

Jeff Sorensen comments (11/17/00)

Thank you for the opportunity to comment on developing Grand Canyon natural resource targets. I am only providing comments on the Kanab ambersnail. In developing resource targets for this mollusk, please keep in mind that there are certain legal requirements (and dedicated funding) linked to the management and conservation of this endangered species. Caution should be used in developing these targets so that the obligations and authorities of state and federal agencies, charged with the protection of species of special concern, are not superceded.

Before I provide my target recommendations, I want to present some of my concerns associated with Kanab ambersnail sampling that must be considered in planning future management goals and activities. Needless to say, I prefer to error on the side of caution in the conservation of this endangered mollusk, given the many unknowns and limits to our ability to quantify its population size. Sampling cryptic species is problematic, and the derived results can be difficult to interpret. However, resource managers still need to make informed decisions (even if they are based on best guesses) on the status and population trends of species of concern. That being said, here are a few things to consider on the reliability of ambersnail population estimates...

Population estimates for the Kanab ambersnail have wide ranges of variance, and may be subject to observation and extrapolation error. Bootstrapping is a valid statistical method for determining population estimates of cryptic species where many zero data points occur in the pool of sampling data. Unfortunately, bootstrapped estimates are based on general assumptions about the population and sampling that may or may not be correct (e.g. ambersnails are equally distributed throughout their habitat, all samples are collected randomly, sample data accurately represents the actual population densities, and sampling bias among researchers is minimal or negligible).

I do not believe that ambersnails are equally distributed throughout their habitat at Vaseys Paradise. We know that ambersnails are more concentrated in certain patches of primary vegetation during different seasons (i.e. ambersnail densities are higher in water sedge and monkeyflower patches during the late fall, winter, and early spring, while in the late spring, summer, and early fall they are generally more abundant in watercress patches). This condition is evident in five years of monitoring data, as well as field observations by many veteran investigators. It is not uncommon in nature to see clumping of individuals across a mosaic of habitat patches, or even within a homogenous patch. We are still trying to understand the microhabitat qualities that separate high-density ambersnail habitat to lesser used, but equally potential habitat.

Our method of **subsampling** is not truly "random" by the statistical definition. It is more appropriately called "haphazard selection", whereby repeated 20-cm diameter sample rings are tossed into a habitat area. While most investigators attempt to get the best representative sample of a vegetation patch, these ring tosses may be biased (consciously or unconsciously) in their location and type of habitat that they cover.

In a series of observation error tests that I conducted as part of my thesis research (final is forthcoming in 2001), I found a huge discrepancy in the ability of subsampling to determine actual population densities in a homogenous watercress patch (Patch 7NU-Apron) over different

seasons. Standard subsampling efforts were compared to total census efforts of this patch in spring, summer, and fall surveys. I found that subsampling had overestimated ambersnail densities in this patch by 470% in the summer and 490% in the fall. Even when young snails (<5 mm in shell size) were removed from these counts, subsampling still overestimated ambersnail densities by 430% in the summer and 540% in the fall. In contrast, there was only a 1% difference in subsampling and total census estimates in the spring. Most likely, the overestimates of subsampling in the summer and fall were due to a non-proportionate amount of sampling areas having clumps of ambersnails rather than more open, unoccupied habitat.

While we have a pretty good understanding of where ambersnails are more abundant over the different seasons, extrapolation errors in bootstrapping may result in an overestimate of the true population size at Vaseys Paradise. For example, the April 1998 survey of Patch 6RMDR had a bootstrapped calculated mean of 13,796 ambersnails (5%-tile was 3247 and 95%-tile was 24,348). This number represented 76% of the total number of ambersnails estimated to be residing at Vaseys Paradise below the 100,000 cfs stage discharge. Unfortunately this estimate was based on ONLY three sample plots (or 0.1% of the total area sampled)! Patch 6RMDR is typically overwintering habitat for ambersnails and is extensive in area (78 m<sup>2</sup> area, or 39% of the ambersnail habitat below the 100,000 cfs stage in April 1998). It is a heterogeneous mixture of monkeyflower, water sedge, smartweed, maidenhair fern, poison ivy, and watercress that is densely overgrown. I agree that this patch does indeed harbor numerous ambersnails, especially in the late fall, winter, and early spring, but inadequate sampling of this patch compounds the risks of extrapolation error for total population estimates. The inclusion or exclusion of a single sample plot, that represents so much similar habitat, may change the mean population estimates by nearly 2000 snails (this was illustrated in the July 1999 survey of Patch 6RMDR, when 20 plots were sampled).

Management actions based on inaccurate bootstrapped population estimates (which are linked to available habitat area) could jeopardize the existence of the Vaseys Paradise ambersnail population if their actual numbers were reduced to less than several thousand. While a river flow of 60,000 cfs is unlikely to jeopardize this population under ideal habitat and climatic conditions, it would have lasting effects for at least two years (as evidenced by the recovery rate following the 1996 flow). Natural overwinter mortality of Vaseys Paradise ambersnails range between 25 and 80% (based on monitoring data over the last five years). Warm, dry winters and reduced suitable habitat will affect the severity of overwinter mortality. These are natural processes already in place that the ambersnail population has existed with. A deliberate high flow following these adverse conditions is not a situation that would have historically occurred, and therefore would not mimic a natural process. A high flow following a warm, dry winter will have a greater impact to the Vaseys Paradise population, which would already be reduced in its total population size. I do support flows up to 60,000 cfs that occur within a natural seasonal range (March-June) in years that follow cold and wet winters.

Critics are quick to argue that historic flows up to 100,000 cfs were more frequent prior to the dam. Indeed they probably were, but in all likelihood so were additional meta-populations of ambersnails throughout Glen and Grand Canyon--which would have relied on large floods to regularly disperse individuals from site to site (the process of local extinction and recolonization). Meta-populations residing in Glen Canyon (prior to being drowned by Lake

Powell) would have provided a source of immigrants and genetic variation for the Vaseys Paradise population. While we can mimic the natural processes of historic floods, we do not have all the historic conditions present that ensure the persistence of extant populations when we experiment with the ecosystem.

In addition, I am skeptical of the premise that there is a sufficient number of ambersnails existing in the very high zone (above 125,000 cfs stage) of primary vegetation at Vaseys Paradise, that are capable of repopulating the site following extreme historic-level floods. I should add--at least not capable of maintaining the current genetic identity of this unique taxon. A team of climbers investigated this upper habitat in June 1995 and reported "numerous" ambersnails in the watercress and monkeyflower patches bordering the waterfalls. The snail densities in these very high zone areas were only 0.03-0.04 snails/m<sup>2</sup>, while densities in the low zone patches of watercress and monkeyflower were 500-4000 times higher (20-160 snails/m<sup>2</sup>). Due to drought conditions, I was able to climb up the face of the Vaseys Paradise waterfall in July 2000, and conducted a limited survey of the same very high zone patches previously studied in 1995. I found densities of ambersnails in the very high zone habitat at 0.02-0.25 snails/m<sup>2</sup> (in monkeyflower and watercress, respectively). Again, we had much higher densities of snails in the low zone habitat during this same survey. What does this indicate?...possibly the best ambersnail habitat (and greatest concentration of the population) is below 125,000 cfs stage.

My recommendations for Kanab ambersnails in Grand Canyon:

1) Population target for Vaseys Paradise--maintain 60% or more (this requires further analysis) of the total estimated population at the site, based on ideal habitat and climatic conditions. If available habitat is significantly reduced from previous natural and/or anthropogenic impacts, and harsh overwinter climatic conditions exist, consider using the lowest range of the population estimate as a base. Conduct standardized monitoring surveys in the spring (to determine overwinter survival and estimates of habitat area and population size) and in the early fall (to document reproduction/recruitment, parasite infection, and habitat area and population size). Monitoring would be reduced to only two surveys per year, instead of the four surveys typically conducted in the previous three years.

2) Population target for Arizona locations other than Vaseys Paradise (current translocation sites in Grand Canyon)--maintain local densities within the range observed at Vaseys Paradise for comparable area of monkeyflower habitat (since this is the predominant vegetation type at the release areas). Conduct standardized monitoring surveys on the same schedule for Vaseys Paradise surveys. Limited augmentation of wild stock from Vaseys Paradise may be needed occasionally to maintain genetic variability and/or boost population size of translocated snails. Ideally this stock would be collected from low zone habitat at Vaseys Paradise prior to anticipated high flows, which would be lost anyway due to inundation and displacement.

3) Area of suitable vegetated habitat at Vaseys Paradise--maintain 60% or more (this requires further analysis) of the total primary habitat (monkeyflower, watercress, water sedge, and smartweed) at the site, based on ideal habitat and climatic conditions. I suggest that flow experiments not exceed 30,000 cfs stage discharge in years following warm, dry winters.

For now, I based the 60% amount of habitat and population size on the condition that Vaseys Paradise habitat has increased by 40% (and presumably the population, too) since the construction of Glen Canyon Dam. I reserve the right to change my opinion on this amount as further investigation might provide better insight. Ideal habitat and climatic conditions could be defined as those conditions that were present in 1995, and possibly in 2000 (the drought notwithstanding).

**Responses to KAS Review Panel Recommendations**  
by  
**Chris Karas, Tony Morton, Randy Peterson, and Dennis Kubly**  
November 20, 2000

**EXECUTIVE SUMMARY**

Members of the Kanab Ambersnail Work Group in the Bureau of Reclamation Upper Colorado Region office have reviewed the report of Kanab ambersnail expert panel and the recommendations for future management actions. We greatly appreciate the panel's efforts, and are giving serious consideration to their recommendations. The panel completed their report as requested based upon the best information available; however, this was incomplete with regard to genetics, ecology, and evolutionary history of the taxon, as they stated in the report. The Bureau of Reclamation, through the Glen Canyon Dam Adaptive Management Program, undoubtedly will pursue additional tests of beach/habitat-building flows of a greater magnitude than the previous 45,000 cfs, as well as other tests of dam operations that could have effects on the *Oxyloma* population at Vaseys Paradise. Test flows which are different from those described in the Record of Decision will require additional evaluation under the National Environmental Policy Act and Endangered Species Act. The Bureau of Reclamation also will pursue development of a "roadmap" to revision of the existing recovery plan for the taxon now known as *Oxyloma haydeni kanabensis*. The results of the expert panel's report will be used to help formulate the basis of these analyses.

A synopsis of our findings follows:

- We agree that our knowledge of the taxonomy, distribution, and ecology of the *Oxyloma* population occurring at Vaseys Paradise, and of other *Oxyloma* populations, is insufficient to make well-informed management decisions and that further studies of the taxon are warranted.
- We find a conflict in logic between the report's characterization of Vaseys Paradise as a representative highly variable environment subject to extreme fluctuations and containing snail populations that wink on and wink off, with the contrasting proposition that the only likely history of *Oxyloma* at that site being one of uninterrupted persistence since before the Pleistocene. We find other scenarios for the history of this taxon, including those acknowledged by the panel, as having sufficient potential not to be discarded, particularly in the face of our limited knowledge of the genetics, biogeography, and ecology of this taxon. For example, it is possible that one or more other populations of this taxon previously existed in the region, and served as founder populations for recurrent extirpations at Vaseys Paradise. These populations may have been lost to natural processes, or they may have been extirpated by anthropogenic causes, such as filling of Lake Powell. It also is possible that other populations presently exist, but that they have not yet been discovered by our limited surveys. Since these other scenarios do not necessarily assume the continuous long-term presence of the population at Vaseys

Paradise, we think a more conservative approach to the welfare of this population is warranted, particularly given the implications for dam operations.

- We agree that the Fish and Wildlife Service incidental take limit should be re-evaluated, and note that this has been done, in light of recent research results and the panel's findings.
- We agree that the frequency and intensity of monitoring the VP *Oxyloma* population should be evaluated with respect to impacts on the population and its habitat relative to benefits from information gained by that activity. We do not, however, think that the existing level of monitoring has nearly the short-term or long-term effect on the population as would a 40% reduction in habitat from a high controlled flood.
- We agree that the parasite *Leucochloridium cyanocittae* does not represent a threat to *Oxyloma* populations or to other mollusk populations.
- We disagree with the contention that the risks of translocation and establishment of new populations outweigh the benefits afforded by redundant populations of a federally listed species to water and wildlife resource managers. We think that captive populations have a value for both research and educational purposes, even if they are unsuitable as sources for reintroduction.
- We agree with the necessity of revising the existing recovery plan for *Oxyloma haydeni kanabensis*. We think, however, that revision can not occur without additional new information on the identity and distribution of the VP *Oxyloma* and other *Oxyloma* populations. Therefore, we propose a "roadmap" to recovery be developed, complete with necessary tasks and a schedule of attainment, which, when completed, would provide the necessary information for plan revision.
- Based on language in the report, the panel seems to have been concerned that work being done to recover the Kanab ambersnail has taken precedence over, or blocked implementation of, other ecosystem management activities for the Grand Canyon as a whole. The Service did submit in their biological opinion on the 1996 beach habitat-building flow that Reclamation should enter into informal consultation prior to conducting a second beach habitat-building flow, and that formal consultation would be required if the incidental take was expected to exceed 10 percent as established in the 1995 biological opinion. There was a difference of opinion between Reclamation and the Service on whether a second population had to be established before a second beach habitat-building flow was initiated. This difference of opinion did not have to be reconciled, however, because no decision was made to go forward with a subsequent beach habitat-building flow and the Service has since rescinded this requirement. Likewise, Grand Canyon Monitoring and Research Center funds expended on the Vaseys Paradise Kanab ambersnail population were used for compliance with the Endangered Species Act, which remains a legal responsibility of Reclamation. Voluntary recovery activities, including the establishment of additional populations in Grand Canyon and experimental work at The Phoenix Zoo were funded from sources unavailable to the Center.

## FINDINGS

**ISSUE 1:** There is insufficient knowledge of the taxonomy and systematics of the genus *Oxyloma* in the Colorado River drainage to ascertain the identity of the Vaseys Paradise population and its relationship to other *Oxyloma* populations.

**Panel Recommendation 1.** Additional analyses of shell morphology, anatomy, and molecular genetics (e.g., mitochondrial DNA), using state-of-the-art methods, are urgently needed to resolve taxonomic, phylogenetic, and, in part, distributional questions.

**Reply:** We agree with the panel's recommendation. The taxonomic status of the *Oxyloma* population at Vaseys Paradise, and the relationship of that population to other *Oxyloma* populations, both within the Colorado River drainage and outside those boundaries, can not be ascertained adequately with our existing knowledge. The panel recommends a genus-wide study, including Old World specimens. We agree that this broad spectrum is desirable, but we suggest that research should be prioritized on the basis of proximity to the Grand Canyon region populations, and that *Oxyloma* populations within the Colorado River drainage should be analyzed first. We also think it is imperative that results of research on *Oxyloma* populations presented at the workshop in December 1999, in both molecular genetics and anatomical arenas, should be published as soon as possible. KAWG members should seek funding, external to the Glen Canyon Dam Adaptive Management Program, to accomplish these tasks.

**ISSUE 2:** Presuming the *Oxyloma* population at Vaseys Paradise has been in existence for millennia, and that it has persisted during natural floods well in excess of those occurring since the emplacement of Glen Canyon Dam, is the Fish and Wildlife Service 10% incidental take limit justified.

**Panel Recommendation 2.** Floods that will result from proposed releases from Glen Canyon Dam (i.e., beach habitat-building floods of 45,000-90,000 cfs) will be well within the natural (pre-dam) range of variability. In fact, a strong case can be made that releases should be increased to more closely match the natural hydrologic regime, including inter-annual variability. There is no reason to believe that the population cannot survive floods of pre-dam magnitude (90,000-125,000 cfs or greater) in the future. There is no ecological basis for the 10% take limit set by the U.S. Fish and Wildlife Service, which corresponds to regulated floods (dam releases) of approximately 25,000 cfs (higher by some accounts). Additional field surveys of potential succineid habitats both upstream of GCD and downstream within the Colorado River drainage, as well as in regions outside the Colorado River Basin that provide potential habitat.

**Reply:** Many of the panel's recommendations rest on a set of assumptions, namely: (1) Vaseys Paradise is representative of other spring habitats in southwestern United States, which are "highly variable environments, subject to extreme flooding, drought, and

associated fluctuations in water table and outflow.” *Oxyloma* populations in the Southwest “were probably always isolated and were regularly decimated by natural events. Hence, populations of these snails can be assumed to have winked on and off over time.” (2) The VP *Oxyloma* population has been continuously resident at that site for a very long time, at least since the beginning of the Pleistocene. It has not undergone extirpation and successive recolonization from one or more founder populations. (3) *Oxyloma* populations in Grand Canyon were always of very limited distribution. It is unlikely that the Vaseys Paradise *Oxyloma* population is a surviving population of a larger, and more widely distributed, complex.

We find the assumptions upon which the panel based its findings questionable and, in some cases, contradictory. For example, if spring habitats in the desert southwest are as characterized, can we expect that the VP *Oxyloma* population has persisted continuously since at least the beginning of the Pleistocene? Or is it just as feasible that this population has been periodically extirpated and then recolonized by dispersal from founder populations that remain undiscovered or have themselves been extirpated. Lack of other conspecific *Oxyloma* populations, whether extant or present only as fossil remnants, may be attributable to the limited surveys for mollusks in this region. Our point is that there are alternative histories and ancestories for the VP *Oxyloma* population and, potentially, for other *Oxyloma* populations in the Grand Canyon region. Unfortunately, the panel only alluded to them and did not describe them explicitly to participants of the workshop or indicate the extent to which the alternatives were considered. This is unfortunate, because most of the panel’s recommendations for management rest on the assumption that the VP population has continuously occupied the site for many millennia in spite of the impacts of the Colorado River and other naturally occurring events.

We agree with the recommendation for additional surveys for *Oxyloma* populations, but we are not clear why this recommendation is being made if the panel recommends against further translocations. Again, we would prioritize the effort first to the Grand Canyon region. Additional funding outside conventional sources would undoubtedly have to be obtained to carry the investigations into other regions. As the Adaptive Management Program pursues test flows of greater magnitude, which will likely have greater impacts on the VP population, redundant populations become increasingly important given the uncertainties recognized in the panel’s report.

**ISSUE 3:** This issue is focused on whether there is justification for differentiating primary and secondary habitats (defined by vegetation) for *Oxyloma* at VP, and whether there are characteristics of the VP site that create unique habitat for the *Oxyloma* population.



**Panel Recommendation 3.** No specific recommendations were made for this issue.

**Reply:** The panel found that ascribing all occupied habitat as “critical” to the *Oxyloma* population’s survival was fallacious. They apparently misinterpreted the identity of secondary habitat, however, in that they held “the secondary habitat would not have been there consistently in any abundance under the pre-dam flow regime” and that it occurs only in the “lower zone habitat, below the 45,000 cfs line.” Vegetation comprising secondary habitat is distributed widely across the VP talus slope, and is not restricted to the area that would have been affected by pre-dam flows.

**ISSUE 4:** Within Grand Canyon National Park, presumed Kanab ambersnails (*Oxyloma haydeni kanabensis*) are limited to VP, and no other populations have been detected in surveys of more than 100 seeps and springs. Is the VP *Oxyloma O. h. kanabensis*, what was the population’s origin, how long has it been at VP, and what is its relationship to other *Oxyloma* populations?

**Panel Recommendation 4.** The panel noted that the VP *Oxyloma* population may be a “Pleistocene relict which was formerly more widespread” or “equally plausible that this particular taxon has always been restricted to this site or a small collection of sites, whether narrowly or widely distributed, with other occurrences yet to be discovered.” The panel concludes from “(w)hat is known, so far, of its genetics” that the VP *Oxyloma* population has been in place and isolated from other populations for a long time, “perhaps much earlier than the Pleistocene.”

The panel advises against “frequent, intensive population surveys, because they are expensive and destructive of vegetation and snails.” They suggest that an annual survey using a photographic series combined with observations of egg masses and young of year would be sufficient. Although they advocate against frequent, intensive population surveys, they are less concerned about loss of habitat from dam operations and find that “initial (habitat) take of 40% would almost certainly not threaten persistence of the snail population.”

The panel believes that take of 40% of the currently occupied VP snail habitat would not threaten the population.

**Reply:** The panel has reached the conclusion that the most parsimonious explanation for the VP *Oxyloma* population’s origin and ancestry is that it “has always been restricted to this site or a small collection of sites” and that it has been present at VP since “perhaps much earlier than the Pleistocene.” They leave us with a dilemma because earlier they portrayed springs such as Vaseys Paradise as “regularly decimated by natural events” and their resident snail populations as having “winked on and off over time.” If the VP population follows this pattern, it may have been periodically extirpated and subsequently re-established by individuals from other populations that may no longer exist, or that have not yet been discovered. Until further sampling, as advocated by the panel, is completed,

or other populations are established through translocation, we find it difficult to accept the risk that take of 40% of the currently occupied habitat would not threaten the population.

We agree with the sentiment against more frequent and invasive sampling than is necessary to understand status and trends for the VP *Oxyloma* population. The KAWG should discuss the panel's recommendations and ascertain what level of sampling will be necessary to determine whether the population or habitat is declining and what factors are contributing to the decline. We also think, however, that periodic surveys of habitat and ambersnails in the upper habitat zone, which has only been assessed one time to date, must be accomplished to determine the baseline against which future management actions should be compared.

**ISSUE 5:** This issue concerns effects of managed flood regimes and overlaps with issues 2 and 4.

**Panel Recommendation 5.** The panel viewed floods as an element of a natural dynamic process, not something that destroys habitat. Only a "Noah-size" flood really threatens the snails.

**Reply:** The panel responds that "flooding is not "habitat destruction;" rather, it is a natural process that creates a variable patch dynamic characteristic of these riverine environments." Federal agencies faced with complying with the Endangered Species Act (ESA) can not assume this attitude toward managed floods when they adversely affect a listed species. The panel's response may be correct from an academic standpoint, but their position is not in concert with agency legal requirements under the ESA. We continue to believe that redundant populations is the best means of ensuring the continued existence of the species while evaluating the effects of test flows of greater magnitude.

**ISSUE 6:** This issue deals with avoidance of jeopardy by Requirement of ESA not to jeopardize species.

**Panel Recommendation 6.** The panel recommended against translocations, terming it an effort of last resort for use in emergency situations. They contended this practice leads to continued agency intervention, is expensive, and disruptive of the animals and habitats. However, the panel was supportive of re-introductions to areas of *known* previous inhabitation. The panel felt that species "resilience" was more important than any prescribed level of population or habitat stability.

**Reply:** We disagree with the conclusion that translocation efforts are not warranted. We see the sites of introduction as important insurance for the future when we assumedly will allow greater risks to the VP *Oxyloma* population by releasing higher beach-habitat building flows (BHBF) intended to benefit the entire ecosystem. We agree with the panel

that attempts to establish snails at additional locations may not warranted at this time, but we think that augmentation of sites having already received ambersnails is justified, particularly if snails used for translocation are salvages from the effects of future BHBFs.

We disagree with the panel on the value of captive populations. Populations established at The Phoenix Zoo and at Glen Canyon Dam were never intended to be used for re-introduction or establishment of new populations, so that is not an issue. The dam population is a research population, held under a research permit, and not intended for long-term purposes. The zoo population has a definite role to play in educating the public about southwestern springs, their flora and fauna, and species listed under the Endangered Species Act. We consider these purposes worthwhile and the populations justified.

**ISSUE 7:** Infection by the parasite *Leucochloridium cyanocittae* and the importance of preventing its dispersal during translocations.

**Panel Recommendation 7.** The panel found this to be a “non-issue,” except to restate their position that further translocations are not justified.

**Reply:** We agree with the panel’s conclusion on the lack of danger to *Oxyloma* or other snails from transfer of the parasite. It should be noted that because there was insufficient information available regarding the parasite, only small snails believed to be free of the parasite were translocated.

**ISSUE 8:** Criteria for establishment of new populations and justification of the action.

**Panel Recommendation 8.** Establishment of new populations is not justified. The recovery plan and biological opinions for the VP *Oxyloma* population should be re-written as soon as the major taxonomic issues are resolved. The Vaseys Paradise population may warrant listing and conservation as a distinct, imperiled taxon, perhaps as a single-site endemic.

**Reply:** We agree with the necessity of updating the recovery plan and are willing to assist the Fish & Wildlife Service in achieving that objective. We also think that there is a large amount of knowledge to be gained on the identity and distribution of what is now deemed to be the Kanab ambersnail at VP before the recovery plan can be revised. Therefore, we propose that a recovery implementation plan be written as a bridge to the revised recovery plan. The plan would lay out a list of actions and a schedule for completion. When completed, results of the proposed actions would provide the necessary information to revise the recovery plan. The revised plan would undergo the same degree of public review, including a notice of availability in the Federal Register and public comment period, as any other recovery plan prepared by the Service.

**What happens next?**

The Bureau of Reclamation does not intend to re-consult on the preferred alternative which is contained in the Record of Decision. However, the Service has formulated an amendment to the January 7, 1995 and February 16, 1996 biological opinions to correct an inaccuracy and adjusted the level of take occurring from a BHBF of 45,000cfs. Furthermore, the requirement for establishment of a second population in Arizona has been rescinded. Any future test flow different from the ROD will still require ESA consultation and NEPA review. Assuming a finding of may affect in Reclamation's biological assessment, formal consultation will be required. The Service will develop a biological opinion with a reasonable and prudent alternative (RPA) if they determine the proposed flow will jeopardize the continued existence of the species. The Service will include reasonable and prudent measures (RPM) designed to minimize take, and terms and conditions for their implementation, if incidental take will occur. We have no reason to believe that we will be unable to identify an RPA or RPM for future consultation, as has been done for all past consultations to date. In addition, Reclamation will pursue development of a "roadmap" to revision of the existing recovery plan and to implementation of tasks necessary to improve our knowledge of the Kanab ambersnail.

February 10, 2000

The position statement presented below comprises the individual viewpoints of Jeff Sorensen, Clay Nelson, and Michael Demlong concerning Kanab ambersnail research and management, specifically addressing recommendations by the KAS expert review panel.

This statement does not comprise an official AGFD position.

#### 1) ADDITIONAL TAXONOMIC AND GENETIC STUDIES

We agree that additional taxonomic, genetic, and character analyses of ambersnail populations are urgently needed, and interagency cooperators should make it a priority to secure funding for this work. Future studies should contain more robust sample sizes from each population, incorporate additional markers in genetic analysis, and improve collaboration and synthesis of data between taxonomists and geneticists in reporting to resource managers. While peer-reviewed manuscripts are the preferred medium for disseminating results, agency reports will suffice in order for resource managers to make timely decisions affecting ecosystem management. Likewise, if new management decisions on the Vaseys Paradise (VP) population are to be made soon, then perhaps it is best to focus additional studies on ambersnail populations of the Colorado River Basin first, rather than the global distribution of succineids as proposed by the review panel. A thorough investigation of the whole family of Succineidae may be overly ambitious given the likelihood of available funding, personnel, and logistical resources. An exhaustive genetic/ morphologic study and revision of the Succineidae family may take several years to complete, whereas administrative concerns require decisions much sooner. We encourage Stevens, Wu, and Miller to publish their recent findings and continue additional genetic/morphologic studies. Although Wu has retired, the KAWG should inquire on his availability to continue identifications of ambersnails or pursue his recommendations of other landsnail taxonomists.

#### 2) ADDITIONAL HABITAT SURVEYS

We agree that additional field surveys of potential succineid habitats is warranted, particularly throughout watersheds within the Grand Canyon region. Although potential habitat may exist outside this region, surveys should initially be focused in this area using cooperative efforts among private, state, and federal resources. If additional funding and personnel become available, these surveys could be expanded beyond the Colorado River Basin. A formal study of mollusk fossil distribution throughout this region may add insight into the historical range of the genus *Oxyloma* and other native landsnails.

#### 3) TRANSLOCATION AND CAPTIVE POPULATIONS

We believe the associated Biological Opinions on KAS and dam operations and the 1995 KAS recovery plan may need to be reviewed, to reflect new information and alternative management options. Until these legal obligations and conservation guidelines are changed, we will continue

to support the monitoring of all wild populations of KAS (including translocated populations in the Grand Canyon), and further research with captive experimental and refugium populations. It is advisable not to pursue introductions of KAS to any new sites, other than the three previously approved sites in Grand Canyon, until additional taxonomic/genetic studies and more widespread habitat surveys are completed. Initial attempts to establish a new population of KAS at "KeyHole Spring", Upper Elves Chasm, and Lower Deer Creek are valid activities to meet recovery objectives for the species and to alleviate Biological Opinion restrictions on the operation of Glen Canyon Dam. KAS translocations to new sites met the required environmental compliance review process, and provided an active approach in endangered species conservation not without precedent. As of October 1999, KAS appear to be establishing at Upper Elves Chasm with new progeny and successively greater population densities observed with each visit. These new populations have full protection under the Endangered Species Act, and are not "non-essential, experimental" like many other reintroduced native wildlife. In light of the genetic uniqueness of the VP population, we recommend the Upper Elves Chasm population receive limited augmentation to maintain genetic variability and boost population demographics. If Upper Elves Chasm becomes a successful establishment site (i.e. self-sustaining), then several legal restrictions to future BHBFs will be reduced.

We disagree with the review panel concerning the usefulness of captive KAS populations. These populations provide data on life history, ecology, husbandry, and observation error tests, that would be difficult or impossible to gain in a field setting. Captive experimental and refugium KAS populations also provide education and outreach opportunities. The KAS interpretative display at Glen Canyon Dam (overlooking the outdoor enclosures) is viewed by thousands of visitors each year. A proposed artificial desert spring exhibit at The Phoenix Zoo (with a KAS interpretative panel) would also inform the general public about native riparian species and the role of springs in the Grand Canyon ecosystem. We recommend maintaining the Northern Arizona University (NAU) experimental population and The Phoenix Zoo refugium for research, conservation, and educational goals. The Glen Canyon Dam population should be relocated to either Denver's Ocean Journey Park or back to NAU. The information gained in the construction of captive enclosures, maintenance of habitat, and sampling techniques may prove to be very useful for preserving and propagating other critically endangered mollusks or spring invertebrates.

#### 4) POPULATION VIABILITY ANALYSES

We support the investigation of non-invasive, scientific approaches that will increase our ability to conserve KAS. Several mathematically-based methods (i.e. elasticity analysis and habitat dynamics models) exist which can better estimate KAS population dynamics at VP, and should be considered in future management decisions. Population and habitat models for KAS should be founded on empirical data from wild and captive populations. Initial population viability analyses of the VP KAS were designed to determine what life history data was missing, and to evaluate the range of stochastic variation using current bootstrapped estimates. We believe future research should attempt to answer these life history questions, and use new or modified sampling methods to improve population estimates (specifically in the reduction of wide variances associated with extrapolation).

## 5) HISTORIC AND CURRENT FLOW REGIMES

We concur that flooding from dam releases, within historic levels, ecologically benefits the river ecosystem. Provided, the VP KAS population is equally abundant in the upper slope habitat of the spring. Only one survey was made in this upper habitat in 1995, at a time when sampling methodology for KAS and habitat area was still being refined. Current bootstrapping estimates of the VP population contain huge variances and varying degrees of extrapolation error. The comparison of KAS abundance in the upper habitat versus the lower habitat of VP needs to be statistically supported with adequate sample data. If few KAS actually occupy the upper slope of VP, the ability to sustain a viable population after a large, historic-level flood may be greatly diminished.

## 6) VASEYS PARADISE AND THE 10% TAKE LIMIT

It may be inaccurate to describe the current VP habitat and ambersnail population as “unnatural” or “artificially large”. During the last 50 years, Glen Canyon Dam has created major environmental changes in the downstream ecosystem. However, the successful colonization of available flood-zone habitat by VP flora and fauna is a natural process in direct response to environmental changes (whether human-caused or natural variation). Historically, the VP habitat may have expanded and contracted due to any number of environmental factors (i.e., wet or dry periods, changes in spring pourouts). Habitat size and KAS abundance at VP may be within the range of natural variation, but this is difficult to quantify without historic data. Turner and Karpiscak (1980) show some variation in extent of VP habitat due to flood scouring in re-matched photographs from 1923 and 1974. Dam operations can attempt to mimic natural disturbance processes through the use of BHBFs, but not all of the natural process or resources of the historic river ecosystem exist today.

We support past and current efforts by the USFWS and USBR to reduce incidental take of VP habitat and KAS conservation activities. To remove the legal limitations to future BHBFs, the USBR could re-consult with the USFWS on the Biological Opinions concerning KAS and dam operations, and continue current conservation activities in the interim. We will continue to support recovery plan objectives or science-based revisions, and believe that the decisions made with regards to the Biological Opinions were justifiable and appropriate based on the best available data. In 1994, the 10% incidental take limit of VP habitat was accepted by all involved agencies as a conservative measure and in the best interest of the species. This decision was made at a time when no ecological data or population estimates for VP was available. Management should allow flexibility over time, and it may be appropriate to modify levels of take based on new information and the status of the VP KAS under various climatic cycles and population trends. It should be noted that the recovery plan and Biological Opinions were created with the perception that they would be revised as additional information, improved population distributions, and new management strategies became available. We support a continuation of research, to gain a better understanding of KAS life history, ecology, propagation, observation error of various sampling techniques, and monitoring of wild and captive KAS populations to determine trends in population dynamics.

## 7) RECOVERY PLAN REVISION

We would support efforts to revise the 1995 KAS recovery plan to reflect new information and management options. If the revision is to wait for the results from additional genetic and morphological studies, then it may be a couple years before this priority task is accomplished (see above comment on additional taxonomic and genetic studies). It is suggested that an interim draft or similar interagency management strategy be written and implemented with adaptive management options for KAS, and acknowledging that the VP snails are genetically distinct. A great deal of new information can be incorporated now into the revised plan, while additional research is in progress.

## 8) ADMINISTRATIVE AND MANAGEMENT DECISIONS

We agree that all administrative and management implications of new findings pertaining to KAS should be disseminated to all interested parties in a timely manner. The KAWG has been exemplary in promoting communications through quarterly meetings since 1995, providing administrative support, and participation in the December 1999 KAS workshop. Compared to other species of concern in the Grand Canyon ecosystem, the KAWG provides an active and functional forum for interagency discussion and coordination of KAS conservation efforts. Future management plans should continue to be reviewed by the KAWG and subjected to a review process as appropriate to allow for additional perspectives prior to implementation.

### A timeline perspective of conditions and events involving KAS in the Grand Canyon region:

1909 - KAS first discovered in Kanab Canyon, Utah; later a second, larger population is discovered at Three Lakes, Utah (both sites on private land).

1948 - Pilsbry revises the taxonomic identity of KAS to its current sub-species status.

1976 - Cole and Kubly visit VP--snails found are believed to be *Lymnaea* (probably KAS?).

July 1991 - KAS discovered at VP by Spamer and Stevens; surveys of the Kanab Canyon locality fail to find any KAS--that population is believed to be extirpated due to de-watering.

August 1992 - KAS emergency listed as endangered by USFWS; planned commercial development threatens the Three Lakes population.

May 1993 - Bills and Stevens make a reconnaissance visit of VP.



1994 - Stevens begins searching for additional KAS populations along the Grand Canyon river corridor.

September 1994 - Interagency research on the VP population begins (Section 6 funded).

December 1994 - USFWS issues a biological opinion on the operation of Glen Canyon Dam and the planned 1996 BHBF--terms and conditions establish the 10% level of incidental take of VP habitat and the need for ecological studies of the VP KAS.

October 1995 - KAS recovery plan approved by USFWS.

February 1996 - A biological opinion is written on the March BHBF of Glen Canyon Dam.

March 1996 - A 45,000cfs BHBF impacts the VP site (~16% total habitat lost); interagency biologists move 1275 affected KAS above the flood zone at VP, and continue monitoring of VP KAS and habitat through October 1997.

April 1996 - A biological opinion amendment is written on the flood effects of the March BHBF.

June 1996 - AGFD begins habitat surveys in the Grand Canyon and northern Arizona to find additional KAS populations or suitable habitat--continue surveys through 1998. Initial genetic analysis of regional *Oxyloma* populations conducted.

1997 - VP habitat still not recovered from 1996 BHBF; to alleviate biological opinion restrictions to future BHBFs, AGFD enters a co-operative agreement with CUPCA to establish a new population of KAS in Arizona; The Phoenix Zoo agrees to establish a zoological refugium for KAS and begins building enclosures; USBR provides a grant and logistic support to AGFD to continue habitat surveys and further recovery and biological opinion activities to establish new populations of KAS in Arizona.

August 1997 - 248 KAS translocated from VP to conduct experimental captive-breeding studies at Northern Arizona University--continues through December 1999.

February 1998 - AGFD and NPS-GRCA begin the environmental compliance work for establishing a new population of KAS in the Grand Canyon; AMWG and TWG increase the planning for a BHBF in 1998; VP monitoring contracted out to SWCA for 1998-99.

July 1998 - An EA and BE on KAS translocation submitted for public review; Meretsky re-discovers the Kanab Canyon population (actually several metapopulations) located on private land and BLM land.

August 1998 - Both the EA and BE are finalized--three sites in Grand Canyon National Park are selected for KAS translocation; The Phoenix Zoo KAS refugium enclosures are completed, but available habitat is limited (delay start up till 1999).

September 1998 - NPS-GRCA submits a FONSI on KAS translocation, and USFWS responds with a biological opinion authorizing the action; 450 young KAS are collected from VP and translocated to the three sites (150 KAS per site); 450 KAS from the NAU experiment moved to outdoor enclosures at Glen Canyon Dam to further captive-breeding studies--continues through December 1999.

October 1998 - Monitoring of translocation sites begins--few KAS found at each site; a preliminary criteria for establishment determination is proposed by USFWS and NPS-GRCA; new genetic/morphological study of U.S. and Canadian ambersnails planned.

January 1999 - AGFD and GCMRC begin the planning and coordination of an independent expert review panel and interagency workshop for KAS; AMWG and TWG continue planning for a second BHBF, possibly in 1999.

May 1999 - 50 KAS from VP translocated to The Phoenix Zoo to start the captive refugium.

July 1999 - Augmentation of translocation sites with an additional 450 KAS from VP after new progeny and survivorship detected at all three sites; additional ambersnail populations discovered in Utah; new genetic/morphological study of ambersnails in U.S. and Canada underway--results due in November; review panel for the KAS workshop selected.

October 1999 - One of three translocation sites (Upper Elves Chasm) appears to be succeeding in establishment of KAS (lots of new progeny and mature KAS entering dormancy).

December 1999 - KAS workshop held at The Phoenix Zoo; new findings and the current status of regional KAS populations are discussed among the review panel and interagency participants--genetic/morphological studies generally inconclusive, except VP KAS are genetically distinct from other populations studied; panel recommends no further translocation of KAS, more genetic/morphologic work, more habitat surveys, and reduced VP monitoring.

January 2000 - TWG & AMWG briefed on the KAS review panel recommendations. KAWG begins commenting on these recommendations and developing questions of clarification.

February 2000 - KAWG meets to discuss recommendation and concerns. KAS review panel refuses to respond to additional questions unless additional money and new information is provided.