



CALIFORNIA  
CHAPARRAL  
INSTITUTE

*...the voice of the chaparral*

Department of Planning and Land Use  
Attn: James Pine  
5201 Ruffin Rd. Suite B  
Mail Stop 0650  
San Diego, CA 92123-1666

June 15, 2010

Re: Revisions to Guidelines for Determining Significance and Report and Content Requirements for Wild Land Fire and Fire Protection

Dear Mr. Pine,

San Diego County is taking several steps backward in its effort to develop an effective plan to mitigate wildfire risk. To partially remedy this problem, **we strongly recommend that either pages 1-8 of the revised Guidelines be returned to their original content or be dropped completely.**

The revisions to the Guidelines document in Section 1 (General Principles and Existing Conditions) are another attempt by the county to promote the Baja California fire mosaic hypothesis, **an idea that has been rejected by the majority of the scientific community** (the mosaic hypothesis states that large fires never occurred prior to 1900, large stands of mature chaparral are unnatural, chaparral cannot type-convert to weedy grasslands, and past fire suppression has caused unnatural "overgrowth" of shrubland habitat). In the process, the county has excised from the Guidelines any scientific research that does not conform to its objectives, purged any statements that may suggest chaparral plant communities are vulnerable to being damaged by fuel treatment activities, and removed any attempt to seriously consider the impact of climate change on wildfire.

This is not the first time the county has tried to do this. In 2003, the county produced the "Mitigation Strategies for Reducing Wildland Fire Risks" report. It was filled with inaccuracies, references that did not exist, and misrepresentations of scientific research, all in an effort to promote landscape-scale plant community modifications. Several of the referenced scientists wrote letters to the county repudiating the document ([Keeley 2004](#), [Fotheringham 2004](#), [Schoenberg and Peng 2004](#)). Local experts also pointed out critical errors in the report ([Spencer et al. 2004](#)).

The mosaic hypothesis was promoted again by Supervisor Bill Horn during the May 14, 2008, San Diego Board of Supervisors meeting. Supervisor Horn has a history of

misunderstanding the region's natural environment. For example, during the January 7, 2004 Board meeting he said, "If you look at pictures of 100 years ago from the San Diego Historical Society, you'll see that our hills were covered in cactus and small grasses. You have, as human beings, turned this into a garden... We have allowed things to grow that turn into green. As you know, or may not know, 200 years ago our back hills were covered in redwood trees." These notions are demonstrably false.

The Board voted unanimously to support Supervisor Horn's perspective on mosaics and directed county staff to "plan for comprehensive vegetation management that would include mechanical, biological, and prescribed fire into the land management plans for all existing and future county owned lands and Multiple Species Conservation Program lands."

Although county staff made a concerted effort to insert the basic tenets of the mosaic hypothesis into the resulting 2009 Vegetation Management Report, scientists whose work was again misrepresented helped to convince the county to do otherwise ([Mensing 2008, Witter and Taylor 2008](#)).

As a consequence, most of the erroneous material was eliminated in the Report's 3rd draft. The manager of the county's Multiple Species Conservation Plan, Tom Oberbauer, promised that the remaining points of contention would be removed in exchange for the Chaparral Institute's affirmative vote on the draft during a public meeting on August 2, 2008. Unfortunately, the corrections were never made ([Halsey 2008](#)).

We are deeply concerned that the county is trying for the third time to insert a discredited idea into its planning process.

## **Consensus vs. Scientific Decision Making**

To justify county's tenacious effort to promote the mosaic hypothesis, planning staff has claimed that there is "no consensus" concerning the impact of fire and fuel treatments on native chaparral ecosystems ([Steinhoff 2010](#), T. Oberbauer - SD County meeting 6/7/10). This approach only serves to establish a "straw man" as a distraction to the real issue: the refusal to accept overwhelming scientific evidence.

What the county staff fails to understand is that **science does not work by consensus**, it works by weighing the "**bulk of the evidence**" accepted by the majority of the scientific community. With every scientific idea, there are always going to be a few holdouts who refuse to accept the preponderance of data. However, government agencies, managers, and society at large cannot wait for outliers to come around. In fact, effective managers never wait for a "consensus" in science before acting. Otherwise, policy would be forever bogged down with the "you have your experts, and we have ours" approach to decision making.

This is why the National Park Service has a mandate to develop policies to address the impact of climate change now. They are not waiting for the few doubters to agree that climate change is posing a serious threat to the nation's natural resources.

In maintaining that there is "no consensus" concerning the impact of fire and fuel treatments in shrubland ecosystems as a way to ignore evidence contrary to its policy objectives, county staff is preventing the development of a successful wildfire risk management plan.

**We challenge Supervisor Horn, Mr. Steinhoff, Mr. Oberbauer, and other county officials to offer their rationale for promoting the fire mosaic hypothesis after objectively examining the "bulk of the evidence" provided on pages 9-10, evidence that demonstrates the hypothesis should be rejected.**

## **Misrepresenting Scientific Research**

We find the pattern of deletion and insertion of statements in the Guidelines similar to how special interest groups have tried to modify climate science findings or the teaching of evolution in public schools.

For example, the county has drastically altered the published conclusions of fire scientists Keeley and Fotheringham in an apparent attempt to dismiss data showing fire frequencies have increased, obfuscate the role of Santa Ana winds, and to remove any implied reference to chaparral. The originally accurate statement read,

*Over 95 percent of fires in southern California shrublands are started by people, which has increased fire frequency and increased the chances of ignitions during Santa Ana winds (Keeley and Fotheringham 2003).*

The statement is changed significantly in the revision, yet it is still attributed to the scientists:

*Over 95 percent of the mapped fires in southern California were started by people, who are **believed** to have caused a **slight increase** in fire frequency (Keeley and Fotheringham 2003). Pg. 8*

In another example of misrepresentation, a sentence describing the increase in fire frequency over the past century has been deleted and is replaced by the following:

*During the 20th century, the area burned has increased in coastal sage scrub, remained flat in chaparral, and decreased in the desert (Wells et al. 2004). Pg. 5*

While the revised Guidelines accurately quotes the paper cited, it fails to note that the research only analyzed fire records from 1900-1997 - it does not include the fires of 2003 or 2007. Interpretations of fire regimes are heavily influenced by rare, large events. If the analysis was repeated today, average fire return intervals would obviously get shorter for large portions of the landscape. The new analysis would also show huge amounts of all cover types burning in this decade. Fig 5 in the paper would show a positive "trend" for all vegetation types.

The revised Guidelines also fail to reveal that two of the major conclusions in Wells et al. 2004 are in conflict with the fire mosaic hypothesis. First, "that increasing human population has resulted in a greater number of ignitions and an increase in area burned." And second, "...sage scrub and chaparral have burned more frequently than other vegetation types during the course of the 20th century." In contrast to this data, the mosaic hypothesis minimizes the impact of human caused ignitions and assumes fire suppression has lead to fire exclusion, which in turn has supposedly allowed large stands of "decadent," old-growth chaparral to develop. None of these assumptions are supported by the bulk of the evidence.

## Denial of the Natural Fire Regime

Research has proven that **infrequent, large fires are a natural and inevitable** part of the Southern California landscape. However, the revised Guidelines have excised this fact.

The original Guidelines stated,

*Fire ecology research has shown that the natural fire regime for shrublands and forests in San Diego County was one of frequent small fires and occasional large fires.*

The revised version removes the reference to "shrublands" and replaces "occasional large fires" with "**moderate summertime fires.**" (revised text in bold),

*Fire ecology research has shown that the natural fire regime for **wildlands** in San Diego County was one of frequent small fires and **moderate summertime fires.** Pg. 2*

The following has also been purged from the document:

*Recent field research on the fire regime shows that the natural fire regime before human intervention included large, high intensity fires, leading to the conclusion that current fire management policies have not created the contemporary large fire regime but that it has always been present (Keeley and Fotheringham 2001).*

Then, in an apparent attempt to shift emphasis away from the fact that weather is the main driver of large fires, the following statement has been deleted:

*Seasonal dry winds like the "Santa Ana" have a tremendous effect on fire speed and flame length.*

With subtle rewording, the following has been altered to conform more closely to the county's viewpoint that undisturbed stands of old-growth chaparral are the primary cause of large fires (revised text in bold):

*The extreme winds, **coupled with large expanses of older chaparral vegetation, burn violently** and can cause wildfires to spread rapidly... Pg. 3*

## Denial of Type Conversion

There is a consistent effort throughout section 1 to remove any reference to type-conversion of chaparral to invasive grasslands. Where the general term "shrublands" was used previously, the revised Guidelines now uses the more limited "*coastal sage scrublands*" or "*sage scrublands*." Pgs. 5-6

Mentioning the hazards of invasive plants was eliminated from the document with the removal of this paragraph:

*Invasive plants can change fire regimes in ways that promote their own dominance. Densely packed invasive grasses are notorious for increasing landscape flammability, which promotes fire return intervals that are often much shorter than native plants can survive (Brooks 2001; Brooks and D'Antonio 2003; Menakis et al. 2003). Pg. 7*

What makes these changes peculiar, besides the county's refusal to acknowledge that type-conversion of chaparral has been recognized as a serious threat by the scientific community, is that a paper cited by the county on page 6 makes it very clear that the invasion of non-native weeds into chaparral has a dramatic impact on the plant community's fire regime and overall ecological health (Brooks et al. 2004).

Brooks et al. also discusses the problem inherent with "mosaics," the key feature in the county's approach to land management:

Landscape patterns can greatly affect the invasion process. For example, the mosaic patchwork of oak savanna and chaparral in the foothills of the Sierra Nevada in North America places alien-dominated savannas in close proximity to largely uninvaded chaparral. Following fire, the extent of alien invasion into chaparral is largely a race between aliens reaching the site and shrublands returning to their former closed-canopy condition (Keeley et al. 2003). Fire extent can affect this process, because the large perimeter-to-area ratio of small burns can make areas more vulnerable to invasion than larger fires (Turner et al. 1997).

Denying type-conversion of chaparral is an essential part of the mosaic hypothesis because it creates significant problems for those promoting the idea.

First, the hypothesis is based on the assumption that young chaparral does not burn. "Young" has generally been defined as any chaparral stand below 20-years-old. However, it has been clearly shown that chaparral 20 years or younger can burn easily under the right conditions. When it does, the plant community is at risk of being type-converted (see references below, pgs. 11-12).

Secondly, the destruction of habitat caused by type-conversion creates a problem for proponents who claim chaparral "always bounces back." If it is acknowledged that creating young-aged "mosaics" across the landscape can destroy habitat, proponents will face a more difficult challenge selling the mosaic concept to funding agencies and the public. This problem was acknowledged by the county in a April 2, 2010 letter to the California Board of Forestry claiming they "strongly

disagreed" with draft California Fire Plan when it stated, "fires have been too frequent in many shrublands, especially those of southern California, which are then at risk of type conversion from native species to invasives that can pose a fire threat every fire season."

The County explained that recognizing the threat of chaparral type-conversion in the Plan "*would impact our ability to obtain funding or carry out important vegetation treatment programs here*" ([Steinhoff 2010](#)).

Whether or not scientific facts will "impact" funding opportunities is not a valid reason to ignore them. The county's perspective on this matter is especially surprising because the author of the letter cited above expressed a desire to develop a plan to "*restore chaparral*" in some of the areas that had burned in the 2007 fires (R. Steinhoff pers. com. 11/27/07).

The county appears to be basing its opinion about chaparral type-conversion on anecdotal evidence that does not meet the basic standards for scientific research. In the letter cited above, the county states that chaparral burned in both the 2003 and 2007 wildfires "*has remained chaparral and is recovering.*" We are not familiar with the protocols the county has used to collect its data, but research conducted by both USGS and ourselves indicates that these twice-burned ecosystems are not recovering properly. We would like to examine both the data sets and the study plots the county has established that support their conclusions.

As if to soften the negative image of the invasive species involved in type-conversion, the county has revised its description of them. The previous Guidelines document stated that,

*Humans have introduced nonnative species and have contributed to their wide spread invasion of native plant communities throughout the developed world.*

The new version states:

*Humans have always brought their plants and animals along as part of global migrations. Occasionally, plants and animals have naturalized and become adapted to native plant communities throughout the developed world. Pg. 7*

Although the revised section on invasive species does mention how nonnative annual grasses can dominate a site that has been burned too frequently, it removes, as it does elsewhere, chaparral from the discussion.

**We challenge Supervisor Horn, Mr. Steinhoff, Mr. Oberbauer, and other county officials to offer their rationale for denying the fact of chaparral type-conversion after objectively examining the "bulk of the evidence" provided on pages 11-12.**

## **Native Plants, Ornamentals and Climate Change**

We find it unfortunate that the County has removed the following from the Guidelines:

*some native shrubs in San Diego County have higher moisture levels than ornamentals when growing in similar environments. In effect, the higher the moisture content, the lower the wildfire threat.*

Planning staff have an obligation to explain this deletion, especially in light of the fact that properly maintained native landscapes have been shown to offer an excellent way to create a low water use, fire-safe environment around a home.

We are also curious why all mention of climate change and its possible impact on fire and the re-distribution of native plant communities has been purged from the Guidelines with the exception of two sentences on page 5.

### **Alternative to the Standards (5.7)**

Section 5.7 states that compensatory safety benefits can be achieved by a "*Fuel modification area (that) exceeds possible flame length.*" As we have stated in numerous comment letters to the county over the past seven years, the idea that excessive clearances will compensate for structures or projects situated in unsafe locations is not supported by scientific evidence. Such clearance distances fail to compensate for flying embers that can travel up to three miles ahead of the fire front, the inevitable planting of flammable ornamental vegetation and accumulation of flammable debris in yards, and the creation of environments that cause the spread of flammable, weedy grasses. Excessive clearance distances also lead to the unnecessary destruction of valuable habitat.

Large clearance zones also eliminate properly maintained shrubs and trees that can protect homes from ignition by catching embers and absorbing heat from an advancing fire front. We strongly suggest the county refer to Dr. Jack Cohen's work listed in the Guidelines' reference list. We also refer the county to our website's ["Protecting Your Home"](#) page.

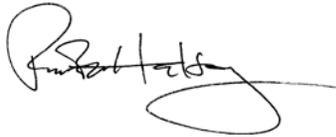
### **Conclusion**

After reading the current revision of the Guidelines document and working with San Diego County over the past seven years on wildfire issues, we have come to the conclusion that the county has made a conscious policy decision to ignore scientific data that does not fit within its land management objectives. The county also has developed a pattern of misrepresenting the work of scientists whose research does not support its viewpoint concerning fire ecology, fire behavior, and the protection of lives and property from wildland fire. These behaviors are consistent with the county's continued refusal to notify certain stakeholders who have disagreed with its policies in the past of review periods for public documents concerning wildfire issues. We requested to be added to the notification list during the 2007 revision of the Guidelines, but the county "respectfully declined." We continue to be perplexed over this effort to exclude interested parties in the democratic process.

In conjunction with these issues, we find it extremely troubling that the county is sponsoring a change in state law (SB 1293) that will further limit environmental review, citizen input, and independent scientific oversight on its landscape-scale vegetation clearance plans. The County's position on the bill as described in its ["point paper"](#) misrepresents science in a manner similar to the revised Guidelines.

We were hopeful that after finalizing its 2009 Vegetation Management Report and its recent loss in court over its attempt to exempt a \$7 million vegetation clearance project from the California Environmental Quality Act (CEQA), the County would reconsider its approach to science and wildfire.

Sincerely,

A handwritten signature in black ink, appearing to read "Richard W. Halsey", with a large, stylized flourish at the end.

Richard W. Halsey  
Director

Most of the references on the following pages can be downloaded from the embedded link provided. For a concise summary of why the Baja California fire mosaic hypothesis should be rejected, please download the following document:

["Resolving the Controversy: Why Large Fires in Southern California"](#)

The California Chaparral Institute is a non-profit, 501(c)(3) corporation that specializes in research and educational programs to help the public and government agencies better understand the fire-prone ecosystems in which we live. A major focus of our organization is to communicate the most recent scientific research as it applies to shrubland ecosystems, especially the chaparral.

**Key research that leads to the rejection of the mosaic hypothesis by testing its data set, assumptions, and/or predictions (with key quotations):**

[Conard, S. G., and D. R. Weise. 1998. Management of fire regime, fuels, and fire effects in southern California chaparral: lessons from the past and thoughts for the future. In Teresa L. Pruden and Leonard A. Brennan \(eds.\). Fire in ecosystem management: shifting the paradigm from suppression to prescription: 1996 May 7-10; Boise, ID: Tall Timbers Fire Ecology Conference No. 20. Tallahassee, FL: Tall Timbers Research Station; 342-350.](#)

"For these purposes, landscape mosaics are impractical, unnecessary, and probably not particularly effective. We basically recommend shifting the management focus away from pure mosaic burning toward development (and rejuvenation) of strategically placed fuel management zones."

[Gorte, R.W. 2009. Wildfire Fuels and Fuel Reduction. CRS Report for Congress. Congressional Research Service 7-5700, R40811. www.crs.gov.](#)

"These (crown-fire) ecosystems contain relatively large volumes of biomass fuels of relatively uniform size. There is no evidence that human activities of the past century—grazing, logging, fire suppression, and more—have had much impact on fuel loads or on the nature of fires in these ecosystems. Similarly, there is no evidence that activities to reduce fuel loads and remove fuel ladders would affect the likelihood of catastrophic crown fires in these ecosystems. The ineffectiveness of fuel treatment was particularly noted for southern California chaparral:..."

[Keeley, J. E., C. J. Fotheringham, and M. Morais. 1999. Reexamining fire suppression impacts on brushland fire regimes. Science 284:1829-1832.](#)

"In brush-covered landscapes of southern and central-coastal California, there is no evidence that fire suppression has altered the natural stand-replacing fire regime in the manner suggested by others (3, 5)."

[Keeley, J.E.; Aplet, G.H.; Christensen, N.L.; Conard, S.C.; Johnson, E.A.; Omi, P.N.; Peterson, D.L.; Swetnam, T.W. 2009. Ecological foundations for fire management in North American forest and shrubland ecosystems. Gen. Tech. Rep. PNW-GTR-779. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 92 p.](#)

"The fire regime in this region is dominated by human-caused ignitions, and fire suppression has played a critical role in preventing the ever increasing anthropogenic ignitions from driving the system wildly outside the historical fire return interval. Because the net result has been relatively little change in overall fire regimes, there has not been

fuel accumulation in excess of the historical range of variability, and as a result, fuel accumulation or changes in fuel continuity do not explain wildfire patterns."

[Keeley, J.E. and P.H. Zedler. 2009. Large, high-intensity fire events in southern California shrublands: debunking the fine-grain age patch model. \*Ecological Applications\* 19: 69-94.](#)

"A review of more than 100 19th-century newspaper reports reveals that large, high-intensity wildfires predate modern fire suppression policy, and extensive newspaper coverage plus first-hand accounts support the conclusion that the 1889 Santiago Canyon Fire was the largest fire in California history."

[Lombardo, K.J., T.W. Swetnam, C.H. Baisan, M.I. Borchert. 2009. Using bigcone Douglas-fir fire scars and tree rings to reconstruct interior chaparral fire history. \*Fire Ecology\* 5: 32-53.](#)

"The historical and modern records both imply that large, landscape-scale fires are inevitable in chaparral landscapes."

[Mensing, S. A., J. Michaelsen, and R. Byrne. 1999. A 560-year record of Santa Ana fires reconstructed from charcoal deposited in the Santa Barbara Basin, California. \*Quaternary Research\* 51:295-305.](#)

"The fuel and weather conditions necessary for large fires were present prior to fire suppression and are a natural part of chaparral ecology in a Mediterranean climate."

[Moritz, M.A., J.E. Keeley, E.A. Johnson, and A.A. Schaffner. 2004. Testing a basic assumption of shrubland fire management: How important is fuel age? \*Frontiers in Ecology and the Environment\* 2:67-72.](#)

"Fire frequency analysis of several hundred wildfires over a broad expanse of California shrublands reveals that there is generally not, as is commonly assumed, a strong relationship between fuel age and fire probabilities."

[Zedler, P.H., Seiger, L.A. 2000. Age mosaics and fire size in chaparral: A simulation study. In 2<sup>nd</sup> Interface Between Ecology and Land Development in California. USGS Open-File Report 00-02, pp. 9-18.](#)

" We conclude that age-based mosaics following the strict rules of the fuel/age paradigm are a transient phenomenon, and therefore we question if fine-grained age mosaics are characteristic of natural systems and whether they should be the objective of long-term landscape planning."

## **Research discussing the negative ecological impacts of short fire return intervals in chaparral:**

[Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.M. DiTomaso, J.B. Grace, R.J. Hobbs, J.E. Keeley, M. Pellant, D. Pyke. 2004. Effects of invasive alien plants on fire regimes. \*Bioscience\* 54:677-688.](#)

[Diaz-Delgado, R., F. Lloret, X. Pons, and J. Terradas. Satellite evidence of decreasing resilience in Mediterranean plant communities after recurrent wildfires. 2002. \*Ecology\* 83: 2293-2303.](#)

[Franklin, J., A.D. Syphard, H.S. He, D.J. Mladenoff. 2005. Altered fire regimes affect landscape patterns of plant succession in the foothills and mountains of southern California. \*Ecosystems\* 8: 885-898.](#)

[Haidinger, T.L., and J.E. Keeley. 1993. Role of high fire frequency in destruction of mixed chaparral. \*Madrono\* 40: 141-147.](#)

[Jacobsen A.L., Fabritius S.L. and Davis S.D. 2004. Fire frequency impacts non-sprouting chaparral shrubs in the Santa Monica Mountains of southern California. In \*Ecology, Conservation and Management of Mediterranean Climate Ecosystems\*. Eds. Arianoutsou M and Papanastasis VP. Millpress, Rotterdam, Netherlands.](#)

[Keeley, J.E. 2005. Fire as a threat to biodiversity in fire-type shrublands, pp. 97-106. \*Proceedings of the Conference, Planning for Biodiversity: Bringing Research and Management Together\*. USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-195.](#)

[Keeley, J.E. 2006. Fire management impacts on invasive plant species in the western United States. \*Conservation Biology\* 20:375-384.](#)

[Keeley, J.E., and C.J. Fotheringham. 2003. Impact of past, present, and future fire regimes on North American mediterranean shrublands. Pages 218-262 in T. T. Veblen, W. L. Baker, G. Montenegro, and T. W. Swetnam, \(eds\). \*Fire and climatic change in temperate ecosystems of the Western Americas\*. Springer, New York.](#)

[Keeley, J.E., A.H. Pfaff, and H.D. Safford. 2005. Fire suppression impacts on postfire recovery of Sierra Nevada chaparral shrublands. \*International Journal of Wildland Fire\* 14: 255-265.](#)

[Keeley, J.E., C.J. Fotheringham, and M. Baer-Keeley. 2005. Determinants of postfire recovery and succession in mediterranean-climate shrublands of California. \*Ecological Applications\* 15:1515-1534.](#)

Lawson, D., H.M. Regan, P.H. Zedler, J. F. Franklin. 2008. Using Death Assemblages in Extant Stands of an Obligate Postfire Seeding Shrub *Ceanothus verrucosus*, to Inform Fire Management. Unpublished study.

[Odion, D.C., and F.W. Davis. 2000. Fire, soil heating, and the formation of vegetation patterns in chaparral. \*Ecological Monographs\* 70: 149-169.](#)

[Odion, D., and C. Tyler. 2002. Are long fire-free periods needed to maintain the endangered, fire-recruiting shrub \*Arctostaphylos morroensis\* \(Ericaceae\)? \*Conservation Ecology\* 6: 4.](#)

Regelbrugge, J.C. 2000. Role of prescribed burning in the management of chaparral ecosystems in southern California. In J.E. Keeley, M.B. Keeley, and C.J. Fotheringham (eds.) 2nd Interface between Ecology and Land Development in California. Sacramento: US Geological Survey Open-File Rep. 00-02, p. 19 – 26.

[Syphard, A.D., J. Franklin, and J.E. Keeley. 2006. Simulating the effects of frequent fire on southern California coastal shrublands. \*Ecological Applications\* 16:1744-1756.](#)

[van Wageningen, J. W.; Keeley, J. E.; Brooks, M. L.; Klinger, R. C. February 2007. Fire in California's Ecosystems. USGS Publication Brief.](#)

[Zedler, P.H., C.R. Gautier, G.S. McMaster. 1983. Vegetation change in response to extreme events: the effect of a short interval between fires in California chaparral and coastal sage scrub. \*Ecology\* 64:809 – 818.](#)

[Zedler, P.H., and T.A. Oberbauer. 1998. Comments on the Minnich and Franco-Vizcaino July 1997 article. \*Letters to the editor. Fremontia\* 26: 34-35.](#)

**These two papers discuss the importance of examining all variables, not just ones that agree with a favored hypothesis:**

[Chamberlin, T.C. 1890. The method of multiple working hypotheses. \*Science\*: Feb. 7. Also reprinted in 1965. \*Science\* 148: 754 –759.](#)

[Feynman, R.P. 1974. Cargo cult science. \*Engineering and Science\*, June.](#)