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303 (d) Deadline:
1/31/06

January 30, 2006

Board Members
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814

Re: Revision to the Federal Clean Water Act § 303(d) List of Water Quality Limited Segments for California – Supporting Evidence for Comments

Dear Board Members,

Please include the enclosed information as part of the administrative record for the review and update of the § 303(d) list of water quality limited segments for California. These documents pertain to those segments located in Northern California, and specifically, Humboldt Bay and the South Fork San Joaquin and Middle Fork Kings River watersheds. Our comments will be submitted separately by email.

Thank you for your time and consideration of this information.

For Clean Water,

Cynthia Elkins
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303 (d) Deadline: 1/31/06

January 30, 2006

Board Members
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814

Re: Revision to the Federal Clean Water Act § 303(d) List of Water Quality Limited Segments for California – Comments for Northern California

Dear Board Members,

The following comments are submitted on behalf of the Center for Biological Diversity regarding the State Water Resources Control Board's ("State Board's") proposed revision to the Clean Water Act § 303(d) list of "impaired" waterbodies. The comments herein focus on water quality limited segments that are located in northern California; we will submit those regarding southern California separately.

The Center is greatly concerned with the continued decline of water quality throughout the state and the resulting impacts to aquatic species. The increasing number of waterbodies on the § 303(d) list is indicative of pervasive, severe problems to overcome, and unfortunately, the Center believes there are additional waterbodies that are impaired but are not currently proposed for listing. The Center formally requests that additional waterbodies be added to the revised list, and also expresses support for your proposal to add the lower Klamath River, portions of the San Joaquin River, the Cosumnes River, Delta waterways, and Bodega Bay. Comments and evidence to support these actions follow.

Specifically, the Center formally requests the State Board add the following waterbodies to the revised 303(d) list of impaired waterbodies for exotic species:

Humboldt Bay
South Fork Joaquin River
Middle Fork Kings River

Tucson • Phoenix • Joshua Tree • San Diego • San Francisco • Los Angeles • Washington D.C. • Portland • Silver City • Shelter Cove
Post Office Box 220 • Shelter Cove, CA 95589 • PHONE 707.986.7805 • FAX 707.986.7506

The Center for Biological Diversity ("the Center") is a non-profit, public interest organization that is dedicated to protecting and restoring native species and their habitat. Founded more than 15 years ago, the Center has approximately 18,000 members today, including more than 6,000 members who live in California and rely on the beneficial uses of water in this state.

CONTACT INFORMATION

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I. INVASIVE SPECIES

"Unlike some chemical pollutants that can degrade over time, biological pollutants have the potential to persist, multiply, and spread. In addition to their economic costs, invasive species can have a devastating effect on natural areas, where they have strangled native plants, taken over wetland habitats, crowded out native species, and deprived waterfowl and other species of food sources."

GAO, October 22, 2005

The introduction of invasive species is one of the single largest environmental problems confronting the country today, increasingly considered by scientists, academics, and others as a leading threat to address in the twenty-first century (GAO 2002; Cohen 2002; Cohen 2004; Groat 2000). It is also one of the most costly, creating an enormous taxpayer burden that—by conservative estimates—approaches $200 billion dollars every year (GAO 2002). But while the economic costs from invasive species are colossal, native aquatic species and beneficial uses of water are paying the true price—the sum of which is incalculable.

Invasive species are second only to habitat destruction as the greatest overall threat to native plants, fish, and wildlife in the United States (Cohen 2004; Wilcove 1998). Their introduction is believed responsible for population declines among almost half the species currently listed in the U.S. under the federal Endangered Species Act (GAO 2005), and was a contributing factor in 65% of all extinctions that occurred in North America during the last century (Cohen 2004; Miller 1989).

The negative impacts from invasive species may be most profound within freshwater and estuary ecosystems. Studies indicate that invasive species adversely affect twice the number of fish and wildlife species as other types of pollution (Cohen 2004; Wilcove 1998). And indeed, some scientists report that invasive species are the primary threat to freshwater fauna throughout the western U.S. (Cohen 2004), and also to biological diversity, regional economies, and public health in coastal areas around the world (Cohen 1997).

It is believed that hundreds of exotic species are introduced to U.S. waters every day. Though many cannot survive in their new environment, a significant number become extremely well positioned to take over. These are the ones that have no natural predators in their new home, tolerate a wide-range of environmental conditions, and have high reproductive rates—a combination that assures they will not merely survive, but flourish.

As invasive species spread in freshwater or estuarine ecosystems, they degrade and impair beneficial uses in a number of ways. This includes the alteration of aquatic habitat by borrowing activities; destroying vegetation or other organisms that provide physical structure; replacing native species with organisms that provide a different type of structure; and shading, covering, or otherwise altering physical or chemical parameters, etc…" (Cohen 2004). Additionally, by competing for spawning, rearing, and/or feeding habitat, reducing food sources, and direct predation, invasive species can also "substantially alter the species composition and populations in a water body…" *Id.* Related impacts are known to reverberate across entire ecosystems, disrupting intricate natural processes and food webs as they spread. (Matthews, 2001; Knapp 2001; Sarnelle 2004).

These "biological pollutants" are quickly invading both freshwater and coastal ecosystems throughout California, and studies are producing a growing body of evidence that reveals immense impacts to beneficial uses. These impacts include significantly impairing recreational uses; cold freshwater habitat; spawning, reproduction, and/or early development habitat; estuarine habitat; the migration of aquatic organisms; shellfish harvesting; and other designated beneficial uses.

These impacts have already caused the extinction of several species in California, and without stronger measures, threaten to push many more towards this same tragic fate (*see*, for example, Cohen and Carlton 1995). Indeed, it has become increasingly evident that existing mechanisms are not effective in preventing the introduction and/or proliferation of exotic species, and that additional measures are necessary to protect and restore beneficial uses (GAO 2002). We believe that implementation of TMDLs will help reverse this problem—and that they are not only a proper tool for the State Board to utilize, but are also one that is obligated under the law.

We commend the State Board for recognizing this—both the severity of the problems caused by exotic species and that TMDLs are an appropriate avenue for dealing with them. It is unfortunate the Bush Administration attempted to block your efforts to address exotic species through TMDLs in San Francisco Bay and elsewhere, but with this issue now resolved at the federal courts (*Northwest Environmental Advocates et al. vs. U.S. EPA*, 2005), we strongly encourage the State Board to move forward as expeditiously as possible in preparing *both* a TMDL and an implementation plan for exotic species in San Francisco Bay. This area is a global example for the problems caused by exotic species, and it is abundantly clear that swift action is necessary to restore the damages they have caused to its beneficial uses.

The Center would also like to express strong support for your proposal to add Bodega Bay, the Delta waterways, the Cosumnes River, and portions of the San Joaquin River for exotic species. The resulting degradation and impairment of beneficial uses from exotic species to these areas are well documented and are only escalating today.

But unfortunately, our review of available information shows that impacts from exotic species are not limited to these areas, and are causing adverse biological responses, degradation of biological populations and communities, and declining trends in water quality within a number of other areas. These include:

(1) Humboldt Bay,
(2) South Fork San Joaquin River,
(3) Middle Fork Kings River.

Scientific data and studies show these water quality segments are "impaired" pursuant to criteria recently adopted by the State Board (specifically, §§ 3.8, 3.9, 3.10, and/or 3.11), and that preparation and implementation of TMDLs for these water bodies is warranted, appropriate, and required by law. We formally request the State Board include these water bodies in the revised 2006 list of water quality limited segments and quickly take related actions to remediate these problems.

Our comments and evidence supporting these actions follow.

II. HUMBOLDT BAY

A. Introduction

Humboldt Bay is the second largest estuary in California, and also one of the most biologically diverse found on the west coast today. Its wetlands, intertidal mudflats, and marshes provide essential habitat for an impressive number of native species, including 141 invertebrate species, 110 fish species, and 251 bird species. But unfortunately, Humboldt Bay is also now home to a growing number of exotic species, and resulting problems to designated uses are spreading by the day.

In a recent survey, 95 possible exotic species were discovered in Humboldt Bay, with 65 being confirmed as such (Boyd 2002) (*see* Table 1). This number rivals that found in some of the most polluted ports in California, and in fact, is only slightly less than the number documented in the Delta waterways—which the State Board is now proposing to list as impaired. (*see* Figure 2).

Exotic species currently invading Humboldt Bay include some of the most notoriously destructive known to U.S. waters, such as the green crab. These biological pollutants have degraded and continue to degrade water quality in Humboldt Bay, seriously impairing the beneficial uses of this coastal estuary.

B. The Invasion of Humboldt Bay

Humboldt Bay is a remote, enclosed estuary along California's North Coast, with a narrow entrance that naturally shifted between two peninsulas. Given its "hidden" nature, it took European explorers a longer time to locate Humboldt Bay compared to others of its size. But in the mid-1800s, when the Gold Rush increased demand in finding an ocean port in the region, Humboldt Bay was "discovered" and quickly became a primary artery through which gold—and later redwood lumber and other natural resources—were exported (Boyd 2002).

With the exportation of natural resources, soon came the importation of numerous exotic species. Many of the biological pollutants that have reached its waters and shores, such as *Spartina densiflora,* found an advantageous environment in which to live and thrive, and have rapidly spread to dominate their new surroundings (Boyd 2002). And as shipping in Humboldt Bay increased over time, and other activities, such as the cultivation of nonnative oysters, arrived, the rate of introduction of exotic species to Humboldt Bay steadily increased.

The number of exotic species in Humboldt Bay has been rising ever since, and studies show that nearly 100 exotic species may now occupy its waters (Boyd 2002) (See Table 1). In a recent study conducted by DFG, "[m]ore than a third (35%) of the species identified on fouling panels [in Humboldt Bay] were introduced. In fact, in several cases the major space-occupying organism was an introduced species..."

Table 1: Species designations for different categories of organisms found in Humboldt Bay and adjacent estuarine areas during surveys conducted in 2000-2001.

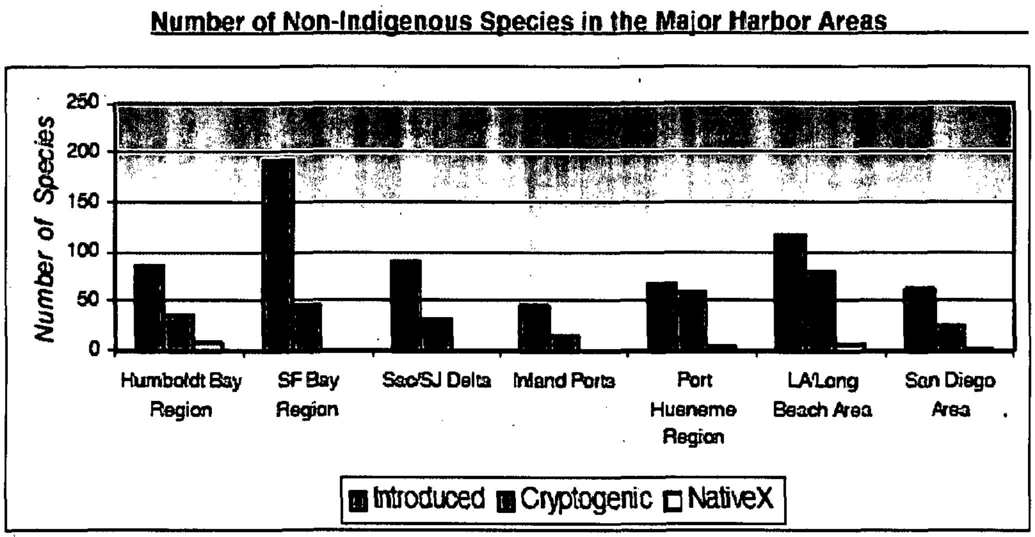
Non-indigenous	Probable Introductions	Status Uncertain	Total
67	17	13	97

Source: Boyd 2002; DFG 2002

While the number of exotic species now documented in Humboldt Bay is alarming, it is likely this number is even higher than studies reveal. Only recently have the presence or problems of exotic species been examined in Humboldt Bay, and even since the first and last comprehensive surveys were conducted, two additional exotic species, *Zostera japonica* and the mahogany clam, were discovered (DFG 2002). It can only be expected that others have invaded its waters and shores as well.

But still, the number of exotic species currently documented in Humboldt Bay is comparable to those catalogued in larger, and more industrialized ports—where problems from exotic species have undergone much more extensive study and research. In fact, the number of exotic species currently known to occupy Humboldt Bay is only slightly less than that in the Delta waterways (*see* Table 2), which the State Board has recognized are impaired.

Figure 1



Source: DFG 2002

It is believed that hull fouling and ballast water are the first and third leading sources of these biological pollutants in Humboldt Bay, respectively, and that introductions associated with aquaculture are the second leading cause (DFG 2002). These sources only threaten to increase, with entities like the Humboldt Bay Harbor District actively developing and implementing plans to expand industrial port development in Humboldt Bay (*see*, for example, the Port of Humboldt Bay Revitalization Plan, developed by the Humboldt Bay Harbor District).

All evidence shows this will intensify the problem. According to the U.S. General Accounting Office, existing regulations regarding ballast water disposal—which apply to California and Humboldt Bay—are ineffective in preventing the introduction of exotic species (GAO 2002). In a recent report, the GAO found that even with high levels of compliance with these regulations, ballast water discharges continue to spread exotic species into U.S. waters today *(Id)*. This was found to be due to at least two factors, with the first being that these regulations classify many ships as having no ballast water when in fact they do, and thus arbitrarily consider them exempt *(Id)*. Additionally, studies indicate that the only required method of disposal, open-ocean exchange, "does not effectively remove or kill all organisms in the ballast tanks," and ships that are subject to relevant disposal requirements are still spreading exotic species *(Id)*.

Moreover, studies show that exotic species, such as *Stenothoe valida*, are being transported into Humboldt Bay from ships traveling from San Francisco Bay and other U.S. ports (Boyd 2002)—traffic that is not subject to ballast water regulations under state or federal laws. Exotic species are also being introduced from the outer layers of the boats themselves, with many, such as barnacles and organisms that live on or in the barnacles, arriving on the hulls of ships, and from extensive aquaculture operations in the Bay (*Id.).*

C. The Ecological Costs

Many of the exotic species now invading Humboldt Bay are notorious for their destructive and deleterious impacts, and are wreaking havoc for native species and designated beneficial uses as they spread. These issues are briefly summarized below, and are discussed in detail in the supporting evidence we have submitted for our comments as well as other studies that are included in the administrative record.

1. The European Green Crab (Carcinus meanas)

In 1995, scientists discovered the European green crab had reached Humboldt Bay. This vicious predator decimated the soft-shell clam industry in Maine and Canada when it was accidentally introduced during the 1950's, and was first recorded on the West Coast in 1989. It is now abundant in portions of Humboldt Bay, causing serious harm to aquatic habitat and a number of native species.

As summarized by Boyd (2002), the green crab:

> "...preys on a multitude of organisms, including clams, oysters, mussels, marine worms and small crustaceans, making it a major potential competitor of the native fish and bird species...[T]hey pose a direct threat to shorebirds, as they have similar diets...In addition, the green crab is an intermediate host to marine worms that could potentially be harmful to local shore birds.

Green crabs are also creating problems for Dungeness crabs and other shellfish in Humboldt Bay. As recounted by the California Department of Fish and Game (DFG 2002), "[g]reen crabs may impact juvenile Dungeness crabs that settle by the thousands in Humboldt Bay and may also prey upon juvenile cultured oysters, clams and mussels. (Green Crab Study 2001)." "They have the potential to restructure the crab population in ecosystems in which they establish themselves, as they feed on the larvae of other crab species devastating their near shore nurseries...Recent experiments in south Humboldt Bay (Meyer 2001) suggest that this species could be a significant predator of small bivalves if it becomes widespread" (Boyd 2002).

Such effects are thoroughly documented in other areas, including Bodega Bay—a water body that the State Board is proposing to add to the §303(d) list due to problems caused, in large part, by the green crab (*see* Staff Report). In its staff report for this update, the State Board states that Bodega Bay is impaired because: "The non-native European green crab exerted top-down control significantly reducing the abundances of several native invertebrate species monitored, which showed sharp declines within 3 years of green crab arrival...Field and lab experiments indicated green crab predation was responsible for these declines." *Id.*

2. The Mosquitofish (Gambusia affinis)

Mosquitofish *(Gambusia affinis)* are among the destructive exotic species known to now occupy Humboldt Bay. Transplanted to California's coast from the southeastern or Midwestern U.S., mosquitofish have seriously harmed native species and beneficial uses in the Delta waterways, among other areas (Cohen 2004). In fact, these exotic fish are described as one of the "most significant predators, competitors, and habitat disturbers throughout the brackish and freshwater reaches of the Delta, with often concomitant impacts on native fish communities." *Id.*

3. Zostera japonica

One of the most recent exotic species discovered in Humboldt Bay is *Zostera japonica*, a competing eelgrass that is indigenous to Japan (DFG 2002). This discovery is particularly troubling, as *Z. japonica* is known to cause severe impacts to native species and water quality. Its introduction poses substantial threats to native eelgrass meadows and other aquatic habitat in Humboldt Bay, along with black brants and hundreds of additional species that rely on this habitat.

Since found on the Pacific Coast in the 1950s, *Z. japonica* "has extensively colonized formerly un-vegetated tidal flats and dramatically altered the habitat structure" (Baldwin 1994). It has also "...changed the physical habitat as well as the richness and densities of resident fauna" (Posey 1988), and is "responsible for declines in foraging habitat of shorebirds" (Durance 2002). Studies also show that "*Z. japonica* invasions alter water column-benthos nutrient fluxes" (Larned 2003).

D. Listing Humboldt Bay is Warranted

The designated beneficial uses of Humboldt Bay include: recreation; spawning, reproduction, and/or early development habitat; estuarine habitat; the migration of aquatic organisms; and shellfish harvesting. Available data and information show exotic species have caused and continue to cause numerous deleterious impacts to each of these, destroying native vegetation; replacing native species; and shading, covering, or otherwise altering physical or chemical parameters. (See Appendices). Establishing a TMDL for these biological pollutants will help resolve and reverse this growing concern, adding necessary force to regulatory mechanisms that have proven unsuccessful alone.

Scientific data and studies show Humboldt Bay is an "impaired" water body pursuant to criteria adopted by the State Board (specifically, §§ 3.8, 3.9, 3.10, and/or 3.11), and preparation and implementation of a TMDL is warranted, appropriate, and required by law. This conclusion is based on the following:

1. Historic, baseline conditions in Humboldt Bay included no exotic species.
2. Surveys in Humboldt Bay have documented a growing number of exotic species.
3. Numerous rare, threatened, and endangered species have declined in abundance in Humboldt Bay since exotic species were introduced.
4. Numerous studies link the decline of aquatic habitat and other beneficial uses in Humboldt Bay to exotic species invading its waters.
5. Available data show exotic species are creating adverse biological responses in Humboldt Bay.
6. Available data show exotic species are degrading biological populations and communities in Humboldt Bay, which in turn, also impairs recreational fishing and other beneficial uses.
7. Available data show a declining trend in water quality in Humboldt Bay.

II. SOUTH FORK SAN JOAQUIN AND MIDDLE FORK KINGS RIVERS

"There are also many examples of nonnative fish introductions gone awry..."

California Dept. of Fish and Game, Nov. 2003

I. Introduction

With the history of international shipping and other anthropogenic activities in California, it is unsurprising that accessible areas like Humboldt and Bodega Bays and the lower reaches of the San Joaquin River are now overridden by exotic species. Much more unexpected is that exotic species are also pervading remote headwater lakes and streams, including those within designated wilderness areas, "...where the earth and its community of life are [intended to be] untrammeled by man, [and] where man himself is a visitor who does not remain." But even more astonishing and ironic still is that these biological pollutants are being spread intentionally, and the primary source is none other than a public trust agency charged with preventing it.

Studies indicate the introduction and spread of exotic species is having the worst possible effects to the South Fork San Joaquin and Middle Fork Kings Rivers. The high mountain lakes in both watersheds are oligotrophic, and having evolved with relatively simple food chains, are "...especially sensitive to impacts from introduced species" (Knapp 1996 citing Li and Moyle 1981 and McQueen, et al. 1986)." And after being introduced into the upper reaches of the watersheds, upstream of natural barriers, these nonnative fish have invaded and continue to invade virtually every stretch of both watersheds (Knapp 2001).

II. Invasion of the Sierra

The South Fork San Joaquin and Middle Fork Kings Rivers begin flowing high in the Sierra Nevada mountains, spilling from lakes and streams found deep within the John Muir Wilderness and Kings Canyon National Park. The majority of these lakes were naturally fishless, but teeming with amphibians and other native aquatic life.

Today the situation is almost completely reversed. Beginning in the mid-1800s, nonnative trout were purposefully introduced into lakes for sport fishing, at first largely by sport fishing groups, but increasingly, and now almost exclusively, by the Department of Fish and Game (DFG) [originally by the California Fish and Game Commission, precursor to DFG (Knapp 1996). In the 1950's, DFG began dropping nonnative trout from airplanes, spreading these exotic species into even the most distant and pristine lakes and streams (Pister 2000).

This has been met with disastrous results, enabling exotic species to "surmount barriers that normally hinder upstream-directed invasions" and occupy virtually every segment of the watersheds (Knapp 2001). Today all of the watersheds in the Sierra Nevada are occupied by as many as five nonnative trout species (Knapp 1996, citing Jenkins 1994), and it is estimated that 63% of all high mountain lakes contain one or more of these veracious predators (Knapp 1996; Bahls 1992; Jenkins 1994). Most of the remaining fishless lakes "are small (<2 ha), shallow (<3 m), and generally incapable of supporting trout populations" (Knapp 1996, citing Bahls 1992).

Native amphibians are disappearing as a result, with populations being consumed and replaced by nonnative, hybridized trout species, and completely extirpated from many areas. Nonnative trout are also having direct and indirect effects on a number of other species, reducing populations of traditional predators like garter snakes (Matthews 2002) as well as native salmonids and others (Cohen 2004; Knapp 2001; Knapp 1996; Matthews 2001; Sarnelle 2004). These and other effects are impairing designated beneficial uses of the South Fork San Joaquin and Middle Fork Kings Rivers, including spawning, reproduction, and/or early development habitat; cold freshwater habitat; habitat for rare, threatened, or endangered species; and recreational uses.

Despite well-documented evidence showing these deleterious impacts, DFG continues to discharge these exotic species today. While it did temporarily suspend nonnative trout introductions in some wilderness areas in 2003, this brief moratorium was soon lifted and stocking has since resumed in many areas throughout the Sierra Nevada, including the South Fork San Joaquin and Middle Fork Kings Rivers (Knapp 2005). A further discussion of these issues follows.

C. The Invasion of the South Fork San Joaquin and Middle Fork Kings Rivers

The State Board has proposed adding the San Joaquin River to the TMDL list for problems tied to exotic species, a proposal the Center wholeheartedly supports. However, the State Board has only proposed to add stretches that lie below the Friant dam, drawing an arbitrary line in the watershed. Exotic species do not stop at this point, but to the contrary, begin at the very top of the drainage.

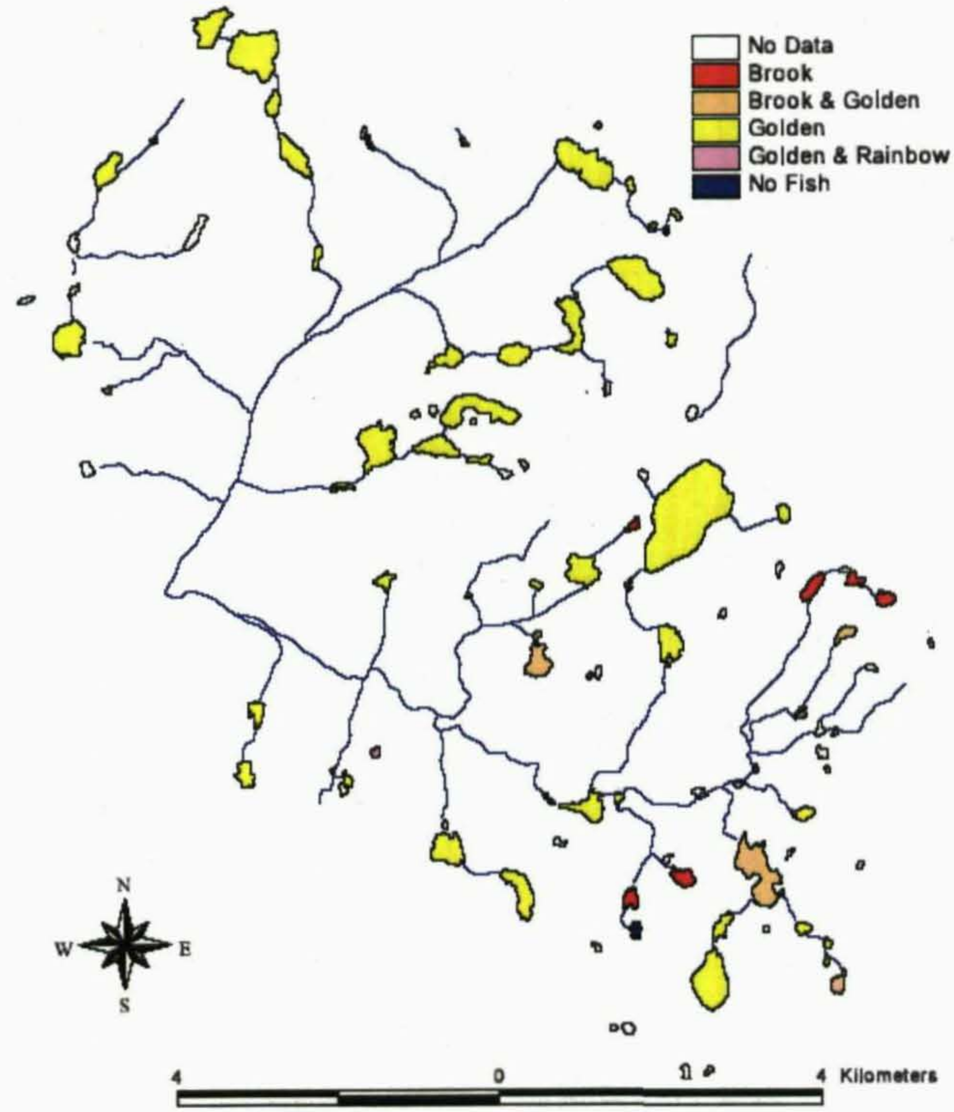
Numerous studies show that exotic trout now pervade the upper reaches of the San Joaquin River, including the South Fork San Joaquin and Middle Fork Kings Rivers (*see*, for example, Bradford 1989; Bradford 1991; Bradford 1993; Bradford 1994; Bradford 1998; Cohen 2004; Knapp 2000; Knapp 2001; Knapp 1996; Matthews 2001; Matthews 2002; Sarnelle 2004; Vredenburg 2004; Zardus 1997). Most comprehensive of these is a study led by Drs. Roland Knapp and Kathleen Mathews, in which surveys were undertaken in more than 1,700 lentic water bodies in the South Fork San Joaquin and Middle Fork Kings Rivers, all of which were historically fishless (Knapp 2001). This study documents widespread occurrence of three exotic species (*Oncorhynchus mykiss* X *O. m. aguabonita* hybrids, *Salvenlinus fontinalis,* and *Salmo trutta*—with hybridized salmon being the most common), with surveys revealing the majority of the total water body surface areas in both watersheds contain at least one of these. Id.

Nonnative trout species are most ubiquitous in the South Fork San Joaquin study area, invading nearly 90% of its total water body surface area. Id. This study area is entirely located within the boundaries of the John Muir Wilderness of the Sierra National Forest, which DFG continues to stock on a regular basis. R. Knapp. Pers. Communication. Conversely, the Middle Fork Kings River study area is located within Kings Canyon National Park, where stocking of nonnative trout was discontinued in 1972 (Knapp 1996). However, exotic trout were still found to occupy more than 50% of the total surface area in the study area (Knapp 2001). It is likely that levels are even higher in other portions of the watershed, which lie inside the Sierra National Forest—where stocking continues to occur.

The following map illustrates the extent of this problem, showing the current distribution of exotic trout in the Upper Pitue and French Creek (both tributaries to the South Fork San Joaquin River). All of the areas shown were naturally fishless.

Current Distribution of Exotic Species

Upper Pitue and French Creek Watersheds
South Fork San Joaquin River Basin



This map shows the current distribution of exotic trout species in the upper Piute Creek and French Creek watersheds, Sierra National Forest. Data were compiled by Dr. Roland Knapp based on records provided by Region 5 of the California Dept. of Fish and Game.

SOURCE: Knapp, R.A. Sierra Nevada Aquatic Research Laboratory, University of California. Non-native Trout in Natural Lakes of the Sierra Nevada: An Analysis of Their Distribution and Impacts on Native Aquatic Biota. Sierra Nevada Ecosystem Project: final report to Congress. Volume III. (1996). [See Appendix II for original map and report].

D. The Ecological Costs

"The most profound human impacts on aquatic communities in the High Sierra appear to be related to historical and on-going stocking of exotic fish species into High Sierra waters."

Bradford et al. (1994)

The adverse effects of nonnative trout in the Sierra Nevada are well documented, and a voluminous body of evidence conclusively demonstrates these impacts are significantly degrading aquatic habitat and water quality (*see*, for example, Bradford 1989; Bradford 1991; Bradford 1993; Bradford 1994; Bradford 1998; Cohen 2004; Knapp 2000; Knapp 2001; Knapp 1996; Matthews 2001; Matthews 2002; Sarnelle 2004; Vredenburg 2004). As summarized by Knapp (1996):

> "Introduced trout are having considerable deleterious effects on native fishes (including trout), amphibians, zooplankton, lake macroinvertebrates, and probably stream macroinvertebrates. Introduced trout are also likely causing community-wide effects as a result of direct impacts cascading to other trophic levels...One species may already have disappeared (the phantom midge) and several others endemic to Sierra Nevada have suffered dramatic population declines (e.g., golden trout, mountain yellow-legged frog.)"

These biological pollutants are responsible for other negative impacts as well, increasing algal production and adversely impacting nutrient cycles and the physical and chemical parameters of the watersheds (Knapp 2001). Each of these effects, taken separately and/or together, has impaired and continues to impair designated beneficial uses in the South Fork San Joaquin and Middle Fork Kings Rivers.

1. Mountain Yellow-Legged Frog

"...[T]he available data are all consistent with introduced trout being the primary cause of the decline of the mountain yellow-legged frog in the Sierra Nevada."

Knapp 2000

Exotic trout introductions are impacting many species in the South Fork San Joaquin and Middle Fork King Rivers, but perhaps none more than the mountain yellow-legged frog. Once abundant at elevations above 1500 m (Knapp 1996 citing Zweifel 1955), this species has been eliminated from a great portion of the lakes and tributaries it historically occupied in these watersheds, and it may now be endangered with extinction (67 Fed. Reg. 44382). Numerous studies illustrate "...the introduction of trout is the most likely mechanism responsible for the decline...." (Vredenburg 2004. See also Knapp 1996; Knapp 2000; Knapp 2001; Bradford 1989; Bradford

1991; Bradford 1993; Bradford 1994; Bradford 1998).

As stated by Knapp (1996):

> Several attributes of this species make it particularly vulnerable to predation and subsequent extirpation by non-native trout. First, adult mountain yellow-legged frogs are highly aquatic and are found primarily in lakes (most of which now contain trout). Second, in contrast to tadpoles of other Sierran anurans that complete metamorphosis to the terrestrial stage in a single summer, mountain yellow-legged frog tadpoles generally require at least two years before metamorphosis to the terrestrial stage. This overwintering requirement restricts breeding to bodies of water that are deep enough to avoid oxygen depletion when ice-covered (>1.5 m; Mullally and Cunningham 1956; Bradford 1983). The majority of these deeper lakes, however, now contain introduced trout.

As also summarized by Knapp (1996):

> There is substantial evidence that introduced trout have severely reduced the abundance of mountain yellow-legged frogs in the Sierra Nevada. As early as 1924, Grinnell and Storer (1924) reported that mountain yellow-legged frog tadpoles and introduced trout rarely co-occur in lakes and ponds in the Sierra Nevada. This observation has been quantified repeatedly in different parts of the Sierra Nevada (Bradford 1989; Bradford and Gordon 1992; Bradford et al. 1993; Drost and Fellers 1994). This lack of overlap is assumed to be the result of predation by trout on the mountain yellow-legged frog, an assertion supported by Needham and Vestal (1938), who observed trout preying on mountain yellow-legged frogs in a lake into which trout had recently been introduced. Given that the presence of fish generally makes a pond or lake unsuitable for mountain yellow-legged frogs, that lakes smaller than 1 ha are generally too shallow to support mountain yellow-legged frogs (Matthews and Knapp 1995), and that 34-85% of formerly fishless lakes larger than 1 ha now contain introduced trout...the amount of suitable habitat for mountain yellow-legged frogs has likely been reduced by a similar amount.

Knapp and Matthews (2000) took this information a step further in the South Fork San Joaquin and Middle Fork Kings Rivers, conducting extensive surveys in more than 1,700 lakes within the watersheds to quantify the impacts of exotic species to mountain yellow-legged frogs and other species (Knapp 2000). This study confirmed previous reports and found a direct causal link between exotic trout introductions and the disappearance of the species "at the scales of the landscape, watershed, and individual water body" (*Id.*).

Specifically, Knapp and Matthews found that mountain yellow-legged frogs "were three times more likely to be found and six times more abundant in fishless than in fish-containing water bodies, after habitat effects were accounted for" (*Id.*). Mountain yellow-legged frogs were found in only 4% of the 669 lakes surveyed in the John Muir Wilderness Area, and when lakes where the species was found in 1997 were resurveyed, it was discovered that mountain yellow-legged had since been extirpated from 61% of the 28 sites. (Knapp 2000).

2. Pacific Treefrogs (Hyla regilla)

Pacific treefrogs share the same habitat as mountain yellow-legged frogs in the Sierra, and it has long been suspected that exotic trout are also negatively impacting this species. Matthews (2001) confirmed this suspicion in the South Fork San Joaquin and Middle Fork Kings Rivers, finding that impacts are substantial and directly linked to exotic species.

> "At the water body scale, after accounting for the effects of all significant habitat and isolation variables, the odds of finding *H. regilla* in water bodies with no trout was 2.4 times greater than in water bodies with trout, and the expected number of *H. regilla* in water bodies with *H. regilla* and without trout was 3.7 times greater than in water bodies with both *H. regilla* and trout. *Hyla regilla* were significantly more likely to be found at the lower elevations (3000–3400 m) compared to higher elevations (3400–3800 m) and in shallow water bodies with high percentages of silt in near-shore habitats. Our study demonstrates a negative relationship between fish presence and *H. regilla* distribution and abundance in lakes and suggests that *H. regilla* has declined in portions of the High Sierra with high numbers of trout-containing lakes. It adds an additional native species to the mounting evidence of landscape-scale declines of native species resulting from the introduction of predatory fish."

3. Mountain Garter Snakes (Thamnophis elegans elegans)

Another study found that exotic trout are also having a serious adverse effect on native predators in the South Fork San Joaquin and Middle Fork Kings Rivers, and in particular, on mountain garter snakes (*Thamnophis elegans elegans)* (Matthews 2002). Garter snakes feed predominately on amphibians, and although they "are reportedly opportunistic feeders (Kephart, 1982; Kephart and Arnold, 1982), garter snakes in high mountain lakes of the Sierra Nevada appear unable to switch to alternative prey following amphibian disappearances" (*Id.*). The results of this study showed that:

> "The occurrence of garter snakes in a particular lake was closely linked to the presence of amphibians: of the 33 lakes with garter snakes, 97% also contained amphibians. In contrast, only 36% of lakes without garter snakes contained amphibians...After controlling for elevation and lake area, the probability of finding *T. e. elegans* in lakes with amphibians was 30 times greater than in lakes without amphibians" (Matthews 2002).

This study also found a negative association "...between snake presence and trout presence: 24% of trout-free lakes also contained snakes while only 12% of trout-containing lakes contained snakes" (*Id.*).

4. Other Damage

Available information establishes that exotic species have degraded and continue to degrade beneficial uses in many additional ways, including:

- **Native Fish:** Studies show "...the introduction of salmonid fishes into headwater lakes can result in disproportionately larger effects on native fishes than introductions lower in drainages. In many river basins, remaining populations of native fishes are concentrated in headwater refugia where they are protected by natural barriers from introduced fishes that are already established at lower elevations. However, introductions of nonnative fishes into headwater lakes provide point sources capable of invading all downstream habitats, as the fish surmount barriers that normally hinder upstream-directed invasions..." Knapp 2001

- **Zooplankton:** "Several studies have documented [negative] effect[s] of introduced trout on zooplankton communities in lakes in the Sierra Nevada. Stoddard (1987) found that the presence or absence of fish (primarily salmonids) was by far the most important predictor of the distribution of zooplankton species among 75 alpine and subalpine lakes in the central Sierra Nevada, with large-bodied species found in fishless lakes and small-bodied species found in lakes with trout. Other studies on Sierran lakes have produced very similar results (Richards et al. 1975; Morgan et al. 1978; Goldman et al. 1979; Melack et al. 1989; Bradford et al. 1994a)." (Knapp 1996) (*see also* Sarnelle 2004).

- **Lake benthic macroinvertebrates:** "In addition to their effects on zooplankton communities, fish are also capable of altering the structure of lake benthic macroinvertebrate communities. In the Sierra Nevada, high elevation fishless lakes contain mayfly larvae (Ephemeroptera), caddisfly larvae (Trichoptera), aquatic beetles (Coleoptera), and true bugs (Corixidae) that are absent in lakes that contain introduced trout (Reimers 1958; Melack et al. 1989; Bradford et al. 1994a)." (Knapp 1996).

- **Nutrients:** "Model results suggest that trout introductions routinely increase phosphorus (P) regeneration from previously inaccessible benthic and terrestrial sources. Because P derived from benthic and terrestrial sources represents a new source of nutrients for plankton, even small increases in nutrient availability can result in increased algal biomass and production. To support the importance of this increased nutrient subsidy to pelagic algae, they present paleolimnological evidence that algal production increased approximately 10-fold following trout introductions and show that this increased production was maintained for the duration of fish presence. These results suggest that widespread fish stocking has caused substantial changes to nutrient cycles in hundreds of lakes throughout montane protected areas of western North America, with impacts being greatest in lakes stocked with high densities of trout" (Knapp 2001).

- **Cumulative/Landscape Level Impacts:** "...the effects of widespread trout introductions into wilderness landscapes are not limited simply to direct effects on prey taxa, but instead can be transmitted throughout lake food webs and even beyond the shorelines of fish-containing lakes to fishless lakes" *Id.*

D. Listing the South Fork San Joaquin and Middle Fork Kings River is Warranted

The designated beneficial uses of the South Fork San Joaquin and Middle Fork Kings Rivers include: recreation; spawning, reproduction, and/or early development habitat; and the migration of aquatic organisms; among others. Available data and information show exotic species have caused and continue to cause numerous deleterious impacts to each of these, destroying native vegetation; replacing native species; and shading, covering, or otherwise altering physical or chemical parameters. (See Appendices). Establishing a TMDL for these biological pollutants will help resolve and reverse this growing concern, adding necessary force to regulatory mechanisms that have proven unsuccessful alone.

Scientific data and studies show the South Fork San Joaquin and Middle Fork Kings Rivers are "impaired" water bodies pursuant to criteria adopted by the State Board (specifically, §§ 3.8, 3.9, 3.10, and/or 3.11), and the preparation and implementation of a TMDL is warranted, appropriate, and required by law. This conclusion is based on the following:

1. Historic, baseline conditions in these watersheds included no exotic species.
2. Surveys have documented a widespread presence of at least three exotic species.
3. Numerous rare, threatened, and endangered species have declined in abundance throughout the San Joaquin River watershed since exotic species were introduced.
4. Numerous studies link the decline of aquatic habitat and other beneficial uses in these watersheds to exotic species invading their waters.
5. Available data show exotic species are creating adverse biological responses in these watersheds.

6. Available data show exotic species are degrading biological populations and communities in these watersheds, which in turn, is also impairing their recreational opportunities and other beneficial uses.
7. Available data show a declining trend in water quality in both watersheds.

IV. CONCLUSION

The beneficial uses in Humboldt Bay, the South Fork San Joaquin River, and Middle Fork Kings River have been severely degraded and impaired by exotic species. These impacts are documented in a growing body of scientific information, including studies contained in the appendices to our comments as well as additional studies and information within the administrative record. This information conclusively demonstrates that many native species are disappearing as these exotic species spread, pushing the mountain yellow-legged frog and others to the brink of extinction.

It is imperative that additional steps are taken to reverse these problems, and the implementation of TMDLs would be a big leap in the right direction. Relevant laws and policies support this action for Humboldt Bay, the South Fork San Joaquin River, and Middle Fork Kings River. We urge you to make wise and appropriate use of your authority to protect and restore the beneficial uses of these water bodies, and add each to the 2006 § 303(d) list

For Clean Water,

Cynthia Elkins
Center for Biological Diversity

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