Wetland/Riparian Policy
Deadline: 4/19/07 12 noon

CENTER *for* BIOLOGICAL DIVERSITY

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Song Her, Clerk to the Board
Executive Office
State Water Resources Control Board
P.O. Box 100
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Re: Scoping Comments on Proposed Wetland and Riparian Area Protection Policy

Dear State Water Resources Control Board Members,

Thank you for the opportunity to provide scoping comments on the proposed wetland and riparian areas protection policy circulated by the State Water Resources Control Board (the "Board"). These comments are submitted on behalf of the Center for Biological Diversity, Desert Survivors, San Gorgonio Chapter of the Sierra Club and the California/Nevada Regional Conservation Desert Committee of the Sierra Club, California Wilderness Coalition, Desert Protective Council, Friends of the Inyo, and Friends of the Panamints ("conservation groups"). The conservation groups represent members of the public who care deeply about the management of California's remaining wetlands and riparian areas. The conservation groups strongly support preservation of all remaining native wetlands and riparian areas throughout the State of California to ensure the survival of native plant and animal species and preservation of water quality.

The Center for Biological Diversity ("Center"), a non-profit organization with over 32,000 members, the majority of whom reside in California. The Center is dedicated to protecting imperiled species and their habitats by combining scientific research, public organizing, and administrative and legal advocacy.

Desert Survivors is an affiliation of desert lovers committed to experiencing, sharing and protecting desert wilderness and the rare and fragile riparian resources and wetlands that remain in the California deserts. Desert Survivors recognizes the places we love to explore will not remain wild unless we give others the opportunity to experience them as we do and unless we remain vigilant and active in our efforts to monitor and preserve them.

The Sierra Club is a nationwide non-profit conservation organization with more than 150,000 members in California. The Club's purposes are to explore, enjoy, and protect the wild places of the Earth; to practice and promote the responsible use of the Earth's ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use all lawful means to carry out these objectives. The San Gorgonio

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Chapter and the California/Nevada Regional Conservation Desert Committee of the Sierra Club both focus on protecting the fragile ecosystems of the deserts in this State.

The California Wilderness Coalition ("CWC") is a statewide nonprofit organization founded in 1976. CWC focuses on protecting the ecological, historical, cultural, recreational, spiritual, and other benefits California's public lands provide. CWC works to protect California's federal public lands by participating in public administrative processes, advocating for legislative solutions, and by engaging in public education and outreach.

The Desert Protective Council is a non-profit organization dedicated to the protection, appreciation, and enjoyment of California's natural desert environment.

The Friends of the Inyo was founded in 1986, and is based in Bishop, California. It is a non-profit conservation organization dedicated to preserving the unique qualities of the east side of the Sierra Nevada mountains: its diverse wild lands, scenic beauty, wild rivers, varied flora and fauna, and abundant opportunities for low-impact recreation. Through a combination of wild land defense, outreach and education, and wilderness advocacy, Friends of the Inyo works to ensure that this remarkable place is preserved for future generations of people, plants and animals. Friends of the Inyo has some 700 members, most of whom reside in Inyo County or neighboring Mono County.

The Friends of the Panamints ("FOP") is an association of over 200 individuals, dedicated to the preservation of the environment of California's Panamint Mountains. FOP is particularly focused on preserving rare riparian ecosystems in the Panamints, including Surprise Canyon Creek, and protecting these fragile riparian areas from off-road vehicle impacts and from excessive water extractions.

I. <u>Introduction</u>

The Conservation Groups strongly urge the Board to focus on developing a broad-based policy to regulate all discharges and activities that impact wetlands and riparian areas as described in Alternative 4. As the Board is well aware, the remaining wetlands and riparian habitat in the California is believed to represent far less than 10% of the historic riparian habitat. Riparian areas support a disproportionate share of the State's biodiversity and preservation of these vegetation communities is critical to the survival of rare, sensitive, threatened and endangered plants and wildlife. Atlas of the Biodiversity of California, California Department of Fish and Game, 2003, at 56.

> Over 225 species of birds, mammals, reptiles, and amphibians depend upon California's riparian habitats (Knopf et al. 1988, Saab et al. 1995, Dobkin et al. 1998). In addition, these beautiful examples of California's biodiversity can help reduce flood flows and flood damage, improve groundwater recharge, prevent damaging chemicals and other compounds from reaching open water, and reduce wind and erosion on adjacent lands. . . .
> Unfortunately, human activities have destroyed or fragmented most of this valuable habitat over the past 150 years. No one has documented how much

> riparian habitat existed in California before 1850. However, a 1984 study estimated that riparian vegetation in the Central Valley and desert regions represented from **two to five percent** of the pre-1850 amount. The northern coastal streams still support up to 15 percent of their pre-1850 riparian vegetation (Katibah 1984). Because they are both biologically rich and severely degraded, riparian areas have been identified as the most critical habitat for conserving neotropical migrant birds.

Id. (emphasis added). The well-documented loss of nearly all of the vast native wetlands in the Central Valley is but one part of the story. Wetlands and riparian areas throughout the State have been systematically destroyed and the beneficial uses and ecosystem services they provided including clean water and wildlife habitat have been lost forever.

Wetlands and riparian habitats are truly among the rarest and most sensitive ecosystem types in California. These areas are critical for biodiversity, harboring high concentrations of threatened, endangered, and sensitive species. Krueper (1992) estimates that wetland and riparian habitat occupies less than 1% of the total land area in the western U.S., yet is critical for up to 80% of terrestrial vertebrate species. Riparian habitats are relatively rare in the California deserts, but extensively degraded. As noted above, more than 90% of the State's riparian areas and wetlands have already been lost, but while there are fewer acres of riparian habitat than other plant communities, riparian areas sustain a disproportionately high number of aquatic and terrestrial wildlife species (Faber et al. 1989). Riparian communities in the arid areas of the State are typically surrounded by far drier environments, and the water and riparian vegetation that they provide are vitally important to many species (Krueper 1992).

In light of this history, preservation and restoration of all remaining riparian habitat and wetlands is vital to the survival of California's diverse ecosystems. While local impacts due to loss of wetlands and riparian areas are truly devastating, the importance of preserving these areas is even more important when seen from a regional and statewide perspective than solely on a project by project basis. The cumulative impacts of the loss of any wetlands and riparian areas are magnified many-fold because of the rarity of remaining riparian habitat throughout the State.

The creation of an expansive definition of riparian areas and wetlands is also important because these areas serve as a filter for pollutants that continue to impair of waters throughout the State. On March 8, 2007, EPA partially disapproved California's decisions not to list 36 water quality limited segments and associated pollutants, and additional pollutants for 34 water bodies already listed by the State under the Clean Water Act § 303(d) list. These 36 water bodies are added to the State's recognized 686 impaired water bodies. Improving protections for wetlands, riparian areas, and riparian buffers will ultimately help decrease the amount of impaired water bodies by allowing natural habitats to filter out pollutants.

These comments focus largely on issues related to the arid southern and eastern areas of California but they are applicable to riparian areas and wetlands Statewide. The detrimental impacts of the loss of wetlands and riparian areas are particularly profound in the arid regions of California. Below we have outlined several issues that have not been adequately taken into account past decision-making and should be thoroughly explored in the Board's CEQA analysis including, but not limited to, the following: the cumulative impacts of climate change on wetlands and riparian areas; the impacts of off-road vehicle use in and near wetlands and riparian areas; and the impacts of grazing on wetlands and riparian areas. We are also concerned with the impacts of logging, mining, groundwater extraction, and other extractive industries on wetlands and riparian areas throughout the State as well as impacts from landscape level projects such as utility lines and pipelines and impacts to coastal wetlands. We hope and expect that the Board will thoroughly examine all of these critical issues.

II. Definition of Wetlands and Riparian Areas

A. The Board Should Adopt an Expansive Definition of Wetlands and Riparian Areas.

As the Board noted in the Scoping Document, the California Water Code and other State regulatory provisions are broadly applied to the "waters of the State" and apply to wetlands and riparian areas that may fall outside the increasingly narrow definition of "waters of the United States" that limits federal Clean Water Act jurisdiction. The definition and delineation of wetlands and riparian areas in arid areas of the State is of particular concern to the conservation groups and should include, at minimum, seasonal washes and arroyos, floodplains, sinks, and dry lakes as well as the more easily categorized areas such as streams, springs, and seeps with perennial flow or seasonal or intermittent annual flow. The extent of wetlands and riparian areas should be looked at broadly to include not only areas with flowing or standing water in rivers, creeks, ponds, springs, and seeps, but also riparian and upland ecosystems dependant upon proximity to such waters.

As the Board has itself noted, the federal Clean Water Act definition for a riparian area is wholly inadequate to protect all of the "waters of the State of California." In fact, it could be argued that the federal definition, based on "ordinary high water mark," is actually the definition of a "river" rather than a "riparian area." A review of several other states' definitions of wetlands shows several key components that could be incorporated into a California definition of wetlands, for example, a tiered approach may be appropriate for California. Tiered protections could be based on a variety of factors important to wetlands. Examples include temperature and precipitation of the area, habitat connectivity, stormwater run-off, microclimate factors like wind protection or shading, distance from pollutant sources, and species of special concern.

Some of the components found in other states' definitions include the following: First, standing water need never show on the surface for an area to function as a wetland. If water is sufficiently near the surface with enough frequency or duration to support hydrophytic plants, that area is clearly a wetland. Second, it is important to separate the actual presence of hydrophytic plants from the definition of a wetland; just the possibility of such plant life makes an area a wetland. Other states accomplish this in one of two ways. It is possible to define a wetland as an area that is capable, as a result of soil moisture content, of supporting hydrophytic plants without needing to determine their actual presence. This would be useful in capturing wetlands characterized, for example, by high concentrations of hydrogen sulfide. Additionally, it is possible to employ common-use terms to capture areas that might be otherwise dismissed from inclusion. For example, any area characterized as an arroyo, sink, sandbar, mudflat, or bog, should be included regardless of whether or not it is, at any given time, supporting hydrophytic plant life. Finally, buffer regions must be recognized as an integral part of any wetlands. A lake as an ecosystem clearly does not stop where the water meets the shore. Destroy the shore and its surroundings and you will eventually destroy the lake. The same is true for any wetland. Some states apply a minimum buffer, for example 100 feet. They also include a proviso for additional buffer acreage where special needs mandate it.

For example, the first 100 feet or more from the edge of the delineated wetland could receive similar protections to the wetland itself for a variety of obvious reasons. But further distances might receive tiered protections based on their functional ties to the wetlands area. Preserving habitat connectivity is an example of a functional tie that might require larger buffers. For example, if there are two productive wetland areas separated by a distance of 500 feet. Absolute buffers of 100 feet for each area would leave an unprotected zone of 300 feet separating these two areas. That zone may be critical for species migration, both flora and fauna. Some economic uses of the intervening area may be appropriate, other uses not. For example, some agricultural use may preserve habitat connectivity to a large degree allowing species to migrate across the gap in the buffer zone – one can picture frogs migrating through fields or meadows. A four-lane highway clearly would not allow for such migration. By creating a second-order buffer of a larger size with limited possible uses, wetlands function could be better preserved without the need for a complete set-aside of all relevant areas.

The consistent factor among riparian area definitions from other states and agencies is the need for a definition based on function. Also, other definitions generally note the transitional nature of riparian areas. While the most consistent marker for riparian function is vegetation type, in desert areas annual vegetation must generally be identified during the often short growing seasons and even perennial vegetation can be difficult to identify particularly if it has be impacted by grazing or drought. Also because of past degradation, an absence of riparian vegetation alone should not disqualify an area from a riparian designation. For example, previous logging cottonwoods or bulldozing vegetation along a desert stream does not eliminate the riparian nature of that area and should not be used as an excuse to exclude such riparian areas and wetlands from protection and require restoration.

The Board should adopt a definition of riparian areas that includes the full transitional zone from the banks of a waterway to the point where vegetation has clearly become upland in nature. The precautionary principle of erring on the side of inclusion is necessary due to the degraded nature of many California riparian areas.

Further, the definition must be broad enough to allow for full remediation of degraded riparian areas. For example, although not generally found in the most arid deserts, beavers were once common in the Sierra Nevada mountains and other mountain ranges in California. Beavers play a critical role in many riparian areas and have been eliminated from much of their original range. A riparian area in recovery could undergo a profound change upon the reintroduction of beavers. Once beavers begin damming a channelized stream, there is an opportunity for the riparian area to braid and widen significantly <u>if</u> properly recognized and protected. California's definition of riparian areas must allow for this kind of natural return to full function.

The example above of a buffer zone of "100 feet from the edge" is only one possible way to look at the appropriate distance for a wetlands buffer zone. There is research suggesting buffers widths can be determined in other ways, for example as a factor of nearby tree canopy height. Reid and Hilton in a 1998 Forest Service technical report suggest: "Thus, a total no-cut zone of at least 4 to 5 tree-heights' width would appear to be necessary if woody debris inputs are to be maintained at rates similar to those for undisturbed forested channels." While this recommendation is specific to limiting logging near forested riparian areas, it is suggestive of the notion that a 100 foot buffer may be significantly short of actual needs in other areas as well.

The definition should protect the existing riparian areas and wetlands and also promote the desired condition of the riparian and wetlands areas in the future. That desired condition description should include, but not be limited to, the following:

- Riparian areas have a range of vegetative structural stages that provide a transitional zone between upland terrestrial habitats and aquatic habitats, and have the features necessary to promote healthy stream, floodplain, and diverse riparian and aquatic habitat conditions. Desirable native riparian vegetation occupies the historical floodplain. Native riparian plant species and assemblages such as willow, sycamore, alder, and coast live oak characterize riparian zones, with naturally occurring openings, meanders, and responses to high flow regimes that provide opportunity for early successional plant communities.
- Ecosystem dynamics (such as flood and fire) and processes (such as nutrient cycling and water and sediment regimes) are within the natural range expected for the watershed. Historical aquatic species distribution is maintained or is expanding into previously occupied habitat, with inter-connectivity between local populations. The amount, distribution, and characteristics of habitats are present to maintain viable populations of historically present and currently present native species. A network of intact, or largely intact and recovering riparian areas represents known high biotic integrity waters and provides critical refuges for listed, special-concern, and endemic species.
- An intact and naturally dynamic native plant community—including litter, downed wood, herbaceous understory, and shrub and tree layers—extends continuously the length of all perennial, intermittent, and ephemeral streams. Microhabitats for invertebrate species, intact riparian vegetation, and upland plant communities for wider-ranging species such as frogs, toads, and turtles are well distributed across the landscape. Habitat conditions contribute to the delisting of species under the California Endangered Species Act and the Federal Endangered Species Act, and prevent further listing of species under both laws.

B. Expansive Definitions of Wetlands and Riparian Areas Will Benefit Native Wildlife and Habitat Connectivity

The Board's duty to protect the public trust resources inherent in waters of the State also encompasses the duty to public trust resources of fish, wildlife and the ecosystems they depend on. By adopting expansive definitions of riparian areas and wetlands the Board achieves the dual duties of protecting public trust resources in waters of the state and wildlife. While fish are entirely dependent on riparian and wetland resources, many other species of wildlife depend on riparian habitats for various life-history functions (e.g., breeding, foraging, overwintering). Terrestrial vertebrates in the State rely heavily on riparian habitats for various life stages, as noted above, the California Department of Fish and Game estimates that over 225 species of birds, mammals, reptiles, and amphibians depend upon California's riparian habitats. A recent study found that there are approximately 173 terrestrial vertebrates in the eastern United States alone that require riparian habitats for some lifehistory function (26 mammals, 27 birds, 50 reptiles, and 70 Amphibians) (Crawford 2007).

To combat habitat loss and degradation in riparian ecosystems and wetlands (in addition to providing wildlife corridors and protecting essential habitat required for completing the life cycles of riparian species), riparian buffer strips adjacent to streams have been used in managed forests for more than 2 decades (Vesely & McComb 2002). Nevertheless, riparian buffer strips not only are critical to the protection of aquatic resources, they can play a role in the conservation of biodiversity (Crawford 2007). Numerous studies have shown a sensitivity of stream communities and fish assemblages to riparian deforestation, attesting to the importance of intact riparian borders along streams (Detenbeck et al. 1990; Armour et al.1991; Lowrance et al. 1997; Schlosser 1991; Waters 1995; Burkhead et al. 1997; Angermeire, et al, 2004). A number of studies have documented the importance of terrestrial habitat adjacent to streams and wetlands for semiaquatic species, including amphibians (e.g., deMaynadier & Hunter 1995; Semlitsch 1998; Vesely & McComb 2002). Degraded aquatic systems generally show a reduction in rare and sensitive species and a higher proportion of introduced species (Hughes & Noss 1992; Moyle & Leidy 1992; Weaver & Carman 1994; Moyle & Light 1996).

To protect stream amphibians and other wildlife dependent on riparian areas and wetlands, land managers and policy makers must consider conserving more than aquatic resources alone (Crawford 2007). Developing core terrestrial habitat estimates and buffer zone widths for wildlife populations is a critical first step in the conservation of many semiaquatic organisms and protecting biodiversity (Crawford 2007). Typically when buffer zones are determined to mitigate edge effects, they are based on criteria that protect aquatic resources alone and do not consider impacts to wildlife, semiaquatic species, and other terrestrial resources (Semlitsch & Bodie 1998; Semlitsch & Jensen 2001). For example, in Oregon, the minimum buffer strip required to protect water resources is 6.1 m, although a minimum buffer of 20 m is needed to protect certain salamander species (Vesely & McComb 2002).

We urge the Board to adopt an expansive definition of riparian areas and wetlands that is fully protective of all public trust resources.

C. Expansive Definitions of Wetlands and Riparian Areas Will Benefit Water Quality and Reduce Flooding

Expansive definitions of wetlands and riparian areas will benefit the water quality of waters of the State. Nonpoint source pollution from activities such as urban runoff, agriculture, and habitat modification are considered the primary source of pollutants to waters of the US (USEPA, 2002). Buffer strips protect water quality from activities such as agriculture and silviculture, which cause siltation and increased water temperatures (Lowrance et al. 1984; Jones et al. 1999; Vesely & McComb 2002). The use of Riparian Forest Buffer Systems is relatively well established as a Best Management Practice for water-quality improvement in forestry practices (Comerford et al., 1992). Riparian vegetation has well-known beneficial effects on the bank stability, biological diversity, and water temperatures of streams (Karr and Schlosser, 1978).

Riparian forests have been found to reduce delivery of nonpoint-source pollution to streams and lakes in many types of watersheds (Vellidis et al. 2002, 2003a; Lowrance et al. 1983, 1984a, 1984b, 1985a, 1985b, 1997). Riparian forest ecosystems are excellent nutrient and herbicide sinks that reduce the pollutant discharge from surrounding agroecosystems (Peterjohn and Correll 1984). For example, studies from coastal plain agricultural watersheds reveal that riparian forest ecosystems are excellent nutrient sinks and buffer the discharge from surrounding agroecosystems (Lowrance 1984a). Riparian buffers are especially important on small streams where intense interaction between terrestrial and aquatic ecosystems occurs (Vellidis et al., 2003b), because first- and second-order streams comprise nearly three-quarters of the total stream length in the US (Leopold et al., 1964). Much opportunity remains to implement riparian buffers systems in forests and deserts as well as in agricultural areas or in urban or suburban settings.

While wetlands provide numerous services to human society, perhaps one of the easiest to quantify is flood protection. A Washington State Department of Ecology evaluation of the economic worth of this single function produced values ranging from $8,000 to $51,000 per acre (Leschine 1997). The study points out that "policies which permit wetlands to disappear that are presently contributing little to mainstem flood protection, but which have the potential to do so in the future, could lead to rapidly rising values for the remaining wetlands for flood protection, as increasingly marginal wetlands are called into service. At some point the 'next best' alternatives to enhanced flood protection will not involve wetlands at all, and the purely engineered systems that might have to be built could prove very expensive indeed." Id. Of course any analysis that included economic values of the full range of wetland functions including pollutant removal, flood protection, recreation, species protection, groundwater recharge, and others would obviously derive much higher values.

The conservation groups urge the Board to provide definitions of "riparian areas" and "wetlands" that will maximize the protections afforded to the existing wetlands and riparian areas in California in order to ensure that these resources, which are held in trust for the people of the State of California, will be preserved for future generations.

III. Policy Priorities

A. Prioritize Preservation of Existing Wetlands and Riparian Areas

In order to implement the Wetlands Conservation Policy contained in the Executive Order which requires that all state agencies ensure no net loss of wetlands and that efforts be made to ensure a long-term gain in wetlands and riparian areas, the Board should prioritize the preservation of existing native wetlands and riparian areas. To that end, the policy should emphasize that preserving existing native wetlands and riparian areas is of the highest priority and every effort should be made to avoid impacts to native wetlands and riparian areas in any proposed project and to relocate any non-essential projects or project components out of wetlands and riparian areas. Any unavoidable impacts must be minimized and agencies must not allow any more than the absolute minimum amount of impacts necessary to carry out a project that cannot be relocated outside of the wetlands or riparian areas.

Restoration of degraded native wetlands and riparian areas should also be a high priority and the first choice for mitigation measures where impacts to native wetlands and riparian areas cannot be avoided. The conservation recommendations for riparian areas in the Riparian Bird Conservation Plan, A strategy for Reversing the Decline of Riparian Associated Birds in California, California Partners in Flight (CalPIF) and Riparian Habitat Joint Venture (RHJV), 2004, Version 2.0, although largely focused on conservation and restoration of bird habitat, provides an excellent starting place for the Board's consideration of the Wetlands and Riparian Area Protection Policy. The recommendations include, but are not limited to:

- avoiding impacts on natural hydrology of meadows, streams, and river channels;
- prioritizing restoration of sites in proximity to existing "high-quality" riparian sites;
- protection and restoration of riparian areas with intact adjacent upland habitats;
- prioritization of sites with intact natural hydrology;
- restoration of natural hydrology; and
- design and implementation of restoration projects that mimic the diversity and structure of natural riparian plant communities (CalPIF et al. 2004 at 72-103).

While creation of artificial wetlands and riparian areas may be a useful tool, it cannot substitute on a 1:1 basis for the loss of any native wetlands or riparian areas for several reasons; we suggest that even a 10:1 ratio may be too low for such mitigation. First, the complexity of native wetlands and riparian areas (including, but not limited to, the hydrology, the shape of the stream banks and bottoms, the soil structure, the biotic community, and the vegetation) is impossible to duplicate in constructed wetlands and riparian areas. Second, even where such wetlands and riparian construction projects are successful they generally require at minimum 10-15 years of growth and structural development before they can provide ecosystem services or beneficial uses at or near the level of existing native wetlands and riparian areas. Third, the destruction of riparian habitat itself degrades water quality through increased sediment inputs into streams (e.g., Castelle et al. 1994), and cannot be mitigated. Finally, the complex web of life that is dependent on native wetland and riparian ecosystems cannot easily be "transplanted" to constructed wetlands or riparian areas. Once native wetlands and riparian areas are destroyed the complex web of life that depended on them is irrevocably changed and often completely destroyed.

The conservation groups urge the Board adopt specific policies that prioritize the conservation of all remaining native wetlands and riparian areas and emphasize restoration of natural hydrology, fluvial systems, soils, and riparian vegetation in order to best preserve and restore wetlands and riparian areas and to protect the waters of the State and the ecosystems that they support.

B. Limit Water Extractions and Promote Preservation of In-Stream Flows

As part of the efforts to preserve wetlands and riparian areas, the Board should consider greater emphasis on limiting excessive and wasteful water use and additional appropriations from heavily impacted stream-systems, and supporting programs to promote preservation of in-stream flows. A comprehensive analysis of water resources worldwide (Pimentel 2004) looked at ways that agriculture can save water to protect California's wetlands and riparian areas. While agriculture is one sector where large water savings can be achieved through implementation of cutting edge irrigation techniques or land use practices, significant water savings can also be achieved in urban and suburban area through xeriscaping and water conservation.

A significant reduction in water use by individuals, farmers, and industry, could significantly benefit wetland and riparian recovery in California. Farmers can be given incentives to achieve conservation in the form of credits for implementing water-saving irrigation techniques and other practices. Assistance can also be provided with cover cropping or crop rotation practices that prevent rapid water run-off. Incentives can also be developed in urban, suburban, and rural areas to diversify landscapes to achieve more water catchment. Strips of trees and other native vegetation can play an important role in water infiltration, as can the increased use of mulching, porous surfacing for driveways and other outdoor living spaces, and low-till or no-till techniques in agriculture.

Water conserved through such efficiency measures should be earmarked first to establish and maintain critical in-stream flows that support the ecological health of wetlands and riparian areas. The Board should also limit any new water appropriations from impaired stream-systems in order to preserve the few remaining native wetlands and riparian areas in the State and the ecosystems that depend on them.

C. Develop More Stringent Water Quality Standards Where Needed

To provide additional protections, the Board should consider adopting more stringent water quality standards for toxics and other substances that may adversely affect riparian areas and wetlands. The Board, in concert with the Regional Boards, should first identify toxic substances that are threats to wetlands and riparian areas and that are under-regulated by the federal government and existing State law. For each of these substances the Board should consider working to develop more stringent standards for the protection of wetlands and riparian areas.

D. Provide Specific Guidance on the Application of State Protections on Federal Lands

In adopting a wetlands and riparian areas policy that is fully protective of the waters of the State, wetlands, and riparian areas, the Board should also provide specific guidance to the Regional Boards that will ensure that these resources are adequately protected on the extensive federal lands within the State. Many activities permitted on federal lands may adversely impact the waters of the State and destroy or damage riparian areas and wetlands. For example, off-road vehicle use and grazing (discussed in detail below), are two activities that have often been permitted on federal lands within the State with little or no input or oversight from the Regional Boards regarding the impacts to the waters of the State, wetlands, and riparian areas. By providing specific guidance on the application of the State policy protecting waters of the State, wetlands, and riparian areas to federal lands, the Board policy will greatly assist the Regional Boards in oversight of these fragile resources and the habitats they support on federal lands.

IV. Reduce Impacts of Roads and Off-road Vehicle Use on Wetlands and Riparian Areas

Removal of native wetlands or riparian vegetation for *any* road construction should be limited to the absolute minimum necessary to safely construct or reconstruct necessary transportation corridors. The design of any crossings should be such that the impacts to wetlands and riparian areas are avoided, and where unavoidable, they are minimize and fully mitigated.

Off-road vehicle use in and near wetlands and riparian areas and in streams and other waters of the State should be completely prohibited under the policy. Construction of any new off-road vehicle routes in wetlands or riparian areas should likewise be prohibited. Existing off-road vehicle trails or routes that impact wetlands and riparian areas should be closed and redesigned to avoid these fragile areas.

Off-road vehicle use can directly impact water quality and riparian dependent vegetation and species where they are ridden in or across wetlands and riparian areas. Impacts include modifying or destroying stream channel topology, creating ruts that cause stream capture, and damaging or destroying riparian vegetation. In addition, off-road vehicle use can cause indirect impacts to water quality and other resources by degrading soil structure, causing increased siltation and runoff, and increasing the spread of invasive non-native vegetation into wetlands and riparian areas.

Past damage to wetlands and riparian areas has been inadequately documented as well as the concomitant impacts to wildlife, fish, and plants. As one recent study regarding bird conservation noted:

> Little research has investigated the impacts of California's large-scale alteration of natural hydrologic regimes to bird communities. Artificial flow regulation with local or upstream dams and diversions, as well as channel alteration and containment with levees and channelization, can alter plant communities at watershed scales (Ohmart 1994, Hunter et al. 1999). Transportation departments may channelize or re-direct sheet flow to manage rainfall events, altering hydrologic input to desert wash habitats (The Nature Conservancy 2001). Vegetation, and therefore vegetation-dependent wildlife, can be dramatically affected by distant upstream water management practices (Ohmart 1994), so that restoration efforts at specific sites may depend ultimately on the cooperation of partners managing water in the wider landscape.

(CalPIF, The Draft Desert Bird Conservation Plan, 2006). As detailed below, similar impacts to hydrologic systems can be caused by so-called "casual" ORV use in and near streams, wetlands, and riparian areas.

A. Scope of Impacts: Virtual Footprint of Roads and Off-Road Vehicle Use

Forman et al. (2003) state all roads not only have a physical footprint, but also a "virtual footprint" surrounding their actual location. This virtual footprint includes the "accumulated effect over time and space of all of the activities that roads induce or allow, as well as all of the ecological effects of those activities (Forman et al. 2003)." For example, the United States has 6.4 million km of public roads that are used by over 200 million vehicles (FHWA, 2003). Road corridors cover approximately 1% of the United States; however, the ecological impacts of these roads are not restricted to this area alone. It is estimated that 19% of the land surface in the U.S. is directly affected by roads, while in total, 22% of the U.S may be ecologically altered by the road network (Forman 2000).

This concept extends to dirt roads and off-road vehicle tracks as well, as they have been shown to cause fragmentation, habitat loss, damage to riparian ecosystems and soil degradation well beyond their actual footprint (Gucinski et al., 2001). Because a larger virtual ecological footprint is associated with the physical footprint of roads, "road planners//builders and environmentalists need to be concerned with the broad landscape rather than the one-dimensional road corridor (Forman et al. 2003)." Environmental review often largely focuses on the one-dimensional road corridor, thus does not provide complete and/or accurate evaluation of the actual ecological impacts made by the virtual footprint. Such cursory environmental review artificially diminishes the true impacts of any proposed construction in or near wetlands and riparian areas and undermines the quality and findings of such environmental review thereby, rendering any decision on such projects unsupportable.

B. Indirect and Direct Effects of Roads and Off-Road Vehicle Use

As most relevant to the Board's proposed policy, direct and indirect impacts of off-road vehicles, include destruction of soil stabilizers, soil compaction, reduced water infiltration rates, destruction of vegetation, and increased erosion (Lovich and Bainbridge, 1999). Each of these impacts should be identified and evaluated by the Board in the context of the proposed policy.

The importance of riparian areas for breeding and rearing of species, from fish and amphibians to song birds to large and small mammals are abundant in the scientific literature. Moreover, many scientists suggest that motorized recreation has become the greatest threat to wildlife on our public lands because it can alter habitat, cause disturbance and lead to the direct death of animals (Luckenbach, 1975, 1978; Bury and Luckenbach, 1983, 2002; Sheridan, 1979; Berry, 1980; Brattstrom and Bondello, 1983; Boyle & Samson, 1985; Havlick, 1999; Joslin and Youmans, 1999; Lovich and Bainbridge, 1999; Lawler, 2000; Belnap, 2003). In addition to the impacts leading to direct mortality of species, the more detrimental repercussions of linear recreation corridors include habitat fragmentation, restriction of wildlife movements and gene flow, and other impacts due to increased human access to remote areas.

The impacts of dirt roads and off-road vehicle use on wetlands and riparian areas as well as wildlife may not be as immediately evident as other impacts to the physical environment (i.e. loss of trees, damage to ground surface, etc.) but they have long lasting impacts that are not easily remediated. Impacts to wildlife and water quality can begin when a route is first cut (legally or illegally) and continue to affect these resources even after the route is no longer being used. As ORVs affect soils, air, water and vegetation, they also impact wildlife species because animals depend on all of these other factors for their survival.

Animal mortality, a significant direct effect, can occur when off-road vehicles hit ground-dwelling animals, destroy birds or small mammals by crushing ground nests or vegetation that contains nests, or cause the collapse of needed burrows. Although animal mortality is an obvious and familiar direct effect, displacement, avoidance and disturbance at specific sites, often associated with breeding and raising young, are the most commonly reported direct effects of motorized trails on wildlife (Bury et al. 1977; McReynolds and Radtke, 1978; Bury, 1980; Luckenbach and Bury, 1983; Sachet, 1988; United States General Accounting Office, 1995 Youmans, 1999). Off-road vehicle activity and harassment can stress animals, resulting in a measured physiological stress response or increase in energy use (Schultz and Bailey, 1978; King and Workman, 1986; Canfield et al., 1999). Changes in animal behavior, (i.e., the abandonment of important activities like hunting, foraging and mating), have been attributed to the passage of off-road vehicles. These behavioral and physiological responses to motorized human disturbance may not only impact individuals, but also entire populations. It has been suggested that the impacts associated with disturbance from ORVs can increase the risk of individual mortality and decrease the productivity and viability of an entire population (Knight and Cole, 1991).

While the consequences of direct effects (i.e. a road kill and habitat destruction) may be more evident, indirect effects on wildlife are significant and often impact habitat in areas subject to motorized recreation. For example, ORV activity and associated route construction and maintenance destroys vegetation by crushing it and exposing roots, and also disturbs soil, thereby negatively effecting future plant growth, the potential for healthy habitat for many animals, and increasing erosion, siltation, and runoff. The destruction of habitat can increase fragmentation and decrease connectivity, breaking previously suitable habitat into smaller patches which may make it less usable and can jeopardize the survival of certain species. "Edge effects" increase and are magnified in areas with small, isolated patches of habitat, especially desert riparian. Increased edge effects can impact wildlife that need interior habitat for foraging, hunting or establishing home ranges (i.e., mountain lions, martens, black bears).

Research also shows that fragmentation and increased edge habitat support the invasion of non-native, noxious and weedy species that eventually displace native interior species. The destruction of native vegetation and changes in the density and diversity of plant communities as a consequence of prolonged off-road vehicle use can even further change the composition of desert reptile and small mammal communities (Bury, 1980). As the Board is well aware, many invasive plant species including salt cedar (tamarisk), tree of heaven, and Giant Arundo have had and continue to have devastating impacts on water resources and native riparian vegetation throughout the State, limiting activities that can spread such invasive plants is critical to the preservation of water resources, riparian areas, and wetlands.

Indirect effects often have such broad implications because the "road effect zone," or the outer limit of a significant ecological effect, extends much further than the actual road, route or trail (Forman 2000). Disturbance due to noise, pollution, ground impact, and speed travel well beyond the actual surface of any route. In addition, ecological effects will ripple, expanding well beyond the perimeter of a route and potentially affecting an entire ecosystem. For example, in riparian and wetland areas off-road vehicles and the associated route construction and maintenance increase the amount of silt and turbidity in a stream by increasing erosion (Moyle and Leidy, 1992).

In an evaluation of threats to biodiversity, Wilcove et al. (1998) ranked habitat destruction and the spread of alien species as the two greatest threats; off-road vehicles contribute to both of these. There are a number of causes of habitat destruction, including land conversion, agriculture, development and outdoor recreation. From their study of these causes, they reported that 15% of all endangered species are affected by roads. Twenty seven percent (27%) of all endangered species, including plants and animals, are harmed by outdoor recreation while 13% of endangered species have been specifically, negatively impacted by the use of off-road vehicles (Wilcove et al. 1998). Studies with similar findings regarding the impacts of off-road vehicles on wildlife and their habitat abound. Bury et al. (1977) studied the impacts of ORV use on wildlife in creosote shrub habitat in the California desert. The authors found a negative effect on desert wildlife wherever ORVs were used. In a comparison with control areas, they reported significantly less species diversity, fewer individuals present and lower biomass of mammals and reptiles in areas used by ORVs. Diversity, abundance, and biomass of avian species were also significantly greater in undisturbed areas than in those used by ORVs (Bury et al., 1977). Results also support the idea that a decrease in fauna is correlated with the level of off-road activity.

Luckenbach and Bury (1983) conducted a study to determine the ecological impacts of ORV use on biota by comparing presence and density of vegetation, rodents, arthropods and lizards on plots with and without use by off-road vehicles in sand dunes in southeastern California. They found that ORV activity in the Algodones dunes reduced the biota; in areas of ORV use, there were less herbaceous and perennial plants, arthropods, lizards and rodents. Researchers found almost no native plants or wildlife in areas of heavy ORV use and also cited negative impacts to the biota in areas with low levels of ORV activity. They argue that even low levels of use can cause a reduction in the biota of ecosystems. Similar or even greater impacts occur in riparian areas and wetland ecosystems.

Although we discuss them separately, the actual environmental effects of these factors are not individual. Rather, they are cumulative and synergistic and seemingly may result in large scale changes in the reproductive success and survival of organisms, thereby altering the entire ecology of an area. The combination of these impacts has the potential to cause disturbance at the landscape level (McLellan and Shackleton, 1989; Eaglin and Hubert, 1993). Few species or habitats are completely immune to the effects of off-road vehicle recreation and many are threatened by similar impacts: habitat loss or fragmentation, disturbance, displacement and direct mortality.

C. Indirect and Cumulative Impacts of Roads and Off-Road Vehicle Use

Any comprehensive analysis of road construction, maintenance and/or off-road vehicle activity in delicate riparian ecosystems and wetlands can not be complete if it only quantifies direct effects based on specific acreage of impact; it must also take into account the far reaching indirect effects. This "effects zone" is even greater when one considers impacts of the proposed construction. Following the very nature of fluvial systems, any and all impacts such as headcutting formed by tire tracks or the erosion resulting from the oversteepening of loose soil banks through retaining walls will be transmitted upstream through natural stream channel formation process, as well as downstream by gravity and fluvial action.

In addition, significant impacts are associated with the heavy maintenance that is required to keep roads open through riparian areas and wetlands. These include, but are not limited to, the cutting and removal or upland and riparian vegetation, repeated filling of so-called "low water crossings", the continual sloughing of the streambanks and upland hillsides, replacement and shoring up of the physical structures such as water bars, rolling dips, and retaining walls.

Roads are responsible for a suite of indirect effects that impact species dynamics, soil characteristics, water flow regimes, and vegetation cover (Bashore et al. 1985; Reijnen et al. 1996, Forman et al. 2003). The degree of indirect effect varies in relation to the distance from a road, extending to what is known as the "road effect zone" or the outer limit of significant ecological effect (Forman et al. 1997; Forman and Deblinger 1998, 1999). Forman and Deblinger (2000) found that the effects of all nine ecological factors studied extended more than 100 m from the road, with some extending outwards of 1 km of the road. The road-effect zone was asymmetric, had convoluted boundaries and a few long fingers and averaged approximately 600m in width.

Native wildlife species are less common or absent near roads, suggesting the existence of a road-avoidance zone (Forman and Alexander, 1998). Evidence of a road avoidance zone exists for deer, elk, coyote, small mammals, birds, amphibians, snakes and caribou. Road-avoidance zones, extending outwards tens or hundreds of meters from a road, generally exhibit lower population densities compared with control sites. Forman et al. (2003) conclude that the ecological impact of road avoidance probably exceeds the impact of either road-kills or habitat loss in road corridors.

Clearly, most of the ecological effects of road systems are negative and their cumulative effect covers an extensive area (Forman 2000). Landscape ecologists and scholars of related fields increasingly recognize ecological flows across the landscape as critical for long-term nature protection (Forman 1995, 1999; Harris et al. 1996). Forman suggests that because of this, the road effect zone should be the basis for any transportation planning, implying that a landscape perspective is necessary to maintain spatial and biological diversity. The road effect zone must be taken into account in any policy that will regulate the placement, construction and maintenance of roads of any kind, including off-road vehicle routes, in or near riparian areas and wetlands in California.

V. Reduce Impacts of Grazing on Wetlands and Riparian Areas

The Board should consider strict limitations prohibiting livestock grazing in all wetlands and riparian areas in the State in order to adequately protect the beneficial uses of the waters of the State. Further, the Board should require measures be put in place to exclude livestock from all native riparian areas, wetlands, seeps, and springs.

Livestock grazing is known to have significant effects on soil and watershed conditions, including directly causing increased soil erosion. The phenomenon has three basic components. Grazing reduces plant cover that binds the soil and destroys soil structure (Beymer and Klopatek 1992, Brotherson, et al. 1983, Brotherson and Rushforth 1983). For example, in low desert areas, grazing destroys microbiological soil crusts that stabilize soil surfaces. Vegetation that impedes overland flow of rainfall runoff in intact watersheds is also lost to grazing (Sharp, et al. 1964). Grazing livestock compact the soil, so instead of rainfall soaking down toward the aquifer it flows faster and in greater volume overland (Arnold 1950, Johnson 1956; reviewed by Belsky et al. 1999, Jones 2000).

Eroding soil and manure throughout watersheds end up in streams as increased sediment load, excessive nutrients, and pathogen contamination. Various grazing management strategies have not been found to reduce such watershed degradation (Gifford and Hawkins 1976, Blackburn et al. 1982). Exclusion of livestock from wetlands and riparian areas and adjacent uplands is the only way to assure that such areas are adequately protected and to restore the hydrology, soil structure, and native vegetation.

A number of authors have outlined the model whereby trampling and loss of stabilizing vegetation due to grazing in riparian areas results in higher peak water flows, channel scouring, and erosion and down-cutting, which in turn lowers water tables, ends permanent stream flows, and dries out watersheds (Kovalchik and Elmore 1992, USBLM 1994, Trimble and Mendel 1995, Belsky et al. 1999). Furthermore, grazing has been shown numerous times to reduce or eliminate cryptobiotic soil crusts. These crusts are important for infiltration and stabilization, especially in the arid southwest where many xeric species rely on stored soil water (Brotherson and Rushforth 1983).

Livestock harm the integrity of riparian areas and wetlands by:

- Reducing herbaceous cover, biomass, productivity and native species diversity;
- Reducing diversity and abundance of native reptiles and amphibians;
- Widening stream channels, destabilizing stream banks, and increasing peak water flows;
- Reducing soil fertility, water infiltration and resistance to erosion;
- Raising water temperature and lowering dissolved oxygen levels;
- Reducing tree and shrub cover and biomass;
- Shifting from cold-water fish and aquatic invertebrates to warm-water species;
- Raising sediment loads, nutrients and pathogens;
- Lowering water tables; and
- Shifting from riparian bird species to upland-generalist species. (Belsky and et al. 1999).

Livestock grazing is also known to be one of the primary causes of the spread of invasive non-native plant species or "weeds." Livestock promote the spread and colonization of alien plants (Billings 1990, Billings 1994, Rosentreter 1994, Belsky and Gelbard 2000). Livestock grazing harms native plant species and promotes exotic plant growth (Kimball and Schiffman 2003, Seabloom et al. 2003). Over-utilization of native vegetation can prevent regeneration of native species and the reestablishment of native vegetation in areas now dominated by non-native grasses (Bartolome et al 1980, Bartolome 1987, Stubbendieck et al. 1991). Because many invasive plant species including salt cedar (tamarisk), tree of heaven, and Giant Arundo have had and continue to have devastating impacts on water resources and native riparian vegetation throughout the State, the Board should adopt a policy that limits activities in wetlands and riparian areas that are known to increase the spread of such invasive species including grazing.

The conservation groups urge the Board to consider strict limitations prohibiting livestock grazing in all wetlands and riparian areas and requiring livestock be physically excluded from these areas in order to adequately protect the beneficial uses of the waters of the State.

VI. <u>Consider Impacts of Global Warming and Climate Change on Wetlands and Riparian Areas</u>

The impacts of global warming on water resources has yet to be thoroughly researched but it is nonetheless clear that the impacts already appear to be quite severe and as those impacts increase they will profoundly affect the future of all water resources in California. Both the legislature and the Governor have recognized the importance of taking these issues into account in planning and adopted AB 32 in 2006, to reduce California's emissions and in turn, combat global warming. This bill requires the California Air Resources Board (CARB) to adopt procedures and protocols by 2008 to reduce greenhouse gas emission to 2000 levels by 2010, and to 1990 levels by 2020. The bill requires the CARB to provide an annual report to the Governor and the Legislature on the progress of greenhouse gas emissions, develop compliance and enforcement procedures, and coordinate with State agencies to implement greenhouse gas reduction standards.

The Board can contribute to these efforts by ensuring that the impacts of global warming on wetlands and riparian areas are fully identified and analyzed in adopting the proposed policy and by providing other agencies with guidance on reducing such impacts in order to preserve the water quality, water resources, and the beneficial uses of the waters of the State for future generations. We urge the Board to take the impacts of global warming and climate change into account in formulating the Wetland and Riparian Area Protection Policy.

A. Global Warming is one of the Greatest Problems Facing California and the World

Concentrations of greenhouse gases are increasing in the earth's atmosphere, primarily from society's burning of fossil fuels for energy and destruction of forests for other human activities. These gases cloak the earth like a blanket, absorbing solar radiation that would otherwise be radiated back into space, causing the earth's climate to warm much like the interior of a greenhouse. This phenomenon is called global warming and is leading to profound changes in the earth's climate. The world's leading scientists agree that society's production of greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), is responsible for the unprecedented rate of warming observed over the past century. (ACIA 2004; IPCC 2001).

Carbon dioxide accounts for approximately 85% of total emissions, and methane and nitrous oxide together account for almost an additional 14%. Because of the persistence and mixing of these gases in the atmosphere, emissions anywhere in the world impact the climate everywhere equally. Therefore, the impact of greenhouse gas emissions produced in California (the 12th largest emitter in the world) will impact not only California, but the rest of the world as well. In the absence of substantial reductions in greenhouse gas emissions, global warming and its impacts on human health, the environment, and the economy will rapidly worsen in this century.

1. Rising Global Average Temperatures

The Intergovernmental Panel on Climate Change ("IPCC") has concluded that the global average temperature has risen by approximately 0.6° C ± 0.2 C during the 20th Century (IPCC 2001). There is an international scientific consensus that most of the warming observed has been caused by human activities (ACIA 2004; IPCC 2001). Carbon dioxide emissions, carbon dioxide concentrations, and temperature over the last 1,000 years are all correlated (ACIA 2004). Mean temperatures during the 20th century were the highest in 1,000 years (Albritton et al. 2001). Global climate has changed in other ways as well. For example, precipitation has increased by 0.5 to 1% per decade in the 20th century over most mid- and high latitudes of the Northern Hemisphere continents, and to a lesser degree over the tropical land areas in the Northern Hemisphere (IPCC 2001).

Global average temperature increases mask significant regional variation. Due to a number of positive feedback mechanisms, warming in the Arctic has been and will be greater and more rapid than in the rest of the world (ACIA 2004). Warming in the Arctic is in many ways a harbinger of what is to come in other areas. Changes already observed in some areas of the Arctic dwarf global averages. In extensive areas of the Arctic, air temperature over land has increased by as much as 5° C (9° F) over the 20th century (Anisimov et al. 2001).

All climate models predict significant warming in this century, with variation only as to the rate and magnitude of the projected warming (ACIA 2004). Determining the degree of future climate change requires consideration of two major factors: (1) the level of future global emissions of greenhouse gases, and (2) the response of the climate system to these emissions ("climate sensitivity") (ACIA 2004a). Global warming will continue and accelerate if greenhouse gas emissions are not reduced.

As hard data are not available for events that have not yet occurred, the future level of society's greenhouse gas emissions must be projected. The IPCC has produced a Special Report on Emissions Scenarios ("SRES") (Nakićenović et al. 2000) that describes a range of possible emissions scenarios based on how societies, economies, and energy technologies may evolve, in order to study a range of possible scenarios (ACIA 2004a; Albritton et al. 2001).

Climate models make different assumptions regarding how various aspects of the climate system will respond to increased greenhouse gas concentrations and warming temperatures. These differing assumptions are expressed as "climate sensitivity," defined as the equilibrium response of global mean temperature to doubling levels of atmospheric carbon dioxide (Stainforth et al. 2005). The IPCC (2001) used climate sensitivities of 1.3-5.8K for projections of warming from 1990-2100 (Stainforth et al. 2005).

Using the SRES emissions scenarios and the world's leading climate models, the IPCC predicts that the global average temperature will warm between 1.4 and 5.8°C by the end of this century. Warming will be greater in the Arctic, where the annual average temperatures will rise across the entire Arctic, with increases of approximately 3-5° C over the land areas and up to 7° C over the oceans. Winter temperatures are projected to rise even more significantly, with increases of approximately 4-7° C over land areas and approximately 7-10° C over oceans (ACIA 2004a). Year-to-year variability is also projected to be greater in the Arctic than in other regions (ACIA 2004a).

For a number of reasons, IPCC (2001) and ACIA (2004) projections may be significant underestimates of the amount and rate of warming. First, the planet is already committed to an additional 1° F warming from the excess solar energy already in our climate system, due to lag time in the climate response (Hansen 2005). Second, actual worldwide greenhouse gas emissions may be on the high end or above the range of the IPCC scenarios. All scenarios utilized by the IPCC assume that energy use will shift away from fossil fuels to a greater percentage of sustainable energy sources and that worldwide greenhouse gas emissions will begin to decline during this century (IPCC 2001). Yet the most recent energy projections show that if current policies continue, worldwide greenhouse gas emissions will be 52% higher in 2030 than they are today (IEA 2005).

Third, climate sensitivity may be substantially greater than the levels used by IPCC (2001). Results from the *climateprediction.net* experiment indicate that much larger climate sensitivities of up to 11.5K are possible (Stainforth et al. 2005). Chapin et al. (2005) studied the warming amplification caused by the expansion of shrub and tree cover in the Arctic and resulting increase in solar absorption. This amplification could be as much as two to seven times (Chapin et al. 2005), and is not accounted for in the climate models used in IPCC (2001) (Foley 2005).

Recent data on the unexpectedly fast rate of warming in the Arctic also reinforces the likelihood that the IPCC (2001) projections will need to be revised upwards. (Overpeck et al. 2005) concluded that the Arctic is on a trajectory towards an ice-free summer state within this century, a state not witnessed in at least the last million years (Overpeck et al. 2005). These scientists conclude that there are few, if any processes or feedbacks within the arctic system that are capable of altering the trajectory toward this ice-free summer state. In September, 2005, scientists reported a new record Arctic sea-ice minimum for the month of September (NSIDC 2005). These scientists called the sea ice reduction "stunning" and concluded that Arctic sea ice is likely on an accelerating, long-term decline (NSIDC 2005).

2. The Impacts of Global Warming Generally

Global warming consists of more than just increases in global average temperature. In 2001 the IPCC predicted a 90-99% chance of the following weather changes:

- Higher maximum temperature and more hot days over nearly all land areas;
- Higher minimum temperatures, fewer cold days and frost days over nearly all land areas;
- Reduced diurnal temperature range over most land areas;
- Increase of heat index over land areas;
- More intense precipitation events.

Albritton et al. 2001.

The IPCC also predicted a 66-90% chance of the following:

- Increased summer continental drying and associated risk of drought;
- Increased in tropical cyclone (hurricane) peak wind intensities;
- Increase in tropical cyclone mean and peak precipitation intensities.

Albritton et al. 2001.

Greenland ice cores indicate that the climate can change very abruptly. Scientists caution that thresholds may be reached that trigger rapid and extreme climatic changes that are difficult to predict but could be devastating. Examples include the shut down of the North Atlantic thermohaline circulation, which transfers heat from the equatorial regions to the Arctic, which could plunge northern Europe into a new ice age. The more rapid melting of the Greenlandic ice sheet, once thought to be several centuries away, could trigger this impact and also result in global sea level rise of up to six meters, completely eliminating many coastal areas. As in the case of the shift to an ice-free Arctic summer, scientists warn that we may be very close to crossing thresholds of rapid climate change from which there is no return.

Increased intensity of precipitation events due to global warming has long been predicted by climate models and remains a consistent result of the most advanced modeling efforts (Cubasch and Meehl 2001). In global simulations for future climate, extreme precipitation events over North America are predicted to occur twice as often (Cubasch and Meehl 2001).The impacts of global warming, once envisioned to be experienced by future generations, are already upon us, bringing profound climactic and ecological changes, great loss of human life, and likely extinction for many of the planet's non-human species. As written recently in the New England Journal of Medicine,

> Since [the release of the *Third Assessment Report* in] 2001, we've learned substantially more. The pace of atmospheric warming and the accumulation of carbon dioxide are quickening; polar and alpine ice is melting at rates not thought possible several years ago; the deep ocean is heating up, and circumpolar winds are accelerating; and warming in the lower atmosphere is retarding the repair of the protective "ozone shield" in the stratosphere….Given the current rate of

> carbon dioxide build-up and the projected degree of global warming, we are entering uncharted seas.
>
> As we survey these seas, we can see some of the health effects that may like ahead if the increase in very extreme weather events continues. Heat waves like the one that hit Chicago in 1995, killing some 750 people and hospitalizing thousands, have become more common. Hot, humid nights, which have become more frequent with global warming, magnify the effects.

Epstein 2005.

In 2002, more than 1,000 people died in a spring heat wave in India (Gelbspan 2004). In the spring of 2003, 1,400 people died in another heat wave in India and Pakistan. Also in 2003, a summer heat wave in Europe killed between 21,000-35,000 people (Epstein 2005).

In 1998, Hurricane Mitch dropped six feet of rain on Central America in three days, and was followed by soaring incidences of malaria, dengue fever, cholera, and leptospirosis (Epstein 2005). In 2000, after rain and three cyclones hit Mozambique over a six week time period, the incidence of malaria rose by five times (Epstein 2005). In June, 2001, Houston suffered the single most expensive storm in modern history when tropical storm Allison dropped thirty-five inches of rain in one week, resulting in $6 billion in damages (Gelbspan 2004). In November, 2001, record flooding killed more than 1,000 people in Algeria (Gelbspan 2004). Also in 2002, more than 12 million people were displaced by severe flooding in South Asia (Gelbspan 2004).

In the Eastern United States, the effect of sea level rise over the last century (primarily from thermal expansion as the oceans warm) has also exacerbated the beach erosion and flooding from modern storms that would have been less damaging in the past (Folland and Karl 2001). In August, 2005, Hurricane Katrina killed hundreds and destroyed the city of New Orleans (Epstein 2005). Katrina was quickly followed by Rita, and then Wilma, putting 2005 on track to setting a new record for hurricane season destruction.

While it may not be possible to link individual episodes to global warming, this overall pattern of increasingly violent weather is very likely linked to human-caused warming. But even more subtle, gradual changes can profoundly damage public health (Epstein 2005). During the past two decades, the prevalence of asthma in the United States has quadrupled, at least in part because of climate-related factors (Epstein 2005). Increased levels of plant pollen and soil fungi may also be involved, as experiments have shown that ragweed grown in twice the ambient levels of carbon dioxide produces 60% more pollen (Epstein 2005). High carbon dioxide levels also promote the growth and spore production of some soil fungi, and diesel particles then help to deliver these aeroallergens deep into human lungs (Epstein 2005).

Widening social inequities and changes in biodiversity caused by global warming have also contributed to the resurgence of many infectious diseases (Epstein 2005). Global warming is credited with the current spread of Lyme disease, as well as malaria, hantavirus, and West Nile virus (Epstein 2005). Floods are also frequently followed by disease clusters, as downpours can drive rodents from burrows, deposit mosquito-breeding sites, foster fungus growth in houses, and flush pathogens, nutrients, and chemicals into waterways (Epstein 2005). Droughts also weaken trees' defenses against infestations and promote wildfires, which can cause injuries, burns, respiratory illness, and deaths (Epstein 2005).

Shifting weather patterns are jeopardizing water quality and quantity in many countries, where groundwater systems are overdrawn (Epstein 2005). Most montane ice fields are predicted to disappear during this century, further exacerbating water shortages in many areas of the world (Epstein 2005).

An even greater threat to human health comes from illnesses affecting wildlife, livestock, crops, forests, and marine organisms (Epstein 2005). One recent report found that 60% of resources examined, from fisheries to fresh water, are already in decline or being used in unsustainable ways (Epstein 2005). This is a grim prognosis indeed as global population continues to rise even as global warming accelerates.

As discussed further below, global warming will also have profound impacts on the earth's biological diversity and threatens many thousands of species. The primary prevention and mitigation of all of these climate impacts is to reduce the nation's energy use and halt the extraction, mining, transport, refining and combustion of fossil fuels (Epstein 2005). Experts believe that a substantial reduction in energy use would have innumerable health and environmental benefits along with stabilizing the climate (Epstein 2005).

3. The Impacts of Global Warming on Water Resources, Wetlands, and Riparian Areas

Only a few weeks before these comments were due, the Intergovernmental Panel on Climate Change Working Group II released a Summary for Policy Makers of its "Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability" report (IPCC 2007). Many of the relevant conclusions that can be drawn from the new report are indicated elsewhere in this letter. Nonetheless, due to the timeliness and broad international consensus-nature of this report, it is worth looking at recommendations that flow directly from it.

For land managers concerned about ecosystem services and ecological health, the mandate is clear. Mitigation of and adaptation to anthropogenic global climate change are the overriding issues to be addressed for the next several decades. Most dramatically: "Approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperatures exceed 1.5-2.5°C." IPCC 2007. And specifically in North America: "Warming in western mountains is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources." IPCC 2007.

If the question is "how can California most effectively protect the ecological integrity of and ecosystem services provided by its valuable riparian areas and wetlands," the one part of that answer must be "mitigate global climate change." Such an answer might at first appear disheartening or even of questionable relevance to the task at hand. A second look suggests otherwise.

It is important that the multiple threats presented by the issue of climate change are matched by multiple calls for mitigation from each and every sector or interest affected or likely to be affected. The policies the Board is developing should make clear to other policy-makers the critical role that climate change mitigation will play in protection of wetland and riparian areas in the State.

Further, all assessments of riparian area or wetland health must account for the unique combination of threats. "The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, over-exploitation of resources)." IPCC 2007. Decision-makers faced with a wetlands issue might err in assuming a single stressor is less than critical if they are not presented with the simultaneous amplifying role climate change will play.

In addition to these general warnings and the specific snow-melt issue, riparian areas face an additional threat. "By mid-century, annual average river runoff and water availability are projected to . . . decrease by 10-30% over some dry regions at mid-latitudes. . . Drought-affected areas will likely increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk." IPCC 2007.

Due to the degraded nature of the State's wetland and riparian resources at this time, it is important for the Board to fully protect the remaining riparian and wetland legacy resources from growing threats. Again the expanding role of climate change must be accounted for. "Over the course of this century net carbon uptake by terrestrial ecosystems is likely to peak before mid-century and then weaken or even reverse, thus amplifying climate change. . . For increases in global average temperature exceeding 1.5-2.5°C and in concomitant atmospheric carbon dioxide concentrations, there are projected to be major changes in ecosystem structure and function, species' ecological interactions, and species' geographic ranges, with predominantly negative consequences for biodiversity, and ecosystem goods and services e.g., water and food supply." IPCC 2007. Worst-case scenarios must be honestly assessed and accounted for in decision-making. Clearly, greatly increased levels of wetlands and riparian protections will be necessary.

The unique nature of coastal wetlands is under the further threat of sea level rise. "Coastal wetlands including salt marshes and mangroves are projected to be negatively affected by sea-level rise especially where they are constrained on their landward side, or starved of sediment." IPCC 2007. This is, if anything, a conservative statement as the following footnote in the report alludes to: "The effect of changes in regional weather systems on sea level extremes has not been assessed." Id. Therefore impacts could be worse. And: "There is medium confidence that at least partial deglaciation of the Greenland ice sheet, and possibly the West Antarctic ice sheet, would occur over a period of time ranging from centuries to millennia for a global average temperature increase of 1- 4°C (relative to 1990-2000), causing a contribution to sea level rise of 4-6 m or more." Id. Granted, this is a longer planning timeframe than is common. Other the other hand, implementation of broadly sweeping changes to coastal policy are likely to take many decades to implement.

Further, the most frequently discussed adaptation to sea level rise is a threat still greater than the rise itself. Coastal wetlands have a chance to survive rising seas, but they are guaranteed to be destroyed by the construction of sea walls. The envisioned policy changes need to anticipate climate change adaptations likely to be proposed by other sectors and interests in California and evaluate wetlands and riparian areas in light of these coming proposals. Another example of an additional threat might result from the altered geographical ranges of disease vectors. There could be increased calls in the future for the chemical treatment of wetlands perceived as sources of disease-bearing mosquitos or other insects. Wetlands must be protected in a manner that anticipates these additional threats.

In one very important sense, global climate is already affecting California's wetlands and riparian areas. "There is very high confidence, based on more evidence from a wider range of species, that recent warming is strongly affecting terrestrial biological systems, including such changes as . . . poleward and upward shifts in ranges in plant and animal species." IPCC 2007.

Many species integral to California wetland and riparian areas are no doubt migrating northward and upslope. Or at least they are trying to. The policies being developed need to consider this broad ecological trend. Barriers to species migration need to be lowered or removed. Development of new barriers to migration need to be anticipated and avoided. A Statewide system of protected migration corridors should be proposed to facilitate the flow of species to new refugia in the face of climate change.

Several recent studies focusing on California water resources reinforce and expand on the recent IPCC conclusions. Many of California's most important rivers are dominated by snowmelt. More than half of their total annual flow comes from this source. Rising temperatures in the last half century have already led to detectable shifts in the timing of snowmelt, and therefore, the timing of river flow rates. Projected increases in future temperatures due to climate change will shift to significantly earlier the flow rate timing of many Sierra Nevada rivers and others.

The pulse of snowmelt water could shift as much as a month or more earlier than past averages (Stewart 2004). "A one-month advance in the timing of snowmelt runoff could threaten storage efficiencies for many reservoirs in the study area. Besides providing water supply, these reservoirs are operated for flood-protection purposes, and consequently may release large amounts of otherwise useful water during the winter and early spring. In such facilities, earlier flows would place more of the year's runoff into the category of hazard rather than resource. A one-month advance would also increase the length of the summer drought that characterizes much of western North America, with important consequences for water supply, ecosystem, and wildfire management." (Stewart 2004). This could leave an extra month of hot temperatures between the historical run-off dates and winter rains. The resultant rise in stream temperature and drop in stream flow for these extended periods will place significant abnormal stress on riparian and wetland ecosystems.

This conclusion by the authors also suggests that California flood protection from dams may be diminished when the dual functions of flood control and water storage compete more intensely. Less flood protection from dams raises the importance of wetland and riparian areas for their natural function in the control of floods. The increased importance of this role in the future should be taken into account when evaluating wetland and riparian systems' values and functions and again argues for stronger protections.

Finally, as climate change may seriously threaten California's future water supply, evaluations of the role of wetlands and riparian areas in regard to their water storage capabilities need to account for a climate-altered future. The ability of California's wetlands and riparian areas to store water today is critically important. In a future of significantly altered climate and significantly diminished water supplies that ability may prove even more important to the population and economy of the State. This increased importance is not far into the future. Therefore any threats to wetlands or riparian areas or any plans to replace or remediate those systems should be evaluated in this future light. All of these future cumulative stresses should be accounted for in all future analyses of wetland and riparian health.

4. The Impacts of Global Warming on Threatened, Endangered, Rare, and Special Species

Climate change is a leading threat to California and the world's biological diversity. Species have already been profoundly impacted by the worldwide average temperature increase of 1° Fahrenheit (.6° Centigrade) since the start of the Industrial Revolution (IPCC 2001). Yet the warming experienced to date is small compared with the 2.5- 10.4° F (1.4-5.8° C) or greater warming projected for this century. The ways in which climate change threatens species are varied and sometimes complex. Below we present an overview of impacts observed to date and projections for the future.

Scientists have predicted three categories of impacts from global warming: (1) earlier timing of spring events, (2) extension of species' range poleward or upward in elevation, and (3) a decline in species adapted to cold temperatures and an increase in species adapted to warm temperatures (Parmesan and Galbraith 2004). A recent survey of more than 30 studies covering about 1600 hundred species summarized empirical observations in each of these three categories and found that approximately one half of the species were already showing significant impacts, and 85-90% of observed changes were in the direction predicted (Parmesan and Galbraith 2004). The statistical probability of this pattern occurring by chance, as opposed to being caused by climate change, is less than one in a billion (Parmesan and Galbraith 2004).

Changes in the life cycles and behaviors of organisms such as plants blooming and birds laying their chicks earlier in the spring were some of the first phenomena to be observed. These changes may not be detrimental to all species, but depending on the timing and interactions between species, may be very harmful.

Global warming's impacts on United States species already listed as threatened and endangered have been well documented. For example, Epps documented the expected impact of continuing climate change on desert dwelling bighorn sheep in California and found a significant extinction risk even assuming only precipitation decreased and natural water sources remained available (Epps et al. 2004).

The Edith's checkerspot butterfly, which occurs along the west coast of north America, has been severely impacted by such changes in the lifecycles of organisms. The Edith's checkerspot's host plant, *Plantago erecta*, now develops earlier in the spring while the timing of caterpillar hatching has not changed. Caterpillars now hatch on plants that have completed their lifecycle and dried up, instead of on young healthy plants (Parmesan and Galbraith 2004). The tiny caterpillars are unable to move far enough to find other food and therefore starve to death (Parmesan and Galbraith 2004). Because of this, many Edith's checkerspot butterfly populations have become extinct. Many more populations have been lost in the southern portion of the species' range than in the northern portion, resulting in a net shift of the range of the species northward and upwards in elevation. All these changes have occurred in response to "only" 1.3° Fahrenheit regional warming (Parmesan and Galbraith 2004).

The southernmost subspecies, the Quino checkerspot butterfly, already listed as endangered under the Endangered Species Act due to habitat destruction from urban development and other impacts, has disappeared from nearly 80% of otherwise suitable habitat areas due to global warming (Parmesan and Galbraith 2004). The Bay checkerspot and Taylor's checkerspot butterflies, also listed under the Endangered Species Act, have been similarly impacted (Parmesan and Galbraith 2004). Butterfly species are impacted in other ways as well. The northward expansion of the treeline into alpine meadow butterfly habitat can impede dispersal, fragment habitat, and increase mortality via bitterly collisions with the trees (Krajick 2004; Ross et al. 2005).

While theoretically some species can adapt by shifting their ranges in response to climate change, species in many areas today, in contrast to migration patterns in response to paleoclimatic warming, must move through a landscape that human activity has rendered increasingly fragmented and inhospitable (Walther 2002). When species cannot shift their ranges northward or to increased elevations in response to climate warming, they will become extinct (Parmesan and Galbraith 2004). Therefore, the least mobile species will be the first to disappear.

The pika is a small, vegetarian relative of the rabbit, which is adapted to life on high, treeless mountain peaks. Because pikas need cold, bare habitat, it is not surprising that their numbers are plummeting all over the globe (Krajick 2004). Fossil evidence shows that pikas once ranged widely over North America but their range has contracted to a dwindling number of high peaks during the warm periods of the last 12,000 years (Krajick 2004). Alpine species like the pika are unable to shift their ranges as warming temperatures and advancing treelines, competitors, and predators impact their mountain habitat (Krajick 2004). Pikas are further limited by their metabolic adaptation to their cold habitat niche, which allows them to survive harsh winters but also causes them to die from heat exhaustion at temperatures as low as 77.9° F (25.5° C) (Krajick 2004).

American pika populations at seven of twenty-five previously recorded localities in the Great Basin of the western United States have disappeared in recent years (Beever 2003). Based on work conducted in the late 1990s, researchers documented that the average elevation of surviving pika populations was 8,310 feet, up from a pre-historic average of about 5,700 feet between 7,500 and 40,000 years ago (Beever 2003; Grayson 2005). Most recently, researchers announced in December, 2005, that at least 2 additional populations have become extinct, and the average elevation of surviving populations has increased by another 433 feet.

In the Yukon, collared pikas declined 90% between 1999 and 2000, when unprecedented midwinter snowmelts, rain, and refreezing eliminated the insulating snow and then iced over the pika's forage plants (Krajick 2004). A pika species endemic to the mountains of northwest China, discovered only in 1986, was not located in extensive surveys in 2002 and 2003 and may be extinct.

Alpine dwelling marmots which rely upon the treeless tundra to visually spot and avoid predators, are also at risk as treelines advance, providing cover for predators like wolves and cougars.

Alpine plants, which have little or no capability to shift their range to higher elevations as the climate warms, may be most at risk. One study predicts that a 3° Centigrade temperature rise over the next century will eliminate eighty percent of alpine island habitat and cause the extinction of between a third and a half of 613 known alpine plants in New Zealand (Krajick 2004).

A study of 15,148 North American vascular plants found that 7%-11% of all species (1,060 to 1,670 plants) could be entirely out of their climate envelopes with just a 5.4° F (3° C) warming, the lower limit of climate change predicted for this century by the IPCC (Morse et al. 1995). At the upper boundary of climate change predicted for this century, 10.4° F (5.8° C), the percentage of plants completely outside their envelope increases to 25-40% (Morse et al. 1995). By contrast, about 90 North American plant species are believed to have become extinct in the past two centuries (Morse et al. 1995).

Species are also at great risk because climate change can alter conditions for diseases and their vectors in a way that allows the incidence of disease to increase and spread. Global warming can exacerbate plant disease by altering the biological processes of the pathogen, host, or disease-spreading organism (Harvell et al. 2002). For example, cold winter temperatures limit disease in some areas because the cold kills pathogens. Warmer winter temperatures can decrease pathogen mortality and increase disease (Harvell et al. 2002). Warmer temperatures can also increase pathogen growth through longer growing seasons and accelerated pathogen development (Harvell et al. 2002). The most severe and least predictable disease outbreaks will likely be when climate change alters host and pathogen geographic ranges, so that pathogens introduced to new and vulnerable hosts (Harvell et al. 2002).

Climate change will also influence wildlife diseases by affecting the free-living, intermediate, or vector stages of pathogens (Harvell et al. 2002). Many vector-transmitted diseases are currently climate limited because the parasites cannot complete development before the vectors are killed by cold temperatures (Harvell et al. 2002). Well studied vector borne human diseases such as malaria, Lyme disease, tick-borne encephalitis, yellow fever, plague, and dengue fever have expanded their ranges into higher latitude areas as temperatures warm (Harvell et al. 2002). Given the sensitivity of the Desert Tortoise to pathogens, this impact of climate change must be considered in the Draft EIR for this project.

Increased ocean temperatures also cause marine pathogen range expansions. One example is the spread of eastern oyster disease on the east coast of the United States from Long Island to Maine during a winter warming trend in which the cold-water barrier to pathogen growth was removed (Harvell et al. 2002).

A study published in *Nature* has linked the extinction of dozens of amphibian species in the tropical highland forests of Central and South America to global warming due to the creation of ideal conditions for growth of the chytrid fungus, a disease which kills frogs by growing on their skin and attacking their epidermis and teeth, as well as by releasing a toxin (Pounds et al. 2006). Seventy-four of the 110 species of brightly colored harlequin frogs of the genus *Atelopus* have disappeared in the past 20 years due to the spread of the fungus (Pounds et al. 2006). The study's lead author stated "Disease is the bullet killing frogs, but climate change is pulling the trigger" (Eilperin 2006). The golden toad (*Bufo periglenes*), endemic to the same tropical mountain forests, was also driven extinct by climate change. These amphibian extinctions from the Monteverde Cloud Forest are one of the largest recorded vertebrate extinction events of at least the last 100 years.

Projected increases in atmospheric carbon dioxide and temperature over the next 50 years will rapidly and substantially exceed the conditions under which coral reefs have flourished over the past 500,000 years (Hughes et al. 2003). Coral reefs are already experiencing a major decline (Hughes et al. 2003). Thirty percent of reefs are already severely damaged, and sixty percent of reefs could be gone by 2030 (Hughes et al. 2003). The link between increased greenhouse gases, climate change, and regional-scale bleaching of corals, questioned by some researchers as recently as ten to twenty years ago, is now incontrovertible (Hughes et al. 2003). In the face of elevated ocean temperatures, corals "bleach" by expelling the symbiotic algae that provide them nourishment. Such bleaching events are often fatal, and as they become more frequent with global warming, threaten not just individual coral species but the entire reef ecosystem.

Corals face an additional threat from greenhouse gas emissions: increasing levels of dissolved carbon dioxide in the oceans from society's fossil fuel use reduces the rate of calcification corals need for growth. The frequency and intensity of hurricanes is also projected to continue to increase, leading to a shorter time for recovery between damaging storm events (Hughes 2003). Two species of Caribbean coral, the elkhorn coral (Acropora palmata) and staghorn coral (Acropora cervicornis) have been listed under the Endangered Species Act, in part due to elevated ocean temperatures from global warming and ocean acidification from anthropogenic carbon dioxide emissions. U.S. Fish and Wildlife Service (USFWS) 2006.

Species in areas of the globe experiencing more rapid warming than the average, such as the Arctic, are also particularly vulnerable to climate change. The Arctic has warmed at over twice the rate of the rest of the world and has been impacted particularly early and intensely by climate change. Winter temperatures in parts of the Arctic have increased by as much as 3-4° C (5-7° F) in just the past 50 years. Over the next 100 years, under a moderate emissions scenario, annual average temperatures are projected to rise 3-5° C (5-9° F) over land and up to 7° C (13°

F) over the oceans. Winter temperatures are projected to rise by 4-7° C (5-9° F) over land and 7-10° C (13-18°) over the oceans (ACIA 2004b:2).

The disproportionate regional warming is caused by several unique characteristics and feedback mechanisms in the Arctic. Chief among these is the decrease in Arctic snow and ice cover and northward expansion of boreal forests and shrubs as temperatures warm. These changes greatly decrease the amount of solar radiation reflected back into space and speed regional warming in a positive feedback loop of enormous magnitude. As temperatures go up, Arctic sea ice melts. Summer sea ice extent is already declining at up to 10% per year, and experienced a new record minimum in September 2005 (NSIDC 2005). An area of sea ice of about half a million square miles, or roughly twice the size of Texas, has been lost (NSIDC 2005). If current trends continue, the Arctic will be ice free in the summer in just a few decades. Decreases in winter sea ice extents in the Arctic have also been documented, approaching reductions of 3% per decade (Meier et al. 2005). The Arctic may already be on a trajectory towards a summer ice-free, "super interglacial" state that has not existed for at least a million years (Overpeck et al. 2005). There appear to be no feedback processes in the Arctic system capable of altering this trajectory towards dramatically less permanent ice than at present (Overpeck et al. 2005).

The rapid warming threatens the entire Arctic web of life, including the polar bear (*Ursus maritimus*), the largest of the world's bear species and an icon of the North. Polar bears live only in the Arctic where sea ice is present for substantial portions of the year. Polar bears are the Arctic's top predator and completely dependent upon the sea ice for all of its essential behaviors. Polar bears are specialized predators of seals in ice-covered waters. Polar bears also use the sea ice to travel, to mate, and some mothers even give birth to their cubs in snow dens excavated on top of the sea ice. The polar bear's dependence on sea ice is so complete that, like whales and seals, they are classified as a marine mammal by scientists and the federal government.

Due to the overwhelming risk to polar bears caused by global warming, in February, 2005, the conservation organization Center for Biological Diversity submitted a Petition to the U.S. Fish and Wildlife Service to list polar bears as a threatened species under the Endangered Species Act. *See* *http://biologicaldiversity.org/swcbd/species/polarbear/petition.pdf*. In February, 2006, the Fish and Wildlife Service found that listing of polar bears "may be warranted," and the listing process is currently ongoing. 71 Fed.Reg. 6,745 (February 9, 2006).

The number and magnitude of the impacts already recorded from a 1° F increase in average global air temperature is profoundly disturbing. And the projected increase, even under moderate greenhouse gas scenarios, for this century of 2.5- 10.4° F (1.4-5.8° C) is many times the warming already experienced. Not surprisingly, the projections for the future are more disturbing still.

The leading study on the quantification of risk to biodiversity from climate change, published in 2004 in *Nature*, included over 1,100 species distributed over 20% of the earth's surface area (Thomas et al. 2004). Under a relatively high emissions scenario, 35%, under a medium emissions scenario 24%, and under a relatively low emissions scenario, 18% of the species studied would be committed to extinction by the year 2050 (Thomas et al. 2004).

Extrapolating from this study to the earth as a whole reveals that over a million species may be at risk. The clear message is that immediate reductions in greenhouse gas emission may save preserve many thousands of species. It is also clear that some impacts from climate change are inevitable, and thus adaptation strategies will be an essential component of any comprehensive strategy to manage the impacts of climate change.

5. The Impacts of Global Warming on California

California is extremely vulnerable to the impacts of global warming and is also responsible for a significant portion of the U.S. and global emissions of greenhouse gases. The significant risks climate change poses to California as well as the considerable benefits the State could realize if it addresses these risks prompted Governor Schwarznegger to issue Executive Order S-3-05 on June 1, 2005. *See* F. Chung et al. 2006 at Appendix 1.7. The Executive Order called for specific emissions reductions and a periodic update on the state of climate change science and its potential impacts on sensitive sectors, including water supply, public health, coastal areas, agriculture and forestry. The Executive Order established the following greenhouse gas (GHG) emissions targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; and by 2050, reduce GHG emissions to 80 percent below 1990 levels. A recent piece of legislation, the California Global Warming Solutions Act of 2006 (AB 32), places a cap on California's greenhouse gas emissions from utilities, oil refineries, and other major global warming polluters and thus brings the state closer to meeting these targets.

In response to Executive Order S-3-05, the California Environmental Protection Agency (CalEPA) formed a Climate Action Team with members from various state agencies and commissions, The Team has issued a series of reports, including a March 2006 Climate Action Team Report to Governor Schwarznegger and the Legislature. This and other reports issued by CalEPA, the California Energy Commission (CEC), Department of Water Resources and other California agencies are available at http://www.climatechange.ca.gov/documents/index.html and should be used by the Board in preparing environmental review for the proposed policy.

Some of the major impacts identified in recent reports include:

- Reduction of Sierra snowpack up to 90 percent during the next 100 years threatens California's water supply and quality as the Sierra accounts for almost all of the surface water storage in the state.

- Impacts to the health of Californians due to increases in the frequency, duration, and intensity of conditions conducive to air pollution formation, oppressive heat, and wildfires. Increasing temperatures from 8 to 10.4°F, as expected under the higher emission scenarios, will cause a 25 to 35 percent increase in the number of days Californians are exposed to ozone pollution in most urban areas. This will slow progress toward attainment of air quality standards and impede many of the state's efforts to reduce air pollution. Temperature increases are likely to result in an increase in heat-related deaths. Children, the elderly, and minority and low-income communities are at greatest risk.

- Potential impacts from limited water storage, increasing temperatures, increased carbon dioxide concentrations, pests and weeds threaten agriculture and its economic contribution to the state. Direct threats to the structural integrity of the state's levee system would also have immense implications for the state's fresh water supply, food supply, and overall economic prosperity.

- Erosion of our coastlines and sea water intrusion into the state's delta and levee systems may result from a 4 to 33-inch rise in sea level during the next 100 years. This will further exacerbate flooding in vulnerable regions.

- Increasing temperatures and pest infestations would make the state's forest resources more vulnerable to fires. Large and intense fires threaten native species, increase pollution, and can cause economic losses.

- Increasing temperatures will boost electricity demand, especially in the hot summer season. By 2025 this would translate to a 1 to 3 percent increase in demand resulting in potentially hundreds of millions of dollars in extra energy expenditures

CalEPA 2006; Cayan et al. 2006; Chung 2006; Drechsler et al. 2006.

The precise nature of the impacts over the next decades will depend upon whether global greenhouse gas emissions continue to increase at current rates, or whether the current rate of increase is slowed, and emissions actually reduced. Scientists model future impacts based on different emissions scenarios (Cayan et al. 2006). Under a low emissions scenario, by the end of this century heat waves and extreme heat in Los Angeles will quadruple in frequency and heat-related mortality will increase two to three times (Hayhoe et al. 2004). Alpine and subalpine forests are reduced by 50-75%, and Sierra snowpack is reduced 30-70% (Hayhoe et al. 2004). Under a higher emissions scenario, heat waves in Los Angeles will be six to eight times more frequent, with heat-related excess mortality increasing five to seven times (Hayhoe et al. 2004). Alpine and subalpine forests would be reduced by 75-90%, and snowpack would decline 74-90%, with impacts on runoff and streamflow that, combined with projected declines in winter precipitation, could fundamentally disrupt California's water rights system (Hayhoe et al. 2004).

6. Tipping Point

The science of global warming is now sufficiently well understood that experts can accurately predict the future changes that will occur if greenhouse gas emissions and atmospheric concentrations continue to increase. Dr. James E. Hansen, Director of the NASA Goddard Institute for Space Studies, and NASA's top climate scientist, and others have recently published a paper stating that additional global warming of 2°C would push the earth beyond a "tipping point" and cause dramatic climate impacts including eventual sea level rise of at least several meters, extermination of a substantial fraction of the animal and plant species on the planet, and major regional climate disruptions (Hansen et al. 2006).

In order to limit future temperature increases to below 2°C, society must follow the "Alternative" scenario, rather than the "Business as Usual" scenario, with respect to emissions (Hansen et al. 2006). In the Business as Usual scenario, CO_2 emissions continue to grow at about 2% per year, and other greenhouse gases such as CH_4 and N_20 also continue to increase (Hansen et al. 2006). In the alternative scenario, by contrast, CO_2 emissions decline moderately between now and 2050, and much more steeply after 2050, so that atmospheric CO_2 never exceeds 475 parts per million (Hansen et al. 2006). The Alternative scenario would limit global warming to less than 1°C in this century (Hansen et al. 2006). However, CO_2 emissions have continued to increase by 2% per year since 2000 (Hansen et al. 2006). If this growth continues for just ten more years, the 35% increase of CO_2 emissions between 2000 and 2015 will make it implausible to achieve the Alternative scenario (Hansen et al. 2006). Moreover, the "tripwire between keeping global warming less than 1°C, as opposed to having a warming that approaches the range of 2-3°C, may depend upon a relatively small difference" in anthropogenic greenhouse gas emissions (Hansen et al. 2006). This is because warming of greater than 1°C may induce positive climate feedbacks, such as the release of large amounts of methane from thawing arctic permafrost, that will further amplify the warming. (Id.).

VII. Conclusion

The conservation groups hope and expect the Board will identify and analyze all of the activities that will need to be regulated in order to implement the Proposed Wetland and Riparian Area Protection Policy in the course of developing that policy and examining the alternatives identified by the Board in the Scoping Document. Given the devastating extent of the historic loss of wetlands and riparian areas in the State, the conservation groups urge the Board to adopt a broad and proactive policy in order to preserve the remaining wetlands and riparian areas in California and to protect water quality, water resources, beneficial uses, wildlife, fish, and native plants. By maximizing the protections afforded to the existing wetlands and riparian areas in California and promoting the restoration of additional wetlands and riparian areas, the Board will help to ensure that these resources, which are held in trust for the people of the State of California, will be preserved for future generations.

Thank you very much for your consideration of these comments. Please contact me at (415) 436-9682 ext. 307 if you have any question or concerns regarding these comments.

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