachment site and oxygenated water). In contrast, YOY and juvenile sturgeon habitat must consist of coarse sediment (sand), must be relatively free of fine sediments (mud or clay), and must contain an invertebrate community capable of supporting the population (Henderson 2013; Barth et al. 2009). As such, this habitat is exponentially more complex, fragile, and difficult to create and maintain. The Proponents have indicated a willingness to create YOY and juvenile habitat to compensate for disturbed areas and to help support the expected larger population once hatchery fish are introduced, and have suggested that this habitat can be created with low to moderate certainty. However, since (1) this type of habitat remediation has never been attempted before, (2) there are almost certainly significant engineering challenges associated with placing sand, and keeping it in place in a constantly changing hydraulic environment, (3) there is no guarantee that the appropriate biota will invade the new habitat or any indication of how long this might take, and (4) there is no guarantee that YOY fish and juveniles will find and use the new habitat, it seems much more likely that the probability of overall success with respect to juvenile proliferation in engineered habitat is low to very low. This is particularly troubling given that the cornerstone of the mitigation strategy is the infusion of YOY fish through stocking. Furthermore, given that the success of the mitigation program depends on the amount and suitability of YOY and juvenile habitat, and given that the uncertainty associated with the idea of creating it, and given the previous arguments that consistently rearing large numbers of fish in the first place will be a significant challenge, it seems that the Proponents prediction of moderate to high probability of an increased lake sturgeon population is very optimistic.

Issue #4: Downstream Passage for Lake Sturgeon

General Recommendations:

(2) there should be a general monitoring program (not a small sample tagging program) to assess the frequency of lake sturgeon interactions with the facility, as well as impingement and entrainment events, so that the true impact of the facility on upstream populations is known

The current strategy for passing lake sturgeon downstream is through the turbines and/or over the spillways. This cannot be considered mitigation to provide safe downstream passage. Based on very few studies with very low numbers of tagged fish at Keeyask, it is proposed (by the Proponents) that adult lake sturgeon will rarely encounter the upstream side of the Keeyask facility, and that those fish that are entrained are expected survive at a rate as high as 90% (9 out of 10 in a very small study). Given the importance of adult sturgeon to the population, it is felt that small sampling studies using telemetry with a very limited ability to resolve movement (on the order of hundreds of meters) are not adequate indicators of the vulnerability of the population to entrainment related injury or mortality. Research has indicated that adult lake sturgeon can be expected to become entrained at Keeyask (McDougal et al. 2013) and that fish will be injured and killed. As populations (hopefully) increase with the hatchery program, interactions with the dam can be expected to increase as well. The Proponents strategy appears to be to facilitate passage (via large spacing in the trash racks) but minimize the probability of injury or death by using an updated turbine design and hope for the best. It is suggested that lake sturgeon would be better protected if (1) the water intakes and associated screens were actively monitored (perhaps using sonar, underwater cameras, or other sensory devices) so that the real impacts could be assessed quantitatively on all (i.e. not just a small sub-sample) lake sturgeon, or (2) large individuals are prevented from entering turbines and spillways (by reducing trash rack bar spacing and/or angling the trash racks with respect to the incoming flow), without increasing risks associated with impingement (i.e. keeping water velocities at the racks well within the swimming capacity of the fish).

Sources

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McDougall, C. A., et al. "Movement Patterns and Size-Class Influence Entrainment Susceptibility of Lake Sturgeon in a Small Hydroelectric Reservoir." *Transactions of the American Fisheries Society* 142.6 (2013): 1508-1521.

Peake (and others), unpublished data 2000-2012

Environmental Impact Documents Primarily (but not exclusively) Used in Evaluating the Program

EIS Supporting Volumes – Aquatic Environment
Response to EIS Guidelines Chapters 2, 6, 8
Responses to Requests for Information – all rounds