

Revised
12/04/00

Goal 7. Kanab Ambersnail Management Objectives

I do however, think we need to discuss the rationale for specific MOs for KAS at this time given that the expert panel has provided some pretty good advice and council on KAS ecology that seems to differ from USFWS assumptions that were codified in the BO. This discussion would in no way affect the legal requirements of the BOR regarding the KAS. It seems entirely reasonable that if the expert panel recommendations are to be adopted that the AMP may not embrace the same goals as the BOR for KAS. Further, I think that a similar discussion about SWFL would be in order.

Norm Henderson 10/24/00

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and authorities of state and federal agencies, charged with the protection of species of special concern, are not superceded.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 m² 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/m², while densities in the low zone patches of watercress and monkeyflower were 500-4000 times higher (20-160 snails/m²). 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/m² (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).

Jeff Sorensen 11/17/00

Goal 7 involves protection of Kanab ambersnail. The Kanab ambersnail population, like that of humpback chub, is presently large, healthy and reproducing well. The following management objectives should be considered:

- (1) Monitoring of habitat and population trends should be continued.
- (2) Resolution of its genetic status should be pursued.
- (3) Research into winter mortality, parasite impacts and biology, and habitat variability should be pursued.
- (4) The recommendations of the KAS Review Panel and GCMRC's 2000 biological protocol evaluation panel (PEP) should be followed.

Larry Stevens 11/18/00

Population target(s) for Vasey's Paradise.

It's not clear to me what the Park means by a "population target" or what tools it believes that it has to hit such a target in the event one is established. First, the question of the target:

The brief window of time during which we have observed ambersnails at Vasey's has shown us the wide, erratic swings of an r-selected invertebrate, a pattern that the expert panel, including some of the world's best malacological geneticists, malacologists, and more broadly-trained conservation biologists, found unalarming. Further, despite recent counters, it seems fairly clear that the Vasey's population has persisted in relative isolation at Vasey's for a considerable period of time - a taxon does not evolve to become as different from others in its genus as the Vasey's taxon has in a short period of time. Explorations upstream, uphill, and in most other directions from Vasey's have discovered other populations

of *Oxyloma* without discovering anything closely related to the Vasey's taxon, despite the fact that several of the discovered populations are clearly closely related to each other. Thus, there is no evidence that flood-driven dispersal from hypothetical upstream populations has been important to the persistence of the Vasey's population for a period of time far longer than the current planning period. Nor does the fluctuating nature of the habitat argue for a "winking" population at Vasey's (one that periodically becomes locally extinct) - it simply suggests that possibility at some sites. Spring habitats have certainly been characterized as changeable, and my research and that of others at the meeting support that characterization. But within any habitat type, there is a range of variability, and in any slowly changing (warming) region, there will be sites that are able to maintain an essential characteristics (in this case, moisture) and others that don't. That Vasey's should have managed to persist as an active spring since the Pleistocene is scarcely surprising given that it drains what is essentially the highest land area in the region, an area very likely to receive precipitation even in dry years by virtue of its elevation and position relative to local weather systems.

Given that the Bureau of Reclamation does not currently plan floods above the pre-dam average flow rate, there seems, as the expert panel indicated, to be little cause for concern for the Vasey's population of ambersnails. Certainly surprises may occur. It would not do to be entirely ignorant of the status of the population, if for no other reason than that it is protected by law, and it's difficult to protect what one never monitors.

If a target, for purposes of the Park, is a minimum below which various alarms will be sounded, then it should indicate a level of realistic concern. The panel has suggested that habitat losses within the range of those incurred by natural processes over the last few hundred years are acceptable, so a level of realistic concern should represent a population size obviously but not ridiculously smaller than that supported by vegetation present after such natural losses. To suggest numbers would be to open the door to more discussion than you will be able to permit, so I will leave the idea at this stage.

I would like, however, to visit the notion of what tools the Park might choose to bring to bear in the event that the ambersnail population at Vasey's suddenly crashes (given the nature of its demographics, a crash is at least as likely as a politely obvious decline). There seems to be general support for a captive population from Vasey's stock, and the dam population, at least, seems to be thriving. While I support the idea of monitoring at Vasey's, I don't encourage the Park to believe that it will be in a position to "rescue" the population in situ should a disaster occur. First, the taxon seems well able to rescue itself. Second, beyond perhaps transplanting back individuals from a captive population, there is likely to

be little to do that will not be obvious at the time without recourse to a population target. Exotic diseases will probably run their course before they can be detected, diagnosed, and cured; fire or other damage to habitat is unlikely to take out all of the habitat, and habitat restoration is reasonably obvious, etc.

Population targets for Arizona locations other than Vasey's Paradise.

Introduction of a taxon into areas it has not occupied in relatively recent times is widely regarded as unwise by the conservation community. In the absence of information about recent range, extreme caution is in order. The panel recommendations were quite clear on this point, and well founded in the current understanding of conservation biology. The current translocated populations were at least established in good faith and with some care. Regardless of the wisdom involved in their establishment, they do provide "backup" for the Vasey's population, and political relief which is welcome in at least some quarters. But to continue to promulgate populations is clearly irresponsible, and I would not support efforts to support current translocated populations that seem to be failing. Captive populations such as the ones at the dam, if maintained, can provide backup without constituting an impact to existing ecosystems.

Area of suitable vegetated habitat at Vasey's Paradise.

I seem to have addressed this in my remarks about population size, as population size and habitat area are inextricably, if not always clearly, linked. Some amount of area obviously but not ridiculously smaller than that supported by vegetation present after unexceptional natural losses would represent a reasonable level of concern. Losses associated with fairly common natural processes should not be of concern. Again, I leave the choice of numbers to those compelled to have them!

Vickie Meretsky 11/20/00

D:\My Documents\Kanab Ambersnail.doc

