

1                   **EXPERT REPORT OF PROFESSOR PETER B. MOYLE, PH.D.**

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4 I have been asked to provide my expert opinion on the potential effects of suction dredging on  
5 fishes of the Klamath River and tributaries, on behalf of the plaintiffs in Karuk Tribe vs  
6 California Department of Fish and Game (Superior Court of California, Alameda County,  
7 RG0521197).  
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9 I. QUALIFICATIONS AND EXPERIENCE

10           I have been researching freshwater and anadromous fish in California since 1969. I was  
11 appointed Professor of Fisheries Biology at the University of California at Davis in 1972, and  
12 held the chair of the University's Department of Wildlife, Fish and Conservation Biology from  
13 1982 to 1987. I have served as Associate Director of the Center for Integrated Watershed  
14 Science and Management since 2002. My *curriculum vitae* is attached as Exhibit A.

15           The principal area of my research and expertise is the ecology and conservation of  
16 freshwater and anadromous fishes, particularly in California. A significant portion of my  
17 research has focused on regulated streams and the impacts of dams, diversions, and other factors  
18 on fish populations in California, including the Central Valley. I have authored or co-authored  
19 more than 160 publications, most of which concern freshwater and anadromous fishes. Among  
20 my publications is *Inland Fishes of California* (Moyle 2002), the standard reference work on  
21 California fishes, as well as four other books and monographs on fishes. A list of my  
22 publications is attached as Exhibit B.

23           In 1993, I was named a Fellow of the California Academy of Sciences. I serve on the  
24 editorial boards of several peer-reviewed journals, including *Environmental Biology of Fishes*,  
25 *Biological Conservation*, and *Biological Invasions*. I am a member of the American Fisheries  
26 Society, American Society of Ichthyologists and Herpetologists, Ecological Society of America,  
27 Society for Conservation Biology, American Association for the Advancement of Science, and  
28 American Institute of Biological Sciences. I also have received an Award of Excellence from the  
29 Western Division of the American Fisheries Society (1991); recognition as a Distinguished

1 Fellow of the Gilbert Ichthyological Society (1993); the Outstanding Educator Award from the  
2 American Fisheries Society (1995, with J. J. Cech); and recognition as Distinguished Ecologist  
3 by Colorado State University (2001). I currently co-hold the President's Chair in Undergraduate  
4 Education at UC Davis.

5 In 2003, I was one of the co-authors of the National Research Council's final report on  
6 the causes of the decline and strategies for recovery of coho salmon and other fishes in the  
7 Klamath River Basin (National Research Council 2003). I also was a member of the Science  
8 Board of the CALFED Ecosystem Restoration Program and its predecessor (1998-2005), led the  
9 USFWS Delta Native Fishes Recovery Team (1993-1995), and served as a member of the USFS  
10 Sierra Nevada Ecosystem Project Team (1994-1996). I currently serve as a member of  
11 interagency Fish Screen Evaluation Committee.

12 I have previously served as an expert witness or consultant on salmon and other fishes in  
13 California in a number of venues. I was retained as a consultant by the City and County of San  
14 Francisco in a re-licensing proceeding before the Federal Energy Regulatory Commission  
15 (FERC), and served as an expert witness for the Putah Creek Council, in the *Putah Creek Water*  
16 *Cases*, Judicial Council Coordination Proceeding Number 2565 (Sacramento Superior Court). I  
17 also have testified before the State Water Resources Control Board and a congressional  
18 committee. In 2000 I was deposed as an expert witness on coho salmon in the case  
19 *Environmental Protection & Information Center. Andrea Tuttle*, Case No. 00-0713-SC (N.D.  
20 Cal). In March, 2004, I was deposed as an expert witness on the 2002 Klamath River salmon kill  
21 in the case *Pacific Coast Federation of Fisherman's Associations, Yurok Tribe, Hoopa Valley*  
22 *Tribe v. Bureau of Reclamation, Klamath Water Users, No.C 02-020006 SBA* (N.D.California). I  
23 am currently serving as an expert witness for the Natural Resources Defense Council on NRDC  
24 vs Rodgers (E.D. Cal. No. Civ. 88-1658 LKK) on restoring flows to the San Joaquin River.

25 I have also been called on to provide expertise on salmon and native fish restoration in  
26 many other venues and proceedings. For example, I recently presented expert testimony  
27 regarding Section 5937 in proceedings before the California State Water Resources Control  
28 Board involving the Santa Ynez River (*in re Santa Ynez River Public Trust Proceedings on U.S.*  
29 *Bureau of Reclamation Water Rights Permits, Applications 11331 and 11332*, 2003).

1 In relation to the suction dredging and fishes of the Klamath River, I have the following  
2 background. I have been keeping track of the status of Klamath River fishes ever since I began  
3 writing the standard reference work on California fishes, *Inland Fishes of California*, first  
4 published in 1976. In the revised edition, published in 2002, I extensively reviewed the biology  
5 and status of fishes of the Klamath Basin. I was responsible for the analyses that led to various  
6 species being listed as Species of Special Concern by the California Department of Fish and  
7 Game (Moyle et al. 1994) and with two postdoctoral scholars in my laboratory, produced the  
8 first major peer-reviewed review of the status of coho salmon in California (Brown et al. 1994).  
9 As the result of my expertise, I was appointed a member of the National Research Council's  
10 committee to review the causes of fish declines in the Klamath Basin (NRC 2003). In the  
11 summer of 2002, Dr. Jeffrey Mount and I brought a team of advanced undergraduates and  
12 graduate students into the Scott River basin to conduct field investigations on the status of coho  
13 salmon in Scott River tributaries. I am aware of the impacts of suction dredging primarily  
14 through the work of Dr. Bret Harvey, who conducted his first studies under me while a graduate  
15 student in my laboratory. Subsequently, I reviewed several drafts of the best (really *only*) review  
16 paper on suction dredging impacts in California written by Dr. Harvey (Harvey and Lisle 1998).  
17 I have also observed suction dredges at work numerous times while conducting field work.

## 18 19 II. PREVIOUS TESTIMONY

20 See qualifications section (last three paragraphs).

## 21 22 III. COMPENSATION

23 I am not being paid and have not been paid for my work as an expert witness for this legal  
24 proceeding or for other similar matters relating to the Klamath River.

## 25 26 IV. SCOPE OF ASSIGNMENT

27 I was asked by the Plaintiffs to investigate and provide expert opinion, as a fisheries biologist,  
28 on the following questions:

- 1 (1) What are the likely effects of suction dredging on anadromous fishes, especially coho  
2 salmon, in the Klamath River and its tributaries?  
3 (2) What tributaries and thermal refugia contain fish that would be particularly at risk from  
4 suction dredging?  
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## 6 V. MATERIALS CONSIDERED IN FORMULATING THIS EXPERT REPORT

7 In formulating the opinions stated in this expert report, I have relied on information I  
8 accumulated working on salmon and other California fishes since 1969. Much of this material is  
9 summarized in my 2002 book, *Inland Fishes of California* (University of California Press, 502  
10 pp) and in my 160+ peer-reviewed publications. More specifically, I considered each of the  
11 publications cited in this report and materials cited in my publications on the Klamath River.  
12 Particularly important was the research I conducted on the status of Klamath River fishes on  
13 behalf of the NRC. Thus the opinions that I express in this report are based on my 35 years of  
14 experience and publications and on periodicals, texts, research, and historical and other materials  
15 that other experts in my field would consider reliable.  
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## 17 VI. SUMMARY OF EXPERT OPINIONS

18 **Opinion 1:** All anadromous fishes in the Klamath basin should be considered to be in  
19 decline and ultimately threatened with extirpation as wild populations because of the long history  
20 of decline and the multiple threats to river system. Suction dredging through a combination of  
21 disturbance of resident fish, alteration of substrates, and indirect effects of heavy human use of  
22 small areas, especially thermal refugia, will further contribute to the decline of the fishes. I agree  
23 with thrust of Harvey and Lisle (1998), that it should be assumed that dredging is harming  
24 declining species unless it can be proven otherwise.

25 **Opinion 2.** Suction dredging should be banned from following areas, unless it can be  
26 proven using peer-reviewed scientific studies that the dredging has no short term or cumulative  
27 effects: All tributaries to the Klamath River, 500 m above and below cool-water refuge areas  
28 (stream mouths) on the mainstem Klamath River, Klamath River from Trinity River confluence

1 to Green Riffle, Canyon Creek and all other Scott River tributaries, and Salmon River  
2 including the north and south forks and all tributaries.

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4 VII. WHAT ARE THE LIKELY EFFECTS OF SUCTION DREDGING ON ANADROMOUS  
5 FISHES, ESPECIALLY COHO SALMON, IN THE KLAMATH RIVER AND ITS  
6 TRIBUTARIES?

7 The general effects of suction dredging on fish are well described in Harvey (1986) and Harvey  
8 and Lisle (1998) and so will be described only briefly here. The effects vary according to a  
9 variety of factors including size of stream, fish species present, season of dredging, and  
10 frequency and intensity of dredging. The key is that suction dredging represents a chronic  
11 unnatural disturbance of natural habitats that are already likely to be stressed by other factors and  
12 can therefore have a negative impact on fishes that use the reach being dredged. Direct effects  
13 include entrainment of invertebrates and small fish in the dredges, altering of the habitat that  
14 supports the food supply of fishes, and changing channel structure in ways that make it less  
15 favorable for fish (usually by making it less stable and complex). An area of particular concern  
16 in the Klamath River and its tributaries is the creation of piles of dredge tailings that are  
17 attractive for the spawning of salmonids but that are so unstable they are likely to scour under  
18 high flows, greatly reducing survival of the embryos placed within the gravel.

19 A more immediate effect is the impact of chronic disturbance of the fishes, which can  
20 change their behavior and cause them to move to less favorable conditions. I am particularly  
21 concerned in this regard with dredging in or near thermal refugia of juvenile salmonids. As  
22 discussed in the NRC (2003) report and references therein, the Klamath River and some of its  
23 tributaries can reach temperatures in excess of 65-70°F during the day in late summer. Such  
24 temperatures are very stressful or even lethal for many salmonids, so the fish seek out cooler  
25 areas, where small tributaries flow into the river or there is upwelling of ground water. Juvenile  
26 coho salmon, Chinook salmon, and steelhead will often be packed into these areas during the  
27 day. This past August, I spent a day with Dr. Michael Deas, who was documenting the nature of  
28 a thermal refuge created by the inflow of single creek into the Klamath River. When I swam  
29 through the refuge area with a mask and snorkel I was impressed with the concentrations of fish

1 in the area (and the lack of them in the main river) and how much even a minor disturbance of  
2 the habitat would reduce the ability of the area to support fish.

3 Adult salmon and steelhead can also be disturbed by the intense dredging activities. I am  
4 particularly concerned with spring-run Chinook salmon, a species with which I have worked  
5 closely in the Sacramento River drainage. Adult spring-run Chinook spend the summer in pools  
6 in rivers, especially the Salmon River (and its forks) and Wooley Creek. They have to survive  
7 the summer without feeding, using reserves of fats and oils they bring up from the ocean.  
8 Chronic disturbance of the type created by dredging and dredgers can increase stress on these  
9 fish and has the potential to reduce their over-summer survival. An often overlooked impact of  
10 dredging is that the people involved often live on or close to the stream in remote areas for weeks  
11 at a time, where they not only dredge, but swim, bathe, and fish (sometimes illegally). Such  
12 activity can cause spring-run Chinook to use up precious energy reserves if they have to move to  
13 less favorable areas or swim about avoiding people.

14 It is important to note that the Klamath River and its tributaries support the highest  
15 diversity of anadromous fishes of any river in California including: coho salmon, chum salmon,  
16 multiple runs of Chinook salmon, coastal cutthroat trout, multiple runs of steelhead, eulachon,  
17 green sturgeon, white sturgeon, Pacific lamprey, and river lamprey. This is the reason, of course,  
18 why the river also supported a rich and diverse fishery by the native peoples who live along the  
19 river. Today virtually all the species are in decline or threatened with declines from multiple  
20 factors (see NRC 2003). Therefore, in my professional opinion, suction dredging should only be  
21 allowed in areas where it can be demonstrated there will no immediate or cumulative impact on  
22 the anadromous fishes. It should be assumed there is harm, unless it can be proven otherwise.

23 One reason for my taking this conservative position, is that we simply do not know the  
24 effects of dredging on many species, especially when the intensity of dredging is increasing. For  
25 example, the larvae (ammocoetes) of Pacific and river lamprey live in soft materials along the  
26 stream edge or in slow-moving sections of stream. Dredging of areas where ammocoetes are  
27 abundant will push them into the water column where they can be readily consumed by  
28 predators, contributing further to the likely declines of the species. Even for salmonids, our  
29 information, with the exception of a few studies such as that of Harvey (1989), is largely

1 anecdotal or in non-peer reviewed reports (see, for example, the bibliography of DFG 1994)..  
2 Studies are also largely confined to looking at immediate effects of single dredges and they do  
3 not examine the cumulative or long-term effects of multiple dredges and activities associated  
4 with the dredges. Indeed little has changed since DFG (1994, p. 71) listed the need for additional  
5 studies on practically every important aspect of the environmental impacts of dredging. Harvey  
6 and Lisle (1998) present a strategy for acquiring much of the needed information.

## 7 8 VII. WHAT TRIBUTARIES AND THERMAL REFUGIA CONTAIN FISH THAT WOULD 9 BE PARTICULARLY AT RISK FROM SUCTION DREDGING?

10 The NRC (2003) report emphasized two important considerations for the recovery of Klamath  
11 basin fishes that are especially relevant here: (1) cold water refuges are key to the persistence of  
12 many species, especially coho salmon and (2) the entire array of anadromous fishes (i.e., the  
13 Tribal Trust Species) need large scale and pro-active measures to assure recovery. Suction  
14 dredging is one more insult to these fishes that is likely to hurt their chances for recovery. In  
15 particular, coho salmon, spring-run Chinook salmon, and summer (spring) steelhead are  
16 particularly vulnerable to the immediate effects of dredging and have been reduced to low  
17 numbers in the Klamath Basin so need special protection.

18 In my professional opinion, the following waters should be Class A (no dredging  
19 permitted) waters beyond what is already classified as such:

- 20 1. All Klamath River cold-water tributaries, including the Shasta (already class A) River. This is  
21 to protect coho salmon in particular.
- 22 2. The Klamath River below Iron Gate at the mouths of all tributaries for a minimum of 500  
23 meters (1500 ft) upstream of the mouths and 500 meters downstream of detectable coldwater  
24 influence. Most of the smaller tributaries of the Klamath River are substantially colder than the  
25 main river and the short sections along the edges that are influenced by the creeks are important  
26 summer refuges for juvenile Chinook and coho salmon, as well as steelhead. For example in  
27 2001, USFWS (unpublished data) found juvenile salmonids using refuge areas at the mouths of  
28 the following creeks: Aikins, Beaver, Blue, Bluff, Bogus, Boise, Cade, Camp, Cappell, China,  
29 Clear, Coon, Dillon, Elk, Elliott, Fort Goff, Grider, Halverson, Hopkins, Horse, Independence,

Indian, Irving, Little Grider, McGarvey, Miners, Oak Flat, Peach, Pecwan, Perch, Pine, Portuguese, Red Cap, Roach, Rock, Rogers, Roseland, Sandy Bar, Seiad, Slate, Stanshaw, Swillup, Thompson, Ti, Tinkman, Tully, Uksnom, Ullthorne, Ukanom, Upsanddown, and Walker. The mouths of the Scott, Shasta, and Salmon rivers should also be protected.

3. Klamath River from Trinity River confluence to Green Riffle, to reduce potential impacts on green sturgeon spawning and rearing.

4. Canyon Creek and all other Scott River tributaries. These streams contain cold water habitats essential for the rearing of juvenile coho salmon.

5. Salmon River including the north and south forks and all tributaries. This designation is to protect the entire suite of Klamath Basin anadromous fishes, especially coho salmon in the tributaries, spring-run Chinook and summer steelhead in the two forks of the Salmon River, and green sturgeon and lamprey in the mainstem salmon.

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Peter B. Moyle      Date

1 EXHIBIT A: CURRICULUM VITAE

2 **PETER BRIGGS MOYLE**

3 **Department of Wildlife, Fish, and Conservation Biology**

4 **And**

5 **Center for Integrated Watershed Science and Management**

6 **University of California, Davis**

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9 **530-752-6355, fax: 530-752-4154**

10  
11 **EDUCATION**

|    |      |                         |                |                     |
|----|------|-------------------------|----------------|---------------------|
| 12 | 1964 | University of Minnesota | <b>B.A. -</b>  | <b>Zoology</b>      |
| 13 | 1966 | Cornell University      | <b>M.S. -</b>  | <b>Conservation</b> |
| 14 | 1969 | University of Minnesota | <b>Ph.D. -</b> | <b>Zoology</b>      |

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16 **UNIVERSITY POSITIONS**

|    |                |                                                                          |
|----|----------------|--------------------------------------------------------------------------|
| 17 | 1969 - 1972    | Assistant Professor, Biology, California State University, Fresno, CA    |
| 18 | 1972 – present | Assistant to Full Professor, University of California, Davis, California |
| 19 | 1982 - 1987    | Chair, Department of Wildlife & Fisheries Biology, University of         |
| 20 |                | California, Davis, California                                            |
| 21 | 2002-present   | Associate Director, Center for Integrated Watershed Science and          |
| 22 |                | Management UCD                                                           |

23  
24 **PROFESSIONAL SOCIETIES/ORGANIZATIONS**

25 American Fisheries Society (national & local chapters); American Society of Ichthyologists and  
26 Herpetologists; Ecological Society of America; Desert Fishes Council; Society for Conservation  
27 Biology; AAAS; AIBS

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Editorial Boards, *Environmental Biology of Fishes*, *Biological Conservation*, and *Biological Invasions*. Expert testimony: Bay/Delta Hearings, State Water Resources Control Board; Congressional hearings, Re-authorization of Endangered Species Act, etc. Head, Delta Native Fishes Recovery Team (1993-1995); Member, Sierra Nevada Ecosystem Project Team (1994-1996); Member, Independent Science Board, CALFED Ecosystem Restoration Program; Vice President, The Natural Heritage Institute; Fisheries Consultant, City and County of San Francisco. Member, National Research Council Committee on Endangered Fishes in the Klamath Basin (2002-2003).

Teach basic courses in fish biology, wildlife conservation, fisheries, watershed ecology, and nature/culture. Co-authored (with J. Cech) widely used ichthyology text (5th edition, 2003) and co-edited (with C. Schreck) handbook on techniques for working with fish. Active in Graduate Group in Ecology (currently on Executive Committee). Steering Committee, Nature and Culture Program.

Author or co-author of over 150 peer-reviewed publications, including five books/monographs.

EXHIBIT B  
**PEER-REVIEWED PUBLICATIONS**  
**Peter Briggs Moyle**

(Does not include ca. 100 non-peer-reviewed publications)

1. Moyle P.B. and J. A. Israel. 2005. Untested assumptions: effectiveness of screening diversions for conservation of fish populations, *Fisheries* 30 (5):20-28.
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12. Crain, P.K., K. Whitener, P.B. Moyle. 2004. Use of a restored central California floodplain by larvae of native and alien fishes. Pages 125-140 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. *Early life history of fishes in the San Francisco Estuary and watershed*. American Fisheries Society Symposium 39, Bethesda, Maryland.
13. 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.

14. Feyrer, F., B. Herbold, S.A. Matern, and P.B. Moyle. 2003. Dietary shifts in a stressed fish assemblage: consequences of a bivalve invasion in the San Francisco Estuary. *Environmental Biology of Fishes* 67:277-288.
15. Matern, S. A., P. B. Moyle, and L. C. Pierce. 2002. Native and alien fishes in a California estuarine marsh: twenty-one years of changing assemblages. *Transactions of the American Fisheries Society* 131:797-816.
16. Moyle, P. B. 2002. *Inland Fishes of California. Revised and expanded*. Berkeley: University of California Press. 502 pp.
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