POSSIBLE THREATENED OR ENDANGERED TERRESTRIAL PREDACEOUS COLEOPTERA OF THE COLUMBIA RIVER BASIN

Prepared for the Bureau of Land Management/U.S. Forest Service -- Eastside Ecosystem Management Project

By

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Preface

The following report was prepared by University scientists through cooperative agreement, project science staff, or contractors as part of the ongoing efforts of the Interior Columbia Basin Ecosystem Management Project, co-managed by the U.S. Forest Service and the Bureau of Land Management. It was prepared for the express purpose of compiling information, reviewing available literature, researching topics related to ecosystems within the Interior Columbia Basin, or exploring relationships among biophysical and economic/social resources.

This report has been reviewed by agency scientists as part of the ongoing ecosystem project. The report may be cited within the primary products produced by the project or it may have served its purposes by furthering our understanding of complex resource issues within the Basin. This report may become the basis for scientific journal articles or technical reports by the USDA Forest Service or USDI Bureau of Land Management. The attached report has not been through all the steps appropriate to final publishing as either a scientific journal article or a technical report.

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INTRODUCTION
AND
CRITERIA FOR ASSESSING THREATENED OR ENDANGERED STATUS

The major difficulty in attempting to ascertain the threatened or endangered (T&E) status of insect species (or invertebrates in general) is the virtual absence of adequate data. For many species we have little more than their taxonomic designations and a few localities from which they are known. What little data exists is often biased or prone to sampling error. For instance, collecting efforts constituting the basis of distributional or habitat data are highly dependent upon site accessibility, the taxonomic interests (or funding sources) of entomologists and the sampling methods utilized.

This problem is not an excuse to list species with abandon - very much the contrary! Vast lists of T&E candidate species about which virtually nothing is known or that are based solely upon single collecting events are worse than useless and are utterly irresponsible. "Rare" species have all too often been found to be relatively abundant or widespread, but were cryptic, restricted to poorly accessed or "uninteresting" habitats, required special collecting techniques or were simply not actively sought in the past. Formally listing or even recommending a species as T&E almost always has enormous economic, political and social implications. Individuals promoting T&E species have onerous obligations, not the least of which are maintaining the credibility of T&E listings and the feasibility of endangered species legislation. However, evading the issue by proclaiming ignorance is equally unacceptable. Some middle ground is clearly necessary. I used the following criteria to select <u>possible</u> T&E species:

1. The species is known from more than one collecting event.
2. Evidence exists that the species is restricted to potentially threatened, specialized, patchy habitat (s).
3. Evidence exists that the species has a very restricted geographic distribution.
4. Evidence exists that the species has poor dispersal capabilities.
5. Habitat threats have the potential to be managed with current technologies. For instance, insects existing in ground-water

near urban areas may be threatened by non-point source pollution. Realistically, imminent management of this problem is remote and such species are not feasible candidates.

Criteria #'s 1, 2 and 5 were requirements for any selected species. At least one of #'s 3 and 4 were required, but meeting both criteria was not essential. This approach is highly conservative, probably excessively so to many individuals. Nonetheless, because of the concerns I addressed earlier I would much rather err by excluding possibly valid T&E species than by including more species than strictly necessary. It should be noted that the current legislative moratorium on listing any more T&E species may render these concerns moot.

The "sensitive/special interest species" previously dealt with in my earlier report via the panel data were not subjected to this screening process. These species originated from sources other than myself. They will be addressed in this addendum and will be clearly distinguished as originating from the earlier list.

My "new" list will exhibit two forms of bias. First, my primary research focus is upon Carabidae. Second, the bulk of my Columbia River Basin experience is in northern California, Oregon and Washington. My experience in Idaho, and especially Montana, is much more limited. Specialists in other families or with more extensive experience in Idaho and Montana may well recommend additional species. Dr. Paul Johnson of South Dakota State University recommended *Ctenicera barri* (Elateridae) for listing.

A list of potentially threatened T&E CRB terrestrial predaceous beetles based upon the original "sensitive species" list and the above criteria and biases follows. Discussions of each listed species are provided thereafter.

LIST OF POTENTIALLY THREATENED AND ENDANGERED TERRESTRIAL PREDACEOUS COLEOPTERA OF THE COLUMBIA RIVER BASIN

SPECIES	FAMILY	CRITERIA MET
Agonum belleri Hatch	Carabidae	1,2,3,4,5
**Cicindela arenicola* Rumpp	Cicindelidae	1,2,3,5
**Cicindela columbica* Hatch	Cicindelidae	1,2,3,5
Ctenicera barri Lane	Elateridae	1,2?,3,4?,5
**Glacicavicola bathyscoides* Westcott[a]	Leiodidae	1,2?,3,4,5?
**Nebria gebleri fragariae* Kavanaugh	Carabidae	1,2?,3,4?,5
**Nebria gyllenhali lassensis* Kavanaugh	Carabidae	1,4,
**Nebria paradisi* Darlington	Carabidae	1,4
**Nebria vandykei wyeast* Kavanaugh	Carabidae	1,2?,3,4,5?
Scaphinotus mannii Wickham	Carabidae	1,2,3,4,5

*Species dealt with in previous report and panel data.

a. Although initially believed to be predaceous, recent published literature indicates this species feeds upon bacterial slimes and/or dead invertebrates. Personal communication with Mike Ivie (Montana State University) suggests it is indeed predaceous upon other cave invertebrates.

Agonum belleri Hatch
(Coleoptera: Carabidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Hatch 1933).

Habitat Description and Requirements

This species has been recorded from southwestern British Columbia, northernmost Oregon (Mount Hood) just east of the Cascade Crest and western Washington from the eastern Puget Sound to the Cascades. The Oregon sites are just at the western margin of the Columbia River Basin, as defined by the funding agencies. Consequently, it is appropriate to consider *A. belleri* in this report.

A. belleri appear restricted to sphagnum bogs (e.g. *Sphagnum magellanicum* & *S. squarrosum*) from ~sea-level to ~1050 meters. Preferred habitat appears to be bog margins in the open with open water and floating mats of sphagnum. Bogs without open water but with mats of sphagnum resting upon a solid substrate are less favored, as is sphagnum in forest/open area ecotones. Circumstantial evidence suggests that *A. belleri* may be able to survive in sphagnum seeps, but this is presumably marginal habitat at best. Preferred habitat exhibits typical sphagnum bog flora, such as *Drosera rotundifolia*, *Eriophorum polystachion* and *Vaccinium oxycoccos*. Areas with living sphagnum appear to be favored over those with dead sphagnum.

All adult *A. belleri* which have been examined were found to be short-winged and incapable of flight, so all dispersal is necessarily via adult and larval walking. Although potentially suitable habitat is widely scattered along both sides of the Cascade Crest (as well as a few remaining lowland bogs), accessible habitat must presumably be essentially contiguous to existing *A. belleri* populations.

Johnson (1979) is the only analysis of the biology of this species of which I'm aware and is the basis of much of my information regarding *A. belleri*, although I have visited both Oregon sites and several Washington sites.

Population Data

Johnson (1979) estimated the total *A. belleri* population of the bog forming the margin of a small lake <10 hectares in area (Kings Lake in King County, Washington) might equal a few thousand adults, extrapolated

from a maximum collection of 15 adults per meter^2. There is no firm data on the stability of extant populations, although it seems the known Oregon demes are almost certainly declining (see below). Historically, the overall population has declined due to habitat degradation and destruction, particularly in the Puget Sound (see below).

Potential Threats

Drainage and filling of sphagnum bogs as a result of urban development in the Puget Sound have destroyed at least several of the lowland Washington *A. belleri* habitats. The type locality, Chase Lake, still exists, albeit much altered and amid a suburban residential area. However, it has been so degraded that it no longer supports *A. belleri* (P.J. Johnson, personal communication).

A. belleri appear to be intolerant of trampling. Johnson and I were unable to find this species along those portions of Kings Lake that had received the greatest fishing pressure, and thus the most trampling.

Sphagnum bogs, particularly those which are upon solid substrates, are susceptible to succession. One of the Oregon sites (Bear Springs) has apparently undergone succession to such a degree that sphagnum, and *A. belleri*, are no longer present. The other Oregon site (at Little Crater Lake) is a rather large wet meadow with small patches of sphagnum scattered along a stream. All such patches are apparently undergoing encroachment by other meadow vegetation, as well as experiencing substantial trampling by cattle. Between succession and degradation, the already marginal habitat is becoming even less favorable.

As with other insects, *A. belleri* are susceptible to pesticides. Since most sphagnum bogs are imbedded within forests, pest control/eradication projects could reduce or eliminate populations of this beetle (and may well have done so in the past). Intentional spraying for mosquito "abatement" may be (or have been) a particularly great threat.

Plans for Candidate Species Listing or Recovery

A. belleri has been listed as a Federal Candidate species (C2) for several years. I know of no efforts to upgrade its T&E status. This is unfortunate, as this is one of the most deserving of the species in this report for strong federal protection. The continuing habitat destruction/degradation, strong stenotopy, presumably limited dispersal capabilities and very patchy habitat distribution all point to a species in

danger of extinction. *Agonum belleri* is clearly a threatened or endangered species. Fortunately, the human threats, and to some extent those stemming from "natural" causes, are (probably) manageable with existing technology, resources, and knowledge.

Since this report focuses upon the habitats east of the Cascade Crest, I will only discuss recovery plans for the sole remaining known Oregon population of *A. belleri*, at Little Crater Lake. Surveys of potentially suitable habitat for other (perhaps more viable) *A. belleri* populations should be immediately initiated. Adequately fencing off the sphagnum areas from the cattle, as well as frequent monitoring of the fence to ensure its integrity, will prevent further degradation of the habitat from cattle trampling. There may be some minor trampling effects from humans due to the adjacent Little Crater Lake, the campground and the trail leading to Timothy Lake (which skirts some of the sphagnum area), but these are not as readily controlled. A major difficulty will be in stabilizing or reversing the successional trend without simultaneously degrading the habitat through human trampling and "weeding". Eliminating or reducing the encroaching meadow vegetation to retain open sphagnum is probably best done manually - herbicides may have deleterious or unforeseen effects upon *A. belleri* and/or prey. Non-destructive demographic surveys of the Little Crater Lake *A. belleri* population should be conducted.

Research Needs

The life history of *A. belleri* is largely unknown (including the larval stage), despite Johnson's 1979 study. More data about the basic biology of this species is required, particularly with regard to its phenology, ecological constraints and requirements, and demographics. This could be acquired by studying the less threatened Washington populations.

The European sister-species of *A. belleri*, *A. ericeti* Panzer, is also a sphagnum bog endemic. However, macropterous (fully winged) individuals of *A. ericeti* are known. These are presumably fully capable of flight. *A. belleri* populations, particularly those which are most remote from others, should be examined for the presence of occasional macropterous individuals. The presence of such individuals would have profound implications for the dispersal capabilities of *A. belleri*.

Surveys of potentially suitable habitat should be made to ascertain the distributional limits of this species.

Cicindela arenicola Rumpp

(Coleoptera: Cicindelidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Rumpp 1967).

Habitat Description & Requirements

This species is known only from southern Idaho.

The following habitat characteristics are based upon Baker et al. (1994) and Makela (1994). This species is presumably restricted to sand dunes or sandy areas with sparse vegetation (no more than ~30% cover) and ranging in elevation from ~750-~1700 meters. The larvae are found in mildly sloping or flat ± stable dune or sandy areas, whereas the adults are somewhat more broadly distributed throughout dune/sandy areas. The minimum dune/sandy area size necessary for population establishment and maintenance has been postulated to be ~25,000 meter^2. Suitable habitats are not necessarily near riparian areas. The range of effective adult dispersal (via flight) may be no more than ~1 kilometer, larval dispersal (via walking) is probably limited to a few tens of meters. Potentially suitable habitat is widely scattered throughout much of southern Idaho.

Population Data

The size of some *C. arenicola* demes has been estimated (Baker et al. 1994, Makela 1994), but I know of no estimates for the population of the entire species. Some of the deme abundances appear stable (e.g. Brunneau Dunes, per Baker et al. 1994) but at least one (the Windmill Site) may be decreasing due to habitat degradation by introduced weeds. There is no data on long-term population trends.

Potential Threats

Habitat degradation through various agencies is the greatest threat to *C. arenicola*. Disruption of the dune and sand substrates by human and livestock trampling and by off-road vehicles may directly destroy young larvae and collapse tunnels of older larvae. Intentional stabilization of dunes by grass seeding would completely eliminate habitat and there is evidence that introduced weeds are encroaching upon and degrading habitat at one site. The more stable and flat larval habitat is particularly

susceptible to the latter influence. Rangeland pesticide applications are obvious potential threats to this species.

Tiger beetles are popular with many entomologists and lay insect collectors, and rare (or rarely available) species are often much sought after. Although it is unlikely that collecting would be a major threat, particularly in the relatively remote areas where *C. arenicola* exist, this potential threat cannot be entirely discounted. This is especially true of readily accessible populations or those which are small. People taking specimens for their personal collections are much less apt to severely reduce populations than those intent upon acquiring specimens for commercial purposes.

Plans for Candidate Species Listing or Recovery

I know of no plans to formally list *C. arenicola* as a T&E species, nor do I know of any recovery plans regarding this species. However, given the relatively high profile of *C. arenicola* and the amount of interest it has generated, I would not be surprised if a proposal to formally list it would be forthcoming. Given its narrow habitat restrictions, patchiness of suitable habitat and apparent sensitivity to habitat disruption, ***Cicindela arenicola*** **seems to be a reasonable candidate for T&E status, although <u>further information about its habitat restrictions and overall distribution should be obtained</u> before making this decision.**

If *C. arenicola* receives formal T&E status, human (both foot and off-road vehicle) and livestock access should be restricted at sites from which it is known. Habitat degradation via succession or weed encroachment should be countered. It may be advisable to monitor readily accessible or well-known sites for collecting activities.

Research Needs

The most pressing need is to acquire a better understanding of the total distribution of this species. Potentially suitable habitats within and adjacent to Idaho should be surveyed. Simultaneously, known populations should be more intensely scrutinized to obtain a better understanding of the ecological requirements and constraints of *C. arenicola*. The long-range dispersal capabilities of adults should also be ascertained. More precise demographic information would be useful, particularly with regard to deme fluctuations. Further investigation into

the response of this species to habitat disruption is also highly recommended.

Cicindela columbica Hatch

(Coleoptera: Cicindelidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Hatch 1938).

Habitat Description and Requirements

Until recently, the range of this species included the eastern Columbia River Gorge and the Snake River in Oregon and Washington. However, it now appears limited to the Snake River drainage of southwestern Idaho.

C. columbica are apparently restricted to the sand bars and sand dunes in the riparian zones of large lowland rivers. The bars may be seasonally flooded. The degree of vegetation cover this species will tolerate is unknown, but presumably substantial vegetation cover would not constitute suitable habitat. Other habitat requirements and constraints are unknown, other than the species appears completely intolerant of damming (see below). Although dispersal capabilities of adults are unknown, contiguous or nearby suitable habitat may be necessary for successful dispersal. Seemingly suitable habitat is apparently restricted to the Snake River drainage in southwestern Idaho.

The above distribution and habitat data was extracted from Leffler (1976, 1979).

Population Data

The size of known *C. columbica* demes is unknown, as is the total population of the species. The stability of known demes is unknown. Historically, the overall population has declined precipitously as the species has apparently been extirpated from Oregon and Washington. The trend of the Idaho populations is unknown.

Potential Threats

The Oregon and Washington Columbia River Gorge populations of *C. columbica* were apparently destroyed by the damming of the Columbia River. Although most riparian tiger beetles are somewhat eurytopic and ± tolerant of such activities, this appears not to be the case with this species. It is unknown whether this is an instance of rather rigid

stenotopy or the result of outright eradication of all Columbia Gorge populations by the rising waters, or some other unfortunate combination of events and phenomena.

Assuming that the life history of *C. columbica* is similar to other riparian *Cicindela*, the eggs, larvae and pupae reside within the substrate of riparian dunes and sand bars. These life stages may be susceptible to trampling of habitat accessible to humans and livestock.

The risk of pesticide applications seems remote given the habitat of this species. However, if such programs were to take place in *C. columbica* locales, the potential for significant reduction or eradication of extant populations would obviously be high.

Although the general locations of the Idaho populations are rather common knowledge, the locations of the precise sites are being zealously guarded for fear that intensive collecting may severely deplete these remaining demes. As with *C. arenicola*, the popularity of tiger beetles with entomologists and collectors leads to great demand for rare or infrequently available species. Since *C. columbica* was believed to be possibly extinct at one time, the concomitant high profile for the species may cause collecting to be a real threat to *C. columbica.*

Plans for Candidate Species Listing or Recovery

I know of no plans to formally list *C. columbica* as a T&E species, nor do I know of any recovery plans regarding this species. Given the historical reduction in habitat and apparent destruction of the Oregon and Washington populations, presumed narrow habitat stenotopy or sensitivity to perturbations (at least of the magnitude of damming) and few known extant populations, ***Cicindela columbica*** **appears to be a truly threatened or endangered species.**

Should *C. columbica* receive formal T&E listing, recovery of destroyed habitat in Oregon and Washington seems unlikely. Efforts would be best devoted to preserving the remaining Idaho habitat. Preventing damming of the stretches of the Snake River drainage in which it now resides would seem to be the single most crucial strategy to prevent further inroads upon the existing populations. Access should be controlled or restricted at sites potentially accessible by humans or livestock to prevent trampling degradation and collecting. Pesticide applications in or near known or potential *C. columbica* sites, especially areas upstream or

upwind of these, should be discouraged. Monitoring of sites for evidence of collecting activities may be advisable, as would continuing discretion about the precise location of known *C. columbica* sites.

Research Needs

The most pressing need is to locate the extent of existing populations of this species. Potentially suitable habitats within and adjacent to the lower Snake River drainage in southwestern Idaho should be surveyed. Simultaneously, known populations should be investigated to obtain demographic data and knowledge about the ecological requirements and constraints of *C. columbica*. The long-range dispersal capabilities of adults should also be ascertained. Assessments of the potential vulnerability of existing populations should be made. Investigations into the phenomena responsible for extirpation of this species from the Columbia River Gorge should also be performed.

Ctenicera barri Lane
(Coleoptera: Elateridae)

Taxonomic Status

Sound (Lane 1965). Although the generic placement is incorrect, this species is valid (Johnson 1992).

Habitat Description and Requirements

Ctenicera barri are known only from two confirmed localities and one unconfirmed site, all in northcentral Idaho. The sister-species, *C. appressa* Randall, has a much broader distribution through the northeastern United States and southeastern Canada.

All known habitats are montane open bogs, at elevations of ~500 meters (O'Hara Campground, U.S. Forest Service, ~13 km SW Lowell) and ~1620 meters (Lolo Pass). The unconfirmed site is a spring-seep at an intermediate elevation along Highway 12 between Lowell and Lolo Pass. The bog at O'Hara campground is bounded by dense conifer forest while the Lolo Pass site (consisting of two bogs) is more open, with patchy subalpine forest somewhat distant from the bogs. The Lolo Pass bog site is less than an acre in area while the O'Hara bog encompasses less than a half-acre.area.

Little is known about the biology of *C. barri*. The adults are believed to feed upon flowers/pollen or perhaps soft-bodied insects such as aphids.

Such behavior is speculative - no feeding behavior has been observed. The larvae are probably predatory, as are the larvae of *C. appressa* and other related elaterids, feeding upon a variety of other invertebrates. As with *C. apressa*, the larvae are probably within and under moss and other vegetation mats in the bogs.

Adult *C. barri* are capable of flight and are certainly the dispersal stage, other than trivial movement by the larvae. The dispersal capabilities of this species are unknown. Presumably suitable habitat is widely scattered throughout montane and subalpine Idaho and adjacent Montana. Since the ecological parameters of these beetles are unknown, as are the dispersal capabilities, whether this habitat is actually suitable or accessible is a matter of purest conjecture.

Population Data

There is no population data available for *C. barri*, although the Lolo Pass population is presumed to have undergone decline because of habitat destruction (see below).

Potential Threats

The O'Hara Campground bog is entirely enclosed by the campground road. Improvement or widening of that road could degrade or destroy the bog. A similar threat is posed by the prospect of campground improvements or expansion. As with *Agonum belleri*, trampling of vegetation may be a significant threat.

The Lolo Pass bogs are probably at greater immediate risk. The type locality (at the current site of a visitor's center) has lost at least half of the original habitat to roadbuilding and construction of the center. The remainder has been badly degraded by hydrologic and subsequent vegetation changes in combination with runoff road pollution. The other bog (located at the state lines on the north side of the highway) is in better condition, although it has been degraded by roadbuilding and is at risk from an adjacent barrow excavation and the dumping of old logging remnants at the bog edges. Ongoing road maintenance will almost certainly pose a threat to both bogs.

Little can be said regarding the unconfirmed locality. However, if it is adjacent to or near the highway (as the vague description suggests), it could also be severely impacted by road construction or maintenance activities.

Along with the specific hazards mentioned in conjunction with the known sites, development, drainage operations, livestock activities (grazing and trampling) and human trampling are general threats to these beetles. As with other insects dwelling in or adjacent to forests, aesthetic/recreational or economically justified pesticide applications probably pose at least some risk for *C. barri*, depending as always upon the agent utilized, time and dosage applied, etc.

Plans for Candidate Species Listing or Recovery

I known of no plans to formally recommend *C. barri* for T&E status. If there are such, Dr. Johnson would be the individual most likely to be involved. It is certainly premature to even remotely consider any recovery strategies, given the limited information available for this species. **The strongest action I can sanction would be to place *Ctenicera barri* upon a "Watch" list.**

Research Needs

Basic biological data is required to assess whether this species is indeed threatened or endangered, beginning with surveys of potential habitat in order to ascertain its distributional limits. Investigations into habitat requirements and ecological constraints, along with demographic parameters and dispersal capabilities must also be performed. More phenological data is also necessary.

Comments

This species was recommended for listing by Dr. Paul Johnson, Associate Professor, Department of Plant Science, South Dakota State University, Brookings, South Dakota. Dr. Johnson should be contacted for any further information regarding this species.

Glacicavicola bathyscoides Westcott

(Coleoptera: Leiodidae)

Taxonomic Status

Sound (Westcott 1968).

Habitat Description and Requirements

This species is known only from southern Idaho and westernmost Wyoming.

G. bathyscoides has only been found in lava tube caves in the vicinity of permanent ice, apparently feeding upon dead arthropods and/or

bacterial slimes, although Dr. Michael Ivie of Montana State University believes these beetles feed upon living cave arthropods (personal communication). The caves from which it is known range in elevation from 1525-1891 meters. This species apparently requires the constantly cool and moist conditions provided in the caves. The eyeless condition and pale coloration of this beetle suggests it is confined to cave habitats. Although it could conceivably exist within the soil or bedrock crevices, the elongate body and appendages are not structural adaptations associated with those environments.

Dispersal capabilities and methods of this species are unknown, although bedrock crevices and underground water pathways connecting suitable habitat may provide avenues of dispersal, as has been suggested for other cave beetles (Barr 1985, Culver 1982). Potential suitable habitat, lava tubes with permanent ice, can be found throughout much of the Columbia River Basin. The accessibility of individual sites, given the probably limited dispersal capabilities of *G. bathyscoides*, is a very different matter and it is probable that much of this potential habitat is effectively inaccessible, at least within the temporal scales of interest to our culture.

The above information was primarily derived from Naseath (1974), Peck (1974), and Westcott (1968).

Population Data

Nothing has been published regarding the size of known *G. bathyscoides* demes and the total population of the species or the stability of known demes. The overall historical population trends are unknown, although presumably stable, other than presumed fluctuations due to climatic changes.

Potential Threats

Although these beetles are almost certainly very sensitive to habitat changes, as is true of many cave arthropods (Culver 1982), the remote nature of the sites from which *G. bathyscoides* are known provides considerable buffering from human habitat alteration. Direct destruction or broaching of the caves is probably the greatest human-induced hazard, but this seems unlikely given the known localities. Changes (human or otherwise) in the groundwater characteristics leading to reduced ice accumulation or retention are a possible threat, but the prospects for

effective human management of this risk seem slim. The greatest overall threat is probably that of global warming. Degradation of the cave environment through human activities (waste, changes in CO_2 production, trampling, collecting, etc.) is likely to be a significant threat only in the event that the caves receive substantial human traffic. I don't know the volume of humans passing through these caves, but I doubt it is substantial.

Plans for Candidate Species Listing or Recovery

I know of no plans to propose *G. bathyscoides* for formal T&E status. The remote and relatively inaccessible habitat in combination with the greatest foreseeable threats originating from relatively unmanageable sources render providing this species with T&E protection questionable. **Perhaps the best strategy would be to place *Glacicavicola bathyscoides* on a "Watch" list with periodic monitoring of its circumstances, particularly with regard to development or degradation threatening known sites.**

Little can be done at present (especially on a global scale) to prevent or reduce the potential impacts of global warming upon this species. Amelioration of this phenomenon may be possible, but management through current technology is unlikely at best. Much the same can be said (to a lesser degree) of groundwater phenomena affecting ice deposition in the lava caves. Denying or restricting human access to caves from which this species is known is probably the most effective means of reducing human degradation of the habitat.

Research Needs

Since our ignorance of *G. bathyscoides* is almost total, basic research is required regarding its ecological and physiological constraints and requirements, food, phenology, dispersal capabilities, demographic data, resilience to perturbation and the extent of its distribution, including surveys of all known potentially suitable and accessible habitat.

Nebria gebleri fragariae Kavanaugh
(Coleoptera: Carabidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Kavanaugh .1979).

Habitat Description and Requirements

Nebria gebleri Dejean (in the broad sense) are extensively distributed throughout western Canada and the United States from the Continental Divide to the West Coast. *N. gebleri fragariae* are only known from northeastern Oregon in the vicinity of the Strawberry Mountains.

This subspecies has been collected from the banks of montane perennial streams at elevations ranging from 1500-2300 meters. Many montane riparian carabids can be found along streams up into the alpine zone, but *N. gebleri fragariae* are currently unknown from that habitat. The forest composition at the type locality at ~1800 meters consists of *Pinus contorta, Tsuga mertensiana, Larix occidentalis* (the preceding are co-dominant), *Picea englemanni* and *Abies lasiocarpa.* The canopy closure ranges from ~50-100%. Forest composition and structure changes with aspect, elevation and slope. The stream banks generally consist of unconsolidated cobble-gravel, sand or mud and are probably at least ephemerally seasonally flooded. These banks range from level to quite steep and often have only sparse vegetation cover.

Adult *N. gebleri fragariae* are macropterous (fully-winged), although flight in this subspecies has not been observed. The potential flight range is unknown. If adults are not capable of flight, active dispersal would be limited to walking by adults and larvae, with the possibility of passive dispersal via downstream drift. Although seemingly suitable habitat in the form of montane perennial streams is prevalent throughout the region, contiguous or nearby suitable habitat may be necessary for successful dispersal.

Population Data

No published population data is available for *N. gebleri fragariae.* The size of known demes is unknown, as is the total population of the subspecies. However, these beetles appear relatively abundant at the type locality, probably on the order of one-to-several individuals per meter^2 in favorable habitat. The stability of known demes is unknown, although populations of riparian carabids may fluctuate dramatically depending upon the annual flooding history of their habitat. There is no data addressing historical population trends.

Potential Threats

As with any insect whose habitat is within forests, this subspecies is at risk from pesticide applications for economic or

aesthetic/recreational purposes. Both the larvae and adults are assumed to be generalist predators. If so, they could be threatened not only by direct or residual contact with pesticides but also by ingestion of pesticide-contaminanted prey (Thacker & Hickman 1990). The tolerance of *N. gebleri fragariae* to habitat perturbation and degradation by logging, stream pollution, livestock trampling or "natural agencies" is unknown. Much of the habitat is contained within the Strawberry Mountain Wilderness, which may provide adequate buffering from the bulk of these potential threats.

Plans for Candidate Species Listing or Recovery

I know of no plans to acquire formal T&E status for *N. gebleri fragariae*. I discussed this subspecies with Dr. David Kavanaugh of California Academy of Sciences (a world authority on *Nebria* and certainly the only authority on *N. gebleri fragariae*) and his rationale for considering it as at potentially threatened was based upon the very limited known distribution. While acknowledging Dr. Kavanaugh's great expertise with *Nebria* in general and *N. gebleri fragariae* in particular, I am aware of no imminent threats to this subspecies, especially with so much of its known range contained within a wilderness area. Consideration of recovery strategies or plans is certainly premature given that we don't know of any need for such. Based on our existing knowledge, **I believe it would be best to place *Nebria gebleri fragariae* on a "Watch" list.** At this time, I do not consider it suitable for consideration of T&E protection since it meets only #'s 1 and 3 of my criteria.

Research Needs

Since there appear to be no imminent threats to *N. gebleri fragariae* , the immediate need for research on this subspecies is debatable. If research is deemed necessary, surveys should first be performed to determine the breadth of suitable habitat, including geographic and elevational limits. Investigations into *N. gebleri fragariae*'s basic biology should follow, with particular emphasis upon demographic parameters and dispersal capabilities. Assessment of its ecological constraints and requirements should be made, especially regarding its tolerance to habitat perturbation.

Nebria gyllenhali lassensis Kavanaugh
AND
Nebria paradisi Darlington
(Coleoptera: Carabidae)

Comments

I've been informed by Chris Niwa that these two species, originally on the "sensitive/special interest" list provided to me by the Eastside Ecosystem Management Project, were listed in error. This is good news, since **I know of no reasons why either of these species should be considered as sensitive/special interest, let alone suitable for T&E status.** As I indicated in the panel information, both have relatively extensive ranges, *N. gyllenhali lassensis* from the Cascade Mountains south of the Columbia River south to the northern Sierra Nevada and *N. paradisi* from the Olympic Mountains and the Washington Cascades south to the northern Cascades of Oregon. *N. gyllenhali lassensis* are broadly distributed through subalpine and alpine habitats (<1300 to ~3000 meters), whereas *N. paradisi* are more strictly alpine (>1350 to >3100 meters). The geographic distributions and habits for both species are sufficiently broad that I perceive no immediate threats to either of them. While global warming could conceivably contract their elevational ranges and to a lesser extent their geographic ranges, there are so many other organisms more imminently threatened by more manageable phenomena that **I question whether any useful purpose would be served by so much as placing *N. gyllenhali lassensis* and *N. paradisi* on a "Watch" list.**

Nebria vandykei wyeast Kavanaugh
(Coleoptera: Carabidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Kavanaugh 1979).

Habitat Description & Requirements

This subspecies is known only from the Oregon Cascade Mountains from Mount Hood south to the vicinity of the Three Sisters. The typical subspecies (*N. vandykei vandykei* Banninger) is known from the Olympic Mountains and Cascade Mountains of Washington.

N. vandykei wyeast are restricted to alpine habitats, perhaps extending down into the highest subalpine areas. The known elevational range is from >1350 to 3400 meters. Primary habitat consists of alpine ice and snow fields, with secondary habitat and diurnal shelters at snowfield margins and amid the adjacent talus and rocky alpine tundra. Alpine and upper subalpine rocky stream banks function as seasonal thermal refugia during the summer and early autumn after snow has receded from some areas.

The presence of at least semi-permanent ice and snow at high elevations and diurnal/seasonal thermal refuges are essential for the continued existence of these (and other) alpine nival insects since they are adapted to the cold and high local relative humidity of the alpine nival habitat (Edwards 1987, Mani 1968). Alpine nival *Nebria* exemplify such adaptations. *N. vandykei vandykei* tolerate freezing down to -10.5 ^{o}C (Edwards 1987). Several species of alpine nival *Nebria* rapidly die at standard room temperature (D.H. Kavanaugh, personal communication) and I have observed that they almost immediately exhibit symptoms of heat shock if held in the hand. These physiological characteristics in the typical subspecies combined with essentially identical habitat parameters make it a virtual certainty that *N. vandykei wyeast* have similar attributes.

N. vandykei wyeast are members of the alpine nival nocturnal predator/gleaner guild, foraging at night upon the ice, snow, and soil/rock surfaces for dead, cold-immobilized or active invertebrates. These beetles may be the top invertebrate consumers in the truncated alpine nival food web. Much of the food for such organisms is derived from wind-deposited invertebrates (aeolian fallout) originating outside of the alpine, and even the montane, environments (Crawford & Edwards 1986, Edwards 1987, Edwards & Banko 1976, Papp 1978). Indeed, the source of the vast majority of this material may be the valleys and basins at the foot of the mountains (Papp 1978).

Typical of many alpine nival insects, *N. vandykei wyeast* are believed to be entirely flightless, lacking both the musculature and sufficiently large wings to permit flight. Active dispersal is thus limited to walking by adults and larvae, with the possibility of passive dispersal via downstream drift when *N. vandykei wyeast* are in the vicinity of streams.

Since the ecological constraints/requirements are not rigorously defined, I can only presume that any habitat of sufficient elevation with permanent or semi-permanent snow and ice and enough aeolian fallout would be suitable for these beetles. However, any favorable habitat currently outside the range of *N. vandykei wyeast* will remain so until the climate changes enough to produce cryic/icy/snowy corridors connecting such sites with presently occupied areas. Furthermore, there can be no significant chance of genetic exchange between populations on even adjacent mountaintops, at least within the last several thousand years or more.

Population Data

No population data has been published for *N. vandykei wyeast*. The size of known demes is unknown, as is the total population of the subspecies. My casual observations suggest these beetles are not abundant, based upon my diurnal collecting of *N. vandykei wyeast* from snowfield margins and my experiences observing other alpine nival *Nebria* foraging at night upon snow and ice fields. The stability of known demes is unknown, although the populations of alpine nival carabids may fluctuate dramatically depending upon the annual snowfall patterns and those of the aeolian drift. There is no data addressing historical population trends.

Potential Threats

The aforementioned ecological and physiological adaptations of alpine nival insects such as *N. vandykei wyeast* predispose them to threatened or endangered status. These adaptations limit such insects to nival habitat "islands" in seas of lowland hydric and thermic barriers, which also act as extensive spatial barriers. The inherently low dispersal capabilities and local endemism further expose these organisms to risk from habitat perturbation.

There are several possible threats to this species and other alpine nival arthropods. Pesticide applications in adjacent forest-lands as the result of economic or aesthetic/recreational concerns present two risks: direct contact from pesticide drift or misapplication and ingestion of pesticide-contaminated arthropods. The latter risk is perhaps the greatest threat of the two since *N. vandykei wyeast* are nival predator-gleaners apt to eat such prey. Mortality rates of carabids ingesting

pesticide-contaminated prey have been found to be much greater than of those only residually exposed to pesticide (Thacker & Hickman 1990). Of course, much of *N. vandykei*'s habitat is currently buffered from such activities by wilderness areas.

N. vandykei wyeast may be at greater risk from widespread contamination of food by pesticides and pollutants. The bulk of the aeolian fallout upon which these beetles are largely dependent apparently originates from non-alpine and non-montane areas, including major agricultural regions (Papp 1978), such as the Hood River Valley at the base of Mount Hood. Consequently, this fallout is apt to be exposed to a wide variety of pesticides and pollutants. Large alpine nival predator-gleaners such as *N. vandykei wyeast* may thus be at considerable risk from bioaccumulation and biomagnification effects, as well as the aforementioned outright toxic effects of ingesting pesticide-contaminated prey. However, this phenomenon has never been investigated in alpine nival systems and its existence must be considered purely speculative. Whether this potential threat can be considered "manageable" within the context of my criteria is also questionable.

Direct recreational impacts upon *N. vandykei wyeast* are not apt to be significant. Construction and maintenance of high altitude resorts (e.g Timberline Lodge) and their associated facilities and activities (hiking trails, snow-making, salt added to retain snowpacks, night-skiing, etc.) may destroy/degrade alpine nival arthropod habitat or disrupt the behavior of these organisms. However, such facilities are probably the equivalent of highly localized point sources of disturbance. I estimate that the aggregate actively managed ski resort acreage upon Mount Hood is at most slightly more than 1% of total suitable *N. vandykei wyeast* habitat, based upon some admittedly crude assumptions.

The ultimate potential threat to this species and other alpine nival arthropods is regional or global climatic warming. Presuming this phenomenon is real, even conservative estimates of its effects suggest that the alpine nival habitat "islands" to which this group of organisms are restricted may be substantially reduced or entirely eliminated. However, as discussed above, I do not believe this threat meets the "manageable" criterion.

The effects of all these potential threats are exacerbated by the stringent adaptations of *N. vandykei wyeast* to the alpine nival habitat, the "altitudinal island" nature and discontinuity of this habitat, and the negligible dispersal capabilities of this species.

Plans for Candidate Species Listing or Recovery

I know of no plans to acquire formal T&E status for *N. vandykei wyeast*. Further research (see below) is necessary to ascertain whether any of the perceived threats other than global warming are real. Consideration of recovery strategies or plans is certainly premature given that we don't know of any need for such. **Based on our existing knowledge, the strongest action I can recommend is to place *Nebria vandykei wyeast* on a "Watch" list.**

Research Needs

Research is necessary to determine the degree to which *N. vandykei wyeast* are dependent upon exogenously originating aeolian fallout, whether this fallout is significantly contaminated by pollutants and pesticides and whether ingestion of this material has deleterious effects upon these beetles. Until such research is performed, we cannot ascertain whether *N. vandykei wyeast* is indeed threatened by human activities other than global or regional warming. Adequate data is also required regarding larval food and feeding behavior, larval habitat parameters, basic phenology, physiological constraints and the southern limits of this subspecies' distribution.

Comments

If the aforementioned threats to *N. vandykei wyeast* are regarded as or proven to be real and are believed to be manageable, at least four other Columbia River Basin terrestrial predatory beetles are good candidates for T&E status, meeting all my T&E criteria. All are alpine nival predator-gleaners like *N. vandykei wyeast*, but have much more restricted known geographic distributions (all in Oregon). All these species are described in Kavanaugh (1984).

Nebria jeffreyi Kavanaugh (known only from Steens Mountain)
Nebria labontei Kavanaugh (known only from the Wallowa Mountains)
Nebria steensensis Kavanaugh (known only from Steens Mountain)
Nebria wallowae Kavanaugh (known only from the Wallowa Mountains)

N. jeffreyi and *N. steensensis* may be at greatest risk from direct pesticide application as their habitat is imbedded in alpine rangeland. Livestock degradation of riparian summer refugia via grazing and trampling may also constitute a significant threat. *N. labontei* and *N. wallowae* are better buffered from this threat as their habitat is within a wilderness area.

Scaphinotus mannii Wickham

(Coleoptera: Carabidae)

Taxonomic Status

Sound (Bousquet & Larochelle 1993, Wickham 1919).

Habitat Description and Requirements

Scaphinotus mannii has been listed from Idaho, Oregon and southeastern Washington (Bousquet & Larochelle 1993, Hatch 1953, Wickham 1919). However, the record from Idaho is dubious (Bousquet and Larochelle 1993) and the Oregon record is also believed to be spurious (Y. Bousquet, personal communication). Hence, the confirmed range is limited to southeastern Washington.

Greene (1975) stated that *S. mannii* are "unusually limited as to habitat selection", relative to the four other cychrines (*Scaphinotus* and related genera) he studied. These beetles are apparently confined to riparian strips in the canyons of lowland (~200 meters elevation) tributaries of the Snake River. Based upon both Greene (1975) and my observations, *S. mannii* seem to be restricted to forested areas with dense canopies. Although Greene (1975) states that the sites where he found *S. mannii* were dominated by *Alnus rhombofolia*, *Philadelphus lewisii* and *Celtis douglasii*, I also found specimens in areas where large *Populus trichocarpa* formed a substantial component of the flora. *S. mannii* may be confined to these habitats as a result of suitable abiotic conditions. Most cychrines favor cool and moist sites (Greene 1975) and the riparian strips provide the coolest and most moist areas in the canyons. These conditions also control the presence of the slugs and snails upon which *S. mannii* prey. This combination of abiotic and biotic factors may determine the distribution and abundance of these beetles.

Adult *S. mannii* are flightless, so all active dispersal must be via walking by adults and larvae. I know of no likely passive dispersal agents.

Suitable habitat is patchy within individual watersheds and its absence outside the immediate vicinity of water in an otherwise xeric landscape makes for great patchiness on a large scale. The destruction of much former habitat (see below) has exacerbated this inherent pattern of the habitat. Although presumably suitable habitat exists in northwestern Idaho and northeastern Oregon, particularly along the unflooded stretches of the Snake River and its tributaries, the likelihood of *S. mannii* colonizing these sites (if currently uninhabited by these beetles) is remote. For that matter, it seems unlikely that there would be any significant chance of genetic exchange between populations in even adjacent canyons.

Population Data

Little population data has been published regarding *S. mannii*. Greene (1975) found these beetles to be "not uncommon" in the Steptoe Canyon (~5-18 km SW of Colton). Over a two-year period, the average density in one small patch of isolated favorable habitat was less than one individual per meter^2, based on eleven specimens in a 13 X 3 meter area. I've often found a number of individuals within a small area. This clumped dispersion pattern is typical of many insects, resulting from available shelter or favorable microhabitats. Average dispersion is generally much less.

The stability of individual demes is unknown, although I assume that those in degraded or progressively diminished habitats to be declining. The trend for the overall species population is certainly that of a decline, as a result of habitat degradation and loss (see below).

Potential Threats

Probably the greatest threat on a landscape scale is further flooding of habitat from damming. The damming of the upper Snake River has already eliminated much of the original habitat, including the type locality (Waiwawai). Further damming or increasing the pool depth of the current dams would certainly eradicate a substantial proportion of the remaining habitat.

Where canyons are inhabited, *S. mannii* habitat is often destroyed to make room for houses, outbuildings and grazing areas, since it exists along aesthetically desirable and valuable water, a scarce commodity in the Washington steppe country. This habitat is very susceptible to

degradation by grazing or trampling, particularly when livestock are confined to such strips by canyon walls or when they aggregate in the riparian areas to obtain water or escape the often intense summer heat. On my last trip to Steptoe Canyon several years ago, this appeared to be the case at the lowest points of the canyon, where livestock had effectively eliminated any forb understory. A colleague knowledgeable of *S. mannii* stopped by the Steptoe Canyon site this spring (1995) and observed that the habitat degradation has both intensified and spread upstream (E. van den Berghe, personal communication). Whether such degraded habitat is at least marginally suitable for *S. mannii* is unknown.

As with other predatory beetles, *S. mannii* is potentially threatened by pesticides, both from direct contact and via ingestion of contaminated prey (Thacker and Hickman 1990). The primary risk from pesticide applications stems from grasshopper control programs to protect rangeland. Although applicators are supposed to provide riparian buffers, both applicators and their customers may not wish to exercise adequate care in this regard.

Plans for Candidate Species Listing or Recovery

Greene (1975) stated that while none of the five species of cychrines inhabiting the Washington steppe were endangered, "*S. mannii* would appear to be substantially more vulnerable than the others" because of its more stringent habitat requirements. I certainly concur with his assessment of the greater vulnerability of *S. mannii.* I'm less inclined to accept his conclusion that this species is not at least threatened. First, all five of my criteria are readily met. Second, twenty years ago, most entomologists and other biologists in this country were reluctantly embracing the concept of insects as valid recipients of T&E protection (many are still having this difficulty today), and I believe that perception and the attendant political/funding climate colored his conclusions. For instance, Greene refers to the advocation of preservation of threatened habitats with unique beetle faunas as "controversial", while reluctantly admitting that such approaches appear valid in the context of cychrines limited to the type of steppe vegetation in which *S. mannii* is found. **Based on the available data, *Scaphinotus mannii* appears to be imminently threatened or endangered throughout its known range.**

It would be premature to propose *S. mannii* for formal T&E status without at least some preliminary investigations specifically addressing distribution and habitat assessment. It would also be useful to determine whether other biota found in *S. mannii* habitat are potential T&E species. If preliminary surveys confirm a very restricted and patchy distribution and habitat assessments indicate widespread immediate threats to habitat quality and existence, I am willing to submit such a proposal. I know of no other plans to propose *S. mannii* for formal T&E status.

Discussion of recovery plans before T&E status has been obtained is "putting the cart before the horse". However, ceasing or limiting further habitat destruction or degradation is the key to preserving this species. The exact management strategies necessary to accomplish this goal cannot be clearly defined until further research has been performed. Obviously some controls or limits would have to be placed upon development and grazing in known *S. mannii* habitat. Careful monitoring of any rangeland pesticide applications in or near known *S. mannii* habitat would also be required. Realistically, major hydroelectric or irrigation projects potentially inundating *S. mannii* habitat would probably have to be "endured rather than cured".

Research Needs

The most immediate research needs have been discussed above. Thanks to Greene's research, we have some basic knowledge of the biology, phenology, and ecological requirements of *S. mannii*, probably enough to work with at this time.

CONCLUSION

The great diversity of terrestrial predaceous beetles of the Columbia River Basin makes it difficult to make meaningful *a priori* generalizations about which species or groups are apt to be threatened or endangered. Some human-induced perturbations are clearly common potential threats to almost all the species discussed in this report, e.g. pesticide applications. On the other hand, phenomena with profound deleterious effects upon uniquely susceptible species, e.g. contamination of aeolian fallout for alpine nival predators, may have little impact on the vast majority of terrestrial predatory beetles, including most of those in this report. The best generalization with regard to this problem may be the statement by E.O. Wilson (1992) that species "trapped by specialization and pressed by shrinking habitat form the largest endangered class". Expanding slightly upon his remark, those species that have stringent behavioral, ecological, or physiological constraints coupled with limited or very patchy distributions are predisposed to becoming threatened or endangered. This appears to be the pattern exhibited by the terrestrial predatory beetles of the Columbia River Basin.

Of the 28 families and over 1,300 species of terrestrial predaceous beetles I was able to verify as recorded from the Columbia River Basin (see Appendix of my original report), only four families and ten species (less than 1% of the total species) were discussed in this report. This is a commentary on our great ignorance of insects rather than an indication of the relative frequency of potentially threatened or endangered species within this functional group.

Compared to the rest of the terrestrial predaceous beetles known from the Columbia River Basin, Carabidae and Cicindelidae were disproportionately represented in this report. Carabid species constitute ~32% of the Columbia Basin terrestrial predaceous beetles, but 60% of those dealt with in this report. The situation is yet more pronounced with Cicindelidae: their species composition is only ~1% of the total but is 20% of those in this report. This phenomenon is to some extent a function of the habitats that are exploited by certain members of these families which may predispose them to potential endangerment. Where the Carabidae are concerned, it is also a reflection of my biased experience. However, it is at least partially, and perhaps predominantly, a result of

the significantly greater attention both of these families have received from entomologists than have many others, such as the Staphylinidae.

Of the species discussed in this report, I believe only three should receive immediate attention as potentially threatened and endangered species, based upon existing information. Of these, *Scaphinotus mannii* is at the greatest risk, with *Agonum belleri* next and *Cicindela columbica* least immediately threatened. The last two may represent a "tie", dependent on the information that cicindelidists more familiar with *Cicindela columbica* than I am may possess. Adequate evidence exists to suggest that *Cicindela arenicola*, *Ctenicera barri* and *Nebria vandykei wyeast* may well be threatened, but further research is required to make that assessment. *Glacicavicola bathyscoides* and *Nebria gebleri fragariae* do not appear to be threatened at this time, but may bear watching. *Nebria gyllenhali lassensis* and *Nebria paradisi* do not warrant any consideration for threatened or endangered status.

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