TO: Biology Committee and Management Committee Members

FROM: Patrick Martinez (Nonnative Fish Coordinator, CRRP) and Harry Crockett (Native Aquatic Species Coordinator, CDOW)

DATE: February 10, 2011

RE: Nonnative Fish Translocation in Yampa and Colorado rivers and mark-recapture population estimation of northern pike in the Yampa River buffer zone between Hayden and Craig

The attached White Paper provides information, data and perspectives on several points regarding the management of nonnative fish arising from discussions at the Nonnative Fish Control Workshop (12/7-8/2010) and the Biology Committee (BC) Meeting (12/13-14/2010). These points included recommendations to discontinue: 1) translocation of smallmouth bass (SMB) into Elkhead Reservoir; 2) translocation of northern pike (NOP) into Kyle's Pond; 3) Mark-Recapture population estimates of NOP in the Yampa River (YAR) buffer zone between Hayden and Craig; and 4) translocation of largemouth bass greater than 10" from the Colorado River into Highline Lake. During the subsequent BC Conference Call (01/24/2011), the majority of the BC supported these recommendations. Based on preliminary internal discussions, the Colorado Division of Wildlife (CDOW) could not support the BC's recommendations and indicated that they would likely pursue "status quo", i.e. a continuation of 2010 sampling protocols in 2011. The Water User's representative abstained.

The State of Colorado followed up with additional internal discussions, including a 1/27/2011 meeting of the CDOW Director and staff, and other conversations with the Colorado Department of Natural Resources' Management Committee representative [collectively '*Colorado*']. Without evaluating or endorsing the White Paper on a point-by-point basis, *Colorado* agreed to support three of the four BC recommendations - the exception being the translocation of NOP captured in the YAR to Kyle's Pond. On 01/28/2011, *Colorado* met with USFWS and Recovery Program personnel to convey and discuss these decisions. USFWS and the Recovery Program appreciated *Colorado's* reconsideration of three of the four BC recommendations, and understood Colorado's decision on the Kyle's Pond translocation. Colorado qualified their current position by recognizing the importance of the ongoing, explicit modeling of SMB data in future decision making. *Colorado* promoted a similar synthesis of the NOP data, which all in attendance agreed could prove equally useful.

Additionally, the Recovery Program supported *Colorado's* recommendation that the costs of translocation for northern pike captured in the YAR during nonnative fish control efforts under Projects 98a, 98b and 125 would continue to be borne by the Recovery Program. The implications of requiring northern pike translocation under Project 125 during an extension of sampling in July when nonnative fish removal would be performed from rafts were also discussed. The CDOW indicated that given the logistics of access, equipment limitations, and unfavorable thermal conditions for sustaining fish alive, that it would relax the requirement for translocation of northern pike during this period within the Scientific Collecting Permit for this particular project.

White Paper Requested at 12/14/2010 Biology Committee Meeting and, Discussed During 01/24/2011 Biology Committee Conference Call

Prepared by: Patrick Martinez (Nonnative Fish Coordinator),
Melissa Trammell (Chair, Biology Committee)

At the Nonnative Fish (NNF) Workshop held December 6-7 2010, several topics were discussed regarding the disposition of NNF captured or removed from the Yampa (YAR) and Colorado (COR) rivers. These included: 1) discontinue translocation of smallmouth bass (SMB) into Elkhead Reservoir (EHR); 2) discontinue translocation of northern pike (NOP) into Kyle's Pond; 3) discontinue Mark-Recapture population estimates of NOP in the YAR buffer zone between Hayden and Craig; and 4) discontinue translocation of largemouth bass (LMB) greater than 10" from the COR into Highline Lake. These recommendations were discussed and approved at the Biology Committee (BC) meeting on Dec 13-14, 2010, and again during a conference call on January 24, 2011. The BC recognized that these recommendations represented a significant shift from previous Recovery Program NNF management positions, but the available information supported them. Therefore, the BC requested that the NNF coordinator and the NNF Subcommittee develop a white paper addressing these recommendations to inform a Management Committee decision at their Feb 16, 2011 meeting.

A majority of the BC recommended considering the following actions (see attachment 4, draft meeting summary, December 13-14, 2010 and agenda item 3, draft web conference summary, January 24, 2011 for details):

I. Cease translocation of SMB into EHR.
II. Cease translocation of NOP into any waters including the Kyle's Pond (State Park Headquarter's Pond).
III. Reallocate translocation efforts and funds to additional NNF removal.
IV. Cease release of marked NOP in YAR buffer zone.

Supporting documentation is provided for each of these recommendations including program policy and biological data. Additional details (some of which are repeated below) from supporting documentation, perspectives and data, and references cited are provided in Attachment 1.

I. Cease Translocation of Smallmouth Bass into Elkhead Reservoir

Recommendation: *The Program should act in a precautionary way and cease translocation of SMB into EHR in 2011, even if a final decision on escapement criteria has not been made before the 2011 sampling season.*

SMB abundance in the middle YAR increased abruptly in 2001 (Anderson 2002); they have since become the dominant predator in the middle Yampa River and their rise in abundance was concurrent with the decline of native fish in the Yampa River (Johnson et al 2008; Hawkins et al. 2009). As early as 2004, the Recovery Program (Roehm 2004) and the U. S. Fish and Wildlife Service (USFWS) (USFWS 2005) have been concerned about escapement of SMB from EHR and recognized the need to define a threshold criteria for excessive escapement. If escapement was determined to be excessive, the USFWS directed the Recovery Program to take action (e.g. screen the spillway and/or curtail

stocking into EHR) to reduce it. Most recently, over concern of reports of EHR escapees, the USFWS in their 2010 Sufficient Progress memo, required the Recovery Program to determine (prior to the 2011 sampling season) if translocation of SMB in EHR should continue (USFWS 2010).

The following are excerpts from key Program documents highlighting the aforementioned concerns:

1) **Yampa Management Plan (Roehm 2004)**
   Page 93; "Laiho (2001) concluded that some form of fish separation will be needed at Elkhead Reservoir to reduce or curtail further escapement to the river. Without such measures, future escapement of nonnative fishes from Elkhead Reservoir is likely to confound ongoing efforts to control their populations in the Yampa River."

   Page 98; "However, nonnative fish escapement over the new spillway will be monitored, and if the Recovery Program determines that escapement of problematic species is at levels that thwart recovery efforts, a net barrier or other fish exclusion device would be installed on the spillway."

2) **Nonnative Fish Management Policy (UCRRIP 2004)**
   Page 1; "Nonnative fish management is one of many management actions necessary to achieve and maintain recovery of the endangered fishes, and failure to adequately manage nonnative fishes may nullify the positive effects of other Recovery Program actions..."

3) **Yampa River Programmatic Biological Opinion (USFWS 2005)**
   Page 14; "The Recovery Program will continue to monitor the escapement of fish from the spillway. The Biology Committee will develop criteria for an escapement threshold that would trigger a decision to screen the spillway and/or curtail stocking into Elkhead Reservoir."

4) **Implementation Committee Directive (IC 2006)**
   Page 2; "The Implementation committee agrees that the approach to nonnative control on the Yampa and elsewhere should be highly proactive and similar to capital projects, i.e., substantial and expensive action is taken based on hypotheses that native fish will benefit from these projects and then the projects are adjusted if the benefits are not realized."

5) **Yampa River Nonnative Fish Control Strategy (Valdez et al. 2008)**
   Page 5; "Monitor escapement of tagged, translocated bass from Elkhead Reservoir using recaptures from control sampling in northern pike buffer and critical habitat reaches; define thresholds for action."

6) **Nonnative Fish Stocking Procedures (USFWS et al. 2009)**
   Page 7; "If problems occur, such as escapement into critical habitat or evidence of an illicit introduction, then the [Lake] management plan will be revisited by the Service and the States."

7) **Yampa River Basin Aquatic Wildlife Management Plan (CDOW 2010)**
   Page 17; "Escapement of nonnative fish from waters in the Yampa River basin that compromises our ability to recover endangered fish will cause our management plans to be re-evaluated and possibly revised to minimize escapement as an impediment to recovery."

8) **2010 Sufficient Progress Memo (USFWS 2010)**

Page 13; "ACTION ITEM (7): Based on their analysis of smallmouth bass recapture information, CDOW and the Recovery Program must decide, prior to the 2011 sampling season, if Elkhead Reservoir can continue to serve as a translocation site for smallmouth bass removed from the Yampa River."

Ongoing Recovery Program studies on abundance, distribution, removal, and translocation of SMB have documented and continue to demonstrate escapement of SMB from EHR, of both resident and translocated fish.

- Of the over 5,628 SMB translocated into EHR since 2003 (J. Hawkins, unpublished data), approximately 5% have been recaptured in the YAR; thus are known to have escaped.

- This percentage is the minimum estimate of escapees, because it does not account for an unknown number of tags lost or removed by anglers, and does not account for the number of tagged escapees not recaptured, particularly since tagged fish have a lower probability of being recaptured (Breton, unpublished data). It does not account for the number of resident fish that escape; 50% of SMB ≥ 250 mm sampled in the reservoir in 2010 were tagged fish translocated from the YAR (B. Wright, unpublished data).

- If the factors of tag loss, and capture probability are calculated, then tagged EHR escapees may be as high as 15%, thus negating 15% of the program's expensive effort to remove SMB from the YAR. An additional multiplier should be then applied to account for untagged escapees, bringing the total number of escapees even higher. This theoretical escapement rate could increase if biases identified in the Breton analysis are factored in.

- Tagged SMB that escaped EHR following translocation have been recaptured at various locations in the YAR as far as 100 miles downstream of the mouth of Elkhead Creek (J. Hawkins, unpublished data).

- EHR, post-enlargement, spills more frequently and for longer durations than originally projected (R. Tenney, unpublished data), likely contributing to the chronic escapement of SMB and possibly other unmonitored species.

Additional perspectives include:

- Arbitrarily setting a percentage of the number of translocated SMB escaping EHR as a threshold to continue or discontinue translocation ignores tag loss, tags removed by anglers or the escapement of un-tagged resident SMB, all of which would contribute to an underestimate of SMB escapement (A. Breton, unpublished data).

- Translocation of SMB into EHR in spite of escapement violates prevention principles of invasive ecology, fails to address a known point source of a problematic species, and ignores the detrimental ecological transformation of the native fish food web inflicted by SMB in the YAR.

- Examination of propagule size suggests that a SMB density as low as one adult fish/four acres may be sufficient to establish a potentially invasive population. Concentration of escaping SMB in preferred riverine habitat, such as in Little Yampa Canyon, likely increases the probability of

successful spawning and population proliferation at a density as low as six adult fish/mile (P. Martinez, unpublished data).

- Using information described above as an example, if 15% of 5,600 adult SMB, or 840 individuals, translocated into EHR escape back into the river below the confluence with Elkhead Creek at rivermile 148, this would represent 5.7 adult SMB/mile in the YAR. Since this example does not include escapement of untagged SMB from EHR, it is likely that escapees could constitute a sufficient propagule size to re-establish SMB in the YAR, particularly if the escapees concentrated in the best habitats for spawning and recruitment during favorable flow and thermal conditions.

- It is acknowledged in the example above that a number of the escapee SMB from EHR to date were the result of unscreened releases during the reservoir's enlargement in 2006 (109; J. Hawkins, unpublished data). However, these escapement data show that SMB stocked in a given year continued to escape in subsequent years, contributing to a cumulative propagule of this long-lived species in the YAR. These data also provide insight into large escapement events that could occur due to high discharge, prolonged runoff, a higher density of SMB in EHR resulting from continued translocation or recruitment, or a combination of these events.

- Stocking SMB into a partially unscreened reservoir violates the principles of the NNF Stocking Procedures (USFWS 1996, 2009), thus setting an inconsistent precedent and a poor example for private and commercial permitees.

- The presence of mercury (Hg) in SMB from EHR has prompted Colorado to issue a consumption advisory (Salley and Hampton 2009).

- Translocating pre-spawn, adult SMB from riverine to a connected reservoir environment could provide this nonnative predator a reproductive advantage, particularly during average to wet hydrologies when their recruitment would be compromised in the river, thereby exacerbating and perpetuating their invasive impact in the Yampa River basin.

Conclusions:

- Resident, recruiting, immigrating and escapee SMB contribute to sustaining SMB in the middle YAR (P. Martinez, unpublished data) and to their movement and expansion into other reaches of the YAR and other rivers, adding to the complexity, difficulty and expense of reducing their abundance and negative effects to the native aquatic community and jeopardizing prospects for endangered fish recovery.

- Prevention of the addition of SMB to the YAR from point sources such as EHR is necessary to expedite the ecological effectiveness and economic efficiency of reducing the abundance, invasive impact and re-expansion potential of SMB as removal efforts strive to achieve and sustain population depletion targets for SMB.

- SMB escapement from EHR is chronic with no known practical, effective or affordable solution available at this time. Continuing to translocate SMB given their escapement undermines the

public trust and fiscal responsibility of native fish restoration given the documented invasive impacts of SMB in the YAR.

- The Recovery Program is advised to halt translocation of SMB from the YAR to EHR as it awaits the analyses of SMB escapement from EHR by A. Breton at al. Based on available data, ceasing translocation follows a precautionary strategy of preventing further entrenchment of SMB in EHR or the YAR as a result of translocation or escapement.

II. Cease Translocation of NOP into any waters including the Kyle's Pond (State Park Headquarter's Pond)

Recommendation: *The Program should no longer translocate NOP into any waters and reallocate project savings to additional removal.*

Kyle's Pond represents the best known translocation site for northern pike because: a) there is no hydrologic connection to the mainstem Yampa River; b) it is a popular fishery that can be readily monitored by State of Colorado personnel; and c) it is relatively close to the removal efforts. The Program has documented one incidence of a northern pike translocated to Kyle's Pond and returned to the river. This single recapture likely represents some larger number of returned fish (see discussion above); although at this time, repatriation of NOP from Kyle's Pond is not considered to be very problematic by the BC. Therefore this recommendation (reiterated in Recommendation III) stems largely from the Program cost savings that could be directed toward additional northern pike removal effort if translocation of northern pike were to cease completely.

The following are excerpts from key Program documents highlighting the aforementioned concerns:

- "Use northern pike and smallmouth bass obtained through Recovery Program funded removal and translocate to off-channel ponds in the middle Yampa River reach and Elkhead Reservoir (smallmouth bass only) in accordance with Nonnative Fish Stocking Procedure, and avoid stocking northern pike in such ponds that have potential for connectivity with the river. (CDOW 2010, pg. 90).

Additional perspectives include:

- Translocation is no longer approved for Loudy-Simpson pond because escapement and reproduction have been documented (CDOW, Sherman Hebein, Pers. Comm.), thus if NOP were translocated they would go to Kyle's Pond.

- Translocation adds extra cost to each project, particularly for NOP removed from the middle YAR due to travel distance. If fish are lethally disposed of on site, savings can be reallocated to additional removal.

- Project 98b estimated annual translocation costs for NOP captured in the YAR buffer zone to be about $17,350, or nearly 10% of the project's annual budget. This amount represents the cost of almost two removal passes at about $9,000/pass.

- Although NOP cannot naturally escape from Kyle's Pond back to the river because there is no riverine connection, one NOP stocked into the pond has been recaptured in the river indicating anglers moved at least one fish.

Conclusion:

Cease translocation of NOP to increase cost efficiency of removal efforts, and to reduce chances of repatriation of NOP.

III. Reallocate All NNF Translocations Efforts and Funds to Removal

Recommendation: *Discontinue translocation to allow those funds to be applied to effort elsewhere.*

Part of the NNF Workshop discussion dealt with translocation costs versus applying funds to additional nonnative fish removal. Translocation of fish requires additional travel time - often at overtime pay – after a full day's work, additional personnel time to sustain live fish in a livewell-equipped boat, and may also require an additional truck, boat/trailer, and fish hauling tank to transport live fish. Discontinuing translocation would allow those funds and effort to be applied elsewhere. This white paper discusses current costs versus expected cost of disposal without translocation in a general sense, without actual numbers. Currently, nonnative fish are translocated only in the Yampa River basin, and, rarely, in the Colorado River (LMB only).

A. YAR

The following are excerpts from key Program documents highlighting the aforementioned concerns:

- "As part of the annual assessment of the nonnative fishes control program the Recovery Program should evaluate the need to implement lethal removal of nonnative fishes in and upstream from critical habitat in Colorado. The program already includes this feature in Utah and in Yampa Canyon in Colorado. Lethal removal of nonnative fishes makes nonnative fish control much more efficient and cost effective." (USFWS 2005, pg. 72).

- "Reallocation of effort may require reduced efforts of lower priority projects in order to make personnel and/or funds available to affect concentration areas or source populations." (Valdez et al. 2008, pg. 14).

- "Non-native fish removal efforts are being conducted and can be expected to continue into the future in the Yampa Basin, in an effort to aid in recovery of the aforementioned species." (CDOW 2010, pg. 12).

- "Since escapement of northern pike and smallmouth bass continues to be an issue, we recommend euthanizing northern pike and smallmouth bass as the only way to ensure they are removed from their populations." (Webber 2010, pg. 3).

B. COR-Highline Lake

– "Survival of largemouth bass [LMB] to adults (≥ 200 mm) in the [Colorado] river is relatively low." (Burdick 2010, pg. 2). This scarcity of larger LMB suggests that individual or very few fish may require translocation to Highline Lake in a given day severely escalating the cost of translocation and diminishing the efficiency of nonnative fish removal.

– The present strategy for performing the required annual maintenance release of water through the bottom outlet of Highline Lake relies on an oxygen depletion threshold of 5 mg/l for the seasonal timing of the release (Martinez 2010). This oxygen level is too high to reliably exclude warmwater fish species from the deeper water near the outlet intake (Piper et al. 1982). While the release in 2010 fell within the recommended mid-summer window, releases in 2006-2009 were performed earlier in the season when oxygen levels at depth would have remained high (Martinez 2010), increasing the risk of warmwater fish escape or entrainment.

Conclusions:

- Translocation of NNF captured in rivers requires extra effort, time and expense. Efforts to increase removal to achieve target depletion rates are made less efficient by the time, equipment and personnel required to keep fish alive for translocation to an off-stem site at day's end. Translocation with full knowledge of considerable escapement risk at some sites also probably sends the wrong message to the public about assumptions, methods, expectations and scientific integrity.

- Relocating adult fish capable of reproduction sustains them in the system, a particularly problematic scenario if they re-enter the river and contribute to nonnative fish densities and recruitment in critical habitat. Euthanizing captured nonnative fish, despite the need for their proper disposal, conserves project funds that can be allocated as additional NNF removal passes to existing or higher priority projects.

- It is recommended that no warmwater fish be stocked (or translocated) into Highline Lake until the issue of the timing of unscreened outlet releases is resolved. Addressing other issues influencing the time of these releases such as water quality in or below the reservoir will be required to best accommodate the need to prevent the escapement of warmwater fish species. This issue should be addressed prior to the anticipated date of the next spillway net replacement in the spring of 2012 (Martinez 2010).

IV. <u>Cease release of marked NOP in YAR buffer zone</u>

Recommendations:

1. Only make [NOP] population estimates every few years, and focus on depletion in the interim years.

Or, 2. Cease all M/R population estimates and use depletion estimates or CPE indices instead.

NOP were introduced into the YAR basin in 1977 by intentional stocking into EHR and NOP escapement from the reservoir was reported as early as 1979 (Tyus and Beard 1990; Johnson et al 2008; Hawkins et al. 2009). NOP became abundant in the upper and middle YAR since the mid-1980s

(Nesler 1995; Hawkins et al. 2005). Ponds, sloughs and reservoirs in the upper Yampa River above Hayden are the primary locations for NOP reproduction that sustain recruitment and downstream emigration of NOP into critical habitat for endangered fishes below Craig (Hill 2004, Orabutt 2006, Fitzpatrick 2008). NOP have been removed from the reach above critical habitat for the past 7 years in an attempt to create a 'buffer zone' and decrease the immigration of NOP into critical habitat. To assess the success of the removals, annual population estimates are made by marking and releasing NOP on one pass, and recapturing (and removing) the tagged fish on subsequent passes.

The BC discussed the benefits and impacts of releasing marked NOP in the buffer zone for the purpose of mark-recapture (M/R) population estimates, and alternative methods to evaluate success of removal efforts. A recommendation to change the timing of the removal to maximize catch and to use alternate assessment methods was made, and strongly supported, but initial BC approval of this recommendation was deferred until further discussion on the need for a NOP synthesis (similar to the SMB synthesis) and the importance of M/R population estimates to the proposed NOP synthesis. This issue was further discussed during the BC conference call on Jan. 24th and recommendation #2 was approved '*Cease all M/R population estimates and use depletion estimates or CPE indices instead.'*

A. NOP in YAR

The following are excerpts from key Program documents highlighting the aforementioned concerns:

- "Over the course of 7 years of northern pike mechanical removal in Critical Habitat of the Yampa River, we have demonstrated a decrease in northern pike abundance and an altered size structure of the population, featuring an overall reduction of large northern pike. When conducted annually, these efforts help minimize the predatory threat of northern pike on the native fish community by reducing predator numbers on a yearly basis." (Wright 2010, pg. 9).

- "However, it appears that long term success of such efforts is limited by the continuous influx of northern pike from source populations in the basin. Annual length frequency histograms combined with growth rate calculations have been a sufficient means to demonstrate the influx of distinct northern pike cohorts that originate outside of our study area, and that replenish northern pike densities within Critical Habitat, despite intensive removal efforts on a yearly basis." (Wright 2010, pg. 9).

- "The Division recognizes the potential for downstream emigration of undesirable non-native game fish species into river reaches occupied by populations of the endangered fishes and the dampening effect that movement may have on the effectiveness of control projects being implemented to reduce the abundance and impact of the non-native fishes." (CDOW 2010, pg. 27).

B. YAR "buffer zone" for NOP

- "Removal of northern pike from the Hayden Reach is considered essential to serve as a buffer for any potential pike movement into critical habitat from populations upstream. In addition, it will allow biologists to determine to what extent such immigration may be occurring." (Roehm 2004, pg. 88).

- "Depletion population estimate in conjunction with NOP removal in Buffer Zone or reliance on CPUE and population structural indices continue to provide information for examining population trends for abundance, reproduction and recruitment." (Webber 2010, pg. 4). Indices of NOP abundance other than mark-recapture population estimates do not require the release of NOP that have been captured by nonnative fish removal crews.

- "By using our 2010 data in a depletion model, we estimate 742 northern pike (679-805 95% C.I.) compared to a mark-recapture estimate of 806 (573-1039 95% C.I.). During the mark pass we released 183 northern pike back to the river, of which 79 were not recaptured. Given that the difference in the estimates is not substantial, we recommend using depletion estimates for this project instead of mark-recapture." (Webber 2010, pg. 4).

Additional perspectives include:

- The "buffer zone" is functionally intended to serve as an "instream screen" to lessen downstream immigration of NOP into critical habitat. Release of NOP captured in the buffer zone for any reason reduces efficiency and effectiveness of buffer zone concept and its "screen/barrier function", thereby allowing long-lived, reproductive piscivores that demonstrate a propensity to move downstream into critical habitat to persist in the YAR adding to predation impacts on native fishes in critical habitat.

- NOP data from Finney and Haines (2008) and Webber (2010) indicate that of the NOP marked annually for population estimates in the buffer zone, an annual average of ~100 of these marked NOP are not recaptured and may move downstream into critical habitat.

- Mark/Recapture population estimates of NOP in the buffer zone have wide confidence intervals which make them unreliable for tracking the population response of NOP to removal, and CPUE and age structure indices may be equally useful.

Conclusions:

- Bioenergetics modeling projects a substantial predatory impact on prey (1,000 pounds consumed per year) by ~100 NOP @~600 mmTL consuming 10 lb prey/year (Johnson et al. 2008). Given that NOP in the YAR live more than ten years (Johnson et al. 2008) and grow ~105 mm (4.1 inches) per year (Wright 2010), the implications for long-term predation impacts by individual NOP that remain at large following tagging and release for population estimation purposes is considerable.

- It is recommended that NOP captured in the YAR buffer zone between Hayden and Craig not be released back into the river to maximize the intended function of the buffer to limit downstream movement of NOP into critical habitat and that alternate indices of NOP abundance (i.e. CPUE and size structure) be employed to monitor NOP population trends.

ATTACHMENT 1

I. Cease Translocation of Smallmouth Bass (SMB) into Elkhead Reservoir (EHR)

A. SMB in YAR

- SMB were absent (Baily and Alberti 1952a; Holden and Stalnaker 1975; Carlson et al 1979) or rare (Miller et al. 1982; Wick et al 1985; McAda et al. 1994) in the YAR before they were flushed in large numbers from EHR during its draining in 1992 (Nesler 1995; Martinez 2003).

- The abundance and distribution of SMB gradually increased in the middle YAR in the mid-1990s (Martinez 2006; Hawkins et al. 2009) and SMB were first detected in the lower YAR within Dinosaur National Monument in 2002 (Fuller 2009).

- SMB sport fishing in the YAR is affected by temperature, turbidity, and boat and shore access, limiting the optimum season for catching SMB and the capacity for angling to contribute to a reduction in SMB abundance (Martinez 2007).

- "In addition to the coldwater recreational fishing resources, a small number of anglers utilize the mainstem of the lower Yampa River for non-native smallmouth bass and northern pike angling, though these species are not promoted by the CDOW as a recreational fishing resource." (CDOW 2010).

- SMB abundance in the middle YAR increased abruptly in 2001 (Anderson 2002), with a strong year class of SMB being produced in 2007, which constituted a large portion of the SMB in the YAR in 2010 (Hawkins 2010).

- SMB are now the dominant predator in the middle Yampa River and their rise in abundance was concurrent with the decline of native fish in the Yampa River (Johnson et al 2008; Hawkins et al. 2009).

- Higher removal rates, both within the study area and at other study areas may be needed to adequately reduce the predatory threat of SMB in the YAR and to restore the native fish community (Hawkins et al. 2009; A. Breton et al., unpublished data).

- Resident, recruiting, immigrating and escapee SMB contribute to sustaining SMB in the middle YAR (P. Martinez, unpublished data) and to their movement and expansion into other reaches of the YAR and other rivers, adding to the complexity, difficulty and expense of reducing their abundance and negative effects to the native aquatic community, and jeopardizing prospects for endangered fish recovery.

- Prevention of the addition of SMB to the YAR from point sources such as EHR is necessary to expedite the ecological effectiveness and economic efficiency of reducing the abundance, invasive impact and re-expansion potential of SMB as removal efforts strive to achieve and sustain population depletion targets for SMB.

B. SMB in EHR

- SMB were introduced into the YAR basin in the late 1970's by intentional stocking into EHR (Johnson et al 2008; Hawkins et al. 2009).

- SMB somatic and population growth were constrained in EHR, prior to its enlargement in 2006, by sub-optimum, cool water temperatures that limited recruitment and resulted in growth rates that were slow in comparison to regional growth rates for SMB in other waters (Martinez 1997, 2007). These cool conditions also limit SMB recruitment in the enlarged EHR (Wright 2009).

- Environmental conditions (thermal, turbidity, nutrients) for SMB in EHR post-enlargement were projected to be sub-optimum for this species, except for a possible short term improvement in conditions ("new reservoir phenomenon") as the reservoir inundated its enlarged basin (Martinez 1997; Bergersen and Martinez 2003).

- SMB translocation from the YAR to EHR began in 2003 (Roehm 2004) and 5,628 tagged SMB captured in the YAR have been stocked into EHR to date (J. Hawkins, unpublished data). The new outlet structure was screened during the enlargement of EHR, but a screen was not installed in the new spillway and it has now been deemed inadvisable to install a spillway screen due to large debris concerns (R. Tenney, personal communication).

- "The smallmouth bass fishery is supplemented with smallmouth bass >10 inches that are removed from the Yampa River during the Upper Colorado River Endangered Fish Recovery Program non-native fish removal efforts. Since 2007, 2,141 smallmouth bass > 10 inches have been released in the reservoir and more will be released in coming years. Reports from various anglers have noted that smallmouth bass fishing has continued to improve since 2007." (Wright 2009, pg. 6).

- Given the marginal conditions for SMB in EHR, the reservoir's SMB population may be highly reliant on translocation to appreciably increase its density. For example, 50% of SMB ≥ 250 mm sampled in the reservoir in 2010 were tagged fish translocated from the YAR (B. Wright, unpublished data).

- 'There are abundant smallmouth bass > 10" [in EHR] because they are transplanted from the Yampa River during endangered fish recovery activities. They are released throughout the summer in the cove on the east side of the lake, across from the island." (Wright 2009, pg. 1).

- The fish consumption advisory for EHR recommends that children aged 6 or younger do not consume any largemouth bass larger than 15 inches or SMB, NOP or black crappie of any size. For pregnant women, nursing women and women who plan on being pregnant, the advisory recommends not consuming largemouth bass larger than 15 inches or SMB of any size and limiting consumption of NOP and black crappie to one meal per month. For the general population, the recommendation is a limit of one meal per month of largemouth bass larger than 15 inches or SMB and black crappie of any size and a limit of two meals per month for NOP (Salley and Hampton 2009).

C. SMB escapement from EHR

- Of the over 5,000 SMB translocated into EHR, approximately 5% are known to have escaped back into the YAR, but this percentage does not account for an unknown number of tags lost or removed by anglers.

- Tagged SMB that escaped EHR following translocation have been recaptured at various locations in the YAR as far as 100 miles downstream of the mouth of Elkhead Creek (J. Hawkins, unpublished data).

- EHR, post-enlargement, spills more frequently and for longer durations than originally projected (R. Tenney, unpublished data), likely contributing to the chronic escapement of SMB and possibly other unmonitored species.

- Tagged fish have a lower probability of recapture, thus the recapture of tagged SMB that escaped EHR following translocation is more improbable. This lower probability of recapture increases the number of escaping SMB represented by each tagged individual SMB recaptured in the YAR (A. Breton, unpublished data).

- Arbitrarily setting a percentage of the number of translocated SMB escaping EHR as a threshold to continue or discontinue translocation ignores tag loss, tags removed by anglers or the escapement of un-tagged resident SMB, all of which would contribute to an underestimate of SMB escapement (A. Breton, unpublished data).

- Arbitrary percentages or underestimates of escapement also do not account for the addition of escapees to the proliferative capacity of SMB and its contribution to the expansion of SMB in the YAR or other rivers (P. Martinez, unpublished data)

- SMB in the YAR are long-lived, living up to 14 years (Martinez 2006), contributing to their reproductive, proliferative capacity, which is capable of sustaining their invasive and predatory impacts on native fishes.

- Translocation of SMB into EHR in spite of escapement violates prevention principles of invasive ecology, fails to address a known point source of a problematic species, and ignores the detrimental ecological transformation of the native fish food web inflicted by SMB in the YAR.

- The escapement of SMB from EHR will increase as the density of SMB increases and approaches the reservoir's carrying capacity for this species. Halting the translocation of SMB into EHR would slow the growth of the SMB population in the reservoir, and over time, the SMB population in the reservoir may decrease due to the marginal conditions and natural and angling mortality of SMB, thereby reducing the contribution of SMB from EHR to the YAR.

- SMB escapement from EHR is chronic with no known practical, effective or affordable solution available at this time. Continuing to translocate SMB given their escapement undermines the public trust and fiscal responsibility of native fish restoration given the documented invasive impacts of SMB in the YAR

- The Recovery Program is advised to halt translocation of SMB from the YAR to EHR as it awaits the analyses of SMB escapement from EHR by A. Breton at al. Based on available data, the question has become whether translocation would reasonably be allowed to resume pending

this evaluation, rather than allowing it to continue until the evaluation provides more insight into the magnitude of SMB escapement from EHR.

D. Guidance Pertaining to EHR Sport Fishery and SMB Escapement

1. Yampa Management Plan (Roehm 2004)

- Page 71; "A water-right application filed by the CRWCD (Colorado District Court 2003) for its proposed Elkhead enlargement project includes among its beneficial uses "piscatorial and recreational (including in-reservoir and in-river fish habitat and river flow maintenance and enhancement uses, and uses in furtherance of the Upper Colorado River Basin Fishes Recovery Program)."

- Page 82; "The Recovery Program may install screens on existing ponds and reservoirs that already have active nonnative warmwater fisheries to prevent or reduce nonnatives from escaping. However, depending upon their location and connectivity with the river, new water storage projects in the Yampa River Basin intended to support warmwater sportfish, may need to consider nonnative fish control measures (e.g., berms, screening and/or stocking restrictions) in the project design and cost. State wildlife agency personnel will inspect screens and berms annually. If these measures fail to control escapement of nonnative fishes, future stocking into the affected waters will occur only after a case-by-case review."

- Page 84; "The Elkhead LMP has been amended to provide for management of reservoir fisheries following the proposed enlargement. This plan will allow smallmouth bass that have been captured in the Yampa River and adjacent floodplain habitats to continue to be relocated to Elkhead Reservoir. Relocation will keep these valuable gamefish within the Yampa River basin and encourage their utilization by local anglers."

- Page 84; "All transplanted fish would be marked with Floy type tags or batch marks, such as fin clips. Monitoring during subsequent efforts to capture and remove more fish from the river would help determine if any tagged fish had escaped back to the Yampa River."

- Page 85; "In accordance with the provisions of the NNSP, the CDOW requested and was granted a variance beginning in 2003 to stock smallmouth bass removed from the Yampa River into Elkhead Reservoir."

- Page 93; "Laiho (2001) concluded that some form of fish separation will be needed at Elkhead Reservoir to reduce or curtail further escapement to the river. Without such measures, future escapement of nonnative fishes from Elkhead Reservoir is likely to confound ongoing efforts to control their populations in the Yampa River."

- Page 98; "However, nonnative fish escapement over the new spillway will be monitored, and if the Recovery Program determines that escapement of problematic species is at levels that thwart recovery efforts, a net barrier or other fish exclusion device would be installed on the spillway."

- Page 175; "Specific control measures are described under Containing escapement from Elkhead Reservoir beginning on page 93. These include the potential incorporation of a permanent fish barrier on the Elkhead Dam outlet and/or spillway. If needed, the Recovery Program will select and fund construction of a fish barrier at Elkhead."

2. Nonnative Fish Management Policy (UCRRIP 2004)

- Page 1; "Nonnative fish management is one of many management actions necessary to achieve and maintain recovery of the endangered fishes, and failure to adequately manage nonnative fishes may nullify the positive effects of other Recovery Program actions associated with habitat management and restoration and endangered fish stocking."

- Page 2; "Because nonnative fish species targeted for management may have sportfish value to the angling public, the dual responsibilities of State and Federal fish and wildlife agencies to conserve listed and other native species while providing for recreational fishery opportunities will be considered in nonnative fish management strategies developed and implemented by the Recovery Program. This consideration will include consultation and approval from the State wildlife agencies prior to implementation of nonnative fish management actions."

- Pages 2 & 3; "The Recovery Program believes it will be necessary to remove substantial numbers of the more abundant target nonnative fish species from certain river reaches, and, through research and monitoring, demonstrate sustained reductions in nonnative fish abundance and resulting positive native fish responses at the population level. As deemed appropriate and practical, efforts will be made to relocate nonnative sportfish removed from rivers to local ponds or reservoirs publicly accessible to anglers. Relocation of sportfish will be in compliance with State laws and regulations, in coordination with State fish and wildlife agencies, and in accordance with the 1996 Procedures for Stocking Nonnative Fish Species in the Upper Colorado River Basin. The number or biomass of sportfish relocated to any one body of water in a given year will be determined by State fish and wildlife agencies. However, once the State agencies indicate that the established relocation thresholds are reached and no other appropriate relocation sites are immediately available, Recovery Program partners recognize the need for and support lethal removal of additional target nonnative fish from the river, in compliance with State laws and regulations and in coordination with State fish and wildlife agencies, to achieve the levels of management necessary to minimize or remove threats to the endangered fishes."

3. Yampa River Programmatic Biological Opinion (USFWS 2005)

- Page 11; "Predatory and competitive nonnative fishes have been identified as an impediment to recovery of the endangered fishes throughout much of the Upper Colorado River Basin (USFWS 2002a-d)."

- Page 12; "Management of nonnative fish species will initially follow an experimental approach to develop effective strategies and identify the levels of management necessary to minimize or remove threats to the endangered fishes. An annual assessment of data will determine future nonnative fish management strategies, including possible changes to the

list of target nonnative fish species, geographic scope of management areas, and methods employed. However, this adaptive process should not unduly delay timely and effective actions to minimize or remove the nonnative threat to the endangered fishes (UCRRIP 2004)."

- Page 12; "Preliminary study results indicate that the Yampa River is extremely vulnerable to the impacts of nonnative fishes and, consequently, stands to benefit the most from an aggressive nonnative fish control program."

- Page 12; "Outlets of both existing and new ponds and reservoirs must be screened before they are stocked with nonnative fish. As part of the proposed action, the Recovery Program will screen Elkhead Reservoir to minimize escapement of nonnative fishes (see detailed description below). In addition, new water storage projects that have a sport fisheries component will comply with the NNSP (e.g., screening to prevent escapement and/or stocking restrictions) in the project design and specifications, if these measures are warranted based upon location and connectivity with the river."

- Page 14; "Following construction, the controlled outlets will be operated in a manner which minimizes releases over the spillway. Up to 540 cfs will be discharged through the tower (440cfs) outlet and service outlet (90 cfs) during spring runoff. Flows over the spillway will occur only when inflows exceed 540 cfs."

- Page 14; "All controlled releases of water will be screened. This will include installation of ¼-inch wedge-wire screens on all three of the tower intakes and the service intake."

- Page 14; "The Recovery Program will continue to monitor the escapement of fish from the spillway. The Biology Committee will develop criteria for an escapement threshold that would trigger a decision to screen the spillway and/or curtail stocking into Elkhead Reservoir."

- Page 14; "Anchors for a spillway net will be installed while the reservoir is drawn down for construction. Future installation of a spillway net will be considered based on results of spillway escapement monitoring and nonnative fish control efforts in the Yampa River."

- Page 58; "In 2003, this effort was expanded to include smallmouth bass, which were translocated to Elkhead Reservoir. Although the ongoing nonnative management actions are not expected to eradicate these species from the river, the expectation is that their populations will be reduced sufficiently to allow endangered fish populations to expand."

- Page 61; "Tyus and Saunders (1996; 2001) recommended several strategies and actions for the Yampa River to deal with these issues including development of a fisheries and conservation management plan emphasizing public relations and acceptable alternative fishing opportunities, and controlling the escapement of nonnative fishes from Elkhead Reservoir."

- Page 61; “After construction, the new spillway would not be screened; therefore, escapement of nonnative fishes from the reservoir would be possible over the new spillway. Part of the proposed action includes screening the new outlet works at Elkhead Reservoir, operating the controlled outlet(s) to minimize spillway discharge, and monitoring fish escapement over the spillway.”

4. Implementation Committee Directive (2006)

- Page 2; “The Implementation committee agrees that the approach to nonnative control on the Yampa and elsewhere should be highly proactive and similar to capital projects, i.e., substantial and expensive action is taken based on hypotheses that native fish will benefit from these projects and then the projects are adjusted if the benefits are not realized.”

5. Yampa Nonnative Fish Management Plan (Valdez et al. 2008)

- Page 1; “Model predictions suggest that the minimum annual removal rates needed to cause a long-term reduction in population size of smallmouth bass exceed 60%. Using the target removal criteria (30 fish per mile) and minimum exploitation, the approximate time period needed to cause a population crash is 20 years. However, if annual exploitation rates are increased to remove 85% of adult smallmouth bass (via a shift in Recovery Program effort and/or favorable environmental conditions), the period required to create a population crash could be reduced to almost 8 years.”

- Page 1; “Develop and implement a stronger adaptive management framework to identify nonnative fish management actions of sufficient scale and intensity to achieve measurable success criteria based on fish population responses over the shortest plausible timeframe.”

- Page 4; “Identifying and implementing the level of effort required to achieve the criteria, identifying and reducing sources of nonnatives, and preventing further invasions are important considerations in achieving these criteria.”

- Page 5; “Monitor escapement of tagged, translocated bass from Elkhead Reservoir using recaptures from control sampling in northern pike buffer and critical habitat reaches; define thresholds for action.”

- Page 5; “This action promotes public support for balanced management of nonnative fish, sportfish, and native fish. This action is adjusted by meeting with angler groups to provide them with information on the nonnative fish management program for the Yampa River and to better understand and address their concerns over removing northern pike and smallmouth bass from the river.”

- Page 8; “Fish that are translocated from the Yampa River to the reservoir are marked and used to monitor escapement. No adjustments are proposed for this action, although if escapement is found to be unacceptably high, further screening options should be considered.”

- Page 12; “The most problematic fish species in the Yampa River have been identified as smallmouth bass and northern pike.”

- Page 22; “Sources of northern pike and smallmouth bass, especially those located upstream of Craig are being targeted with various management methods including screening of Elkhead Reservoir, removal of northern pike from Catamount Reservoir, and reductions of northern pike in riverside floodplains. The effectiveness of these actions has not been evaluated.”

6. Nonnative Fish Stocking Procedures (USFWS et al. 2009)

- Page 1; “One of five elements of the Recovery Program is nonnative fish species and sportfishing management to reduce the threat of certain nonnative fishes while maintaining sportfishing opportunities.”

- Page 2; “The purpose of the Stocking Procedures is to ensure that all future stocking of nonnative fish are consistent with recovery of the endangered fishes within critical habitat of the Upper Basin in Colorado, Utah, and Wyoming.”

- Page 2; “The goal of the Service and the States is to reach consensus on issues related to stocking of nonnative fishes so that neither the Service nor the State fish and wildlife agencies have to independently assert their authority. The Service and the States will make a concerted effort to resolve any disagreements that may arise from a stocking proposal.”

- Page 4; “The Recovery Program and its participating partners recognized the need to manage nonnative fish populations to achieve and maintain endangered fish recovery in a Nonnative Fish Management Policy (UCREFRP 2004), which includes the need for regulation of nonnative fish stocking in the Upper Basin.”

- Page 4; “The States and the Service recognize that introducing nonnative fish species into an ecosystem can result in unanticipated impacts on native fishes. For this reason, the Stocking Procedures are intended to minimize access by stocked nonnative, nonsalmonid fishes to critical habitat where they may adversely affect endangered Colorado River fishes.”

- Page 5; “Stocking on nonnative, nonsalmonid fishes and their management in public waters will require evaluation by the State fish and wildlife agencies and the Service on a case-by-case basis to ensure that the proposed stocking of these fishes will not adversely affect the endangered fishes. The intent here will be to address escapement potential and potential impacts if stocked fish were to gain access to critical habitat.”

- Page 5; “Stocking proposals, as a component of broader lake management plans, at a minimum will include: C. an assessment of the potential for escapement, potential for survival in critical habitat if escapement occurs, and measures that could be implemented to reduce the risk of escapement.”

- Page 6; "Public waters that have a direct connection to rivers in the Upper Basin will be equipped or managed with an anti-escapement device or practice acceptable to the Service and the State fish and wildlife agencies. Management plans will be prepared or revised and approved by the Service and the State fish and wildlife agencies before the continued stocking of nonnative, nonsalmonid fish species will be allowed."

- Page 6; "Nonnative, nonsalmonid sportfish that are removed from the river or other problem areas can be transplanted to waters that comply with the Stocking Procedures and already contain these species."

- Page 7; "If problems occur, such as escapement into critical habitat or evidence of an illicit introduction, then the management plan will be revisited by the Service and the States."

7. Yampa River Basin Aquatic Wildlife Management Plan (CDOW 2010)

- Page 12; "Conservation and recovery of federally listed fish species such as the Colorado pikeminnow, humpback chub, razorback sucker and bonytail chub, as part of the Colorado River Endangered Fishes Recovery Program, are emphasized in the Yampa River basin, particularly in the lower basin."

- Page 12; "Approximately 225 miles of riverine habitat on the Yampa River below the town of Hayden and the Green and Lower Little Snake Rivers, within Colorado, serve an important role in sustaining populations of these species and are managed explicitly and primarily for conservation of the native fish community."

- Page 17; "Escapement of nonnative fish from waters in the Yampa River basin that compromises our ability to recover endangered fish will cause our management plans to be re-evaluated and possibly revised to minimize escapement as an impediment to recovery."

- Page 52; "Continue to translocate smallmouth bass and northern pike from Yampa River non-native fish control projects as appropriate and consistent with Procedures to maintain recreational fishing opportunities for these warmwater sportfishes."

- Page 52; "Locate other waters that would be conducive to translocation of smallmouth bass and northern pike and that pose no threat of establishment of self sustaining populations or escapement of translocated fish; explore possibilities to develop public fishing leases on private water bodies that could be used as translocation sites in accordance with Procedures."

- Page 90; "Use northern pike and smallmouth bass obtained through Recovery Program funded removal and translocate to off-channel ponds in the middle Yampa River reach and Elkhead Reservoir (smallmouth bass only) in accordance with Nonnative Fish Stocking Procedures…"

8. 2009-2010 Sufficient Progress Memo (USFWS 2010)

- Page 13 “Researchers continue to recapture some nonnative fish which were translocated to Elkhead Reservoir as part of nonnative fish management efforts. The CDOW is reviewing the recapture data in 2010, and the smallmouth bass population dynamics modeling (programmatic synthesis) being conducted by Colorado State University also will help evaluate this problem.”

- Page 13; “ACTION ITEM (7): Based on their analysis of smallmouth bass recapture information, CDOW and the Recovery Program must decide, prior to the 2011 sampling season, if Elkhead Reservoir can continue to serve as a translocation site for smallmouth bass removed from the Yampa River.”

II. Cease Translocation of NOP into any waters including the Kyle’s Pond (State Park Headquarter’s Pond)

- Translocation is no longer approved for Loudy-Simpson pond because escapement and reproduction have been documented (CDOW, Sherman Hebein, Pers. Comm.), thus if NOP were translocated they would go to Kyle’s Pond.

- Translocation adds extra cost to each project, particularly for NOP removed from the middle YAR, due to travel distance.

- Although NOP cannot naturally escape Kyle’s pond back to the river because there is no riverine connection, one NOP stocked into the pond has been recaptured in the river indicating anglers moved at least one fish.

III. Reallocate All NNF Translocations Efforts and Funds to Removal

- “Survival of largemouth bass [LMB] to adults (≥ 200 mm) in the [Colorado] river is relatively low.” (Burdick 2010, pg. 2). This scarcity of larger LMB suggests that individual or very few fish may require translocation to Highline Lake in a given day severely escalating the cost of translocation and diminishing the efficiency of nonnative fish removal.

- Martinez (2001, 2002) provided data and a rationale for timing the required annual maintenance release during mid-summer between mid-July to late-August when oxygen levels fell below 2 mg/l below a depth of 6-8 m. It is recommended that unscreened outlet releases be performed when oxygen levels are no higher than 3 mg/l below a depth of 7 m to best ensure that no fish will escape or be entrained.

- The present strategy for performing the required annual maintenance release of water through the bottom outlet of Highline Lake relies on an oxygen depletion threshold of 5 mg/l for the seasonal timing of the release (Martinez 2010). This oxygen level is too high to reliably exclude warmwater fish species from the deeper water near the outlet intake (Piper et al. 1982). While the release in 2010 fell within the recommended mid-summer window, releases in 2006-2009 were performed earlier in the season when oxygen levels at depth would have remained high (Martinez 2010), increasing the risk of warmwater fish escape or entrainment.

- It is recommended that no warmwater fish be stocked (or translocated) into Highline Lake until the issue of the timing of unscreened outlet releases is resolved. Addressing other issues influencing the time of these releases such as water quality in or below the reservoir will be required to best accommodate the need to prevent the escapement of warmwater fish species. This issue should be addressed prior to the anticipated date of the next spillway net replacement in the spring of 2012 (Martinez 2010).

- "Management of nonnative fish species will initially follow an experimental approach to develop effective strategies and identify the levels of management necessary to minimize or remove threats to the endangered fishes as identified in the recovery goals." (USFWS 2002a-d).

- "An annual data assessment will determine future nonnative fish management strategies, including possible changes to the list of target nonnative fish species, geographic scope of management areas, and methods employed. However, this adaptive process should not unduly delay timely and effective actions to minimize or remove the nonnative threat to the endangered fishes (UCRRIP 2004)." (Roehm 2004, pg. 85).

- "As part of the annual assessment of the nonnative fishes control program the Recovery Program should evaluate the need to implement lethal removal of nonnative fishes in and upstream from critical habitat in Colorado. The program already includes this feature in Utah and in Yampa Canyon in Colorado. Lethal removal of nonnative fishes makes nonnative fish control much more efficient and cost effective." (USFWS 2005, pg. 72).

- "Reallocation of effort may require reduced efforts of lower priority projects in order to make personnel and/or funds available to affect concentration areas or source populations." (Valdez et al. 2008, pg. 14).

- "Non-native fish removal efforts are being conducted and can be expected to continue into the future in the Yampa Basin, in an effort to aid in recovery of the aforementioned species." (CDOW 2010, pg. 12).

- "Continue to collect and lethally remove all centrarchids from the Colorado and Gunnison rivers during all station sampling studies which includes sampling on the Colorado and Gunnison rivers during 2011." (Burdick 2010, pg. 16).

- "Since escapement of northern pike and smallmouth bass continues to be an issue, we recommend euthanizing northern pike and smallmouth bass as the only way to ensure they are removed from their populations." (Webber 2010, pg. 3).

- Translocation of NNF captured in rivers requires extra effort, time and expense. Efforts to increase removal to achieve target depletion rates are made less efficient by the time, equipment and personnel required to keep fish alive for translocation to an off-stem site at day's end.

- Relocating adult fish capable of reproduction sustains them in the system, a particularly problematic scenario if they re-enter the river and contribute to nonnative fish densities and

recruitment in critical habitat. Euthanizing captured NNF, despite the need for their proper disposal, conserves project funds that can be allocated as additional NNF removal passes to existing or higher priority projects.

IV. Release of Marked Northern Pike (NOP) in Yampa River (YAR) Buffer Zone

A. NOP in YAR

- NOP were introduced into the YAR basin in 1977 by intentional stocking into EHR and NOP escapement from the reservoir was reported as early as 1979 (Tyus and Beard 1990; Johnson et al 2008; Hawkins et al. 2009).

- NOP were detected below the dam at Catamount Reservoir by 1980 (Fitzpatrick 2008) and NOP became abundant in the upper and middle YAR since the mid-1980s (Nesler 1995; Hawkins et al. 2005).

- Ponds, sloughs and reservoirs in the upper Yampa River above Hayden are the primary locations for NOP reproduction that sustain recruitment and downstream emigration of NOP into critical habitat for endangered fishes below Craig (Hill 2004, Orabutt 2006, Fitzpatrick 2008).

- "Over the course of 7 years of northern pike mechanical removal in Critical Habitat of the Yampa River, we have demonstrated a decrease in northern pike abundance and an altered size structure of the population, featuring an overall reduction of large northern pike. When conducted annually, these efforts help minimize the predatory threat of northern pike on the native fish community by reducing predator numbers on a yearly basis." (Wright 2010, pg. 9).

- "However, it appears that long term success of such efforts is limited by the continuous influx of northern pike from source populations in the basin. Annual length frequency histograms combined with growth rate calculations have been a sufficient means to demonstrate the influx of distinct northern pike cohorts that originate outside of our study area, and that replenish northern pike densities within Critical Habitat, despite intensive removal efforts on a yearly basis." (Wright 2010, pg. 9).

- "Control of source populations is perhaps the only measure that will aid researchers working within Critical Habitat to significantly reduce northern pike numbers below the current level. Starting in 2008, the Colorado Division of Wildlife has been engaged in northern pike control projects in several of the presumed source populations located in the upper Yampa River basin, near Steamboat Springs." (Wright 2010, pg. 9).

- "The lack of large influxes of adult northern pike into the study area since 2007 may be attributed to such control efforts; however it may also me a matter of time before another massive influx is observed." (Wright 2010, pg. 9).

- "The Division recognizes the potential for downstream emigration of undesirable non-native game fish species into river reaches occupied by populations of the endangered fishes and the dampening effect that movement may have on the effectiveness of control projects being

implemented to reduce the abundance and impact of the non-native fishes." (CDOW 2010, pg. 27).

- "Although the lower portion of the Yampa River (from Hayden downstream to the confluence with the Williams Fork) is inhabited by smallmouth bass and northern pike, it is not managed as a warmwater fishery. It is managed for the recovery of endangered fishes of the Upper Colorado River Basin and other native species of concern (roundtail chub, mountain whitefish, flannelmouth sucker, and bluehead sucker). The upper portion of the mainstem of the middle Yampa River is utilized recreationally as both a wild trout fishery and a stocked trout fishery." (CDOW 2010, pg. 51).

- "Use northern pike and smallmouth bass obtained through Recovery Program funded removal and translocate to off-channel ponds in the middle Yampa River reach and Elkhead Reservoir (smallmouth bass only) in accordance with Nonnative Fish Stocking Procedure, and avoid stocking northern pike in such ponds that have potential for connectivity with the river." (CDOW 2010, pg. 90).

B. YAR "buffer zone" for NOP

- "Removal of northern pike from the Hayden Reach is considered essential to serve as a buffer for any potential pike movement into critical habitat from populations upstream. In addition, it will allow biologists to determine to what extent such immigration may be occurring." (Roehm 2004, pg. 88).

- "Remove from upstream buffer (Hayden to Craig) to reduce downstream movement into critical habitat; electrofish river with block and shock of secondary channel and tributary backwaters." (Valdez et al. 2008, pg 4).

- The "buffer zone" is functionally intended to serves as an "instream screen" to lessen downstream immigration of NOP into critical habitat. Release of NOP captured in the buffer zone for any reason reduces efficiency and effectiveness of buffer zone concept and its "screen/barrier function", thereby allowing long-lived, reproductive piscivores that demonstrate a propensity to move downstream into critical habitat to persist in YAR adding to predation impacts to native fishes in critical habitat.

- "Depletion population estimate in conjunction with NOP removal in Buffer Zone or reliance on CPUE and population structural indices continue to provide information for examining population trends for abundance, reproduction and recruitment." (Webber 2010, pg. 4). Indices of NOP abundance other than mark-recapture population estimates do not require the release of NOP that have been captured by NNF removal crews.

- "By using our 2010 data in a depletion model, we estimate 742 northern pike (679-805 95% C.I.) compared to a mark-recapture estimate of 806 (573-1039 95% C.I.). During the mark pass we released 183 northern pike back to the river, of which 79 were not recaptured. Given that the difference in the estimates is not substantial, we recommend using depletion estimates for this project instead of mark-recapture." (Webber 2010, pg.4).

- NOP data from Finney and Haines (2008) and Webber (2010) indicate that of the NOP marked annually for population estimates in the buffer zone, an average of ~100 of these marked NOP are not recaptured and may move downstream into critical habitat.

- Bioenergetics modeling projects a substantial predatory impact on prey (1,000 pounds consumed per year) by ~100 NOP @~600 mmTL consuming 10 lb prey/year (Johnson et al. 2008). Given that NOP in the YAR live more than ten years (Johnson et al. 2008) and grow ~105 mm (4.1 inches) per year (Wright 2010), the implications for long-term predation impacts by individual NOP that remain at large following tagging and release for population estimation purposes is considerable.

- It is recommended that NOP captured in the YAR buffer zone between Hayden and Craig not be released back into the river to maximize the intended function of the buffer to limit downstream movement of NOP into critical habitat and that alternate indices of NOP abundance be employed to monitor NOP population trends.

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