Report of Science Advisors

Mendocino Redwood Company
Natural Community Conservation Plan
Habitat Conservation Plan

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EXECUTIVE SUMMARY

The Natural Community Conservation Plan (NCCP) Act mandates that a process be established for independent scientific analysis and review of plans prior to their completion. Such review is intended to assure that each plan is based on scientifically defensible criteria and methods and has a high probability of meeting its conservation goals while allowing compatible development and resource use. Our team of science advisors was asked to conduct a review of Mendocino Redwood Company's (MRC's) draft NCCP/HCP (Habitat Conservation Plan), at an early stage in its completion. We have been charged with the task of providing "objective insight, information and review pertaining to scientific issues of conservation planning and implementation on this privately owned and managed redwood forest." We were specifically asked, "to consider strategies for forest management, species and habitat conservation, and adaptive management within a planning area where timber management is a primary means to achieve the goals of the NCCP Act."

After receiving preliminary chapters of the NCCP/HCP and other materials from MRC, we held a workshop May 23-24, 2003, in Ukiah. Following presentations by agency and company representatives, we toured portions of the 232,000-acre MRC property. For most of the following day, the science advisors and facilitator met privately. We decided to prepare our report as explicit responses to the questions prepared for us. These questions and our responses are summarized below:

(*1) What are the necessary components for a plan and rationale for a conservation plan? (What other permanent mechanisms exist to insure long-term/multiple ownership conservation strategies?) (What are external and/or adjacent land-uses that may impact the conservation measures addressed within this plan?)*

The rationale for a conservation plan is based on the need to address potential threats to biodiversity and ecological processes. Besides the federal HCP program and the state NCCP program, there are relatively few options for insuring long-term management and conservation of natural resources on private lands. A habitat-based approach to conservation planning would modify many of the current practices of MRC and utilize existing expertise in manipulating habitat and developing desirable future forest conditions. However, there is still a need to monitor the populations of a few select species that may best represent the species assemblage for that habitat type or are species known to be declining or at high risk of regional or global extinction. In addition, an adaptive management approach should be built into any strategy, as we can expect additional species to be listed over time and catastrophic events may alter the landscape away from the conditions on which the original conservation plan was based.

Appropriate conservation planning should insure the protection of listed and other vulnerable species and provide for the enhancement and recovery of their populations while integrating, at a landscape level, the land management objectives of various ownerships. The issue of multiple adjacent landowners and their management practices affecting the ability of MRC to successfully implement their NCCP/HCP is important.

Effective conservation planning will enlist landowners into the conservation process so that their management activities, on a landscape scale, will provide a dynamic mosaic of habitats and refugia for the protection and enhancement of species and communities. In addition, the long-term management plan should be a covenant to the land and not become void when ownership changes.

We provide a list of suggested components of a conservation plan in our detailed comments. These include an articulation of the objectives of the plan; review of applicable laws, regulations, and ordinances; inventory of biological resources; review of the biology and ecology of species and communities; review of the geography, ecology, and land-use history of the planning area; review of management plans of the landowners in the planning area; identification of conflicts between economic management objectives and conservation; identification of opportunities for the protection and enhancement of species and communities; development of management prescriptions to address specific populations of species and communities of special interest; development of a monitoring program and a set of prescribed feedback loops to modify prescriptions and plans if conservation objectives are not being met; and several others.

2) Is the current list of species and communities to be addressed by the plan comprehensive enough to achieve the plan's biological goals?

We find a few deficiencies in this area. Although mentioned in the plan as existing in the assessment area, there are several communities that need more attention, including fens and bogs, coastal prairie, and coastal scrub. A proactive approach would map these communities, briefly assess their condition, and conduct a survey for rare plants in their appropriate habitats in each community.

The list of species addressed by the plan is fairly comprehensive, and the treatments are often thorough. However, the plan does not present a comprehensive list of plant species based on actual surveys of the property. The current list of plant species is not comprehensive enough to achieve the plan's biological goals. Several vertebrate species should be addressed more thoroughly in the plan, including the Pacific fisher (*Martes pennanti pacifica*), the California tiger salamander (*Ambystoma californiense*), and Pacific giant salamander (*Dicamptodon tenebrosus*). Two or three invertebrate species may warrant mention in the plan: the possibly extinct Lotis blue butterfly (*Lycaides idas lotis*), Behren's silverspot butterfly (*Speyeria zerene behrensii*), and California freshwater shrimp (*Syncaris pacifica*).

3) Does the plan currently address physical properties and processes that shape species and community dynamics?

We do not feel that physical properties and processes were adequately addressed, although MRC has made a start in this direction. The MRC NCCP/HCP appears to address the standard set of watershed physical processes, but avoids questions pertaining to the role of disturbance (including fires, landslides, bank erosion etc.) in habitat creation. Related to this is the lack of analysis of habitat-forming processes over large spatial scales. The NCCP/HCP would benefit from inclusion of principles of disturbance ecology and larger-scale drivers of physical heterogeneity in river systems.

We also suggest that MRC give greater attention to riparian zone protection and roads. The primary logic for riparian zone protection is to maintain the integrity of the physical and biological riparian environment. This requires a variable distance of streamside buffer, depending on the shape of the land. An effective conservation plan must anticipate and plan for the consequences of large and infrequent events, such as large storms, floods, and landslides, while considering the shorter-term consequences of intervening conditions. Roads are generally the most ubiquitous and influential human-made feature affecting physical and biological processes in managed forests. Hence, the discussion of road use and design should be more comprehensive.

4) Should any species and communities be added to assist in design of conservation strategies (e.g., species with no special protection status but that could be useful in planning conservation strategies or as monitoring indicators)?

Some additional species and communities that might be addressed are discussed in our response to Question 2. Terrestrial animal species that might be considered for conservation planning and monitoring, though not necessarily as a covered species, are the red tree vole (*Phenacomys longicaudus*), ringtail (*Bassariscus astutus*), bobcat (*Felis rufus*), and mountain lion (*Puma concolor*). There are no bats or passerines mentioned in the plan, although MRC is currently conducting point-count surveys for passerines. This is acceptable unless some bat or passerine species show up in the "grouping species process" discussed in question 6.5 below. Sensitive bat species are known to occur on adjacent lands (Navarro State Park).

5) Should any species be removed as highly unlikely to be found in the plan area or affected by the plan?

We do not recommend the removal of any species at this time. The choice of species to be covered by the plan seems logical (albeit incomplete) based either on the current federal and/or state status of the species or the likelihood of impacts on their habitat and associated populations by MRC land management activities.

6) Are there any new or pending taxonomic revisions or other issues that would affect the list of species addressed?

None are currently known.

6.5) What are the most effective ways of grouping species to assist in designing, managing, or monitoring conservation strategies?

There are several ways to group species that might be useful. One logical approach would start by grouping species into habitat guilds by the major habitat types they depend on. This habitat-based approach can be further refined to a "focal species approach," where managers identify, for each major habitat type, groups of species whose vulnerability can be attributed to a common cause, such as loss of area or fragmentation of a particular habitat type or alteration of a disturbance regime. Species in each group then can be ranked in terms of their vulnerability to those threats. For each group the focal species are the ones most demanding for the attribute that defines that group. They serve as the umbrella species for that group. The aquatic species may not be effectively grouped and probably require monitoring (and adaptive management) on a species-by-species basis.

7) Do current data-gathering methodologies provide a mechanism to develop biological and physical information sufficient to provide a firm scientific foundation for conservation planning?

For the most part, the methods used to measure the habitat components in the plan are well described and the metrics chosen are appropriate. However, the lack of a well-defined botanical survey protocol presents a serious problem for the development of this NCCP/HCP. For most other species, the data gathering methods appear to be well described. However, we provide a number of suggestion concerning definitions and methodology, for example making clearer the definition of old-growth trees for each species earlier in the NCCP/HCP, referring to the literature for the specific field methods that will be used to monitor populations of plants and amphibians, and describing how it will be decided whether portions of a LACMA will need "improving" for marbled murrelet habitat. We also have some concerns about the treatment of Class III streams and the proposed watershed analysis, described in our detailed comments in this report. Additional data gathering on terrestrial ecological processes is also needed.

8) Does there exist a body of scientific information sufficient to provide a foundation for conservation planning?

Components with reasonably complete information include large woody debris recruitment processes, mass wasting and erosion processes, road inventory data, mapping of the different stream classes, and the amounts and distribution of particular habitat types including mature and old-growth coniferous forests, deciduous forests, and riparian communities. However, there appears to be considerable uncertainty regarding the distribution and amounts of Type II old growth. These stands could be more abundant on the ownership than recognized, and could be important for many species. Unless it appears in other portions of the document that we did not have access to, there seem to be large information gaps regarding the presence, amounts, and distribution of unique habitat types, including near coastal communities (coastal prairie, coastal scrub), bogs, fens, wetlands, vernal pool, major rock outcrops, and chaparral plant communities.

From a species perspective, sufficient survey information and presence/absence data appears to be available for the northern spotted owl and foothill yellow-legged frog. As recognized in the plan, more information on the presence, distribution and habitat use of the Point Arena mountain beaver, red-legged frog, Olympic-tailed frogs, and marbled murrelet needs to be collected. The distributions of the red-legged frog and Olympic tailed frog are largely unknown. The plan needs to better define the species of rare plants that may be present in the unique communities that exist on the ownership and conduct surveys to describe their distribution, abundance, and habitat associations.

Regarding watershed processes, we believe sufficient scientific understanding exists for providing a general foundation for conservation planning. We recommend that MRC address several key issues, including scientific certainty/uncertainty over a range of scales; dynamics of landscapes (i.e., disturbance ecology); and large-scale sources of physical heterogeneity and biological productivity and diversity. Other gaps in information involve insufficient knowledge of the fire history of the area and other components of the disturbance regime.

9) Are there additional data sources or literature pertaining to the resources of the planning area that should be incorporated into the database and considered during planning and analysis?

We suggest several additional data sources, including information on the experimental research in Caspar Creek (Jackson Demonstration State Forest) and work published by the Redwood Sciences Lab and the Pacific Southwest Research Station. The NCCP/HCP needs to make better use of existing technology to map the presence, distribution, and abundance of the community types present on the ownership. In addition, literature pertaining to the survey methodologies for particular species needs to better referenced. Appropriate technology for mapping vegetation includes low-elevation aerial photography and Landsat imagery. It might be useful to examine the Wieslander (1935) vegetation maps to determine the potential locations of unique habitats and plant communities.

10) What gaps in existing information create the greatest uncertainties for planning, analyzing, managing, and monitoring conservation strategies in this setting?

This question is largely addressed in our response to Question 9.

11) What are the most effective methods for addressing these information gaps?

The most effective methods for addressing information gaps in the distribution and amounts of certain plant communities (outlined in our response to Question 9) would be the uses of technology such as low-elevation aerial photography and Landsat imagery across the ownership. Effective methods for addressing the information gaps in the distribution and abundance of particular species (see responses to Questions 2 and 10) would be the planning and implementation of survey protocols already available in the literature for these species. We recommend a change in the underlying approach to field studies, including rejecting the primacy of the “watershed analysis” approach to the study of watersheds and focusing on broader-scale processes.

12) Are habitat suitability models or other models recommended for predicting species ranges where distribution data are sparse?

Spatially explicit habitat-suitability models developed with the use of geographic information systems are proving very useful in conservation planning, especially for wide-ranging animals. These models can be based either on empirical data or on natural-history information from the technical literature or expert opinion. Because the development of spatially explicit habitat-suitability models is time-consuming, we would not expect new models to be developed and validated by MRC for the NCCP/HCP. However, we strongly recommend that MRC search the literature to find models for sensitive animal species (e.g., Pacific fisher) that are known to occur or may occur in the region, and apply them to the planning area.

(13) Are there physical process models recommended for predicting relationships between physical and biological communities?

There is a paucity of physical models that predict relationships between physical watershed conditions and in-stream biological communities, and a distinct lack of models for predicting channel, floodplain, and valley morphology given inputs of water, sediment, and wood. We recommend an epistemological analysis of what is known and not known about watershed processes.

(14) If models are used, what standards for formatting, parameterizing, testing, or monitoring can you recommend?

The only (physical) model described in the Plan is SHALSTAB, which is used for predicting locations and relative likelihood of shallow landsliding in steep and convergent zones of hillslopes. SHALSTAB predictions need to be tested using landslide inventories over decades. We were unable to find sufficient details to determine how the predicted landslide risk was generated. Regarding models of surface erosion, it is stated, "surface erosion estimates will be developed by use of a surface erosion model." Unfortunately, there is no description of that model. With respect to long-term channel monitoring, it is useful to select appropriate monitoring periods based on the timing of geomorphically significant events (large storms, wet years, etc.) rather than on pre-selected years.

15) What basic tenets of landscape management are pertinent to conservation planning in this area and how should these tenets be translated into measurable standards and guidelines for landscape management design?

By appealing to well-accepted planning principles, decisions can be reasonably defensible despite limited data. The conservation planning principles developed by the Scientific Review Panel (SRP) for the NCCP program are:

1. Conserve target species throughout the planning area.
2. Larger reserves are better.
3. Keep reserve areas close to one another.
4. Keep habitat contiguous.
5. Link reserves via corridors.

6. Reserves should be diverse.
7. Protect reserves from encroachment.

An eighth principle, well supported in the ecological literature, was added for the Southern Orange County NCCP:

8. Maintain natural processes.

Because the MRC NCCP/HCP is based more on maintaining the suitability of the landscape matrix ("the working forest") rather than a network of reserves to accomplish its conservation goals, the SRP planning principles (i.e., not including #8) are generally less relevant than, for instance, in coastal southern California, where the NCCP program was initiated. Nevertheless, the principles still apply, albeit in modified form. Principle #8 is one we address most extensively in this report. Maintaining (or mimicking) natural processes such as fire and hydrologic regimes within a historic range of variability is fundamental to sustaining biodiversity across the ownership.

16) What theoretical or empirical support is available for designing necessary and sufficient biological core areas, linkages, wildlife/fish movement corridors, buffer or other aspects of design?

Our response is combined with Question 17, below.

17) Are explicit reserves/buffers recommended and are existing data sufficient for their design and implementation?

There is abundant theoretical and empirical support for the efficacy of well-designed reserves in maintaining biodiversity. Reserves are especially important for species and other resources sensitive to human exploitation, persecution, or harassment. The role of reserves becomes somewhat less critical as the surrounding landscape matrix becomes more suitable for the native species. However, there are still species so sensitive to human activities (e.g., even to the presence of recreationists) that refugia secure from human access are recommended.

Specific reserves have been designated in some cases (e.g., old-growth redwood) on MRC land and should be designated in other cases for the protection for listed plant species and plant communities of special interest (e.g., serpentine balds). It would be also appropriate to select and set aside future "old growth" areas for each of the natural plant communities in the conservation planning area to serve as refugia for species requiring these habitats.

For salmon and other anadromous species, the requirement of stream habitat connectivity is critical. Explicit dimensions for riparian buffers and the types of harvest activities that can occur within them are outlined in the NCCP/HCP. The size of the buffers in the plan is substantially smaller than that considered adequate to protect salmonid habitat in the Northwest Forest Plan. Insufficient information exists to know how these particular widths and the management activities prescribed in each band within the buffers will affect fish and other riparian and stream-related species and in-stream processes. This is also true for the buffers specified for wetlands, bogs, seeps, and other unique communities.

Reserves and buffers should also be established in the case of known nesting trees used by marbled murrelets. Buffer designs for the Point Arena mountain beaver appear to be a best-guess approach due to a lack of specific information. A substantial number of studies have been completed on the northern spotted owl. Since the plan will collect demographic information on a large sample of pairs each year over time, the effects of the owl reserves designed to protect breeding pairs can be assessed.

18) How can conservation strategies be arrived at which are functional across multiple environmental gradients (e.g. topographic, climatic, and vegetational considerations)?

By using a habitat-based approach to conservation planning, conservation strategies can be derived that are functional across multiple environmental gradients. The protection of plant communities and their natural variation (due to position in relation to the coast, topographic, climatic, and elevation factors) can be provided by accurately mapping and documenting the distribution and abundance of these communities. Since protection is designed to occur across the MRC landscape, the natural variation of these communities associated with environmental factors will likely be incorporated into the conservation strategy. For the rare plant communities that may make up a small proportion of the MRC landscape, accurate mapping of these communities appears to be needed.

19) Does existing information reveal specific geographic locations or landscape positions that are critical for landscape design (e.g. biodiversity "hotspots", crucial linkages, rare microhabitats, refugia, genetically unique population areas)? If not, how can that information be collected? (note: develop a mechanism to inventory and monitor unique areas).

Hotspots and other areas of concentrated biodiversity value can only be identified on the basis of accurate map-based (e.g., GIS) information. The maps we were provided did not contain any biological information; hence, they are inadequate for the identification of hotspots. Maps are essential for the identification of biodiversity hotspots, crucial linkages, rare microhabitats, refugia, and genetically unique populations. We recommend that the plant communities on the ownership be mapped and their distribution and amounts described, including those rare plant communities that make up a small proportion of the MRC landscape. Then, a more detailed assessment of potential biodiversity hotspots, rare microhabitats, and refugia could be made.

From an aquatic perspective, the term "biological hotspots" refers to habitat-forming processes and habitat development that is non-uniformly distributed across the landscape at scales larger than simply pools, riffles, and logjams. Hotspots might include unconstrained valley segments, canyon-floodplain transitions, upstream or downstream of large landslides, and near certain tributary confluences. Additionally, watershed disturbances can contribute to the formation and maintenance of biological hotspots preferentially at those locations. MRC's NCCP/HCP does not contain this type of perspective, which would require scaling up both in time (i.e., disturbance regimes) and space (landscape scale sources of physical heterogeneity).

20) How can the plan address unique areas that are significant in a broader regional context?

The biological and aquatic-habitat hotspots referred to above qualify as areas significant in a broader regional context. It is important to determine whether the MRC property contains unique areas or areas that are common throughout the region. This requires an analysis that considers a geographic area substantially beyond the boundaries of the MRC ownership. The concept of regional context should eventually include assessing the demographic contributions of populations of rare or sensitive species on MRC's land to regional populations or metapopulations. Species requiring such regional-scale analysis include the northern spotted owl, marbled murrelet, red-legged frog, foothill yellow-legged frog, Olympic tailed frog, Pacific fisher and other species covered by the plan or suggested to be covered.

21) How can long-term processes or cycles (e.g., population dynamics, disturbance cycles, ecological migration) be effectively addressed?

Long-term processes are difficult to predict and to plan for, yet intelligent consideration of their roles in the ecosystem is probably crucial to the long-term success of a conservation plan. A longer-term perspective in the NCCP/HCP, even if mostly qualitative, would aid in placing bounds on landscape and riverscape dynamics over multiple decades. A 40-year record of rainfall, streamflow, and sediment transport is available from Caspar Creek. Studies at Caspar Creek have produced a good understanding of the effect of logging on hydrologic processes in second-growth coastal redwood and fir forests. MRC has used the research from Caspar Creek to develop much of the discussion of hydrologic processes presented in the NCCP/HCP. Still, a 40-year climate and hydrologic record, though rare, represents a short window into variability that can be expected during the life of the NCCP/HCP. Fortunately, research and monitoring is expected to continue at Caspar Creek for the duration of the NCCP/HCP, which will provide a context to responses of the MRC landscape to climatic and hydrologic stresses. The plan should assume that unprecedented events are likely to occur.

From the perspective of maintaining terrestrial ecological diversity, perhaps the best strategy for dealing with the long-term processes and cycles is to maintain a diverse landscape in terms of successional stages of each of the natural vegetation types, within a historic or natural range of variability. Fire and floods play a major role in the ecology of the redwood region. Most of the listed plant species in the region are in the herbaceous understory and many are dependent on disturbance events. Logging operations do not mimic natural disturbances such as fire precisely and, in some cases create habitat for invasive exotics, which outcompete native early-successional species. Also needed is a robust adaptive management strategy that is flexible and contains strong feedback loops to managers.

22) How might climatic variation affect this landscape ecosystem and the target species and how can these effects be effectively addressed (e.g.. plant populations, higher intensity weather events, frequency of events, etc).

Watershed-scale stochastic simulation models could be constructed, and the climate probability distributions could be altered to reflect the predictions coming from global climate models. Several models suggest this area of California will most likely experience increased temperature and decreased precipitation. This change could have a major impact on the redwood forest. One strategy to address this issue would be to begin now to identify redwood trees growing on the drier sites on the property and initiate a program of seed orchards or cloning to provide a supply of these more drought-adapted genotypes for replanting in the more eastern stands. A combination of stump sprouts from existing trees and planted seedlings from drought-adapted genotypes might provide a means of maintaining the redwood habitat in areas further from the coast. Very little is known about the biology and ecology of many of the listed plant species, so it is not possible to make suggestion for management of these species in relation to climate change.

The higher intensity of weather events and the frequency of these events have already been incorporated into the redesign of stream crossing and the replacement of culverts. A monitoring of high-intensity weather events could provide a better database for the prediction of future of stream discharge

23) How should the plan address exotic species?

At a minimum, those exotic species that may affect the viability of the species covered by the plan should be addressed. Changes in the presence and distribution of these exotic species over time could indicate potential problems. Exotic animal species also pose a threat to native biodiversity. An aggressive program of the control of exotic predators, such as bullfrogs, needs to be developed as a part of the plan. Populations of some native corvids (crows, ravens, Steller's jay) have increased substantially over the last few decades due to human urbanization (e.g., campground development) and other factors. These increases have likely had a large negative impact on marbled murrelet nesting success in some areas. The cost to collect information on problematic exotics should be minimal if the data are collected simultaneously with the monitoring effort for the species covered by the plan.

24) What monitoring actions are necessary and sufficient to evaluate the plan's effectiveness in meeting the conservation objectives?

MRC's monitoring and adaptive management strategy is one of the most comprehensive and detailed we have seen in a NCCP/ HCP. To make the monitoring program even more defensible, the strategy should outline the specific kinds of monitoring that will take place, clearly state what the objectives are for each kind of monitoring, discuss the assumptions of the monitoring plan, define what assumptions will be tested over time using the adaptive management approach, clearly state definitions of terms to avoid confusion, explain how the data will be collected, explain the specific sampling and survey methods used for the monitoring and adaptive feed-back mechanisms, define clearly what thresholds or relative changes in parameters will be used to trigger changes in management direction, and outline the interactions that will take place with the agencies over time.

25) Are the management actions proposed sufficient to meet the plan's conservation objectives?

The proposed management actions are not adequate for the sensitive plants and plant communities. In the MRC presentation to our team, a plan for conversion of a portion of the broadleaf upland forest to conifer forest was discussed. This plan should be included in chapter 5, so that it can be critically reviewed. Conversion to conifer forest could endanger some populations of sensitive species. More specific information is needed on the current distribution of the plant species in order to evaluate the proposed management actions. Prescribed fire may be a management action necessary to maintain some of the areas of chaparral, pygmy forest, and bishop pine forest.

One aspect of the proposed management actions that concerns us is the potential impact of group selection as a silvicultural technique on the extent and distribution of "edge" and "interior" habitats in the north coast forest type. If a two-acre "checkerboard" of group selection openings develops over the forest landscape as a result of the application of group selection, forest-interior habitats may be reduced to a non-functional size for some interior species. Regarding aquatic resources, although the AMZ band widths appear sufficient for Class I, Large Class II, and Small Class II watercourses, the AMZ widths proposed for Class III watercourses appear minimal and may not be effective in reaching their objectives. The conservation measures for the marbled murrelet are problematic and probably insufficient. Similarly, the management objectives for protection of northern spotted owl pairs may not sustain the population.

26) Does the plan appropriately provide a framework for adaptive management applicable to the planning area? (chapter 7) What specific management principles or hypotheses are most important to test via the adaptive management program?

In order to test specific management principles or hypotheses with regard to sensitive plant distributions and the impacts of invasive exotics, baseline data need to be collected as a basis for comparison with management treatments applied in an adaptive management program. Otherwise, we are impressed with the framework built for adaptive management. The timeline and details provided are well thought out. Among the most important hypotheses to test in the adaptive management program are those that relate to changes in the reproductive rate of species and/or population sizes/densities. A general concern with adaptive management relates to the long-term institutional will to carry it out.

27) Which species, habitat and ecosystem indicators can serve to monitor species viability and other ecological characteristics important to the NCCP? Are the proposed species, habitat and ecosystem indicators adequate to meet this objective? If not, what other species, habitat and ecosystem indicators should be considered?

A greater range of indicators of the structure, function, and composition of the ecosystems on MRC property should be considered. The animal species chosen are appropriate (albeit possibly incomplete) and the protocols for monitoring their habitat conditions are well justified (see our response to Questions 2 and 24 for additional species and indicators to consider). A similar program needs to be developed for the plants and plant communities. It would be useful to monitor climatic condition and the impacts of wild and prescribed fire on the various plant communities and habitats. Landscape-level indicators should also be added.

28) What are the indicators that should trigger a change in management strategy? (chapter 7)

Indicators (or indications) that should be considered include the collapse of a population of a rare or listed species; a significant change in climate that appears to be changing the vegetative mosaic; major invasion of exotic species; emergence of new plant pathogens and/or insects; extensive stand-replacing wildfire; and collapse in the lumber market that could essentially terminate timber harvesting for 10 years or more. As noted in our response to Question 26, a change in a particular demographic parameter for a sensitive species would be an obvious indicator for triggering a change in a management. For ecological processes, those indicators that are most closely tied to the life history and viability of species covered in the HCP would be the most appropriate to monitor and trigger a change in management strategy (e.g., stream temperatures for salmon).

29) Does the plan have sufficient scientific information to identify biological and physical variability (and/or central tendencies or mean values) for monitoring species or ecosystem processes?

The limitations of the watershed analysis approach should be recognized. We encourage MRC to pursue questions and answers pertaining to spatial heterogeneity and temporal variability over broad spatial and temporal scales. The plan has done a reasonably good job of reviewing the known scientific information on the species and communities (with exceptions regarding plants, as noted). The sampling intensity for most species and processes (number of sites, streams, and/or watersheds) is impressive, as is the planned frequency of data collection.

30) Are the proposed monitoring protocols sufficient to detect changes in species populations or processes?

In general, the proposed monitoring protocols are sufficient to detect changes in sensitive animal populations (there are no protocols described for plant inventory work or for monitoring plants). The monitoring protocols are perhaps minimally adequate to detect changes in processes. The amount of change detected before a management strategy is modified may need to be re-examined and clarified. Regarding riparian and stream monitoring procedures, it is not clear how the described measurements will be used and how they are related to changes in species populations or hydrologic processes. Since most measurements are to be made over several decades, with intervening years having no measurements, consistency of procedure is a serious challenge. For a number of the variables being measured, there is a lengthy lag between cause and effect.

31) Additional Advice

Despite our criticisms of portions of the draft NCCP/HCP, the plan has many strengths and good ideas. Given the overarching objectives of limiting human disturbance in the area covered by the plan and steadily increasing the amount of old forest over time, there is little doubt that many aspects of terrestrial and riverine ecosystems will be on upward trajectories.

INTRODUCTION

The Mendocino Redwood Company (MRC) has embarked on a planning process intended to satisfy the requirements for a Habitat Conservation Plan (HCP) under Section 10(a) of the U.S. Endangered Species Act and a Natural Community Conservation Plan (NCCP) under the California Natural Community Conservation Planning Act. The NCCP Act mandates that a process be established for independent scientific analysis and review of plans prior to their completion, in order to assure that each plan is based on scientifically defensible criteria and methods and, therefore, has a high probability of meeting its conservation goals while allowing compatible development and resource use. The MRC intends to design a conservation plan with a "working landscape" (i.e., a managed forest with timber harvest) as its foundation, rather than a reserve design. This plan is the first NCCP/HCP for a managed forest landscape in the state of California and the first to involve a single landowner. Therefore, this plan is potentially precedent setting.

Our team of science advisors was selected by the Mendocino Redwood Company, Greg Giusti (Forest Advisor, University of California Cooperative Extension), the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. We were asked to conduct this review based on our knowledge of the geographical area and its ecology and/or for our expertise in forest ecology and conservation planning. Collectively, we offer expertise in locally occurring species (primarily aquatic and terrestrial vertebrates and vascular plants) and natural communities; key ecological processes and the physical environment (for example, hydrology, mass wasting, fluvial geomorphology, natural and anthropogenic disturbance regimes); landscape ecology; reserve design; monitoring; and forest management.

We have been charged with the task of providing "objective insight, information and review pertaining to scientific issues of conservation planning and implementation on this privately owned and managed redwood forest." We were specifically asked, "to consider strategies for forest management, species and habitat conservation, and adaptive management within a planning area where timber management is a primary means to achieve the goals of the NCCP Act." It is not our role to supply and rigorously analyze data or to answer planning questions definitively. An implicit objective of our review is to ensure the quality of the data, planning principles, analytic techniques, and interpretation of the results of analyses. However, we were asked not to prepare detailed critiques of particular technical methods in the NCCP/HCP (Chapter 5, Conservation Measures). We would have liked to review Chapter 4, the Plan and Rationale for Conservation Approach, but this chapter was not made available to us. In any case, we generally do not comment on the goals or outcomes of planning, as these are value-laden policy considerations beyond our purview. As stated by the California Department of Fish and Game in its August 2002 Guidance for the NCCP Independent Science Advisory Process, science advisors "do not comprise a 'blue ribbon panel' established to approve the planning process or alternatives, but instead are individual scientists providing expert advice and information to the planning process."

SCIENCE ADVISORS' WORKSHOP

In preparation for a two-day workshop, we were supplied with background material, including a set of initial questions, chapters on Conservation Measures and Monitoring and Adaptive Management from the MRC plan, and a MRC document from August 2000 on Management Plan, Policies and Targets (available at www.mrc.com).

We held our workshop May 23-24, 2003, in Ukiah. On the morning of the 23rd we were provided extensive overviews of the NCCP science process (Greg Giusti), the MRC NCCP/HCP planning process (Mike Jani), and the California Department of Fish and Game's involvement in the NCCP/HCP (Brenda Johnson). This was followed by presentations and discussion of MRC's landscape planning process, watershed analysis program, fisheries program, herpetofauna program, terrestrial vertebrate program, and botanical assessment (albeit a botanical assessment protocol was not presented; rather, MRC acknowledged a "data canyon" regarding rare plants on the property). After lunch, we took a several-hour vehicle and walking tour of selected areas of the 232,000-acre MRC property. For most of the following day, the science advisors and facilitator met privately to discuss the planning issues, revise the initial questions, and make assignments for the preparation of this report. We agreed that our collective responses to the set of questions would constitute the bulk of our report.

We are generally favorably impressed with MRC's goals, planning principles, and management approach for this NCCP/HCP. The MRC personnel who presented their proposed management and monitoring efforts and led the field tour impressed us as dedicated and knowledgeable. They were familiar with the current scientific literature related to their areas of expertise, aware of the constraints regarding land management actions when listed (ESA) species may be affected, and sincerely interested in hearing our advice. However, we identified several serious data gaps and methodological inadequacies that need to be fixed. The entire process faces many obstacles, two of which stand out as preeminent: 1) Can the ambitious conservation objectives be met while "getting out the cut" to meet economic objectives? 2) Given the extremely fragmented distribution of MRC lands (scattered throughout Mendocino and Sonoma counties), the NCCP/HCP must address current and probable future activities on adjacent lands not under MRC control. Can the adaptive management procedures in the NCCP/HCP be made sufficiently robust and flexible to accommodate current and future land management actions by adjacent (or upstream/downstream) landowners? We recommend that MRC planners consider these questions carefully as the planning process proceeds.

Our comments are meant to help MRC improve the planning process and make it more defensible in the face of public scrutiny. We have strived to make our recommendations consistent with the conservation planning principles of the Natural Community Conservation Planning (NCCP) program and with the findings of recent research in conservation biology and other relevant scientific disciplines.

RESPONSES TO QUESTIONS

Species and Communities Addressed

(*1) What are the necessary components for a plan and rationale for a conservation plan? (What other permanent mechanisms exist to insure long-term/multiple ownership conservation strategies?) (What are external and/or adjacent land-uses that may impact the conservation measures addressed within this plan?)*

The rationale for a conservation plan is based on the need to address potential threats to habitat quality, biodiversity, population viability of sensitive species, and key ecological processes on both public and private land. For a conservation plan situated in the Redwood Forest Zone that addresses a working landscape where habitat has historically been and will continue to be manipulated on a large scale over time, a habitat-based conservation strategy is most appropriate. Since large-scale manipulation of the forested habitats will likely continue to take place in the normal operations of MRC, developing a plan that provides for the habitat needs of multiple species over time is clearly the best approach. Foresters and biologists for the company already have, for the most part, the tools and expertise necessary to monitor forest composition, age, and structural conditions over the landscape through the use of remote sensing and aerial photo interpretation, stand inventory databases, and Geographic Information Systems (GIS) for analyzing and displaying this information. Because this information system is already in place to a large degree, the additional cost to the company for monitoring habitat conditions for particular species on the landscape should be very reasonable. Conversely, an approach that attempted to monitor the distribution and trends of populations of a large group of species, and then respond to significant changes in the distribution or trends of each of these, would be prohibitively costly and would entail putting in place systems, methods, and expertise to accomplish these tasks that do not currently exist at a large scale. Private forest companies are well equipped to manage forest habitat. A habitat-based approach would simply modify many of the current practices and utilize existing expertise in manipulating habitat and developing desirable future forest conditions.

An additional advantage of a habitat-based approach is that entire species guilds can be provided for and protected by concentrating on maintaining, enhancing, and protecting habitat elements required by that guild. Because other factors besides habitat can affect populations (disease, competition, predation, etc.) there will still be some need to monitor the populations of a few select species that may best represent the species assemblage for that habitat type or are species known to be declining or at high risk of regional or global extinction. Species that play significant roles in the ecosystem (e.g., salmon, large carnivores) may also need individual attention. In addition, an adaptive management approach should be built into any strategy, as we can expect additional species to be listed over time. Also, catastrophic events (fire, forest diseases, long-term drought, major flood events) may greatly change the landscape away from the conditions on which the original conservation plan was based.

Besides the federal HCP program and the state NCCP program, there are relatively few options for insuring long-term management and conservation of natural resources on private lands. The federal and state endangered species offer protection of listed species. However, these laws focus on protecting individual species, not communities and ecosystems, and often most of the efforts in recovering listed species are concentrated on state and federal lands. Plants listed under the federal Endangered Species Act receive essentially no protection on private lands. Critical habitat designations for listed species are often not applied to private forestlands. Other laws that offer some protection of private lands are the federal migratory bird treaty, riparian habitat protection regulations in the California State Fish and Game code, and the (somewhat limited) habitat protection provisions of the California Forest Practices Act and their corresponding rules. Since a Timber Harvest Plan in essence replaces a CEQA review, it therefore falls under the guidelines of CEQA, and listed plants and animals must be considered in all projects.

Regarding the physical aspects of the ecosystems on the ownership, in particular the potential impacts of forestry operations and infrastructure on aquatic ecosystems, we have several concerns. The scientific approach underpinning MRC's treatment of these issues is a conventional one, specifically the focus on small-scale channel features (i.e., logs, pools, bank erosion, single landslides, etc.), the treatment of all erosion, including mass wasting, as an overarching threat to aquatic ecosystems, and the absence of an analysis of scientific uncertainty in the disciplines dealing with watershed processes. We suggest that the conservation plan extend beyond these conventions, including focusing on disturbance aspects of habitat formation, specifically erosion, including mass wasting, fires, and landslides and sedimentation. Moreover, the spatial scale of analysis should be expanded so that landscape-level sources and patterns of riverine heterogeneity over kilometer scales can be examined. In addition, the rather large scientific uncertainty in the watershed sciences pertaining to the relationship between terrestrial and aquatic ecosystems should be addressed somewhere in the plan. These omissions weaken the plan and make it more susceptible to criticism. Details on the three gaps are outlined below (A-C). Presumably, this type of theoretical/philosophical underpinning would go in MRC's NCCP/HCP Chapter 4 – a chapter that, as noted above, was either not completed or not made available to our team.

(A) Lack of a broad perspective on disturbance regimes. The scientific literature in both geomorphology and riverine ecology is replete with conceptual and empirical perspectives on the role of disturbance in creating riverine habitats, including fires, storms, landslides, floods, and sedimentation (Resh et al. 1988; Swanson et al. 1988; Reeves et al. 1995; Benda and Dunne 1997a,b; Poff et al. 1997; Wiens 2002; USDA Forest Service 2002, to list a few). Because forestry activities are a form of disturbance and they can also modify natural disturbance regimes, a conservation plan should include analysis of the role of disturbance. We do not make this suggestion to layer on to MRC yet another scientific burden. Rather, we suggest that a dynamic perspective incorporating disturbance could enhance the NCCP/HCP, since it would encourage serious consideration of the role of erosion (including human-triggered) such as landsliding in habitat creation (as well as destruction), the role of watershed dynamics in confounding simple interpretations of channel morphology and aquatic habitat in time and space, and the feasibility of monitoring channel properties in a dynamic world.

(B) Insufficient attention to large spatial scales and riverine heterogeneity. There is mounting evidence in the scientific literature on the role of large-scale topographic drivers of physical heterogeneity in riverine ecosystems (Grant and Swanson 1995; McDowell 2001; Baxter and Hauer 2000; Fausch et al. 2002; Wiens 2002; Benda et al. submitted). These sources of heterogeneity include variations in valley widths (canyons vs. floodplain segments), large landslides, tributary confluences, and bedrock outcrops. For the most part these controls on river systems cannot be affected by land uses, such as forestry, although they can be affected by more permanent engineered structures, such as dams and dikes. Moreover, some of these sources of heterogeneity are linked to "watershed disturbances" such as landslides and alluvial and debris fans at tributary confluences. The types of channel morphology that characterizes the larger floodplains associated with unconstrained segments, landslides, and tributary confluences are more susceptible to channelized disturbances, such as floods and sedimentation events. MRC's NCCP/HCP would benefit from a "scaling up" from the almost inscrutable scale of individual logs, pools, and undercut banks that are presently in the plan to larger landforms.

(C) Lack of an evaluation of scientific uncertainty in the appropriate watershed sciences. The question that permeates a conservation plan such as MRC's, and reflected in the science panel's list of question, is how well do they (MRC) understand the environment and do they understand it well enough to craft a successful conservation plan? This question needs some airing in MRC's NCCP/HCP. Without considering this question, the plan is open to honest criticism but also to sniping from detractors. A review of what is known and not well known about watershed ecosystem functioning in the different disciplines involved with the conservation plan would strength the plan rather than weaken it. For some guidance, MRC might refer to NAS (1986), Ford (2002), Benda et al. (2002) and Nilsson et al. (in press).

Conservation planning should insure the protection of listed and other vulnerable species and provide for the enhancement and recovery of their populations while integrating, at a landscape level, the land management objectives of various ownerships. The issue of multiple adjacent landowners and their management practices affecting the ability of MRC to successfully implement their NCCP/HCP is an important one. Since relatively little federal or state ownership occurs in the region, having some certainty that the management practices on adjacent lands will not change significantly or greatly affect MRC conservation strategies would be desirable. (However, Big River State Park is adjacent to MRC land and covers 7000 acres; the 50,000 acres of Jackson Demonstration State Forest are nearby.) Effective conservation planning will enlist landowners into the conservation process so that their management activities, on a landscape scale, will provide a dynamic mosaic of habitats and refugia for the protection and enhancement of species and communities.

To be effective as a conservation plan, the long-term management plan should be a covenant to the land and not become void when ownership changes. Subsequent owners should be bound by the existing plan until such time as a formal plan is revised and approved by the respective agencies. If this covenant is not provided explicitly by the NCCP/HCP, permanent conservation easements should be placed on the land, the terms to which future landowners will be bound. Ideally, there should be similar and coordinated plans by adjacent landowners. In those areas where MRC lands represent a small isolated parcel, there is little expectation that a conservation strategy applied to a small parcel will be successful in affecting the dynamics occurring at the larger scale. Similarly, in-holdings within a larger block of MRC-managed land by other landowners that have no conservation plan can affect the efficacy of the MRC plan.

Land owned and managed by MRC is not isolated; activities within MRC's boundaries affect neighbors and, conversely, activities by current and potential neighbors can affect and be affected by MRC's land and its management activities. These effects are often greatest along boundaries, but may occur along any pathways, such as streams and roads. The larger the contiguous holding, the proportionately smaller the edge effect. Some of the MRC holdings are very small parcels surrounded by other ownerships. Effectiveness of the NCCP/HCP for these small parcels is questionable. Following are only a few examples where neighbors can affect MRC lands or be affected by MRC lands:

- Cattle trespass can affect stream restoration, stream banks, and regeneration. Cattle can also import noxious weeks.
- Timber harvesting occurs within portions of the watersheds not owned by MRC and covered by their NCCP/HCP.
- Urban/suburban development affects trespass by ORV, hikers, domestic and feral animals. Conversely, noise, smoke, dust, traffic from the ownership that was non-objectionable in a rural setting, can become a problem in an urbanizing setting.
- Adjacent agricultural and suburban activities may introduce exotic animals and plants and produce herbicide and nutrient drift. Conversely, the forestlands may be a source of wildlife (deer, squirrel, bear, cougar, etc.) that affects neighbors, sometimes quite negatively.
- Adjacent lands can be a source of wildland fire encroaching into MRC lands; or MRC management and fire-control activities can encroach onto adjacent ownerships.
- Increasing woody debris loading in streams will likely increase the risk of damage to downstream infrastructure, such as culverts, bridges, and road fills on adjacent lands.
- Roads through the property are a source of trespass, ORV erosion, fire, noxious plants and animals, etc. There are several public roads that pass through the property and some access is allowed on company private roads. In addition, MRC has road easements through Big River State Park.

The MRC Management Plan (pp. 47, 49) discusses grazing and hunting leases and the open policy of allowing the public access to MRC lands for hiking, camping, hunting, fishing, collecting burls, greens, etc. However, we find no mention of the potential effects of these activities in the NCCP/HCP document, except one mention of limiting grazing around mountain beaver burrows. Certainly grazing has an effect on erosion and watercourse stability. Fishing can affect depressed fish populations, and hunting can affect animal behavior and movement patterns.

The MRC ownership is part of a larger functional landscape. Because the majority of lands adjacent to MRC are private, it will likely be left to the state and federal agencies to encourage the larger landowners in the region to develop HCPs and/or NCCPs of their own that would complement the final plan developed by MRC. Multiple plans in place within the same region would go a long way toward protecting those coarse-scale and regional-scale species that require large areas to survive and also would encourage ecosystem-level strategies where entire watersheds may be protected under different plans. To encourage such an approach for other private landowners, the development and execution of these plans must be economically viable for the companies.

To summarize, the necessary components of a successful conservation plan include the following:

- Articulation of the objective of the plan.
- Delineation of the area for which the plan is to be developed (including the identification of the various land owners).
- Review of laws, regulations, and ordinances, which govern the protection of species and communities in the designated area.
- Inventory of biological resources (e.g., common species, occasional species, and rare and sensitive species) in relation to landscape units in the planning area.
- Review of the biology and ecology of all listed species and communities of special interest.
- General review of the geography, ecology (e.g., food webs, natural disturbance regimes, watershed processes), and land-use history of the planning area at a broad scale.
- Definition of management objectives and review of management plans of the landowners in the planning area.
- Identification of constraints resulting from of any conflicts between the management objectives and species and community conservation.
- Identification of opportunities for the protection and enhancement of species and communities that could be afforded by modifications of existing management plans.
- Development of management prescriptions to address specific populations of listed species and communities of special interest.
- Development of management prescriptions to address general management practices that have contributed to the long-term degeneration in habitat quality (e.g., road design, culvert design and management, livestock access to stream channels).
- Development of time-series of maps to illustrate how the proposed management practices of the various landowners will affect the distribution of plant communities and habitats into the foreseeable future (the complete rotation over a

working cycle in the case of land managed for timber production).

- Evaluation of the time-series maps to identify any conflicts that may arise between proposed management and species and community protection.
- Development of a monitoring program and a set of prescribed feedback loops to modify conservation prescriptions and resource management plans if the objectives of the plan are not being met.

2) Is the current list of species and communities to be addressed by the plan comprehensive enough to achieve the plan's biological goals?

We find a few deficiencies in this area. Although mentioned in the plan as existing in the assessment area, there are several communities that are not addressed as thoroughly as they should be. Although not a large part of the ownership, these communities include fens and bogs, coastal prairie, and coastal scrub. Although the plan states that operations will not be conducted within these natural communities except for use of existing structures, and that rare plant surveys would be conducted prior to any new planned activity, we recommend a more proactive approach because of the uniqueness of these communities and the rarity of some of the species associated with them. A proactive approach would map these communities, briefly assess their condition, and conduct a survey for rare plants in their appropriate habitats in each community. This approach would provide information to the company on the presence and amount of any of these communities/species on their ownership. It is difficult to protect species without knowledge of their existence and location. Bog/fen habitat types and coastal prairie often have rare plants present and, in some cases, rare beetles and/or butterflies.

The list of species addressed by the plan is fairly comprehensive, and the treatments are often impressively thorough and well referenced, but we note some important omissions. The plan does not present a comprehensive list of plant species based on actual surveys of the property. The current list of plant species is not comprehensive enough to achieve the plan's biological goals. The NCCP/HCP document should provide a listing of the rare plants likely to exist in the planning area, describe their habitat associations, and any current threats to their existence. Rare plant surveys should likely be conducted proactively in a sample of communities that are likely to contain these species. These communities include bogs and fens, pygmy forest, coastal prairie, coastal scrub community types, and vernal pools, in addition to redwood forest.

A list of sensitive plant species in Mendocino County can be downloaded from the web site CNPS.org. A basic inventory of plants (native and non-native) needs to be conducted to establish a flora for the MRC ownership. This flora will provide baseline data for future decisions. Then, a search using California Department of Fish and Game's RareFind database will help determine what is currently known about sensitive plant species in the area. A lack of records in this database does not mean, however, that the plants do not occur in the project area; it may only mean that surveys have not been conducted. Plants form the basis of the food web. Protection of animal species is not possible without protection of the plants that form the habitat and the food that animals rely on. It is fair to assume that several populations of some of the listed plant species would be found as a result of surveys.

Several vertebrate species should be addressed more thoroughly in the plan. One of the most important is the Pacific fisher (*Martes pennanti pacifica*). Although not currently federally listed, on 7 July 2003 the USFWS issued an initial positive decision that the Pacific fisher qualifies as an endangered species in the forests of California, Oregon, and Washington. The Pacific fisher is dependent on mature and old growth forests. Logging was one of the main reasons the mink-like predator was petitioned for listing as most of the historic habitat has been harvested on the west coast. It is possible that this species will be listed soon after the plan is completed. Although mentioned in the plan, the fisher is not a featured (covered) species.

The California tiger salamander (*Ambystoma californiense*) should be considered in the plan. This salamander was until recently considered a subspecies of *Ambystoma tigrinum* but is now regarded as a separate species. The Sonoma County population was petitioned for listing as a federally threatened species on 23 May 2003. This species requires temporary ponds and pools (including stock ponds and sag ponds) in annual grasslands and open woodlands to breed that are below 1,500 feet in elevation. It hibernates in burrows of ground squirrels or other burrowing mammals. It is possible that this species occurs in the most southern portions of the MRC ownership in Sonoma County. A known breeding site exists 15 miles east of the MRC ownership block that lies south of Guerneville. If these southern ownership blocks are part of the plan area, some brief analysis of this species may be warranted.

We also recommend consideration and monitoring of Pacific giant salamanders (*Dicamptodon tenebrosus*). These animals have requirements for cool (cold) water and low quantities of fine sediments that are similar to salmonids (e.g., coho and Chinook salmon, steelhead trout) but do not exhibit large population changes in response to ocean conditions as seen in anadromous salmonids. We refer MRC biologists to the paper by Welsh and Ollivier (1998).

Two or three invertebrate species may warrant mention in the plan, although biologists with MRC may have information indicating these species or habitats are not present on the ownership. The Lotis blue butterfly (*Lycaides idas lotis*) is possibly extinct. No specimens have been found since 1983. It is known only from a few sites near Mendocino on California's north coast. It was thought to be restricted to a rare coastal bog type. Droughts in the late 1970s caused severe declines in populations of coast hosackia (*Lotus formosissimus*), the suspected larval food plant. If wetlands or fen/bog sites exist on the few small blocks of near-coastal MRC ownership near Mendocino or Rockport, these areas may warrant an investigation into the presence of this species. If the butterfly is rediscovered, attempts will be made by scientists to breed the species in captivity. If rare plant surveys are conducted in this plant community, botanists could be trained to identify this butterfly and conduct surveys for it concurrent with the rare plant surveys.

Behren's silverspot butterfly (*Speyeria zerene behrensii*) is only known from coastal northern California. The species historically ranges from the Russian River in Sonoma County north to Pt. Arena in southern Mendocino County. The butterfly now is known from only a single population at Pt. Arena. Preferred habitat includes coastal terrace prairie. The sole food plant for larvae is a violet (*Viola adunca*). If any coastal terrace prairie exists on the MRC ownership, then a discussion of this species may be warranted. As for the Lotis blue, botanists conducting plant surveys in this plant community could be trained to identify this butterfly.

The California freshwater shrimp (*Syncaris pacifica*) is a federal endangered species. Historically, the shrimp was probably common in low-elevation, perennial freshwater streams in Marin, Sonoma, and Napa counties. Today, it is only found in 16 stream segments within these counties. The species occurs in the lower Russian River drainage, only in low-elevation and low-gradient streams. Populations potentially exist on the block of MRC ownership just east of Jenner. This area likely contains tributaries of the Russian River. If all the tributaries on MRC lands are higher in elevation or higher gradient streams, then the probability of this species occurring is low.

3) Does the plan currently address physical properties and processes that shape species and community dynamics?

From what we were given to review (Chapters 5 and 7), we cannot conclude that physical properties and processes were adequately addressed, although MRC has made a start in this direction. The NCCP/HCP appears to address the "standard" set of watershed physical processes, namely erosion, including landsliding of various types, the role of floods, sediment, and woody debris on channel morphology, and the recruitment of wood through mortality, bank erosion, and mass wasting. Likely effects of forest practices on these processes are addressed in the plan, either quantitatively or more often qualitatively. (Many qualifications are justified given the rather high level of uncertainty regarding effects of forestry on many physical processes.) The MCR perspective on these physical processes mirrors, in general, previous research on these topics across the region from California up to the Pacific Northwest. In that sense, the MRC plan appears reasonably comprehensive in addressing physical processes. A substantial portion of the MRC perspective with respect to physical processes originates from "watershed analysis," a watershed assessment framework developed in Washington State (Washington Forest Practices Board 1997).

Despite the inclusion of the standard set of physical processes, the MRC NCCP/HCP avoids questions pertaining to the role of disturbance (including fires, landslides, bank erosion etc.) in habitat creation. Related to this larger-scale temporal omission is the lack of analysis of habitat-forming processes over large spatial scales, a centerpiece of current paradigms in river ecology (see Wiens 2002; Fausch et al. 2002). The NCCP/HCP would benefit from some inclusion of principles of disturbance ecology and larger-scale drivers of physical heterogeneity in their river systems. This would provide further information from which to consider how MRC's logging practices fit into the bigger picture of habitat development in the coastal watersheds.

Whether the plan addresses physical processes that "shape species and community dynamics" is another question. In general, the work of physical watershed scientists, at least regionally, does not address questions of species and community dynamics. Rather, the scientific approach is much more utilitarian and focuses on simple cause-and-effect relationship between physical processes on hillslopes and physical processes and features in the channel (i.e., a log falls into the stream and creates a scour hole and stores sediment). Hence, the MCR plan, through its analysis of physical processes, does not specifically address "species and community dynamics." Rather the plan's unwritten philosophical or theoretical framework appears to be one of "build it and they (species) shall come." Perhaps this view is contained in Chapter 4 (Plan and Rationale for Conservation Approach) but we did not have access to that chapter. A general section in a preliminary chapter will need to discuss climate, geology, topography, soils, hydrology, land use history, significant physical processes, fire history, and successional changes.

We suggest that MRC give greater attention to riparian zone protection and roads. The prime logic for riparian zone protection is to maintain the integrity of the physical and biological riparian environment. If this protection of habitat is effective, it will in turn protect the riparian and aquatic obligates, both locally and downstream from land management activities. A principal objective should be to retain that vegetation that provides an integral contribution to the stability of the channel and banks. This suggests a variable distance of streamside buffer, depending on the shape of the land. A 10-foot no-cut zone is perhaps a reasonable minimum starting point, but the distance should be increased to include the over-steepened slope adjacent to the channel (sometimes referred to as inner gorge) and also include any unstable areas. This protection zone should apply to Class I, II, and III channels. The "Default Conservation Measures" listed for MWMU 1 – 7 (Chapter 5, pp. 5-56 to 5-65) seem reasonable, but their application is entirely dependent on the quality and competence of the geologist and "individual knowledgeable in the relevant aquatic resources" that makes the appropriate determinations. If one assumes that the specialists are technically capable of correctly assessing the issues, then success depends upon the institutional ease by which the specialists' recommendations are accepted and then translated into management action. It is not uncommon for agency and corporate culture to reward the "team players," which can compromise technically sound recommendations that are politically unpopular with supervisors.

Physical processes that drive riparian structure operate at long time scales. As we noted above, large and infrequent events, such as large storms, floods, and landslides, are often the most important factor that shapes riparian and aquatic habitats for decades. An effective conservation plan must anticipate and plan for the consequences of such events, while considering the shorter-term consequences of intervening conditions. For example, the presence of large woody elements in a channel depends both on the delivery of wood by (1) "normal' tree mortality through insects, disease, and windthrow; and (2) "unusual" episodic events of landslides, debris torrents, wind storms, etc. The source of wood and the timing and mechanisms of delivery by the "usual" and "unusual" events may be quite different. A similar discussion applies to the delivery and transport of sediment. A conservation plan that focuses on the "normal" event and inadequately considers the "unusual" event is flawed. Narrow riparian buffers concentrated along perennial streams are often designed to address delivery from the "usual" type of events. The source of wood and sediment delivered during the "unusual" type of events is often far upslope from these narrow buffers. It is important to correctly assess the source of materials that compose the riparian and aquatic ecosystem.

Roads are generally the most ubiquitous and influential human-made feature affecting physical and biological processes in managed forests. Because of this dominant role of roads in shaping the effects of land management, the discussion of road use and design provided in the NCCP/HCP should be more comprehensive. Trombulak and Frissell (2000) and Gucinski et al. (2001) provide a comprehensive discussion of social and environmental effects of roads. A proper goal of a landowner is to design and manage a road system that is safe and responsive to the landowner's (and, in some cases, the public's) needs, that is affordable and efficiently managed, that has minimal negative ecological effects, and that is in balance with available funding needed for overall management of the land. A comprehensive road analysis methodology is presented in USDA Forest Service (1999).

4) Should any species and communities be added to assist in design of conservation strategies (e.g., species with no special protection status but that could be useful in planning conservation strategies or as monitoring indicators)?

Some additional species and communities that might be addressed are discussed in our response to Question 2. The list of plant communities is rather broadly drawn. They represent, in some cases (e.g., north coast coniferous forest) a lumping together of vegetation types that have different ecological properties. This lumping is not in the best interest of either timber management or conservation. A review of the California Natural Diversity Data Base (California Department of Fish and Game, Natural Heritage Division) might have revealed additional plant communities of special interest within the conservation planning area.

The classification "wet areas" is not a recognized habitat separate from a seep, spring, or wetland. If a habitat is predominantly vegetated by obligate wetland species (by federal guidelines) then it should be classified as such. Creating a "wet area" habitat and then decreasing the buffer is not adequate protection (page 5-15). Excluding human-constructed roadside ditches does not give adequate protection to mesic species. Due to past disturbance and hydrologic changes, some sensitive species are now only found in roadside ditches (e.g., *Lycopodium clavatum* and its distribution in Jackson Demonstration State Forest).

Conversion of hardwood dominated areas to late-seral conifers by the hack and squirt method is not appropriate as a conservation strategy. Tanoak (as the most common and dominant hardwood) is a highly important component of the redwood forest. Its acorns make up a significant portion of the diet of birds and mammals in the North Coast region. It is thought that the mycorrhizae associated with tanoak play an important ecological function in the redwood forest (Mateo Garbelleto, SOD Reports).

Sensitive plant species found in the redwood, upland forest, wetland, and oak woodland need to be added. There are many more sensitive plant species occurring in the pygmy forest than are listed on page 5-106. It would also be useful to add documentation for the plant species occurrences listed for each community.

As noted in our response to Question 2, the Pacific giant salamander could be added as an indicator species (e.g., section 5.2.1). Although it is not listed under the ESA, the distribution and abundance of this salamander reflects both water temperatures and benthic sediment concentrations, two physical features of streams that are responsive to timber harvest and roads and are important to anadromous salmonids. A terrestrial animal species that might be considered for conservation planning and monitoring, though not as a covered species, is the red tree vole (*Phenacomys longicaudus*). This species is often associated with old-growth forests and can be an important prey item for the northern spotted owl (*Strix occidentalis caurina*). It may be possible for foresters to collect information on red tree vole nest densities and number of active nests as part of their regular forest inventory duties. With little extra cost, a database could be developed that shows this species' habitat use on MRC ownership over time.

We suggest the plan address the ringtail (*Bassariscus astutus*), which occurs across a wide range of habitat types from riparian woodlands and coastal forests to brushfields and rocky areas. It is not a top predator, but plays an important, mid-level role in the food web. Its home range (109 to 1280 ac. [Grinnell et al. 1937]) seems a more appropriate size for conservation management planning than that of the mountain beaver (60 to 3,000 ft^2 [Goslow 1964]). Other mammals that might be considered are the bobcat (*Felis rufus*) and mountain lion (*Puma concolor*), which are important predators that have shown sensitivity to fragmentation (especially the mountain lion) in more developed areas of California (e.g., Crooks 2002). As the human population and associated urban and road development increase in California, forested landscapes such as the MRC ownership may be among the few source areas (i.e., where annual reproduction exceeds mortality) for carnivores.

We noticed that there are no bats or passerines mentioned in the plan, although MRC is currently conducting point-count surveys for passerines. This is acceptable unless some bat or passerine species show up in the "grouping species process" discussed in question 6.5 below. Sensitive bat species are known to occur on adjacent lands (Navarro State Park).

5) Should any species be removed as highly unlikely to be found in the plan area or affected by the plan?

We do not recommend the removal of any species at this time. The choice of species to be covered by the plan seems logical based either on the current federal and/or state status of the species or the likelihood of impacts on their habitat and associated populations by MRC land management activities (but see answer to question 2). The choice of species as indicators of the various aquatic environments is appropriate. For example, the Olympic tailed frog is associated with old growth and mature coniferous forests and upper stream reaches. It needs clean, fast-flowing, cool water to survive and breed and is sensitive to influxes of sediment into its habitat. Monitoring this species will provide information concerning changes to Class II and III streams over time. The red-legged frog uses wetlands and ponds and the bottom reaches of slower moving side channels in large streams and rivers. Monitoring this species will provide information on the quality of the wetland ecosystems and portions of Class I streams on the ownership. The foothill yellow-legged frog is experiencing declines throughout its range from a variety of factors and, due to these declines, is another good choice of a species to be included in the plan. However, as we note, the list of aquatic indicator species is potentially incomplete and could be improved by the addition of the California tiger salamander and Pacific giant salamander.

6) Are there any new or pending taxonomic revisions or other issues that would affect the list of species addressed?

None are currently known. It might be noted, however, that the northern subspecies of the red-legged frog (*Rana aurora aurora*) occurs from southwestern British Columbia, through Washington and Oregon and into northern California. South of northern California, it intergrades with the California subspecies (*R. aurora draytonii*) in Mendocino County, California (Nussbaum et al. 1983; Hayes and Miyamoto 1984).

6.5) What are the most effective ways of grouping species to assist in designing, managing, or monitoring conservation strategies?

There are several ways to group species that might be useful in the MRC NCCP/HCP. Because of the way the plan is organized, one logical approach would start by grouping species into habitat guilds by the major habitat types they depend on. Since the plan will likely use a habitat-based approach, assessing management effects on species and monitoring these effects will likely be accomplished separately for each habitat type included in the plan (i.e., old-growth coniferous forest, riparian, wetlands, pygmy forest, etc.). The next step in the process would be to choose and prioritize those species within each habitat guild that are considered to be most vulnerable to the land management activities taking place on the landscape and where field methods are available to monitor their populations.

This habitat-based approach can be further refined to a "focal species approach" as described by Lambeck (1997). Lambeck suggested that managers identify, for each major habitat type, groups of species whose vulnerability can be attributed to a common cause, such as loss of area or fragmentation of a particular habitat type or alteration of a disturbance regime. Species in each group then can be ranked in terms of their vulnerability to those threats. Lambeck identified area-limited species, dispersal-limited species, resource-limited species, and process-limited species as vulnerability groups. For each group the focal species are the ones most demanding for the attribute that defines that group. They serve as the umbrella species for that group. Two or more species might be selected within a group, and a single species may occur in more than one group.

Together, these species tell us what patterns and processes in the landscape must be sustained in order to sustain biodiversity. Their needs define the thresholds—patch size, isolation, fire frequency, etc.—that must be exceeded if the native biota is to be maintained (Lambeck 1997). In many cases (but probably not all) listed or candidate species would include species most affected by land management activities. Some of the vulnerable species (e.g., the tailed frog and Pacific giant salamander, as discussed above) would also serve as bio-indicators by representing the health of the ecosystem. They would be early indicators of any negative changes to the habitat or community they are associated with. Two species come to mind that could be used as negative indicators of early problems for a community and/or species; the bullfrog (*Rana catesbeiana*) and barred owl (*Strix varia*). The non-native (to the West) bullfrog often feeds on the larvae and adults of other amphibian species. The barred owl, which has recently expanded its range in the West, is a known competitor of the spotted owl.

This approach takes into account the habitat-based approach of the NCCP/HCP, the concept of using guilds, the concept of using vulnerability to human disturbance as a way to identify focal species, and the concepts of bio-indicator and umbrella species. An additional category of species which might be considered is keystone species, which are defined as highly interactive species that play roles in their ecosystems that are disproportionately large for their abundance (Power et al. 1996). Salmon are sometimes considered keystone species; however, their former abundance suggests that they are more accurately described as foundation species that support(ed) a diverse food web.

The aquatic species may not be effectively grouped and probably require monitoring (and adaptive management) on a species-by-species basis. The habitat requirements of each species are unique (albeit there is some overlap with respect to water flow and temperature, etc.) and the amphibians, unlike salmonids, do not respond to ocean conditions, thereby reducing some of the potential variability.

Existing Data

7) Do current data-gathering methodologies provide a mechanism to develop biological and physical information sufficient to provide a firm scientific foundation for conservation planning?

For the most part, the methods used to measure the habitat components in the plan are well described and the metrics chosen appear well thought out (trees/acre, canopy closure, buffer widths, coarse woody debris, etc.). As mentioned in our response to Question 2, there are several species and unique community types that are not as well considered in the plan, as they should be. MRC should develop data-gathering methodologies for these communities and species.

The lack of a well-defined, seasonally appropriate, floristic botanical survey performed by an experienced botanist presents a particular problem for the development of this NCCP/HCP. We recommend the intuitive search method for sensitive plant surveys rather than randomly placed line transects or quadrants. It is not effective to search for rare plants in a random fashion. The surveyor must identify the rare plant habitats (niches) and then search for species using those parameters. Rare plants by their very nature often have rather narrow niches. A niche is defined as the functional role of a species in an ecosystem, or the specific space occupied by a species within its habitat. In looking at plant species, focusing on the specific space that the plant occupies is most relevant. Delineating the habitat niche of rare species can help locate individuals in the field. Understanding the abiotic and biotic requirements that define the habitat is the first step. Abiotic features of a plant's habitat niche include substrate, light, moisture, aspect, and topography (Sholars in press).

For most other species, the data gathering methods appear to be well described and refer frequently to the literature. Some definitions used for field methodologies are not clear. Our suggestions concerning definitions and methodology include:

A) Make clearer the definition of old-growth trees for each species of conifer and deciduous trees earlier in the NCCP/HCP document so that when the retention of old-growth trees is discussed in the conservation measures for Class I and Large Class II AMZ's, readers will know what is being referred to.

B) Define what a "screen tree" is when discussing the retention of screen trees around individual old growth trees (p. 5-99).

C) Make clear that not all the characteristics described for old-growth trees (p. 5-100) are needed to define a tree as old growth, for example, Douglas-fir trees often have little or no moss since they grow on drier sites, and old-growth redwood trees often have little moss.

D) If rare plant surveys are planned, refer to the literature and methods that will be used to conduct these surveys.

E) Refer to the literature for the specific field methods that will be used to monitor populations of red-legged frogs, foothill yellow-legged frogs, and Olympic tailed frogs.

F) Specify targets or a percentage in the methods used to describe the densities of egg masses that would indicate a significant decline of foothill yellow-legged frogs.

G) Specify how an egg-to-metamorph survival ratio will be calculated for the foothill yellow-legged frog, when the survey method indicates that the survey is complete after the first metamorph is observed within each stream index reach.

H) For the Olympic tailed frog surveys, describe in more detail how data will be gathered to describe their distribution—how many streams will be surveyed? How will the stream indexes to be surveyed be defined? What percentage of streams or stream reaches will be surveyed?

I) Describe how it will be decided whether portions of a LACMA will need "improving" for marbled murrelet habitat (p. 5-38).

J) Change the definition of a potential murrelet nesting platform from nearly horizontal to ±45 degrees; murrelets are not limited to nesting on perfectly horizontal limbs.

K) Describe the methods for the collection of all canopy closure data.

L) The definitions of murrelet habitat types (High, Medium, and Low) should perhaps be converted into trees/acre so that the metric is more clearly standardized (p. 5-140).

M) Better describe how the percent of ground cover disruption will be calculated in order to determine if rare plant surveys will be done prior to the management activity-taking place (p. 5-149). For aquatic organisms, we recommend determination of their distributions and abundance, tracking their changes through time (and space), and relating these changes to environmental conditions.

We have some concerns about the treatment of Class III streams. On page 37 of the Management Plan, the table estimates 720 miles of Class III streams, whereas on page 5-40, the area in Class III buffers, assuming a 25-foot buffer on each side of stream, was 9732 acres, which translates to 1606 miles of Class III stream. This buffer area also translates into 4.2% of the total ownership. We could not find in the documents a discussion of the criteria by which the head of a Class III stream was determined. At Caspar Creek, Class III streams often begin in areas having a drainage area of 3 to 5 acres. Pipeflow is the dominant mechanism of water delivery in these small watersheds. Open channel surface flow generally occurs as a discontinuous gully formed by collapse of piping channels. The drainage area at the upper location of Class III channels depends on the "maturity" of the piping tunnels, with mature piping development resulting in Class III streams occurring in smaller drainage areas than recently developing piping networks. The important point is that water and sediment are being transported downslope by both classic open channels and by piping. If headwater-piping networks are disturbed and collapsed by heavy equipment, large increases in sediment delivery would result. In this terrain, the definition of a Class III (provided in Table 5-1) should be modified to read, "Shows capability of transporting sediment ... timber operations, *whether by surface channel or pipeflow*." One could argue that substantial protection is needed in the swale immediately above the channel head, because the channel head could migrate upslope dramatically, with commensurate increases in sediment transport, if subsurface pipes are collapsed by heavy equipment.

There is an inconsistency in the stated size of Class III buffers. Page 5-40 uses a 25-foot buffer on either side of the stream, whereas page 5-2 states a no-harvest zone within 10 feet of all Class I, II, and III streams, and page 5-4 indicates no inner or middle AMZ Band and a 25-foot AMZ for Class III's on slopes <30% and 50 feet on slopes >30%.

There also needs to be some consideration of buffers and equipment exclusions in areas up-swale from the top of the designated Class III.

Regarding the watershed analysis, page 29 of the Management Plan states that intensive field watershed analysis will be completed on all 303d listed watersheds (70% of ownership) by the end of 2001. We find little reference to the result of this analysis in the documents that we received. The information developed from these analyses would have been useful to the Science Advisors. As mentioned above, the HCP contains numerous methods for data collection on small-scale attributes of hillslopes and rivers. This is the conventional approach contained within "watershed analysis" which forms the basis of MRC's approach. The problem with relying solely on a watershed analysis (Washington Forest Practices Board 1997) is that it has somewhat failed in its applications across the region. From all of the various small-scale data on substrate sizes, pools, logs, fine sediment, bank erosion, etc., it is hard to put humpty dumpty (i.e., the ecosystem) back together again. Nevertheless, this is the conventional approach and MRC should not be faulted for incorporating it into their plan. However, if they conducted a review of the scientific merits of certain types of analyses (i.e., an epistemological analysis of the various watershed disciplines—see Benda et al. 2002) this limitation might become more apparent and could motivate some larger-scale analysis of landscape controls on riverine ecosystems (see response to Question 1 above) in addition to providing further defensibility regarding recognition of the scientific limitations of any NCCP/HCP.

Additional data gathering on terrestrial ecological processes is also needed. Systematic study of fire history would provide important information necessary for the development of strategies for the maintenance of some plant communities. No mention is made of any collection or use of climatic data. Incorporating the existing network of relevant weather stations and adding new stations if needed could provide useful information to better understand future fluctuations in species population levels as well as patterns of forest growth.

8) Does there exist a body of scientific information sufficient to provide a foundation for conservation planning?

For some components and species described in the plan there appears to be sufficient biological data to describe the current condition of these habitats or species on the MRC ownership, how these will be managed over the life of the NCCP/HCP, and possible effects to these habitat and/or species from management activities over time. At least there are not complete gaps in information. These components with reasonably complete information include large woody debris recruitment processes, mass wasting and erosion processes, road inventory data, mapping of the different stream classes, and the amounts and distribution of particular habitat types including mature and old-growth coniferous forests, deciduous forests, and riparian communities. However, there appears to be considerable uncertainty regarding the distribution and amounts of Type II old growth. These stands could be more abundant on the ownership than recognized, and could be important for particular species including the Pacific fisher, marbled murrelet

(*Brachyramphus marmoratus*), northern spotted owl, Olympic tailed frog, and other species associated with old-growth forests.

If MRC could find a way to map the amount and distribution of Type II old growth, this information gap would be removed and planning for future older stand conditions (which is an objective of the plan) would be improved. Unless it appears in other portions of the document that we did not have access to, there seem to be large information gaps regarding the presence, amounts, and distribution of unique habitat types, including near coastal communities (coastal prairie, coastal scrub), bogs, fens, wetlands, vernal pool, major rock outcrops, and chaparral plant communities.

From a species perspective, sufficient survey information and presence/absence data appears to be available for the northern spotted owl and foothill yellow-legged frog. As recognized in the plan, more information on the presence, distribution and habitat use of the Point Arena mountain beaver, red-legged frog, Olympic-tailed frogs, and marbled murrelet needs to be collected. The distributions of the red-legged frog and Olympic tailed frog are largely unknown. Although some data exists on the Point Arena mountain beaver, more information needs to be collected and surveys need to be conducted. The surveys for these species outlined in the plan seem adequate, but see our earlier comments in response to survey methodology in Question 7.

Only a few occupied sites are known for the marbled murrelet, and they are all located in lower Alder Creek. It is likely that other occupied sites exist for this species on MRC ownership. Recently, two new occupied sites were discovered up the Ten Mile River on Campbell Group Managed Lands in areas where the birds were not expected because of the distance to the marine environment and young condition of the habitat. It is likely that other occupied sites exist on MRC lands in other watersheds besides Alder Creek. Because the species was almost extirpated from this area, any new occupied sites that can be located will be extremely important to protect for this population to have some chance of recovery. Because of the low numbers of birds in this area, it will be difficult to detect stand occupancy with the current 2003 Pacific Seabird Group Marbled Murrelet Survey Protocol. A more robust protocol may need to be developed for this area (i.e., greater survey effort per year).

If MRC decides it is warranted to include in the plan one or more of those species discussed in our response to Questions 2 and 4, then significant data gaps on the distribution, abundance, and local habitat associations now exist for the Pacific fisher, California tiger salamander, Lotis blue butterfly, Behran's silverspot butterfly, and California freshwater shrimp, among others.

The plan needs to better define the species of rare plants that may be present in the unique communities (fens/bogs, pygmy forest, vernal pool, immediate coastal plant communities such as coastal prairie and coastal scrub) that exist on the ownership and conduct surveys to describe their distribution, abundance, and habitat associations. There is a body of information about which plant species are sensitive, but the plan needs to properly inventory the land in order to accumulate data on their occurrences. There remains a lack of fundamental scientific understanding of the biology and ecology of the listed plant species and communities of special interest (e.g., serpentine balds).

For all of the species for which additional information is needed, the plan does not adequately address the need to collect habitat information at the locations where these species are found. Collecting habitat association information (general cover type information and specific structural and micro-habitat features) will be critical in:

> 1) Inferring impacts to these species' habitats from land management activities;
> 2) Predicting where these species may be present on other parts of the ownership (i.e., habitat models) and;
> 3) Devising protection strategies using the adaptive management procedures developed in the plan. The collection of habitat association data for these species needs to be better planned and described in the conservation plan.

Regarding watershed processes, we believe sufficient scientific understanding exists for providing a general foundation for conservation planning. The understanding is admittedly coarse-grained (for example, limiting human disturbance in ecosystems, maintaining the large-scale processes of habitat formation, etc.). Scientific understanding of watershed processes breaks down rapidly at finer spatial and temporal scales. Therefore we recommend that MRC, through their conservation plan, address several key issues that would underlie their NCCP/HCP, including 1) scientific certainty/uncertainty over a range of scales; 2) dynamics of landscapes (i.e., disturbance ecology); and 3) large-scale sources of physical heterogeneity and biological productivity and diversity.

Other gaps in information involve insufficient knowledge of the fire history of the area and other components of the disturbance regime. Conservation planning should go forward in the absence of complete scientific information, but the plan should be prepared in such a way that it can adapt this information as it becomes available in the future.

9) Are there additional data sources or literature pertaining to the resources of the planning area that should be incorporated into the database and considered during planning and analysis?

The MRC plan (Chapter 5) includes a comprehensive review of the available scientific literature in California as well as regionally on various aspects of watersheds, including landslide processes and rates, erosion rates (sediment budgets), large wood in streams, stream temperature, channel morphology, etc. These studies include the Caspar Creek (Jackson Demonstration State Forest) experimental work as well as work published by the Redwood Sciences Lab and the Pacific Southwest Research Station. Nevertheless, from the information we have seen, it appears the plan needs to make better use of existing technology to map the presence, distribution, and abundance of the community types present on the ownership, especially those unique community types mentioned in our response to Question 2. These data should be displayed in the plan so that an assessment of the possible effects of the land management activities on these ecosystems can be assessed and the potential occurrence of rare species associated with these communities can be determined. In addition, literature pertaining to the survey methodologies for particular species needs to better referenced. Appropriate technology for mapping vegetation includes low-elevation aerial photography and Landsat imagery. It might be useful to examine the Wieslander (1935) vegetation maps to determine the potential locations of unique habitats and plant communities. Wieslander's maps could be quite useful in planning plant surveys. These maps are available through Professor Barbara Allen-Diaz at the University of California, Berkeley.

10) What gaps in existing information create the greatest uncertainties for planning, analyzing, managing, and monitoring conservation strategies in this setting?

This question is largely addressed in our response to Question 9. As we have noted in several places, one glaring gap is an adequate inventory of plants and scientific information on the biology and ecology of these species. A botanical survey should compile information on dominant plants, common plants, and plants that occur occasionally. It is important that all botanic surveys be conducted at seasonally appropriate times and be floristic in nature. Sensitive species can be surveyed by searching within appropriate habitats, as described on the CNPS web site. This inventory is required for the development of a defensible monitoring program for rare plants and communities. Survey guidelines can be found at www.cnps.org and www.dfg.ca.gov/whdab/guideplt.pdf. Also, the fire history of the planning area has not been well documented. Another significant question is whether the "properly functioning ecosystems" required by the terrestrial and aquatic species addressed in the planning process can be maintained across the MRC lands when timber is harvested.

11) What are the most effective methods for addressing these information gaps?

We have addressed this question, in part, above. The most effective methods for addressing the information gaps in the distribution and amounts of certain plant communities (outlined in our response to Question 9) would be the uses of technology such as low-elevation aerial photography and Landsat imagery across the ownership. Effective methods for addressing the information gaps in the distribution and abundance of particular species (see responses to Questions 2 and 10) would be the planning and implementation of survey protocols already available in the literature for these species. Lists of sensitive species that may occur on the property could be compiled from CNPS, CNDDB, CDFG, and RareFind. New survey information could be collected in association with other forest management activities to reduce the cost, but attention should be paid to timing surveys to correspond to plant phenology (i.e., blooming). A fire-history analysis could be based on tree rings and fire scars. The literature on physical and biotic responses to roads, timber harvest, and forest chemicals should also be consulted. MRC should consider the suggestion that no more than 1.5% of any watershed be harvested per year in order to prevent or minimize adverse cumulative effects (Dunne et al. 2001). We recommend a change in the underlying approach to field studies in the NCCP/HCP, including rejecting the primacy of the "watershed analysis" approach (Washington Forest Practices Board 1997) to the study of watersheds. Instead, we recommend an approach similar to that described by Reid (1998). Such an approach was effectively used in the U.S. Forest Service Roads Analysis (USDA Forest Service 1999). This issue should be considered in Chapter 4 of the plan, which (as noted) we were not given to review.

12) Are habitat suitability models or other models recommended for predicting species ranges where distribution data are sparse?

Spatially explicit habitat-suitability models developed with the use of geographic information systems are proving very useful in conservation planning, especially for wide-ranging animals. These models can be based either on empirical data (e.g., by relating species occurrences to potential landscape predictor variables, such as vegetation, climatic, topographic, or satellite imagery metrics using logistic regression or other statistical techniques) or on natural-history information from the technical literature or expert opinion. These models (also known as resource selection functions; Boyce and McDonald 1999) are able to predict habitat suitability for a given species in areas beyond documented occurrences. They can be used to estimate potential population densities of the species of interest and can be validated by independent field data (Carroll et al. 2001).

The development of spatially explicit habitat-suitability models is time-consuming; hence, we would not expect new models to be developed and validated by MRC for the NCCP/HCP. However, we strongly recommend that MRC search the literature (unpublished as well as published) to find models for sensitive animal species that are known to occur or may occur in the region, and apply them to the planning area. For example, a validated model for the Pacific fisher showed high prediction accuracy in the Klamath-Siskiyou region (Carroll et al. 1999) and could potentially be extended southward.

(13) Are there physical process models recommended for predicting relationships between physical and biological communities?

There is a paucity of physical models that predict relationships between physical watershed conditions and in-stream biological communities. Even more regrettably, there is a distinct lack of models for predicting channel, floodplain, and valley morphology given inputs of water, sediment, and wood. Much of the knowledge in this area is qualitative, which is why the MCR plan takes on the aura of qualitative "best management practices (BMPs)" when it comes to managing or regulating the relationship between upslope physical processes and in-stream biological communities. Admitting this type of scientific uncertainty would actually help the plan (i.e., justify qualitative interpretations of cause and effect) and help defend it against attacks that will likely come in the future. We recommend an epistemological analysis of what is known and not known about watershed processes; this could be placed in Chapter 4 "Plan and Rationale for Conservation Approach."

(14) If models are used, what standards for formatting, parameterizing, testing, or monitoring can you recommend?

The only (physical) model described in the Plan (Chapter 5) is SHALSTAB (Montgomery and Dietrich 1994), which is used for predicting locations and relative likelihood of shallow landsliding in steep and convergent zones of hillslopes. Use of the model SHALSTAB provides important input to landscape planning and the design of harvest plans. Standards for parameterizing SHALSTAB can be found in the scientific literature that covers that type of model. Perhaps more importantly, SHALSTAB predictions need to be tested using landslide inventories over decades. SHALSTAB has been shown to be a poor predictor when the readily available 30-meter DEMs are used. Predictions improve when LIDAR-generated fine-scale DEMs are used. Since there are virtually no other quantitative models available on process interactions between terrestrial and aquatic systems, no other standards are necessary. We were unable to find sufficient details to determine how the predicted landslide risk was generated.

Regarding models of surface erosion, page 7-27 states that "surface erosion estimates will be developed by use of a surface erosion model." Unfortunately, there is no description of that model, so it is not possible to comment on the model's appropriateness for this area. If the model is appropriate, it is important to calibrate the model for the local conditions and verify the model predictions. Simply using a model and trusting the predictions is dangerous. Surface erosion models are notorious for being misused in forested steeplands, and the predictions are seldom validated.

With respect to long-term channel monitoring, page 7-6 begins a discussion of Aquatic Monitoring in Focus Watersheds. The plan describes years when certain types of monitoring will and will not be conducted. For physical watershed and stream conditions, it is more useful to select appropriate monitoring periods based on the timing of geomorphically significant events (large storms, wet years, etc.) than on pre-selected years.

Conservation Guidelines and Reserve Process

15) What basic tenets of landscape management are pertinent to conservation planning in this area and how should these tenets be translated into measurable standards and guidelines for landscape management design?

Since the 1970s, biologists have proposed principles derived from theory, empirical generalizations, and rules of thumb to help guide conservation planning (e.g., Diamond 1975; Wilcove and Murphy 1991; Noss et al. 1997). Although virtually all of the principles proposed have been shown to have exceptions, they have nevertheless proved useful in situations where case-specific data are limited and uncertainty about how to design a landscape to meet multiple objectives is high. Although each case is to a large extent unique, if one considers enough cases, general patterns emerge. Because HCPs and NCCPs are constrained by available time and money, there will rarely be enough data to assure that the decisions made are the best decisions possible. Therefore, by appealing to well-accepted planning principles, decisions can be reasonably defensible despite limited data.

One general principle for planning, attributed to ecologist Frank Egler, is that ecosystems are not only more complex than we think, but also more complex than we can think (Egler 1977). Although the physical properties of ecosystems are based on invariant laws and are relatively predictable, biological responses are less predictable. As one moves from the physical to the biological realm, the basis of practical knowledge moves from universal laws to theories to empirical generalizations. Surprises are inevitable. For this reason, scientists generally recommend that caution and prudence be exercised when attempting to conserve or manage natural ecosystems. Moreover, the fewer data or the more uncertainty, the more conservative a conservation plan should be (Noss et al. 1997). When information on species distributions, population sizes and trends, interactions among species, responses to disturbance, and other factors is scarce or questionable, a defensible strategy is one that minimizes anthropogenic disturbance until the biological information necessary to make reasonably accurate predictions of responses becomes available. Such an approach is often called the “precautionary principle.” In a NCCP/HCP planning process, the precautionary principle is typically applied case by case through negotiation, a process beyond the purview of science advisors. Nevertheless, the general idea that cases with fewer data or more uncertainty demand a more conservative approach is scientifically defensible.

The conservation planning principles developed by the Scientific Review Panel (SRP) for the NCCP program reflect the evolution of reserve design principles from the 1970s to the early 1990s. The California Department of Fish and Game and California Resources Agency directed that “subregional NCCPs will designate a system of interconnected reserves designed to: 1) promote biodiversity, 2) provide for high likelihoods of persistence of target species in the subregion, and 3) provide for no net loss of habitat value from the present, taking into account management and enhancement.” The SRP recommended seven principles of reserve design as a way to accomplish these goals. We do not discuss the theoretical or empirical basis or the means of application of these principles here, but refer the reader to previous NCCPs/HCPs (e.g., Noss et al. 2002) and other literature (Noss et al. 1997), where the principles are discussed at some length. The seven planning principles offered by the SRP are:

1. Conserve target species throughout the planning area.
2. Larger reserves are better.
3. Keep reserve areas close to one another.
4. Keep habitat contiguous.
5. Link reserves via corridors.
6. Reserves should be diverse.
7. Protect reserves from encroachment.

An eighth principle was added to the Southern Orange County NCCP and also was emphasized by Noss et al. (1997):

8. Maintain natural processes.

Because the MRC NCCP/HCP is based more on maintaining the suitability of the landscape matrix ("the working forest") rather than a network of reserves to accomplish its conservation goals, the SRP planning principles (i.e., not including #8) are generally less relevant than, for instance, in coastal southern California, where the NCCP program was initiated. Nevertheless, the principles still apply, albeit in modified form. For example, principle #1 suggests that appropriate habitat for species of concern be well distributed across the MRC ownership, rather than clustered in one corner (albeit this does not apply to unique plant communities, such as pygmy forest, that are naturally clustered). Distributing habitat and populations across a broad landscape helps guard against catastrophic losses from fire, landslides, disease, or other events. The principles that apply to reserves (#2 – 7) apply both to protected habitat areas within the MRC ownership, such as old-growth stands and unique plant communities, and to the matrix of managed forest. Habitat fragmentation and encroachment by roads should be minimized on MRC lands in order to sustain populations of fragmentation-sensitive species and discourage invasions by weedy, non-native species. In a well-managed forest landscape, however, corridors as movement routes become somewhat less important because the landscape matrix (e.g., areas harvested with selection systems or variable retention) is permeable to most species.

Principle #8 is one we have already dealt with, to some extent, in this report—maintaining (or mimicking) natural processes such as fire and hydrologic regimes is fundamental to sustaining biodiversity across the ownership. Forest ecologists have suggested that natural disturbance regimes should serve as models for silvicultural systems (Hunter 1990, 1993; Noss and Cooperrider 1994). One of the more useful ideas is the concept of "natural" or "historic" range of variability (Landres et al. 1999; Swetnam et al. 1999). This concept recognizes that natural ecosystems are highly variable and that this variability itself changes over time, for example with changes in climate. Nevertheless, over a defined, ecologically meaningful span of time, variability falls within certain bounds. Most of the species that compose an ecosystem have evolved within this range of variability—they are adapted to these conditions. Hence, in timber harvesting and other practices, managers should seek to mimic natural disturbances in such a way that key components of the forest ecosystem—for example, patch size and structural complexity—remain within the historic range of variability.

Many ecologists consider the historic range of variability during the late Holocene the appropriate set of "reference conditions" for comparison with human-altered conditions and as a guide to enlightened management (Stephenson 1999). For example, a recent study in the Oregon Coast Range used data from fire scars on trees and from pollen and charcoal laid down in lake sediments to assess variation in fire-return intervals and the proportion of old growth in the region over the last 3000 years (Wimberly et al. 2000). Not surprisingly, the study found that the proportion of old growth in the region today is much lower than at any previous time in the last three millennia. That is, present conditions are far outside the natural range of variability and defy any notion of sustainability. Such results also tell us the appropriate management direction today: protect the remaining old growth and continue to grow more until the proportion is within the historic range of variability.

Of course, managing all components of an ecosystem within an historic range of variability, while still removing commodities, is impossible. Natural fires kill trees, but seldom consume a large proportion of the wood—typically no more than 25% of the total live biomass is consumed by fire (Auclair and Carter 1993) and often much less. Hence, fires leave in their wake large stands of dead trees, which are critically important to wildlife. Few forms of large-scale logging leave most of the dead wood on the site and none leave all of it, for obvious reasons. Moreover, the charcoal and ash left after a fire plays an important role in nutrient cycling (Zackrisson et al. 1996). Differences in species composition are also apparent in forests arising from logging rather than fire. For instance, because of differences in the disturbance of the forest floor, fire-regenerated forests often have a greater abundance of pioneer species and lichens and lower abundance of residual species compared to stands arising after logging (Nguyen-Xuan et al. 2000).

Nevertheless, the logic behind the use of historic variability to guide ecosystem conservation and management is compelling. Changes that occur at a different rate, intensity, pattern, or spatial scale than naturally—or which persist for a longer period of time—are likely to fall outside the limits of adaptability for at least some species, which will become locally or regionally extinct. If some of those species are endemic to the region in question, they may ultimately become globally extinct.

16) What theoretical or empirical support is available for designing necessary and sufficient biological core areas, linkages, wildlife/fish movement corridors, buffer or other aspects of design?

Our response is combined with Question 17, below.

17) Are explicit reserves/buffers recommended and are existing data sufficient for their design and implementation?

There is abundant theoretical and empirical support for the efficacy of well-designed reserves in maintaining biodiversity. The design principles mentioned in our response to the previous question, and which are often translated into a core-corridor-buffer design (Noss 1992), are well accepted and applied worldwide. Reserves are especially important for species and other resources sensitive to human exploitation, persecution, or disturbance (Noss and Cooperrider 1994: Meffe and Carroll 1997; Woodroffe and Ginsberg 1998; Soulé and Terborgh 1999). Conservation biologists also recognize that the role of reserves becomes somewhat less critical as the surrounding landscape matrix becomes more suitable for the native species. However, there are still species so sensitive to human activities (e.g., even to the presence of recreationists) that refugia secure from human access are recommended (Miller et al. 1998; Noss et al. 1999).

Specific reserves have been designated in some cases (e.g., old-growth redwood) on MRC land and should be designated in other cases (e.g., listed plants) for the protection for listed plant species and plant communities of special interest (e.g., serpentine balds).

It would be also appropriate to select and set aside future "old growth" areas for each of the natural plant communities in the conservation planning area to serve as refugia for species requiring these habitats. The current plan has insufficient data to establish a system of reserves for listed plants and plant communities of special interest.

Buffers along streams are required under the California Forest Practice Rules and may serve as reserves as well. The effects of tree management on habitat conditions, in these buffers, should be part of an ongoing monitoring plan to determine if the standards under the California Forest Practice rules are sufficient to maintain quality habitat for riparian species and provide for stream protection.

There is little direct reference to core areas for freshwater systems in the published literature, although there is much information addressing habitat suitability and habitat selection of salmonids. Much of the fisheries literature addresses either micro-habitat (e.g., depth, velocity, cover) preferences, or meso-scale (e.g., pools, riffles, glide) habitat selection (e.g., Bisson et al. 1997). A number of investigations have related juvenile salmonid survival or abundance to macro-scale (e.g., river segments or reaches) habitat complexity. One might define salmon core areas as a group of connected habitats that are essential to sustain a viable salmon population. For salmon and other anadromous species, the requirement of stream habitat connectivity is supported both theoretically and empirically; their life history entails upstream and downstream movements and different habitat conditions for spawning, rearing, and overwintering, etc. A group of habitats refers to multiple patches that contain the physical and biological elements required for each salmon life phase and are connected by the movements of fish between different habitats. In this context, MRC's NCCP/HCP would have to move beyond the small spatial scale of the pool – riffle – logjam and up to whole valley segments and evaluate the sources of large-scale heterogeneity (and habitat diversity) in riverine systems. Guidance for this is outlined in our responses to previous questions.

Explicit dimensions for riparian buffers and the types of harvest activities that can occur within them are outlined in the NCCP/HCP. Most of the dimensions are targeting adequate wood recruitment to streams, and most of the data and studies supporting MRC's riparian buffer design originate from outside the HCP area in north and north-central California. In general, it appears the buffer widths are reasonably well justified, at least from the perspective of wood recruitment resulting from "usual" events, but perhaps not from "unusual" events (see Questions 3 and 21). However, it should be remembered that no one knows the effect on channel morphology, including pool formation, by reducing wood loading from, say 100% to 85%.

A great deal of information is available concerning the logic and design of riparian buffers (i.e., aquatic management zones; AMZs) for the protection of anadromous fish habitat. This information is discussed in depth in the Aquatic Conservation Strategy of the Northwest Forest Plan (Forest Ecosystem Management Assessment Team, 1993). The size of the buffers in the MRC NCCP/HCP is substantially smaller than that considered adequate to protect salmonid habitat in the Northwest Forest Plan. Although some microclimate data and large woody debris recruitment data are available to prescribe buffer widths on the MRC lands (see above), it appears that insufficient information exists to know how these particular widths and the management activities prescribed in each band within the buffers will affect fish and other riparian and stream-related species and in-stream processes for this particular landscape. This is also true for the buffers specified for wetlands, bogs, seeps, and other unique communities. Riparian buffers areas also may provide the major linkages and movement corridors for a variety of animal species. How wide do these corridors need to be to facilitate animal movement and be relatively free of edge effects? The studies to answer this question have not been done.

The design of a system of riparian buffers should be based of information obtained by a comprehensive watershed analysis. Such an analysis was not available to us, and consequently it was not possible to determine the adequacy of the information that led to the proposed riparian protection measures. In the absence of a comprehensive analysis, it would be prudent to have conservatively large riparian buffers that could possibly be reduced once detailed local information becomes available that would justify a reduction in size for a specific area. It is possible for future mangers to reduce the size of conservatively large buffers, but it is not possible to later increase the size of narrow buffers once the trees are cut. It is important to bear in mind that whatever AMZ conservation measures are adopted will likely affect a majority of the vertebrate and invertebrate species on this landscape, along with water quality, mass wasting levels, and other environmental factors.

Reserves and buffers should also be established in the case of known nesting trees used by marbled murrelets, if nesting trees can be located. Reserves designed for occupied sites for marbled murrelets indicate that some habitat will be "improved" through management activities and that any proposed THP within a LACMA must have a Pacific Seabird Group (PSG) approved survey completed. We have little information on how to "improve" murrelet habitat and know nothing of the effects of these improvements on the nesting ecology of this seabird. We suggest that reserves for occupied marbled murrelet sites include no management activity until more is known about how to improve habitat and about the effects of these improvements on nesting birds. Management activity should be limited to buffer areas surrounding reserves. Considering that this is one of the most important occupied sites in Mendocino County, and one of the last remaining occupied sites with a high density of birds, extreme caution is warranted concerning management activities in and adjacent to the site. In addition, MRC may want to consider limiting any human activity (e.g., camping) in this area to keep the density of corvids (i.e., ravens, jays, crows) low near the occupied site. If marbled murrelet habitat-improvement activities do take place, the plan does not state how managers will decide when a stand needs improving. From the requirements listed on page 5-138, it appears the stands with the best murrelet habitat will be "improved," which seems illogical.

Buffer designs for the Point Arena mountain beaver appear to be a best-guess approach due to a lack of specific information. A monitoring program and adaptive management strategy that assesses the effects of management activity within 100 feet of these colonies may be warranted.

A substantial number of studies have been completed on the northern spotted owl. Since the plan will collect demographic information on a large sample of pairs each year over time, the effects of the owl reserves designed to protect breeding pairs can be assessed and an adaptive management strategy implemented based on these data.

18) How can conservation strategies be arrived at which are functional across multiple environmental gradients (e.g. topographic, climatic, and vegetational considerations)?

A key strategy of modern conservation planning is to represent natural ecosystems across their range of variation in protected areas (or areas managed for biological values); in practice, this often means capturing biological variation along environmental gradients. By using a habitat-based approach to conservation planning, conservation strategies can be derived that are functional across multiple environmental gradients. For the MRC plan and design, the protection of plant communities and their natural variation (due to position in relation to the coast, topographic, climatic, and elevation factors) can be provided by accurately mapping and documenting the distribution and abundance of these communities. Since protection is designed to occur across the MRC landscape, the natural variation of these communities associated with the factors mentioned above will likely be incorporated into the conservation strategy. For the rare plant communities (mentioned in our responses to other questions) that may make up a small proportion of the MRC landscape, accurate mapping of these communities appears to be needed to implement a successful strategy that takes into account these environmental gradients.

19) Does existing information reveal specific geographic locations or landscape positions that are critical for landscape design (e.g. biodiversity "hotspots", crucial linkages, rare microhabitats, refugia, genetically unique population areas)? If not, how can that information be collected? (note: develop a mechanism to inventory and monitor unique areas).

Hotspots and other areas of concentrated biodiversity value can only be identified on the basis of accurate map-based (e.g., GIS) information. The maps we were provided (i.e., on the CD, Appendix A: Watershed Management Areas and the general ownership map) did not contain any biological information; hence, they are inadequate for the identification of hotspots. There were no references to additional maps in the list of figures at the end of the two chapters. Maps are essential for the identification of biodiversity hotspots, crucial linkages, rare microhabitats, refugia, and genetically unique populations.

We recommend that the plant communities on the ownership be mapped and their distribution and amounts described, including those rare plant communities that make up a small proportion of the MRC landscape. Then, a more detailed assessment of potential biodiversity hotspots, rare microhabitats, and refugia could be made. Currently, this information is not available in the detail needed to make this kind of assessment. In addition, more complete surveys need to be conducted for many of the rare plant and animals species mentioned in the plan and for the few additional species not mentioned in the plan but suggested in our response to Question 2. In addition, refer to our response to Question 9, which suggests a mechanism to inventory unique areas along with additional specific surveys conducted on the ground that would help identify and catalogue unique plant communities and associated species. Although incomplete, information from CNPS, CNDDB, CDFG, and RareFind should be used as a start for species occurrence mapping (see our response to Question 11).

From an aquatic perspective, the term "biological hotspots" refers to habitat-forming processes and habitat development that is non-uniformly distributed across the landscape at scales larger than simply pools, riffles, and logjams. Hotspots might include unconstrained valley segments, canyon-floodplain transitions, upstream or downstream of large landslides, and near certain tributary confluences (Everest and Meehan 1981; Sedell and Dahm 1984; Grant and Swanson 1995; McDowell 2001; Baxter 2002). Additionally, watershed disturbances, including heightened sediment supply and floods, can contribute to the formation and maintenance of biological hotspots preferentially at those locations (Benda et al. submitted). As mentioned previously, MRC's NCCP/HCP does not contain this type of perspective, which would require scaling up both in time (i.e., disturbance regimes) and space (landscape scale sources of physical heterogeneity). This is not the fault of MCR, since the most widely available approach to assessing watershed conditions is the one adopted by MRC, namely "watershed analysis" (Washington Forest Practices Board 1997).

20) How can the plan address unique areas that are significant in a broader regional context?

The biological and aquatic-habitat hotspots referred to above (Question 19) qualify as areas significant in a broader regional context. It is important to determine whether the MRC property contains unique areas vs. areas that are common throughout the range of the issues being analyzed. This requires an analysis that considers a geographic area substantially beyond the boundaries of the MRC ownership. The extent of this broad-scale analysis depends upon the issue being evaluated. For example, determining unique areas having a small geographic extent, such as the availability of cold-water sources in a 10,000 ha watershed, would simply require looking at that particular watershed. However, if the issue encompassed a large area, such as coho salmon habitat, then a scoping that encompasses the range of available habitats for that evolutionarily significant unit (ESU) would be needed to identify, first, those watersheds having unique characteristics, and second, those portions of the unique watersheds that make those watersheds unique. Such a scoping for context can result in planning for more or less protection and can assist in a more appropriate allocation of budgets, expertise, scheduling, and accountability that is more closely based on need. Without such information about the broader regional context, funds and constraints may be used in areas where they are not needed, and conversely, areas where additional effort would be most effective may be overlooked.

For some unique areas, such as coastal prairie, coastal scrub, vernal pool, and fen/bog habitats, that are significant and deserving of protection in a broader regional context, MRC biologists must make plans to coordinate with other broad-scale conservation planning efforts by state and federal governments, as well as by NGOs and academic conservation biologists. This will be easier after these unique areas have been better mapped and described, and their flora and fauna more accurately documented. Presentations by MRC biologists of the results of these mapping and survey efforts at professional scientific meetings, such as the coastal forest science symposium and annual state wildlife society meetings would facilitate such regional cooperative interactions.

The concept of regional context should eventually include assessing the demographic contributions of populations of rare or sensitive species on MRC's land to regional populations or metapopulations. Species requiring such regional-scale analysis include the northern spotted owl, marbled murrelet, red-legged frog, foothill yellow-legged frog, Olympic tailed frog, Pacific fisher, and other species covered by the plan or suggested to be covered (see our response to Question 2). Freely contributing demographic data and information to other scientists and agencies who are addressing the needs of species and communities of conservation interest on a regional scale would also help ensure their consideration within a broader regional context. Because such efforts can require time and funds, MRC would have to provide some support for these efforts, which may be crucial to the success of the NCCP/HCP.

21) How can long-term processes or cycles (e.g., population dynamics, disturbance cycles, ecological migration) be effectively addressed?

Long-term processes are difficult to predict and to plan for, yet intelligent consideration of their roles in the ecosystem is probably crucial to the long-term success of a conservation plan. Physical processes that drive riparian structure operate on long time scales. The topic of disturbance cycles represents one of the most difficult ones in the study of watersheds. Large and infrequent events, such as large storms, floods, and landslides, are often the most important factors that shape riparian and aquatic habitats for decades. An effective conservation plan must anticipate and plan for the consequences of such events, while considering the shorter-term consequences of intervening conditions and management actions. For example, the presence of large woody elements in a channel depends both on the delivery of wood by (1) "normal' tree mortality through insects, disease, and windthrow; and (2) "unusual" episodic events of landslides, debris torrents, wind storms, etc. The source of wood and the timing and mechanisms of delivery by the "usual" and "unusual" events may be quite different. A similar discussion applies to the delivery and transport of sediment. A conservation plan that focuses on the "normal" event and inadequately considers the "unusual" event is flawed. Narrow riparian buffers concentrated along perennial streams are often designed to address delivery from the "usual" type of events. The source of wood and sediment delivered during the "unusual" type of events is often far upslope from these narrow buffers. It is important to correctly assess the source of materials that compose the riparian and aquatic ecosystem.

Extreme erosional events linked to fires, large storms, and floods construct many riverine landforms. Hence, erosion disturbance regimes can be defined by event frequency and magnitude (i.e., erosion cycles) (USDA Forest Service 2002). Highly punctuated erosion is common in hilly to mountainous terrain in North America, including the southwestern chaparral of California (Rice 1973) and California Coastal Ranges (Kelsey 1980). Determining variability (cycles) of erosion would require long time-series data (10^2 – 10^3 yrs), which do not exist for any basin in the world, although stratigraphic analysis of sediment layers in depositional basins (i.e., ponds, lakes, estuaries, etc.) could be used to estimate variation in erosion rates (Sommerfield and Nittouer 1999). Another method is the construction of watershed stochastic simulation models of basin erosion regimes leading to estimates of variance since the full probability distribution of erosion is predicted (Benda and Dunne 1997a; Istanbullouglu 2002; Ziemer et al. 1991a,b). However, simulation models are difficult to construct and time consuming, and will always be in limited supply. In some instances information from sediment discharge regimes in rivers could be used as a proxy for estimating erosion regimes.

Despite these problems, it would be useful for the NCCP/HCP to include some perspective on figuring out long-term disturbance cycles and their role in habitat formation (USDA Forest Service 2002). A longer-term perspective, even if mostly qualitative, would aid in placing bounds on landscape and riverscape dynamics that might prove very useful for private companies involved with monitoring conditions on the ownership over multiple decades. Constructing stochastic simulation models is not out of the question for a company seeking to develop a long-term NCCP/HCP and a conservation strategy.

A 40-year record of rainfall, streamflow, and sediment transport is available from Caspar Creek. Companion studies at Caspar Creek have produced a good understanding of the effect of logging on hydrologic processes in second-growth coastal redwood and fir forests (Ziemer 1998). This is fortunate, because these data represent conditions similar to those found in the MRC ownership. Such data are rare, and MRC has recognized this and effectively used the research from Caspar Creek to develop much of the discussion of hydrologic processes presented in the NCCP/HCP. Still, a 40-year climate and hydrologic record represents a short window into variability that can be expected during the life of the NCCP/HCP. There is a high probability that events, both wet and dry, will occur during the NCCP/HCP timeframe that are larger and longer and more significant than those observed since the Caspar Creek study began. Fortunately, research and monitoring is expected to continue at Caspar Creek for the duration of the NCCP/HCP, which will provide a context to responses of the MRC landscape to climatic and hydrologic stresses. There is also a possibility that global climate change will modify the frequency and magnitude of weather events, so the historic record may not be a guide to the future. Nevertheless, the NCCP/HCP should assume that unprecedented events are likely to occur and MRC should plan accordingly by being conservative in designing conservation measures for riparian and aquatic systems.

From the perspective of maintaining terrestrial ecological diversity, perhaps the best strategy for dealing with the long-term processes and cycles is to maintain a diverse landscape in terms of successional stages of each of the natural vegetation types, within an historic or natural range of variability. A landscape composed of replicate examples of successional units provides a diversity that may be able to better absorb the stresses associated with long-term processes and cycles. Fire and flooding, in particular, play a major role in the ecology of the redwood region. Most of the listed plant species in the region (69%; see Tibor 2001) are in the herbaceous understory and many are dependent on disturbance events. For example, the state endangered *Astragalus agnicidus* and CNPS listed *Sidalcea malachroides* depend on natural disturbances to perpetuate their populations. More study is needed to clarify the actual kind, area, intensity, and frequency of disturbances that favor sensitive species. In addition, more study is needed to characterize the specific habitat characteristics that promote the health of these populations. Logging operations do not mimic natural disturbances such as fire precisely (Noss and Cooperrider 1994). Rather, in some cases logging creates habitat for invasive exotics, which outcompete native early-successional species.

Also needed is a robust adaptive management strategy that is flexible and contains strong feedback loops to managers. This adaptive management strategy would need to be based on information collected on a periodic basis so that sound decisions could be made regarding the effects of particular land management actions. If possible, specific a priori management thresholds should be developed for each adaptive management strategy. These thresholds would assist the land manager through a decision-making process when a change or action needs to take place (Noss and Cooperrider 1994).

22) How might climatic variation affect this landscape ecosystem and the target species and how can these effects be effectively addressed (e.g.. plant populations, higher intensity weather events, frequency of events, etc).

See our response to the previous question (21) regarding potential effects of climate change on long-term processes. To make the consideration of the impacts of climate change on resources in the planning area more rigorous, watershed-scale stochastic simulation models could be constructed (Benda and Dunne 1997a,b; Istanbullouglu 2002; Ziemer et al. 1991a,b), and the climate probability distributions could be altered to reflect the predictions coming from global climate models.

Several models developed for the prediction of patterns of climatic change suggest this area of California will most likely experience increased temperature and decreased precipitation (Franco et al., 2003; Woodman and Furiness, 1988). This change could have a major impact on the redwood forest type in the conservation planning area. The future may see a further restriction of the redwood type to areas closer to the coast, as well as a northward shift in the range of coast redwoods. The inability of redwood trees to deal with high levels of evaporative stress will make them very susceptible to the predicted regime of lower precipitation and higher temperature. One strategy to address this issue would be to begin now to identify redwood trees growing on the drier sites on the property and initiate a program of seed orchards or cloning to provide a supply of these more drought-adapted genotypes for replanting in the more eastern stands of the redwood forest. A combination of stump sprouts from existing trees and planted seedlings from drought-adapted genotypes might provide a means of maintaining the redwood habitat in areas further from the coast. One might also re-evaluate the growing space research conducted by Ed Stone and Janet Cavalero on redwoods at Jackson Demonstration State Forest to see if thinning guidelines could be developed to maximize growing space and therefore minimize future competition for soil moisture. At some more eastern sites it might be appropriate to plan for the conversion of marginal redwood stands to Douglas-fir. Very little is known about the biology and ecology of many of the listed plant species, so it is not possible to make suggestion for management of these species in relation to climate change.

The higher intensity of weather events and the frequency of these events has already been incorporated into the redesign of stream crossing and the replacement of culverts. A monitoring of high-intensity weather events could provide a better database for the prediction of future of stream discharge. As a part of the monitoring and adaptive management strategy of the plan, periodic recalculation of stream rating curves could inform the design of culvert and stream crossing to minimize the loss of these structures and the degradation of stream habitats.

Management and Monitoring

23) How should the plan address exotic species?

At a minimum, those exotic species that may affect the viability of the species covered by the plan should be addressed by the NCCP/HCP. As part of the monitoring and adaptive management strategy outlined in the plan, the presence and distribution of these problematic exotic species could be recorded and mapped. Changes in the presence and distribution of these exotic species over time could indicate early problems for the species they may be affecting.

The plan should address the invasion potential of exotic plant species and their potential impacts on natural habitats. Current and potentially invasive exotic plant species should be surveyed for, mapped, and plans developed for the control of these species. Much is currently known about the invasive nature of species like French broom, *Arundo*, and bull thistle. Research at Jackson Demonstration State Forest on the management of French broom could provide some guidelines for its control. The California Exotic Pest Plant Council (CALEPPC) provides lists and management guidelines for this and other species. The *Eucalyptus* stands in the planning area should be evaluated as to their potential for invasion of adjacent native habitats. Over the long term the *Eucalyptus* stands should be phased out along with any stands of Monterey pine, which may have been established in the past. Appropriate silvicultural methods should be employed that minimize the potential for increased exotic species distributions. For instance, instead of placing roads through areas infested with brooms or pampas grass, use helicopter yarding instead, which may save time and money in the long run and will help maintain native sucessional components.

Exotic animal species also pose a threat to native biodiversity. An aggressive program of the control of exotic predators needs to be developed as a part of the plan. The bullfrog is a known voracious predator on a number of native amphibian species (and other animals, such as pond turtles) and has been reported to have contributed to declines in populations of these animals. The northern barred owl is a non-native species that is a major competitor with the northern spotted owl. Although native, populations of some corvids (crows, ravens, Steller's jay) have been shown to have increased substantially over the last few decades due to human urbanization (campground development) and other factors. These increases have likely had a large negative impact on marbled murrelet nesting success in areas such as the Santa Cruz Mountains due to nest predation by these birds. Similar effects could be occurring at the Alder Creek marbled murrelet management area. Other exotics include game animals such as feral hogs (wild boar) and wild turkey, which may play a role in the oak regeneration problem and compete with native animals for acorns. They should be controlled, if not eradicated. The cost to collect information on any problematic exotics should be minimal if the data are collected simultaneously with the monitoring effort for the species covered by the plan.

24) What monitoring actions are necessary and sufficient to evaluate the plan's effectiveness in meeting the conservation objectives?

MRC's monitoring and adaptive management strategy is one of the most comprehensive and detailed we have seen in a NCCP/ HCP. It represents a substantial outlay of funds and personnel resources to implement. Some detail is missing for some of the monitoring tasks; the development of this detail should be accomplished with agency review and input so it is satisfactory to all parties. To make the monitoring program more defensible, the strategy should outline the specific kinds of monitoring that will take place, clearly state what the objectives are for each kind of monitoring, discuss the assumptions of the monitoring plan, define what assumptions will be tested over time using the adaptive management approach, clearly state definitions of terms to avoid confusion, explain how the data will be collected, explain the specific sampling and survey methods used for the monitoring and adaptive feed-back mechanisms, define clearly what thresholds or relative changes in parameters will be used to trigger changes in management direction, and outline the interactions that will take place with the agencies over time.

We recommend periodic (possibly every five years) inventory of known populations of sensitive species and invasive exotic species, supplemented by systematic 10-year inventory of resources that includes forest structural parameters, wildlife, and plants. These 10-year inventories would monitor both the forest management activities and the effects of the conservation plan. Monitoring has been proposed in the plan to follow certain physical parameters (e.g., erosion rates, sedimentation, stream temperature). Climate should be added to the physical parameters that are to be monitored. Additionally, a landscape-level monitoring program should be initiated to observe (using remote sensing and ground truthing) the changing mosaic of habitats.

25) Are the management actions proposed sufficient to meet the plan's conservation objectives?

The proposed management actions are not adequate for the sensitive plants and plant communities. Surveying for sensitive species depending on the percentage of forest cover removed is not defensible. Sensitive plant species occur on a micro-scale within specific habitats. Disturbance of any kind can possibly impact sensitive species. It is important to gather baseline information about the distribution of rare plant habitats.

The management actions indicated in chapter 5 are either logging or no operations. In the MRC oral presentation in Ukiah, a plan for conversion of a portion of the broadleaf upland forest to conifer forest was discussed. This plan should be included in chapter 5, so that it can be critically reviewed. As we recall it would convert about half of the broadleaf upland forest type into the north coast coniferous forest. Some discussion of this management objective needs to be discussed in light of the impact it would have on rare plant species and the habitats of listed animal species within the existing distribution of the broadleaf upland forest. Conversion to conifer forest could endanger some populations of these species. More specific information is needed on the current distribution of the plant species in order to evaluate the proposed management actions. Prescribed fire may be a management action necessary to maintain some of the areas of chaparral, pygmy forest, and bishop pine forest. The plan indicates a prescribed burning program will be developed for the pygmy forest. Prescribed burning plans should also be developed for areas of chaparral and bishop pine. Many of the species in these communities require fire for their regeneration.

One aspect of the proposed management actions that concerns us is the potential impact of group selection as a silvicultural technique on the extent and distribution of "edge” and “interior” habitats in the north coast forest type. If a two-acre “checkerboard” of group selection openings develops over the forest landscape as a result of the application of group selection, forest-interior habitats may be reduced to a non-functional size for some interior species. As Franklin and Forman (1987) suggest in their evaluation of the size and distribution of forest openings, the habitat needs of interior species are better served in the long run by large forest openings that are not re-entered for harvesting purposes until the end of the rotation (assuming that large blocks of forest remain in the landscape as refugia until the logged forest recovers late-seral or interior conditions). Their research also suggested that the negative impacts of forest management on streams and water quality would also be minimized using larger openings that are not disturbed until the end of the rotation. This aspect of the proposed management actions needs to be addressed in the conservation plan.

Regarding aquatic resources, although the AMZ band widths appear sufficient for Class I, Large Class II, and Small Class II watercourses, the AMZ widths proposed for Class III watercourses appear minimal and may not be effective in reaching their objectives. The reason for our concern is not just that the AMZ width is only 50 feet, but also that there is only one band (no inner and middle band), there is no basal area retention requirement, the 50-foot band can be entered and partially harvested, and apparently there is no old-growth tree retention in the band. The reason this is important to note is that the HCP states that the majority of MRC forest is in site Class III with limited areas of the other sites classes found. Therefore, whatever management strategy is proposed for buffering different stream classes, it will likely have a major effect on the landscape, all in-stream processes, and riparian related species. To make clear the magnitude of the AMZ treatments on the landscape, MRC should show in a table the relative proportion of the different stream classes (km of stream) by watershed on their ownership. Obviously, buffer requirements can be very costly to a company, but the relative protection capability of the AMZ requirements in the NCCP/HCP cannot be judged without this information. Typically, AMZ requirements, because they can add up to a substantial acreage, can provide protection over time to a variety of species including the spotted owl, marbled murrelet, amphibians, fish, etc. Regarding amphibians, MRC may want to use minnow traps (set for 24-hour periods) to catch the tadpoles of red-legged frogs as an effective way to monitor and track the reproductive success of this species.

The conservation measures for the marbled murrelet are problematic. This is a state and federal listed species for which extremely few breeding sites (occupied sites) are known between the Santa Cruz Mountain population (south of San Francisco) and the southern end of Humboldt County. In the management prescriptions, MRC states that if surveys are not completed for murrelets, then a forester could assume murrelet presence and apply appropriate conservation measures. Unfortunately the conservation measures may not be appropriate. Murrelets need only one suitable tree to breed. Although we concur with MRC that areas with higher densities of mature and old growth trees are more likely to have breeding birds, the habitat use by birds in this zone is largely unknown.

Experience with other landscapes that have relatively little habitat remaining for murrelets indicates that the birds are often forced to nest in marginal habitat that they would not normally use. Two occupied sites were recently found on Campbell Group managed lands in Mendocino County. These two sites were 8 and 9.5 miles inland, so they would fall into the "lower use zone" (Zone 2) that MRC has proposed. At one of these sites there were only four large trees. The important point is that the habitat use of this seabird in this region is not well understood; therefore, the specific measures proposed to protect and survey suitable habitat may not be meaningful. Evidence of a cooler microclimate (discussed below) would be a better way of zoning the ownership.

For areas with fewer than 4 trees within 50 feet of one another, we suggest that instead of using the number of suitable trees within a certain distance of one another as a measure of the likelihood of murrelets being present, that MRC use the presence of large trees with moss cover on their limbs, suitable potential nest platforms, the presence of mixed coniferous forests (redwood mixed with either Douglas-fir or western hemlock), and cooler microclimate (adjacent to stream courses, lower 1/3 of slope or valley bottom, north slopes). The zone approach MRC has implemented is supposed to take advantage of this microclimatic feature of murrelet breeding sites, but because of microclimate influences of the landscape, it is too crude in resolution to be accurate. Farther inland sites are hotter and drier only in general. Some sites further inland that are on north slopes, adjacent to streams, and on the lower 1/3 of the slope can have microclimates similar to near-coastal sites. Using the measures of habitat suitability suggested above, MRC may have more success in finding additional occupied sites and not inadvertently harvesting un-surveyed breeding habitat. We also suggest removal from the definition of a platform, the requirement that it must be horizontal and with an overhead cover requirement of >50%. We simply do not know enough to use these parameters when assessing platform densities.

In addition, PSG survey protocols were developed for the "average stand on the average landscape," so for those landscapes with few birds, the protocol may have a much higher rate of misclassifying occupied sites (i.e., not detecting them). MRC may want to consider a stricter survey protocol that has lower error rates. The plan states "MRC will determine if murrelets are occupying an area if more than ten detections occur at a survey station during the course of five surveys." The meaning and intent of this statement are not clear.

MRC proposes habitat improvement projects or habitat manipulations for ten-acre "unoccupied" habitat blocks within the LACMA and habitat manipulations in buffer areas around the LACMA. Because this is the only occupied site known on the ownership, one of the few occupied sites known in the County, and because little or no information is available on the effects of these prescriptions on habitat suitability, we recommend that MRC avoid any experimentation on this site. Experimentation would be valid only if a larger number of sites existed on the landscape, so that a few might be sacrificed if the manipulations did not work. Future habitat manipulations (once we know more about the effects of these treatments) should be possible. Recording of all corvids should be a part of the murrelet survey protocol.

The management objectives for protection of northern spotted owl pairs seem awkward from a population demographic perspective. Only a few of the highest reproductive pairs (Level 1) are managed and protected, with larger numbers of Level 2 and Level 3 pairs protected. Instead of having a landscape where most of the spotted owl pairs have low reproductive capacities, why not manage for a smaller number of the low reproductive pairs and a larger number of the highest reproductive pairs? Of course, "floaters" are needed to replace lost members of actively breeding pairs, but these single birds will be present on the landscape anyway with the way it is being managed long-term to provide older forest characteristics. The plan shows that the number of Level 1 owls is not expected to change much in 40 to 80 years. The management approach in the NCCP/HCP does not appear to be the one having the best chance of sustaining the population.

26) Does the plan appropriately provide a framework for adaptive management applicable to the planning area? (chapter 7) What specific management principles or hypotheses are most important to test via the adaptive management program?

A section on plants was not included in the material for review, which is a serious omission. In order to test specific management principles or hypotheses with regard to sensitive plant distributions and the impacts of invasive exotics, baseline data needs to be collected as a basis for comparison with management treatments applied in an adaptive management program. One cannot tell how a plan is affecting a species if one lacks information about the distribution and status of the species in the first place.

Otherwise, as noted above (response to Question 24), we are impressed with the framework built for adaptive management. The timeline and details provided are well thought out. Among the most important hypotheses to test in the adaptive management program are those that relate to changes in the reproductive rate of species and/or population sizes/densities. It is only through directly measuring some of these demographic parameters that one can adequately assess the effects of particular management prescriptions on each species. For example, the marbled murrelet adaptive management plan is based only on habitat parameters measured over time, with no knowledge of how the prescriptions may affect the reproduction of this seabird. Although reproduction data are difficult to collect for this species (until more efficient methods are developed), meaningful adaptive management ultimately depends on demographic data.

A general concern with adaptive management relates to the long-term institutional will to carry it out. Further, as discussed in Question 1, to be effective, the HCP and NCCP should be a covenant to the land and not become void when ownership changes. Adaptive management represents a promise made by one generation of land managers, which the next generation may or may not fulfill. There is no absolute assurance that the federal HCP or state NCCP programs will monitor the implementation of a plan closely enough to guarantee that intelligent, biologically conservative adaptive management is taking place. The current resource management staff of MRC seems to have the best of intentions, but it will be necessary for the California Department of Fish and Game, in particular, to monitor the next generation of managers to see that adaptive management is pursued.

27) Which species, habitat and ecosystem indicators can serve to monitor species viability and other ecological characteristics important to the NCCP? Are the proposed species, habitat and ecosystem indicators adequate to meet this objective? If not, what other species, habitat and ecosystem indicators should be considered?

A greater range of indicators of the structure, function, and composition of the ecosystems on MRC property should be considered. There is nothing written with respect to plants in the monitoring section. The animal species chosen are appropriate and the protocols for monitoring their habitat conditions are well justified (but see our response to Questions 2 and 24 for additional species and indicators to consider). A similar program needs to be developed for the plants and plant communities. It would be useful to monitor climatic condition and the impacts of wild and prescribed fire on the various plant communities and habitats. Landscape-level indicators should also be added, e.g., the proportion of the landscape in various vegetation types and seral stages, road density (in various classes) by watershed and across the ownership, etc. Refer to Noss (1990; Noss et al. 1999) and the "Adaptive Management and Monitoring" section of Thornburgh et al. (2000) for additional indicators to consider. The list of potential indicators can be narrowed down to a cost-effective set using the criteria given in those references.

28) What are the indicators that should trigger a change in management strategy? (chapter 7)

Several indicators (or indications) should be considered:

(1) Collapse of a population of a rare or listed species;
(2) Significant change in the climate that appears to be changing the vegetative mosaic (e.g., the type of change that appears to be currently taking place in the San Bernardino mountains where lower-elevation stands of ponderosa pine and mixed conifer forest are dying and being replaced by chaparral);
(3) Major invasion of an exotic species that threatens individual listed species or their habitats;
(4) Emergence of new plant pathogens and/or insects with the potential to destroy large areas of given habitats;
(5) Extensive stand-replacing wildfire (i.e., the conservation planning area has experienced extensive fires in the past); and
(6) Collapse in the lumber market that could essentially terminate timber harvesting for 10 years or more.

As discussed in our response to Question 26, a change in a particular demographic parameter (e.g., mortality, reproductive success, finite rate of population growth) for a species would be an obvious indicator for triggering a change in a management. If demographic data cannot be collected, then some response variable that is known to be closely tied to a demographic parameter would be most appropriate (i.e., burrow density of Point Arena mountain beavers). For ecological processes, those indicators that are most closely tied to the life history and viability of species covered in the HCP would be the most appropriate to monitor and trigger a change in management strategy (i.e. stream temperatures for salmon).

29) Does the plan have sufficient scientific information to identify biological and physical variability (and/or central tendencies or mean values) for monitoring species or ecosystem processes?

Not entirely. As mentioned numerous times above, the plan has adopted a scientific framework (called watershed analysis, Washington Forest Practices Board 1997) that does not focus on physical or biological variability. One reason for this is that the Washington Forest Practices Board (1997) methodology does not contain a coherent or rigorous ecological framework. If it did, it would address issues such as spatial heterogeneity and temporal variability (disturbance). We do not fault MRC, since they are going with the packaged “state of the art” methodology. However, the limitations of this approach should be recognized. We encourage MRC to pursue questions and answers pertaining to spatial heterogeneity and temporal variability. The latter raises issues of theoretical and empirical certainty in the various disciplines dealing with watershed processes, and hence opens the door nicely to evaluating it within the context of their NCCP/HCP.

The plan has done a reasonably good job of reviewing the known scientific information on the species and communities (with the exceptions regarding plants, as noted). Unfortunately, the scientific basis for monitoring the listed plants and communities of special interest in the area is all but non-existent. We really do not know what the mean values (or central tendencies) of these populations should be in this particular landscape.

Knowledge is also somewhat limited with regard to ecosystem processes, particularly pre-settlement fire and landslide frequency in this area. The way the plan is designed, we believe it has the capacity to collect the necessary information by sampling enough sites for a variety of species and processes to identify biological and physical variability across its landscape. The sampling intensity for most species and processes (number of sites, streams and/or watersheds) is impressive, as is the planned frequency of data collection.

30) Are the proposed monitoring protocols sufficient to detect changes in species populations or processes?

In general, the proposed monitoring protocols are sufficient to detect changes in sensitive animal populations (there are no protocols described for plant inventory work or for monitoring plants). The monitoring protocols are perhaps minimally adequate to detect changes in processes (i.e., some processes are very difficult to monitor). The amount of change detected before a management strategy is modified may need to be re-examined and clarified, as noted above in our discussions of adaptive management. In some cases large changes need to take place (50%) before a management approach is altered, which is arguably not conservative enough.

There are a number of riparian and stream-monitoring procedures described in Section 7.3.4.1 and 2. Although the planned effort is commendable, it is not clear how these measurements will be used and how they are related to changes in species populations or hydrologic processes. Many of the procedures require careful selection of location and timing of observations, adequate training of observers, and skilled interpretation of data. Since most measurements are to be made over several decades, with intervening years having no measurements, consistency of procedure is a serious challenge because a conclusion that a change has occurred will be based on a comparison with previous measurements, probably made by different technicians. For a number of the variables being measured, there is a lengthy lag between cause and effect. For example, by the time a change in stream channel morphology can be observed, the land-use condition that produced that change will likely have occurred several decades earlier. An adaptive management strategy in which the observation of change lags the activity by many years is not very effective. Similarly, if the initial buffers designed for large woody debris (LWD) recruitment turn out to be too small, there is no effective change in strategy that can later make those buffers wider, because the trees will have already been cut. It will then require a century or more to grow replacement trees of sufficient size to provide adequate LWD. The effective adaptive management strategy in this case would be to design buffers conservatively so that initially they are wider than the anticipated final width, and then later reduce the size if data supporting such adjustments become available.

31) Additional Advice

As referred to in the answers to several questions above, the plan needs to focus more attention on plants and communities of special interest. A systematic inventory should be conducted to learn more about the distribution of these species and communities.

Information of this type would better inform management strategies for the conservation of these resources. Also as noted, additional information needs to be developed on the fire history of the area.

Despite our criticisms of portions of the draft NCCP/HCP, the plan has many strengths and good ideas. Given the overarching objectives of limiting human disturbance in the area covered by the plan (in comparison with the previous heavy-handed logging practices) and steadily increasing the amount of old forest over time, there is little doubt that many aspects of terrestrial and riverine ecosystems will be on upward trajectories. Many of the questions we were asked to respond to border on academic musings; none of us really know the answers to some of the questions posed during this exercise.

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