

## Abstract

### **Small Feet, Big Tracks: The Potential Economic Effects of Critical Habitat Designation on the Economy of Southeastern Wyoming**

Thomas Foulke, David T. Taylor and Roger H. Coupal

Preble's Meadow Jumping Mouse, *Zapus Hudsonius Preblei*, is a small rodent that lives in the foot hills of the Rocky Mountains. It was listed as a threatened species under the Endangered Species Act in 1998. Since that time it has become either the standard bearer for the move to stop rural residential sprawl or the poster-child for what is wrong with the Endangered Species Act, depending on one's point of view.

The US Fish and Wildlife Service designated over 125 miles of rivers and streams and over 10,000 acres of land as critical habitat for the mouse in Southeastern Wyoming in 2003. Of this, about 88 percent is on private land. Herein lies the difference for the mouse. In past endangered species controversies, the species was located primarily on public lands, such as with wolves, grizzly bears and the spotted owl. So even though many jobs were dependant on those lands, ultimate control of the land lay with the federal government. Not so with the mouse. Not only is a high percentage of mouse critical habitat on private land, but the type of land (riparian zones and along irrigation ditches) is especially important to landowners' economic survival in the arid west. By imposing federal control on even a small percentage of this critical land type, the economics of an already precarious agricultural economy can be upset.

The researchers took a somewhat different approach to identifying and analyzing the potential economic impact of critical habitat designation on the Southeastern Wyoming economy. First they conducted a series of listening sessions to find out how people in the area are using the land and what specific agricultural practices are prevalent. They then constructed a hypothetical model ranch based on these parameters. Using a multi-period linear programming model, they ran a series of scenarios to see how profitability would be affected by different levels of designation (since designated land would be lost to production). They looked at the affect of designation at the firm level and then translated these problems to the regional level using Census of Agriculture producer numbers and IMPLAN software.

The results show that agricultural producers would be significantly affected at even relatively modest acreages, especially if this acreage were hay meadow. This is because, in the words of one local resident, "they would be cutting the heart out of the operation". In other words, removing hay meadow acreage from production hurts the operation's ability to produce in the summer because that land could not be grazed or hayed and winter because the operation would have less feed, thereby reducing overall carrying capacity.

The results of our research are presented in the context of a discussion of property rights versus habitat protection in the Rocky Mountain West. A brief update of the Preble's mouse controversy will also be given.

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# Small Feet, Big Tracks: The Potential Economic Effects of Critical Habitat Designation on the Economy of Southeastern Wyoming

Thomas Foulke, David T. Taylor and Roger H. Coupal<sup>1</sup>

## Background

In May 1998 the Preble's Meadow Jumping Mouse (PMJM), *Zapus Hudsonius Preblei* was listed as a threatened species by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act. PMJM is a small rodent about nine inches in length, 60 percent of which is tail. PMJM occupies shrub habitat adjacent to streams and along irrigation ditches of the Front Range of the Rocky Mountains in Colorado and Southeastern Wyoming. At the time of listing, the species' range in Wyoming was thought by the USFWS to be confined to portions of five counties (Albany, Converse, Goshen, Laramie, and Platte).

The listing of PMJM was almost immediately a controversy due to the location of its habitat along the Front Range in Colorado, where suburban and rural residential development is occurring at a rapid pace. Developers and agriculturalists were quick to claim that environmental groups had been searching for a species which they could use, under the guise of the Endangered Species Act (ESA), to slow development in the region. The area of mouse habitat in Wyoming, for the most part, does not have the development pressures of Colorado. Rather it is primarily rural ranch land.

In July 2002, the USFWS proposed designating critical habitat in Wyoming and Colorado. The proposed critical habitat in Wyoming included approximately 237 miles of rivers and streams and over 20,000 acres of land. Approximately 77 percent of this land is privately owned and approximately 94 percent is currently used for agricultural production. On June 23, 2003 the USFWS made the final designation of critical habitat for PMJM. It included about one half of what was originally proposed for Wyoming. One hundred twenty-five miles of rivers and streams and 10,540 acres of critical habitat were designated in Wyoming. Much of the private land is hay meadows, producing critical winter-feed for ranches in the region. Under sections 7, 9 and 10 of the ESA some or all of this production could be affected. Eighty-eight percent of the final designation lands are privately held.

The State of Wyoming holds the position that PMJM is not a separate species and therefore should not be protected under the ESA. A DNA analysis was conducted by Ramey et al in 2004. His findings rocked the endangered species community at the time, showing that PMJM was not a distinct species at all, but is in fact the more common *Zapus Hudsonius Campestri*, the Bear Lodge Jumping Mouse. Naturally, his findings were immediately disputed and the USFWS commissioned a review of the methods that Ramey et al used. Another series of tests were conducted by King et al from the U.S. Geological Survey. King et al found that PMJM was a distinct species after all. With conflicting studies, the USFWS resorted to a panel of experts to resolve the issue. The report issued by Sustainable Ecosystems Institute (SEI) in July, 2006 came down on the side of King et al supporting the contention that PMJM is as distinct species.

The USFWS proposed delisting the mouse after the first DNA study came back showing that the mouse was not a distinct species. The subsequent controversy has slowed the process. No new information has been issued by the USFWS as of this writing (June, 2007).

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## Previous work

The authors' involvement came at the request of the Office of the Governor of the State of Wyoming. The Governor's office was interested in what critical habitat would mean for the economy of Southeastern Wyoming. A year-long economic study was completed in September 2004. A three-step approach was used to estimate the potential economic impact of critical habitat designation on the five-county region. The basis of the approach was to determine the impacts at the farm level and scale them up to the regional level.

As a first step, "listening" sessions were held in each of the five counties in the region. This was an opportunity for local landowners, businessmen, and county officials to indicate their concerns regarding the efforts to protect PMJM and for the researchers to collect production information. The University of Wyoming Cooperative Extension Service in each county coordinated these listening sessions. Information obtained during these sessions served as the starting point for the analysis.

The results of the listening sessions were startling. Anger, frustration, confusion and distrust were some of the sentiments felt at the sessions. Landowners and community leaders present were unanimous in feeling that the process appeared to by-pass some of the fundamental tenants of the American way of life. Many of the participants felt that the process and particularly the ESA was an assault on their property rights. At times the sessions became emotionally charged. One County Commissioner was so incensed she said that if this were true (what the ESA can do to private property owners) then 'we should secede from the Union'. Another producer commented that "this takes the heart right out of your operation" referring to the potential loss of hay meadows. The researchers also gathered information on which production practices would continue and which would be curtailed and how profitability might be affected.

One issue which aroused heated emotions among the producers was that of a "federal nexus". A federal nexus or "connection" has particularly onerous connotations among area producers because it could allow federal officials legal access to their private lands (some producers claimed that they had already ejected trespassing USWFS personnel from their lands). The regulatory effects of critical habitat designation under section 7 of the ESA are triggered by activities conducted, authorized, or funded by a federal agency. This is referred to as a Federal nexus. Section 7 of the ESA requires federal agencies to confer with the USFWS on any action that is likely to result in the destruction or adverse modification of proposed critical habitat regardless of whether the action is physically located on public or private land. Activities that require consultation include (50 CFR Part 17):

- Any activity that results in development or alteration of the landscape of a unit.
- Any activity that results in changes in the hydrology of the unit.
- Any sale, exchange, or lease of Federal land that is likely to affect habitat.
- Any activity that detrimentally alters natural processes in a unit.
- Any activity that leads to the introduction, expansion, or increased density of exotic plants or animal species.

Because of their far reaching effects, landowners are particularly distrustful of the ESA, the USFWS and the federal government in general. For this reason, and the fear of triggering a federal nexus, a number of area producers told the listening sessions that they did not accept the free cattle feed offered during the drought of 2002.

The second step was to evaluate the potential impact of PMJM on agricultural operations in the region. The Draft Economic Analysis and some of the language in the USFWS's Critical Habitat Designation leave open the possibility of extending protective measures for species protection to a larger land area (see Taylor et al, 2004). Since the ESA protects the species wherever it is found, regardless of critical habitat designation, it is impossible to know the boundaries of the species or what the eventual area of protection will be. But since PMJM lives close to water, it seems logical that the most impact will be on agricultural operations that use irrigated and sub-irrigated land in the region. Beauvais et al (2004) estimated there to be 832,825 acres of suitable habitat for PMJM in the five-county region, 77 percent or 677,422 acres of which is private land. So while the USFWS designated only 10,540 acres as critical habitat, the potential for an expanded range and thus expanded economic impact is clear.

The authors adapted a linear programming model developed for the W-192 (now W-1192) USDA regional research project to Southeastern Wyoming to estimate the economic impact on profitability of a typical ranch in the region. Other factors considered in this part of the analysis included effects on economic viability of agricultural operations and the potential for a federal nexus among producers in the region. Analysis of economic viability was based on USDA Economic Research Service's Commodity Cost and Returns Budgets for cow-calf operations in the Northern Great Plains. Information on the potential for a federal nexus among agricultural producers in Southeastern Wyoming was obtained from various Federal government reports and agencies.

In order to adapt the model, an appropriate measure had to be found to evaluate the effect initiated by a policy change. The USFWS designated critical habitat for PMJM as 110 meters from the edge of either side of a stream (for stream orders 1 and 2. Larger stream have been given a 120 meter boundary). This measure is rather difficult to use as a meaningful value from an economic perspective. Therefore, the researchers translated the 110 meter measurement into an area to see what the value of habitat per linear mile of stream would be and how its withdrawal from the ranchstead would affect profitability. Figure 1 shows a schematic of a hypothetical one-mile section of a typical stream or ditch in Southeastern Wyoming.

**Figure 1.** Hypothetical view of a linear mile of PMJM habitat.

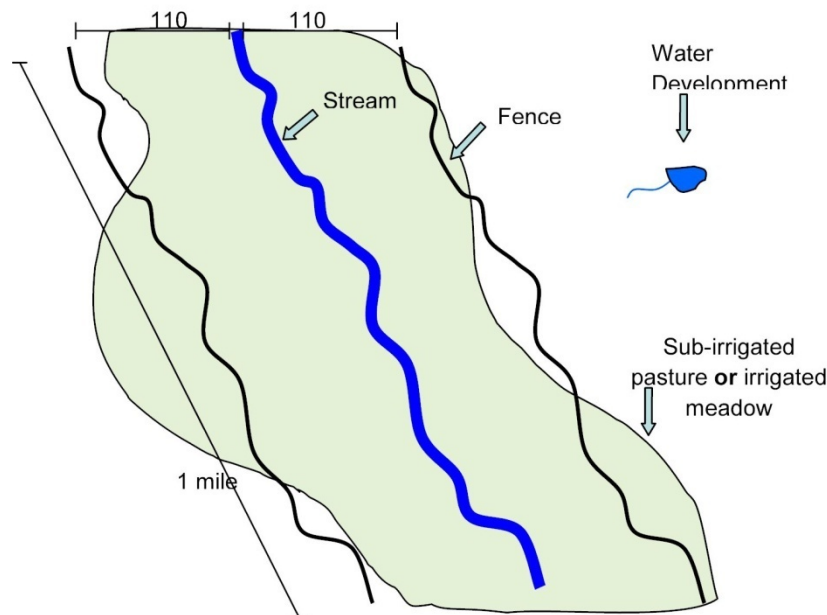
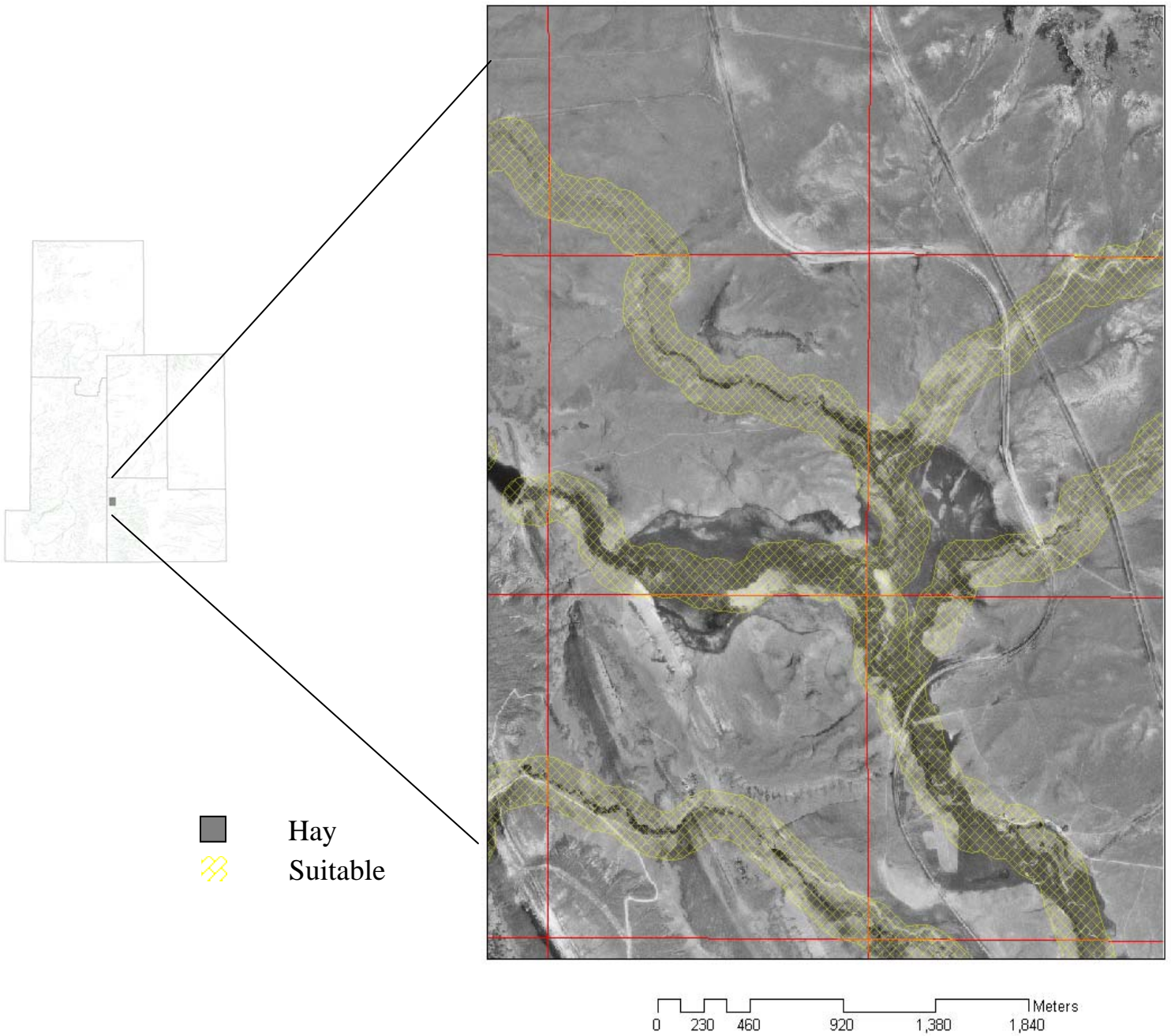


Figure 1 also illustrates an important point, the shape of hay meadows in this region. Due to the geographic location of the ranches, adjacent to the Laramie range, many of the creek bottoms tend to be narrow. These ranches were homesteaded in the 19<sup>th</sup> century and the construction of some of the irrigation ditches (and their accompanying water rights) date from this period. The technology of the time meant that ditches had to very nearly follow the contours of the land. Consequently, many of the hay meadows in the region tend to be long and narrow, following the creek bottom (Figure 2). This means that often most of an operation's hay meadow is located within 110 meters of a stream and that these operations could potentially be significantly impacted by PMJM protection policies.

**Figure 2.** Aerial photo from Southeastern Wyoming showing USFWS policy buffer.



The results show that one mile of sub-irrigated pasture would have an estimated cost of \$2,271 (\$25.96 per acre) per year, and that the per mile costs increase with each additional mile of sub-irrigated pasture on the ranch. On average, one mile of sub-irrigated critical habitat would reduce ranch profitability about 6 percent per year.

When hay meadow was considered, the estimated cost per mile was significantly higher. The model shows that a mile of irrigated hay meadow reduced ranch profits by \$7,163 (\$81.90 per acre) per year. This would reduce ranch profitability nearly 20 percent per year. Again, these per unit costs increase with each additional mile on the ranch. With three miles of irrigated hay meadow critical habitat withdrawn from the ranch, the income for the ranch would fall below the U.S. Census Bureau’s definition of poverty for a family of four.

The cost differences between sub-irrigated pasture and irrigated hay meadow are a direct result of the difference in productivity between the two classes of land. Sub-irrigated pasture productivity in the region ranges from essentially dry land pasture quality of 0.52 animal unit months (aum’s) per acre to 1.34 aum’s/acre. Irrigated hay meadow produces an average of 1.5 tons/acre of hay for winter feed or sale (Taylor et al, 2004).

Table 1 shows how profitability is affected on the model ranch. For each mile of the selected class of land, ranch profits, herd size (brood cows) and purchased alfalfa hay are shown. If only sub-irrigated pasture is affected by the withdrawals, alfalfa hay purchases decline with herd size since the producer is still able to winter the herd on grass hay produced on the ranch and is only reducing herd size in response to a decrease in available summer grazing land.

However, if irrigated hay meadow land is affected, the results are more dramatic. The producer is trying to stay in business, (the model assumes that the producer wants to continue to raise cattle and will try and find a way to do such.) even though the critical winter feed base has been reduced. The producer will therefore purchase additional alfalfa hay, even as herd size and profitability are decreasing with each mile of land withdrawn to protect PMJM.

**Table 1.** Linear programming model results.

	Base	1 Mile	2 Miles	3 Miles	4 Miles	5 Miles	6 Miles
<b>Sub-irrigated pasture</b>							
Ranch profits	\$39,423	\$37,152	\$34,754	\$32,170	\$29,443	\$25,898	\$22,328
Cows (head)	430	424	417	408	398	382	366
Alfalfa purchased (tons)	94.5	85.7	79.7	78	76	73	70
<b>Irrigated pasture</b>							
Ranch profits	\$39,423	\$32,260	\$24,978	\$17,673	\$10,071	\$2,056	-\$6,253
Cows (head)	430	413	404	395	384	367	349
Alfalfa purchased (tons)	94.5	174	287	395	502	596	690

Step three in the analysis was to evaluate the economic impact of the changes in agricultural production on the economy of communities in Southeastern Wyoming. An IMPLAN model of the five-county region was developed to estimate the economic impacts of PMJM on total (direct and secondary) jobs and income in the region. Since the number of agricultural operations and the actual amount of affected production were unknown, the researchers estimated the impact of irrigated agriculture on the region. This would provide an indication of the economic importance of the sector that would be most impacted by conservation of PMJM. It would also provide an upper limit on the potential economic impacts of PMJM on agriculture in the region.

Table 2 summarizes the economic impact of irrigated agriculture in Southeastern Wyoming. Value of production for agriculture is estimated to decrease by \$177.2 million per year from \$220.5 million with irrigation to \$43.3 million without irrigation. The \$177.2 million loss represents over 21 percent of the value of production for all agricultural commodities in Wyoming in 2000 (Wyoming Agricultural Statistics 2002). Nearly fifty percent of this loss was due to the decrease in hay production (\$85.4 million).

Employment (both direct and secondary) is estimated to decrease by 3,000 jobs from approximately 4,000 jobs (Table 3) with irrigation to approximately 1,000 jobs without irrigation. Approximately 70 percent of the total lost jobs would be in agriculture with the rest coming in other sectors of the region's economy. Nearly 64 percent of the job loss was due to the decrease in hay production. Total employment in the agricultural sector would decline by 75 percent under this scenario.

Table 3 estimates labor earnings (both direct and secondary) could decrease by \$75.7 million per year from \$81.1 million with irrigation to \$8.3 million without irrigation. Approximately 60 percent of the total lost labor earnings would be in agriculture with the rest coming from other sectors of the region's economy. Nearly 72 percent of the labor earnings loss was due to the decrease in hay production. Labor earnings in the agricultural sector would decline by 95 percent under this scenario. Average earnings per job for all sectors would decline from \$21,190 with irrigation to \$8,624 without irrigation.

**Table 2.** Value of production, irrigated agriculture in Southeastern Wyoming.

	Value of Production W/Irrigation	Value of Production W/O Irrigation	Change	Percent change
Hay Production	\$122,516,662	\$37,144,458	-\$85,372,204	-69.7
Corn Production	\$57,709,019	\$4,208,579	-\$53,500,440	-92.7
Sugar Beet Production	\$34,721,982	\$899,798	-\$33,822,184	-97.4
Dry Bean Production	\$5,594,749	\$1,035,635	-\$4,559,114	-81.3
<b>Total</b>	<b>\$220,542,412</b>	<b>\$43,288,470</b>	<b>-\$177,253,942</b>	<b>-80.4</b>

**Table 3.** Agricultural Employment in Southeastern Wyoming.

	Employment W/Irrigation	Employment W/O Irrigation	Change	Percent change
Hay Production	2,778.8	870.7	-1,908.1	-68.7
Corn Production	767.8	67.2	-700.6	-91.3
Sugar Beet Production	319.5	14.4	-305.1	-95.5
Dry Bean Production	101.6	16.5	-85.1	-83.8
<b>Total</b>	<b>3,967.7</b>	<b>968.8</b>	<b>-2,998.9</b>	<b>-90.1</b>

### Policy implications

PMJM already has policy implications on several levels and is a watershed species in regard to national environmental policy. It is the first species where DNA analysis is playing a major role in determining whether or not a species should have protection under the ESA. It is

the first species that has a significant percentage of its critical habitat on private land. And it has increased calls for ESA reform from property rights activists and others.

The DNA issues are largely beyond the scope of this paper; however, they may play the largest role in the eventual outcome. Indeed, it appears at present, that the entire issue is focused on the controversy outlined over the taxonomy of the species. PMJM, as the first species listed under the ESA to be challenged as a distinct species using this method, is a precedent setting species and will most likely see a number of legal challenges to whichever decision the USFWS eventually decides upon. And yet, beyond the legal challenges, the repercussions are already being felt in the biological sciences. The Sustainable Ecosystem Institute report (2006) stated that:

“All readers should recognize that taxonomy is a field undergoing evolutionary change of its own. The integration of genetic data into ‘classical’ taxonomy is far from complete, and there are as yet no clear guidelines on, for instance, which characters are more or less ‘important’. There will be cases where expert opinion will be divided.” (SEI, 2006)

Meaning that the relatively new science of DNA analysis is changing our perception of what we call a species and that naming conventions have not yet been developed to match. How this process plays out and where it plays out, whether on campuses or in the courts, may have further repercussions for the ESA.

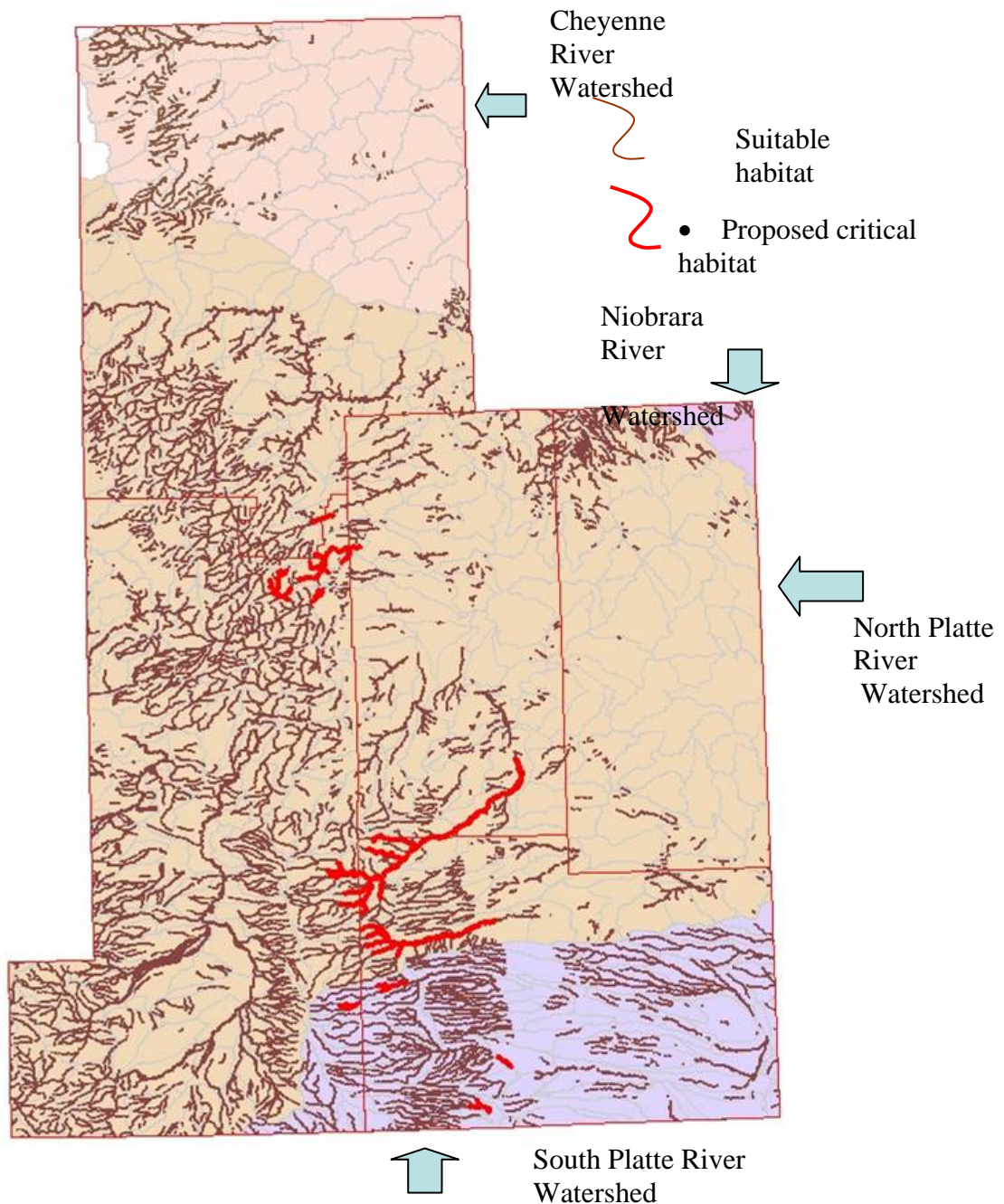
In the long run, questions of geography and economics may over shadow the taxonomic issues. Eighty-eight percent of the land designated as critical habitat for PMJM in Wyoming is private land; most of which is within 110 meters of a stream or irrigation ditch (due to the policy constraint set by the USFWS and the location of PMJM habitat). These lands are either sub-irrigated meadow or hay meadow. Hay meadows are the “heart” of the ranch from a productivity standpoint. If hay meadow acreage is reduced, the overall carrying capacity of the ranch is reduced because the ability to feed cattle during the winter is impaired. Reducing the carrying capacity of the ranch reduces producer income which in turn impacts the local economy. Taylor et al (2004) has shown the level of the region’s dependency on agriculture and how this might affect the regional economy.

With critical habitat for PMJM already designated, landowners know that they could be told that they are no longer allowed to hay or graze their land. If landowners have to give up land for PMJM habitat, and have to pay for fencing to keep their cattle out of mouse habitat on their own land, there will likely be legal as well economic implications. Landowners may well feel that this qualifies as a “taking” under section 7 of the ESA and desire compensation from the federal government. It is estimated that the fencing alone for the 125 miles of critical habitat would cost approximately \$2.4 million (not including annual maintenance). Additionally, landowners would want compensation for lost use of their land. This cost could potentially range between \$200,000 and \$1.5 million per year, depending on the land use and quality. Administration and enforcement costs would have to be accounted for as well. Initial fencing cost would be a one-time cost, but require annual maintenance. All other costs would be annual and in perpetuity.

The above costs are estimated for what is currently designated as critical habitat. However, there is the potential for a much wider scope, should the USFWS determine that PMJM qualifies for continued protection under the ESA. The Draft Economic Analysis notes “Section 9 and 10 of the Act [ESA] apply to all landowners with PMJM on their property regardless of whether a Federal nexus exists or whether their property is located with critical habitat (page B-1).” The Draft Analysis further notes “Because the PMJM inhabits riparian

areas in or surrounding irrigation ditches and hay fields, some incidental take of individual mice is inevitable during normal farming and ranching operations in the mouse's range (page B-1).” As a result the effects of protection of PMJM could be much more widespread and significant than just the designation of habitat under section 7 of the ESA (Industrial Economics, 2003). Figure 3 shows suitable habitat as developed from trappings and modeling of PMJM's environment by Beauvais (2004). The amount of (in this case, proposed) critical habitat is relatively small compared to where the mouse could possibly be found, adding weight to the argument of potentially much larger impacts.

**Figure 3.** Suitable habitat by major watershed.



This also shows that uncertainty regarding future regulation for the protection of PMJM is creating mixed signals, at the very least, for landowners in the region. The effects on agriculture from PMJM remain unclear. In the final critical habitat designation the Service notes that:

“While some aspects of irrigated hayfields are undoubtedly beneficial to the Preble’s, overall effects on Preble’s populations are likely complex and have not yet been studied (USFWS 50 CFR Part 17 – page 54)”.

And,

“The Service has adjusted the discussion of grazing and water management to indicate that these activities, under certain management scenarios, may be consistent with Preble’s conservation. However, the Service still views both grazing and water management as threats to the Preble’s (USFWS 50 CFR Part 17 – page 89)”.

An important point is that the costs imposed by the ESA would have to be borne by someone in order to comply with the provisions of the law. If the USFWS decides that PMJM is a distinct species and qualifies for protection then it could simply impose these costs on landowners through regulation. Landowners would likely mount a legal challenge to this as a taking. If the landowners were to prevail in court, then the USFWS would have to pay the costs. If courts were to rule against landowners (and likely landowner supported advocacy groups) then in addition to the costs of supporting preservation previously outlined, landowners and their allies would have the legal costs to shoulder as well. Furthermore, there could potentially be some longer term effects as landowners most affected are unable to continue ranching operations due to preservation costs. When this land changes hands, the new owners would likely realize that agriculture had not been viable for the previous owner and that a portion of the land that they were purchasing is effectively out of their control. With the exception of a neighbor, buying to consolidate, new owners would likely have to look for a new use for the land, beyond agriculture. With rapid rural residential development occurring just to the south in Colorado, it is not hard to imagine that this could be the fate of some of these parcels. Of course, the area of critical habitat could not be developed, but contiguous lands outside of the critical habitat designation would not be affected. So in perverse twist of irony, efforts to preserve the mouse could end up fueling the very activity that it was rumored to be enlisted to stop.

This is where the implications for national environmental policy could become important and where the political aspect of the issue comes to the fore. If the federal government were required by a court to pay a large sum, in perpetuity (or some undefined period), to protect PMJM, this would set a legal precedent that people in other areas of the country who face similar issues may decide to litigate as well. These challenges would further tie up the resources of the USFWS that could otherwise be used to more efficiently.

In essence then, the argument comes down to a political one (with economic and legal implications of course) of what value society places on PMJM; how much it is willing to spend; and who will bear the costs. The ESA is mostly concerned with species protection, not economics in general. Species protection was an important focus when the act was passed, 35 years ago. At that time there were a number of high profile species, such as the Bald eagle that were on the verge of extinction and that society, in general, was willing to pay a high price to conserve. Today, the USFWS is moving forward with delisting the Bald Eagle (but still protect it), and would like to delist the Grizzly bear and Grey wolf. The country’s environmental consciousness is more focused today on global warming and greenhouse gases. It may be more difficult to rouse the type of sympathy formerly seen for high profile species for a mouse. And

yet PMJM has all the same protections under the law and the USFWS is required to protect it in the same way. The only way that this will change is if there is change in the law. So while scientists argue about whether or not PMJM is a separate species, the real argument is whether or not society is willing to make available the resources needed to conserve the species.

If PMJM is judged to be a separate species, then costs that will be imposed to protect it and to try to restore it to some population level. The USWFS will be required to work toward progress and be held accountable for any failures toward eventual delisting. If PMJM is judged not to be a separate species then the USFWS could continue the move towards delisting PMJM.

## Summary

This paper is an extension of earlier work by the authors. It attempts to recast the issue in a different light; putting it in a framework of discussion of how the property rights of affected landowners could be impacted and what the implications could be for national environmental policy. Earlier work has been summarized to help the unfamiliar reader learn the situation and place it in context.

PMJM is a precedent setting species several different ways. It is the first species where DNA analysis is playing a major role in determining whether or not a species should have protection under the ESA. It is the first species that has a significant percentage of its critical habitat on private land. And it has already increased calls for ESA reform from some circles.

Whatever the USFWS decides in regard to PMJM, litigation is almost assured due the controversy of whether or not it is a distinct species. And yet there are larger questions and larger implications for science, policy and the regional economy of Southeastern Wyoming. Science is grappling with what the precise definition of a species is, given new information by DNA analysis. Policy questions arise as to who will bear the cost of species conservation on private lands when there are significant amounts of critical habitat on private land. Landowners in the region are angry and confused. And finally, the potential for expansion of the range of PMJM hangs like a sword of Damocles over the issue, threatening to greatly expand the region affected by the issue.

PMJM is a small rodent about nine inches in length, 60 percent of which is tail. Its activities have been un-noticed until recently. And yet, these small feet are leaving very big tracks indeed.

## References

Beauvais, Gary P. *Preble's Meadow Jumping Mouse in Wyoming, Status Report: July, 2003*. Appendix K in: "The Potential Economic Impact on the Economy of Southeastern Wyoming from Designation of Critical Habitat for Preble's Meadow Jumping Mouse". Unpublished report to the Governor of the State of Wyoming. Online at: <http://agecon.uwyo.edu/EconDev/PMJM1.htm> . University of Wyoming, Department of Agricultural & Applied Economics September, 2004.

Industrial Economics, Incorporated. *Draft Economic Analysis of Critical Habitat Designation for the Preble's Meadow Jumping Mouse*. Prepared for U.S. Fish and Wildlife Service by Industrial Economics Incorporated. <http://mountain-prairie.fws.gov/preble/index.htm>. Cambridge, MA. January 2003.

King, T.L., J.F. Switzer, C.L. Morrison, M.S. Eackles, C.C. Young, B.A. Lubinski and P. Cryan. *Comprehensive genetic analyses of molecular phylogeographic structure among meadow jumping mice (Zapus hudsonius) reveals evolutionary distinct subspecies*. A report submitted to the U.S. Fish and Wildlife Service. Online at: <http://mountain->

[prairie.fws.gov/preble/PEER/PEERindex.htm](http://mountain-prairie.fws.gov/preble/PEER/PEERindex.htm) .U.S. Geological Survey-Biological Resources Division, Kearneysville, WV. January 2006.

Ramey, R., L. Hsiu-Ping, L. Carpenter. *Testing the Taxonomic Validity of Preble's Meadow Jumping Mouse*. Report to the Governor of Wyoming and the U.S. Fish and Wildlife Service (Revised). Denver museum of Nature and Science, Denver, CO. March 2004. Online at: <http://mountain-prairie.fws.gov/preble/PEER/PEERindex.htm>

Sustainable Ecosystems Institute, The. *Evaluation of Scientific Information Regarding Preble's Meadow Jumping Mouse*. Report to U.S. Fish and Wildlife Service. Online at: <http://mountain-prairie.fws.gov/preble/PEER/PEERindex.htm> P.O. Box 80605, Portland, OR 97280. July 2006.

Taylor, David T. Roger H. Coupal, Thomas Foulke and Dennis Feeney. *The Potential Economic Impact on the Economy of Southeastern Wyoming from Designation of Critical Habitat for Preble's Meadow Jumping Mouse*. Unpublished report to the Governor of the State of Wyoming. Online at: <http://agecon.uwyo.edu/EconDev/PMJM1.htm> . University of Wyoming, Department of Agricultural & Applied Economics September, 2004.