CENTER FOR BIOLOGICAL DIVERSITY

Protecting endangered species and wild places through science, policy, education, and environmental law

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

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.

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.

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.

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).

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.

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.

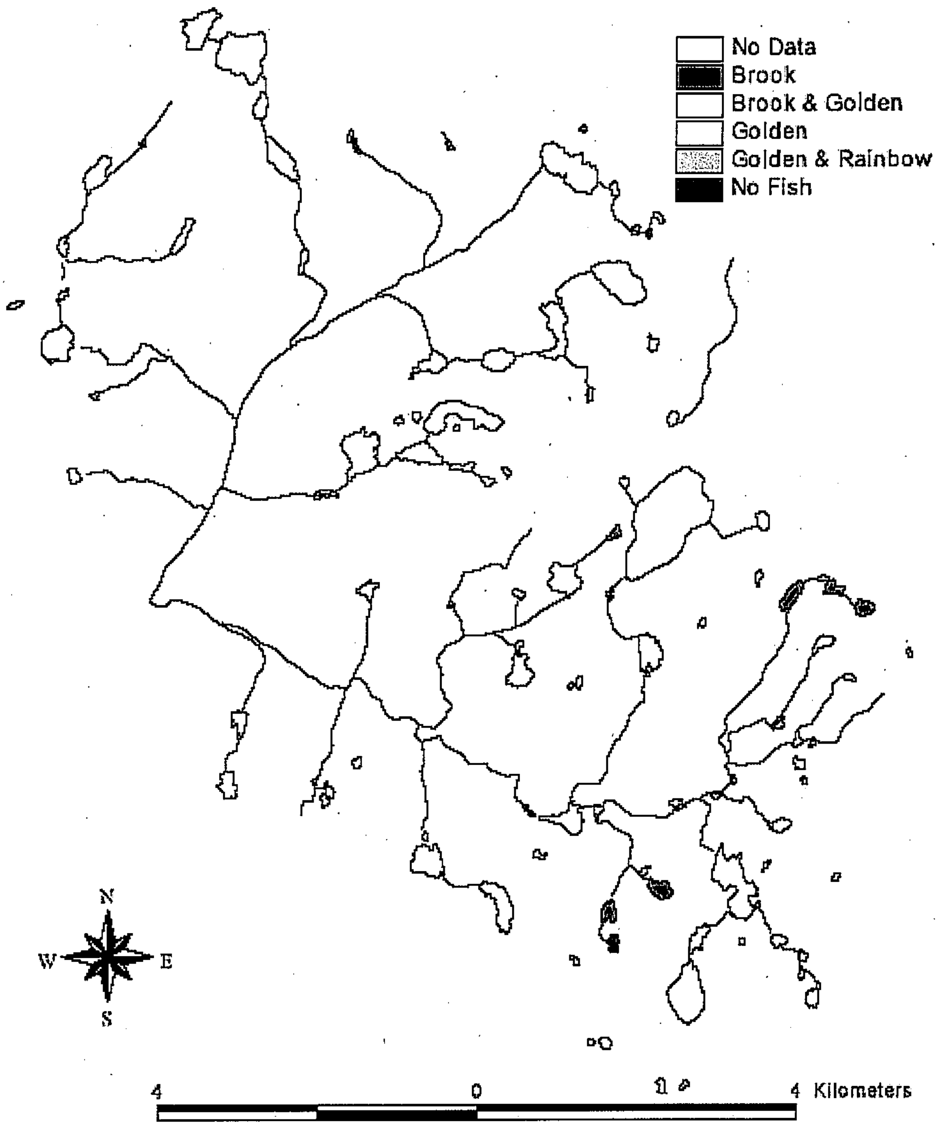
C. The Invasion of the South Fork San Joaquin and Middle Fork Kings Rivers

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

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].

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

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

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

species have impaired the beneficial uses of certain California waters.

Courtenay, W. R., and P. B. Moyle. 1992. Crimes against biodiversity: The lasting legacy of fish introductions. Transactions of the 57th North American Wildlife and Natural Resource Conference. Pp. 365-372.

Courtenay, W. R., Jr. and P. B. Moyle. 1996. Biodiversity, fishes, and the introduction paradigm. Pages 239-252 in R. C. Szaro and D. W. Johnston, eds. Biodiversity in managed landscapes. Oxford University Press: N.Y.

Drost, C. A. and G. M. Fellers. 1994. Decline of frog species in the Yosemite section of the Sierra Nevada. National Biological Survey, Univ. of Calif., Davis. iii+54

Durance, C. 2002. The Search for Introduced Eelgrass - *Zostera japonica*. Eelgrass Watchers Issue No. 1.

Fisher, R. N. and H. B. Shaffer. The decline of amphibians in California's Great Central Valley: historical patterns and anthropogenic causes. Conservation Biology xx:xx_ xx

Herbold, B., and P. B. Moyle. 1986. Introduced species and vacant niches. American Naturalist 128:751-760.

Knapp RA. 1996. Nonnative trout in natural lakes of the Sierra Nevada: an analysis of their distribution and impacts on native aquatic biota. In: Sierra Nevada Ecosystem Project: final report to Congress. Volume III. Davis (CA): Centers for Water and Wildland Resources, University of California, Davis. p 363– 407. Also available online at ceres.ca.gov/snep/pubs.

Knapp, R. A., and K. R. Matthews. 2000. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conservation Biology 14:1-12.

Knapp, R., A., P. Corn, Stephen, and D. Schindler, E. 2001. The introduction of nonnative fish into wilderness lakes: Good intentions, conflicting mandates, and unintended consequences. Ecosystems [print] 4:275-278.

Knapp, R., A. 2005. Personal communication.

Larned, S. T. 2003. Effects of the invasive, nonindigenous seagrass *Zostera japonica* on nutrient fluxes between the water column and benthos in a NE Pacific estuary. Marine Ecology-Progress Series 254:69-80.

success? Ecology 77:1666-1670.

Moyle, P. B. 1999. Effects of invading species on freshwater and estuarine ecosystems. Pages 177-191 *in* Sandlund, O.T., P.J. Schei & C. Viken, eds. *Invasive species and biodiversity management.* Kluwer, Leiden.

Moyle, P. B. 1999. Effects of invading species on freshwater and estuarine ecosystems. Pages 177-191 *in* Sandlund, O.T., P.J. Schei & C. Viken, eds. *Invasive species and biodiversity management.* Kluwer, Leiden.

Moyle, P. B., P. K. Crain, K. Whitener, and J. F. Mount. 2003. Alien fishes in natural streams: fish distribution, assemblage structure, and conservation in the Cosumnes River, California, USA. Environmental Biology of Fishes 67:277-288

Posey, M. H. 1988. Community Changes Associated with the Spread of an Introduced Seagrass, *Zostera japonica.* Ecology. 69(4). 1988. 974-983.

Relyea Rick, A., and N. Mills. 2001. Predator-induced stress makes the pesticide carbaryl more deadly to gray treefrog tadpoles (Hyla versicolor). Proceedings of the National Academy of Sciences of the United States of America [print] 98:2491-2496.

Sarnelle, Orlando, and K. Knapp. 2004. Zooplankton recovery after fish removal: Limitations of the egg bank. *Limnol. Oceanogr.,* 49(4, part 2), 2004, 1382-1392.

U.S. General Accounting Office. 2002. *Invasive Species: Clearer Focus and Greater Commitment Needed to Effectively Manage the Problem,* GAO-03-1.

Vredenburg, V. T. 2004. Reversing introduced species effects: Experimental removal of introduced fish leads to rapid recovery of a declining frog. National Academy of Sciences. Vol. 101 No. 20.

Zardus, M., T. Blank and D. Schulz. 1977. Status of fishes in 1,937 lakes in Sequoia and Kings Canyons National Parks, California. U.S. Department of Interior, National Park Service, Sequoia and Kings Canyons National Parks, Three Rivers, California.