Pomo Indian legends tell of droughts lasting 20-30 years, and of a time when there was a drought so deep that Clear Lake disappeared and became a meadow.

Moreover, there have been droughts in California lasting 100, 140, and 220 years. The last 100 years may have been unusually wetter than normal. (for details see Severe Ancient Droughts: A Warning to California by William Stevens, New York Times 19 July 1994 http://query.nytimes.com/gst/fullpage.html?res=9D03E5DB163EF93AA25754C0A962958260&sec=&spon=&pagewanted=all ; Extreme and persistent drought in California and Patagonia during mediaeval time by Scott Stine, Nature 369:546-9 16 June 1994 doi:10.1038/369546a0 abstract http://www.nature.com/nature/journal/v369/n6481/abs/369546a0.html) All the indigenous species including the fish have evidently been through such droughts, though presumably at reduced population levels in a smaller usable habitat. Thus a method needs to be found to calculate the expected population for a given severity of drought as it's not fair to the land managers to expect them to keep populations going up in a big drought.

But at the same time that can't be the target or allowable level, as we can't allow populations to decline like they must have in prehistoric times when they had vastly more habitat and higher populations than now.

With a population of 100,000 even a 90% reduction probably leaves enough to rebound when conditions improve, but with a population of 100 a 90% reduction would probably be below the threshold of genetic diversity needed for long-term viability. Thus because of the damage that has already been done, population fluctuations that could be tolerated in aboriginal times can no longer be tolerated; we have lost the option of letting nature take its course as it did before and it is incumbent on us to intervene. The HCP needs to address interventions to prevent significant declines in populations of species of concern even if droughts last decades or more.

The criteria and targets for healthy populations must not just count numbers but must assess genetic diversity. The population of potatoes in Ireland was in the millions prior to 1845 after which it dropped suddenly because the genetic diversity was disastrously narrow. The lower the population goes, and thus the narrower the genetic bottleneck, the greater the risk of such instabilities that can result in sudden crashes, a risk that continues even if the population numbers increase many-fold, as they may all have the same susceptibility to particular diseases.

Actually genetic diversity is not the right criterion either, since adding random foreign genes increases diversity but reduces viability by throwing them out of whack with local conditions.

But they'll probably need genes for life histories to deal with droughts which have not been witnessed since science began studying them, climate change which they have not experienced in 10,000 years or more, not to mention human-caused habitat changes which they have never experienced in their genetic history.

If we're unable to come up with authoritative criteria to assess the right amounts and types of population genetics, then we need extra margins of caution to compensate for our ignorance. The sudden collapse of Sacramento Salmon is a warning of the kinds of instabilities and surprises that are liable to continue to occur until our watersheds are fully returned to health.

A corollary to these points is that we cannot rely on science alone. "Scientific evidence" is too often a euphemism for "the damage has been done, it's too late to act to prevent it".
The amount that science does not know is much greater than the amount it knows.
Data must be balanced by an understanding of what we do not know and the implications of that. There is very little likelihood science will ever figure out everything each endangered species needs for long-term sustainability, much less figure out all the impacts of the myriad tamperings we continue to do to ecosystems. Endangered species can't afford to wait for science to figure it all out. In our actions we must go well beyond what science indicates is needed, to ensure they survive while science is working on figuring things out.

Researchers at Andrews Experimental Forest catalogued 3,500 species of arthropods in the soil but believe that is less than half of the estimated 8,000 species that live there. In contrast, they counted a total of 143 species of mammals, birds, reptiles, and amphibians. Many of these bugs are finely tuned to particular microclimates, environmental conditions, and/or plant species. Researchers concluded there are "keystone bugs" in the soil so critical to forest survival that if they vanish the ecosystem might collapse. [Hidden Forest by Jon Luoma p96,106-9]
Soil ecosystems can have 10,000 species of bacteria. Some genetic data indicates the number could be as high as a million species.
[Computational Improvements Reveal Great Bacterial Diversity and High Metal Toxicity in Soil, Jason Gans, Murray Wolinsky, John Dunbar, Science 26 August 2005 v309#5739 p1387-1390, http://www.sciencemag.org/cgi/content/abstract/309/5739/1387 ; Bacteria Get Their Day by Henry Fountain, New York Times 30 August 2005, http://www.nytimes.com/2005/08/30/science/30obse.html?pagewanted=print] Fungi, bacteria, protozoa, micro-arthropods, worms, and other soil species are essential to nutrient cycling, soil structure, water-holding capacity, etc; without them plant health suffers, and erosion, fuel loads, and thus fire risk can increase.
Is there anyone in the world who knows the optimal proportions of all these species in this soil ecosystem, which soil species are ecological keystones, the relationship between soil water-holding capacity and differing distributions of soil species, and whether we have any threatened soil species here? I doubt it.
Somebody should be looking into it so we at least have an inkling.
Myco-remediation and myco-filtration should be in the repertoire of techniques for land management, habitat mitigation, maintenance of water quality, etc.
For details see Mycofiltration: a novel approach for the bio-transformation of abandoned logging roads by Paul Stamets & David Sumerlin http://www.fungi.com/mycotech/roadrestoration.html and Helping the Ecosystem through Mushroom Cultivation by Paul Stamets http://www.fungi.com/mycotech/mycova.html

Andrews Experimental Forest researchers measured 219 tons of down logs and 47 tons of standing snags in 1 acre, and came to recognize that decaying logs are supersponges able to accumulate enormous volumes of water and retain it even after an intense fire at the peak of a summer drought. [Hidden Forest by Jon Luoma p72,86]

Big logs are not a significant fire risk. The more water can be held in and on the soil, the less the fire risk and the less water may be needed in dams.
Strategies to build more soil, increase water-holding capacity in the soil, increase water-holding biomass above the ground, etc need to be analyzed as alternatives to grazing to reduce fire risk, and as alternatives for holding water that can reduce the size of dams and reservoirs.
What is the effect on watershed water-holding capacity of growing different types of fungi? ants? worms? What is the effect on water-holding capacity of different fire regimes? vegetation regimes?

From The Ohlone Way by Malcolm Margolin:

> Nowadays, especially during the summer months, we consider most of the Bay Area to be a semi-arid country. But from the diaries of the early explorers the picture we get is of a moist, even swampy land. In the days of the Ohlones the water table was much closer to the surface, and indeed the first settlers who dug wells here regularly struck clear fresh water within a few feet. Places that are now dry were then described as having springs, brooks, ponds -- even fairly large lakes.

The PUC must figure out why there was such a difference between then and now, and how Indians accomplished this with no dams or diversions, before it can be allowed to increase or indefinitely perpetuate its dams and diversions.

Also needed is an investigation into the prehistoric role of beavers in this watershed, and the alternative strategy of restoring beavers to their original prevalence with many distributed small more salmon-friendly dams (perhaps with distributed tapping of the recharged groundwater) instead of 1 or 2 highly disruptive big dams.

Fish-friendly water flow regimes must be required of all the dams. Fish passage must be on the table for all the dams, and must be mandated if other means do not achieve restoration of healthy anadromous populations.

The overriding priority of the HCP must be to ensure ecosystem health and survival of at-risk members, not to provide guarantees to the applicant.
Allowable activities will at all times be conditional on the actual health, and the best available projections of future health, of the ecosystem, and especially its at-risk members. The HCP must not give any right to continue engaging in activities no matter how destructive to habitat and at-risk species survival they turn out to be in practice.
Public participation and oversight will be ongoing, not just relegated to 3-minute sound bytes at the beginning and then excluded for years thereafter.

30 years is far too long to go without a review.
Habitat Conservation Plans and Incidental Take Permits only came into existence 25 years ago. The ESA itself is only 35 years old.
The 5 listed species were all listed only within the last 5-12 years.
Climate change will undoubtedly result in significant impacts in 30 years but nobody can be sure of what forms it will take.

All provisions of the plan must be re-opened to review if 10 years have elapsed, and/or any additional species are listed by state or federal authorities, and/or if milestones for recovery of at-risk species are not met, and/or if any of the assumptions the plan is predicated on are found to be invalidated, and/or if unanticipated impacts are discovered.
Under no circumstances must a HCP be allowed to become a defacto license to undermine the ability of any species to remain healthy, even if entirely inadvertently and by a previously unknown mode of impact.

Indigenous sites of cultural significance must be respected. Some may only be discovered when digging starts. Permission must be obtained from indigenous authorities, projects may need to be moved to different sites, reburials may need to be conducted in the proper way, etc.

Where possible, indigenous management and traditional ecological knowledge should be incorporated into the plan and its implementation. A couple places to start: Before the Wilderness: Environmental Management by Native Californians edited by Thomas Blackburn and Kat Anderson; and Indigenous Peoples' Restoration Network http://www.ser.org/iprn/default.asp