To: State Board of Forestry, 8/6/03

CLEARCUT ADJACENCY RULE (913.1; 33.1; 53.1)

With the existing rule, there is a colloquial saying, "4 makes 3 go away," that is: 913. 4 makes 913.3 inoperable.

The effect of that is that a clearcut unit may be butted up against another as soon as the trees in the first unit are five feet tall OR five years old.

And the effect of THAT (including other provisions of that rule re separation etc.,) is that hill slopes above rivers and creeks may be peppered with blocks, with trees anywhere from zero to five years old . Trees moderate air flow and air temperature--but not much when five feet tall, or smaller, and none when clearcut.

Science now tells us that AIR temperature is the single most influential element governing WATER temperature. We cannot influence sun spots and major climate events and conditions, so it behooves us to work doubly hard at controlling those elements over which we do have control.

So I am proposing a rule that would substitute 25 years for 5 years of age for the trees in the clearcut blocks, and 25 feet for 5 feet tall, before a unit within 300 feet in any direction may be harvested using the clearcut or other even-aged regeneration method.

In addition to cooling air temperature, so vital for amphibians and the water temperature for threatened and endangered fish, this rule would reduce erosion and slow down habitat loss. See accompanying scientific literature.

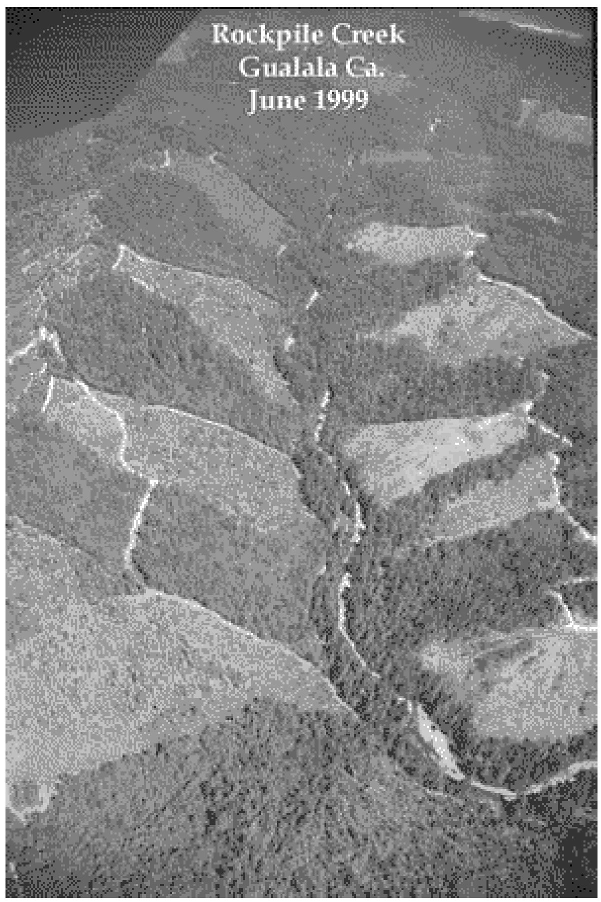
Helen Libeu

Letter to BOF re Clearcutting Forest Practice Rules

California Board of Forestry
P.O. Box 944246
Sacramento, CA 94244 -2460
August 6, 2003 (revision)

Dear Board Members,

We are increasingly seeing new listings (by the EPA and the Boards of Water Quality) of waters in California for TMDL pollutants **--** particularly, of late, listing of **temperature impaired rivers**. The Gualala and several other rivers have just been added to the State and Federal 303d lists of waters impaired for temperature. Anyone who views the slides (http://www.rrraul.org/BOF_8_6_03/BOF_8_6_03/MicroclimateBOF.html) we are exhibiting today of the Gualala River can see why this is: too many trees have been and are being removed too quickly from too many hillsides -- trees which would **shade and cool the air, which in turn cools the stream** below.



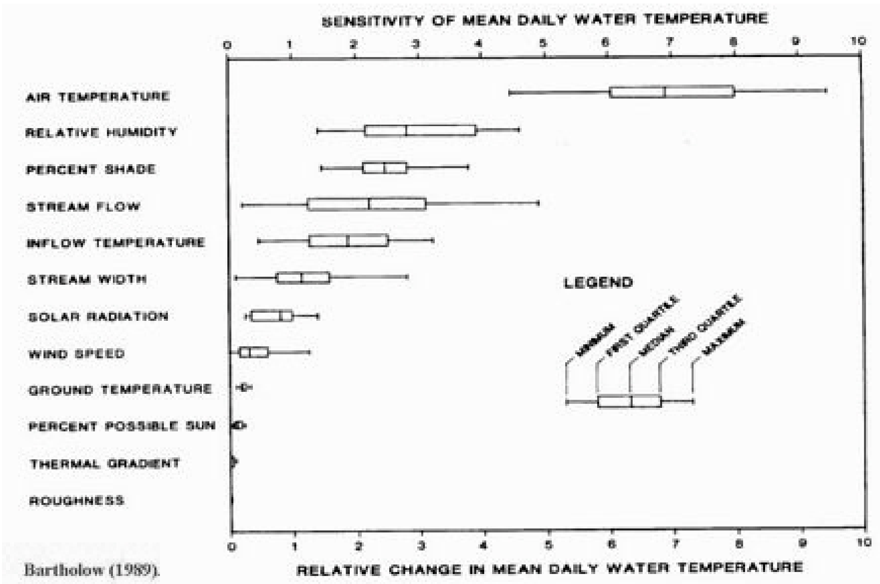
Water temperature is a **critical limiting factor** in the lives of many **fish and amphibians**. I.e., "Aquatic habitats critical to salmonids are the product of processes acting throughout watersheds and particularly within riparian areas along streams and rivers. This document depends on the premise that **salmonid conservation can be achieved only by maintaining and *restoring* these processes and their natural rates**." (Spence et al. 1996)

Consider these remarks from a Regional Water Quality Control Board North Coast Region Second Pre-harvest Inspection Report (Hope, D. 2001):

> "The Gualala River has been listed by the U.S. Environmental Protection Agency as an impaired waterbody under Section 303 (d) of the Clean Water Act. High sediment loads in the Gualala River necessitated the impairment listing [the Gualala is now also listed as temperature impaired -- Ed.]. Both coho salmon and steelhead are listed as “Threatened” under the Endangered Species Act and are present in the Gualala River and have their last refuge in the streams covered by this THP. Coho salmon in particular are sensitive to temperature increases, and require large woody debris (LWD), deep pools and abundant shade to moderate this water quality issue. Stream Maximum Weekly Average Temperatures (MWAT) listed for 8 streams in this area

> show **most streams have water temperatures that range above the preferred range for coho salmon. Given this data the NCRWQCB must consider temperatures as a limiting factor for salmonid survival and other beneficial uses in the Gualala River watershed. These documented elevated temperatures are due to removal of tree canopy that in turn increases solar exposure,** increases air mixing and lowers humidity by reducing evapotransporation. ***Increased overall basin canopy*** **has been shown to moderate local ambient air temperatures, which directly effects stream temperatures. "** (Source: http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/gualala/swrcb/hopethprpt.pdf)

Although uncertainties remain in specialized areas, the science (see the Attachments and the Bibliography below) underlying these problems is generally well-known and well-established, Specifically, with respect to clearcutting (and other forms of even-aged management), it is clear to both science and common sense that air temperature is the most important factor in stream temperature.



Bartholow (1989).

The following is an excerpt from the introduction to Essig (1998): The Dilemma of Applying Uniform Temperature Criteria in a Diverse Environment: An Issue Analysis

> "Bartholow (1989) describes the physical factors affecting stream temperatures as used in the Instream Water Temperature Model (SNTEMP) (Theurer and others 1984), and reports the results of a sensitivity analysis of the SNTEMP. When predicting mean daily water temperature, **air temperature is the most sensitive input variable**. Relative humidity is the next most sensitive input variable, accounting for less than half as much change in stream temperature. Percent shade follows a close third to relative humidity. When predicting maximum daily water temperature, air temperature is just as important, but percent shade, which affects diurnal range, overtakes relative humidity as the second most sensitive variable. For both measures, stream flow is the fourth most sensitive variable and **'water temperature is very sensitive to changes in air temperature when stream flow is low'.**" (Source: http://www.krisweb.com/krisgualala/krisdb/html/krisweb/stream/tempkr_gualala.htm)

The following is an excerpt from Poole and Berman (1999): Pathways of Human Influence on Water Temperature Dynamics in Stream Channels.

> "Stream characteristics that influence the rate of heat exchange with the atmosphere can be said to insulate the stream. These characteristics include the height, density, and proximity to the channel of riparian vegetation and the width of the stream channel. Riparian vegetation shades the stream, blocking solar radiation from reaching the channel and reducing the heat load to the stream (Hostetler 1991, Naiman and others 1992, Davies and Nelson 1994, Li and others 1994). Vegetation also reduces wind speed across the stream channel thereby trapping air against the water surface. This action reduces conductive heat exchange with the atmosphere by decreasing convection and advection of heat energy to the water surface (Naiman and others 1992). Width influences channel surface area across which heat is exchanged; a greater surface area allows for more rapid conductive heat transfer. Under the same climatic conditions, narrower, deeper channels will not exchange heat with the atmosphere as rapidly as shallow, wide channels. Similarly, riparian vegetation of a given height will shade a larger percentage of a narrow channel than a wide channel." (Source: http://www.krisweb.com/krisgualala/krisdb/html/krisweb/stream/tempkr_gualala.htm)

Consider, too, the effects that increased sedimentation (clearly visible in our slids) has had on stream temperatures in the Gualala (e.g. wider channels, increased width-to-depth ratios, simplified bed topography and the resulting reduction of hyporheic exchange, shallower pools, etc). With respect to the adequacy of the current FPRs, the State's own independent panel of scientists (Scientific Review Panel) concluded **4 years ago** that:

> "...the state agreed to organize an independent panel of scientists to undertake a comprehensive review of the California Forest Practice Rules (FPRs), with regard to their adequacy for the protection of salmonid species...
>
> The SRP concluded that the FPRs, including their implementation (the "THP process") **do not ensure protection of anadromous salmonid populations**. The primary deficiency of the FPRs is the lack of a watershed analysis approach capable of assessing cumulative effects attributable to timber harvesting and other non-forestry activities on a watershed scale. As currently applied, Technical Rule Addendum No. 2 **does not provide the necessary cumulative effects assessment** at the appropriate temporal and spatial scales." (Source: Report of the Scientific Review Panel, http://resources.ca.gov/SRP_Rept.pdf)

When, if ever, is the BOF going to acknowledge these scientific facts and do something to cure this disgraceful situation, which it has permitted for so long? In the long run, the only help will be through beneficial changes in the Forest Practice Rules, and in their enforcement.

Consider also the joint policy statement of the BOF and the California Fish and Game Commision (August, 2001), which reads in part:

> "The departments shall be guided by the understanding that it is the desire of the State of California to: 1) recover Pacific salmon and anadromous trout populations to viable self-sustaining levels; 2) maintain wild populations where they exist; 3) restore populations where feasible; 4) sustain the human uses that depend on them; and 5) ultimately allow for delisting... All feasible steps shall be taken to protect habitat and facilitate habitat recovery. The Board and Commission shall oppose any project which will result in the irreplaceable loss of fish, the net loss of fish habitat and/or impede the recovery of populations and habitat."

Brave words. Helen Libeu is today proposing a microclimate alteration in the rules regarding clearcutting: a rule whose effect would be to prohibit adjacent cuts until the trees removed in a clearcut have been replaced by new growth reaching twenty-five feet. That is a entirely sensible restriction which would both permit continued logging and go a long way towards cooling off our overheated streams. **We strongly urge you to adopt this rule.**

Sincerely,
Jay Halcomb
Russian River Residents Against Unsafe Logging (RRRAUL)
<http://www.rrraul.org>

Attachments (excerpts):

California Regional Water Quality Control Board (CRWQCB). 2001. Assessment of aquatic conditions in the Mendocino coast hydrologic unit. North Coast Region, CRWQCB. Santa Rosa, CA. 284 pp.

Higgins, P.T. 1997. Gualala River Watershed Literature Search and Assimilation. Funded by the Coastal Conservancy under contract to Redwood Coast Land Conservancy. Gualala, CA. 59 pp

Libeu, Helen: Microclimate Rule Proposal, Presentation to the California Board of Forestry

Rynearson, Gary, Frank Ligon, Alice Rich, Dale Thornburgh, and William Trush, Report of the Scientific Review Panel on California Forest Practice Rules and Salmonid Habitat, June 1999, Prepared for The Resources Agency of California and the National Marine Fisheries Service, Sacramento, California Scientific Review Panel.

Bibliography:

Armour, C.L. 1991. Guidance for evaluating and recommending temperature regimes to protect fish. U.S. Fish and Wildlife Service. Fort Collins. Biological Report 90(22). 13 p.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/usfws/armour.pdf>

Bartholow, J.M. 1989 . Stream temperature investigations: field and analytic methods. Instream flow information paper no. 13. Biological Report 89(17). U.S. Fish and Wildlife Service, Fort Collins, Co.

<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/usfws/bartholo.pdf>

Bartholow, John M., U.S. Geological Survey: Estimating Cumulative Effects of Clearcutting on Stream Temperatures
<http://smig.usgs.gov/SMIG/features_0902/clearcut.html>

Beschta, R.L., and R.L. Taylor. 1988. Stream temperature increases and land use in a forested Oregon watershed. Water Resources Bulletin. 24:19-25.

Bolton, Susan and Carrie Monohan: A Review of the Literature and Assessment of Research Needs in Agricultural Streams in the Pacific Northwest as it Pertains to Freshwater Habitat for Salmonids, Center for Streamside Studies University of Washington, July 21, 2001.
< http://depts.washington.edu/cssuw/Research/finalcted.pdf>

Bourque, Charles P.-A. and Joseph H. Pomeroy, 2001: Effects of forest harvesting on summer stream temperatures in New Brunswick, Canada: an inter-catchment, multiple-year comparison, Hydrology and Earth System Sciences, 5(4), 599–613.
< http://www.copernicus.org/EGS/hess/hs5/5/599.pdf>

Brett, J.R. 1952. Temperature tolerance in young Pacific salmon, genus Oncorhynchus. J. Fish. Res. Board of Canada. 9(6):265-323.
<http://www.humboldt.edu/~fsp/tim/1952article.html>

CA Department of Fish and Game. 2002. Status Review of California Coho Salmon North of San Francisco . Report to the California Fish and Game Commission. California Department of Fish and Game, Sacramento , CA. 336pp.
<http://www.dfg.ca.gov/nafwb/pubs/2002/2002_04_coho_status.pdf>.

California Regional Water Quality Control Board (CRWQCB). 2001. Assessment of aquatic conditions in the Mendocino coast hydrologic unit. North Coast Region, CRWQCB. Santa Rosa, CA. 284 pp.
<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/regional/swrcb/assessmentmhu2001.pdf>

CA Resources Agency. 2002. DRAFT Gualala Watershed Synthesis Report. April 2002. Sacramento, CA. 145 pp (report body, 6.1 Mb pdf file) and 123 pp (appendices, 9.2 Mb pdf file) .
<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/gualala/gualala_synthesis_draft_appendix.pdf>
<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/gualala/gualala_synthesis_draft_appendix.pdf>

Chen, J., Franklin, J.F. and Spies, T.A., 1993. Contrasting microclimates among clearcut, edge, and interior old-growth Douglas-fir forest. Agriculture and Forest Meteorology, 63: 219-237.

Cooperrider, A., R.F. Noss, H.H. Welsh, Jr., C. Carroll, W. Zielinski, D. Olson, S.K. Nelson, and B.G. Marcot. 2000. Terrestrial fauna of redwood forests. (136k) Pages 119-163 in R.F. Noss, ed., The Redwood Forest: History, Ecology, and Conservation of the Coast Redwoods. Island Press, Covelo, California.
<http://www.fs.fed.us/psw/rsl/projects/wild/cooperrider1.pdf>

Dong, J., J. Chen, K. D. Brosofske and R. J. Naiman: Modelling air temperature gradients across managed small streams in western Washington
<http://research.eeescience.utoledo.edu/lees/pubs/Dongetall1998.pdf>

Essig, D. 1998. The Dilemma of Applying Uniform Temperature Criteria in a Diverse Environment: An Issue Analysis. Idaho Division of Environmental Quality Water Quality Assessment and Standards Bureau, Boise, ID. 34p.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/misc/essigidahotemp.pdf>

Hicks, M. 2000. Preliminary Review Draft Discussion Paper Evaluating Standards for Protecting Aquatic Life In Washington's Surface Water Quality Standards Temperature Criteria. Washington State Department of Ecology, Water Quality Program, Watershed Management Section. Olympia, Washington.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/misc/hicks2000.pdf>

Higgins, P.T. 1997. Gualala River Watershed Literature Search and Assimilation. Funded by the Coastal Conservancy under contract to Redwood Coast Land Conservancy. Gualala, CA. 59 pp.

<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/regional/misc/higginsgual.pdf>

Hope, D. 2001. Little North Fork Gualala Pre-Harvest Inspection Report. North Coast Regional Water Quality Control Board. Santa Rosa, CA. 14 p p.
<http://www.krisweb.com/krisgualala/krisdb/html/krisweb/biblio/gualala/swrcb/hopethprpt.pdf>

Ice, George: HOW DIRECT SOLAR RADIATION AND SHADE INFLUENCES TEMPERATURE IN FOREST STREAMS AND RELAXATION OF CHANGES IN STREAM TEMPERATURE, National Council for Air and Stream Improvement.
<http://www.ncasi.org/forestry/research/watershed/radiation.pdf>

Keeton, William S., Jerry F. Franklin, and Philip W. Mote: Climate Variability, Climate Change, and Forest Ecosystems in the Pacific Northwest, in *Rhythms of Change: Climate Impacts on the Pacific Northwest*, by Edward L. Miles, Amy K. Snover, and the Climate Impacts Group.
<http://tao.atmos.washington.edu/PNWimpacts/585/ROC_Ch6.pdf>

Ledwith, Tyler: "The Effects of Buffer Strip Width on Air Temperature and Relative Humidity in a Stream Riparian Zone"
<http://watershed.org/news/sum_96/buffer.html>

Lewis, T., D.W. Lamphere, D.R. McCanne, A.S. Webb, J.P. Krieter and W.D. Conroy. 2000. Executive Summary: Regional Assessment of Stream Temperatures Across Northern California and Their Relationship to Various Landsa\cape-Level and Site-Specific Attributes. Forest Science Project. Humboldt State University Foundation, Arcata, CA. 14 p.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/misc/lewis2000.pdf>

Rynearson, Gary, Frank Ligon, Alice Rich, Dale Thornburgh, and William Trush, Report of the Scientific Review Panel on California Forest Practice Rules and Salmonid Habitat, June 1999, Prepared for The Resources Agency of California and the National Marine Fisheries Service, Sacramento, California Scientific Review Panel
<http://resources.ca.gov/SRP_Rept.pdf>

Little Hoover Commission. 1994. Timber Harvest Plans: A Flawed Effort to Balance Economic & Environmental Needs. Milton Marks Commission on California State Government Organization and Economy. Sacramento, CA. 84 pp.
<http://www.lhc.ca.gov/lhcdir/126rp.html>

McCullough, D. 1999 . A Review and Synthesis of Effects of Alterations to the Water Temperature Regime on Freshwater Life Stages of Salmonids, with Special Reference to Chinook Salmon. Columbia Intertribal Fisheries Commission, Portland, OR. Prepared for the U.S. Environmental ProtectionAgency Region 10. Published as EPA 910-R-99-010.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/misc/mccullough99.pdf>

National Marine Fisheries Service. 1996. Coastal Salmon Conservation: Working Guidance for Comprehensive Salmon Restoration Initiatives on the Pacific Coast. NMFS, Northwest Region, Seattle, WA. 6 p.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/nmfs/salmon.pdf>

Noss, Reed F. (2001) Beyond Kyoto: Forest Management in a Time of Rapid Climate Change. Conservation Biology 15 (3), 578-590.
< http://mailer.fsu.edu/~jstallin/dir/course/home/Geo5934/Noss.pdf>

Poole, G.C., and C.H. Berman. 2000. Pathways of Human Influence on Water Temperature Dynamics in Stream Channels. U.S. Environmental Protection Agency, Region 10. Seattle, WA. 20 p.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/usepa/pathways.pdf>

Poole, Geoffrey, John Risley, and Mark Hicks: Issue Paper 3: Spatial and Temporal Patterns of Stream Temperature, U.S. EPA, Oct. 2001.
<http://yosemite.epa.gov/R10/WATER.NSF/6cb1a1df2c49e4968825688200712cb7/5eb9e547ee9e111f88256a03005bd665/$FILE/Paper%203-Spatial-temporal-10-29.PDF>

Spence, B.C, G.A. Lomnicky, R.M. Hughes and R.P. Novitski. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Corp, Corvalis, OR. Funded by National Marine Fisheries Service, U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency. Available from NMFS, Portland, OR.
<http://www.nwr.noaa.gov/1habcon/habweb/ManTech/front.htm>

Standiford, R.B. and R. Arcill. 2001. A Scientific Basis for the Prediction of Cumulative Watershed Effects. The University of California Committee on Cumulative Watershed Effects. University of California. Berkeley, CA. 103 pp.
<http://www.cnr.berkeley.edu/forestry/curr_proj/cwe/cwe_i.html>

Sullivan, K., D.J. Martin, R.D. Cardwell, J.E. Toll, and S. Duke. 2000. An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria. Sustainable Ecosystems Institute. Portland, OR. 192 pp. [1.5Mb]
<http://www.sei.org/downloads/reports/salmon2000.pdf>

Thornburgh, D.A., R.F. Noss, D.P. Angelides, C.M. Olson, F. Euphrat, andH.H. Welsh, Jr. 2000. Managing redwoods. (216k) Pages 229-261 in R.F. Noss, ed., The Redwood Forest: History, Ecology, and Conservation of the Coast Redwoods. Island Press, Covelo, California.
<http://www.fs.fed.us/psw/rsl/projects/wild/thornburgh1.pdf>

> See especially the section: Appendix 8.I. California Forest Management and Aquatic/Riparian Ecosystems in the Redwoods, which discusses CDF and the FPRs.

Teti, Patrick A. 1998. The Effects of Forest Practices on Stream Temperature, A Review of the Literature. Unpub. Rpt. For the Ministry of Forests.
< http://www.for.gov.bc.ca/kamloops/district/merritt/tss/temp_review.pdf>

Torgersen, Christian E., Nathan J. Poage, Oregon State University/USDA Forest Service, Dept. of Fisheries and Wildlife, Forestry Sciences Lab, Corvallis, OR: Airborne Thermal Remote Sensing Of Salmonid Habitat For Restoration Planning In Pacific Northwestern Watersheds,
<http://www.for.gov.bc.ca/kamloops/district/merritt/tss/temp_review.pdf>

Washington State Department of Ecology. 1996 . Water Quality Standards for Aquatic Life. Wash. Dept. of Ecology, Olympia, WA.
<http://www.krisweb.com/kristenmile/krisdb/html/krisweb/biblio/general/misc/watribal.pdf>

Watson, Robert T. Ian R. Noble, Bert Bolin, N. H. Ravindranath, David J. Verardo and David J. Dokken (Eds.):**Land Use, Land-Use Change, and Forestry** (Summary for Policy Makers). 2000 Special Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, UK. pp 375
<http://www.ipcc.ch/pub/reports.htm>

Welsh, Jr., Hartwell H., Garth R. Hodgson, and Bret C. Harvey: Distribution of Juvenile Coho Salmon in Relation to Water Temperatures in Tributaries of the Mattole River, California, U.S. Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521.
<http://www.fs.fed.us/psw/rsl/projects/wild/welsh/welsh5.pdf>

Welsh, H.H., Jr., T.D. Roelofs, and C.A. Frissell. 2000. Aquatic ecosystems of the redwood region. (316k) Pages 165-199 in R.F. Noss, ed., The Redwood Forest: History, Ecology, and Conservation of the Coast Redwoods. Island Press, Covelo, California.
<http://www.fs.fed.us/psw/rsl/projects/wild/welsh/welsh12.pdf>

> See especially the sections: Changes in Stream Ecosystem Processes Resulting from Timber Harvesting and Related Activities, and Stream Classification and Its Problems, which discusses CDF and the FPRs.

For more information on air and stream temperature, see also:

The Klamath Resource Information System (KRIS)
<http:www.krisweb.com>

> Aquatic habitats critical to salmonids are the product of processes acting throughout watersheds and particularly within riparian areas along streams and rivers. This document depends on the premise that salmonid conservation can be achieved only by maintaining and restoring these processes and their natural rates.

McCullough (1999) also describes the importance of understanding the requirements of salmonids on a watershed level:[8]

> In the management of coldwater fish species, the greatest degree of expression of life history variation by species is achieved by restoration of the thermal regime on a stream system-wide basis, along with other pre-management conditions of channel morphology and the watershed. Moving the summer maximum temperature threshold upstream constricts the available spawning or rearing area of all coldwater fish species. Fish zonation from headwaters to downstream reaches in the Pacific Northwest can be characterized roughly as proceeding from bull trout/cutthroat trout to steelhead, to spring chinook/coho, to summer chinook, to fall chinook, to chum (Li et al. 1987). With the exception of bull trout, the other species do not vary substantially in their response to summer maximum temperature. However, they do vary in their preference for size of spawning and rearing stream, size of spawning gravel, and stream gradient tolerated. Increase in summer maximum temperature in headwater stream zones cannot occur without causing increase to downstream reaches. Constraining species more and more to compete in high gradient streams that may provide suitable water temperatures would severely limit production and impair survival in the majority of the historic habitat of each species, but further, it is not feasible energetically for large-stream species to occupy smaller, high gradient streams."

The habitat features that determine the suitability of a stream for salmonids include (Spence et al. 1996):

1. Flow regime – depth and velocity of water, total available habitat, sediment distribution, gravel flushing and movement, vegetation dispersal
2. Water quality – cool temperatures, high dissolved oxygen, natural nutrient concentrations, low levels of pollutants
3. Habitat structure – pools, riffles, substrate cover, depth, channel complexity
4. Food sources – maintain natural inputs of food and the habitat structures needed to retain food
5. Biotic interactions – competition, predator-prey, and disease-parasite interactions

In general, salmonids require cold water with low turbidity. Since salmonids are poikilothermic, water temperature has a fundamental effect on all of their life processes. Water temperature is a trigger for some changes in salmonid life stages. "Variation in temperature is required to trigger spawning, support growth, initiate smoltification, and enable other parts of the salmonid life cycle."[9] Water temperatures outside of the preferred ranges can cause lethal and sublethal effects. "Two important elements of temperature affect the growth and survival of fish: 1) the relationship between temperature, metabolism, and food conversion efficiency over long periods, and 2) the

---

8 McCullough 1999, Page 193.

9 Spence et al. 1996, page 4.

thermal tolerance of fish to lethal temperatures over relatively short periods."[10] Some of the salmonid life cycle processes affected by temperature include: metabolism; food requirements (appetite and digestion); growth rates; development of embryos and alevin; timing of life history events (such as adult migration, fry emergence, smoltification); competitor and predator-prey interactions; disease-host and parasite-host interactions; and, the development of aquatic invertebrate food sources (Spence et al. 1996, McCullough 1999, Sullivan et al. 2000). McCullough (1999) explains that even within the range of tolerance, water temperatures may affect salmonid behavior and survival.

> Within temperature boundaries defined by the tolerance zone, swimming, metabolism, growth, food conversion efficiency, reproductive capacity, embryonic development, and aggregation of fishes (Brett 1970, Alderdice 1972; both as cited by Griffiths and Alderdice 1972) may all have different response fields and may each have an influence on survival and fitness.[11]

For cold water fish, such as salmonids, on the North Coast the critical temperature regime is associated with summer rearing because water temperatures during summer have been recorded routinely above the preferred range. The range of temperature requirements for coho salmon are shown in Table 2.2 and are discussed as they relate to individual life stages further in this chapter.

---

10 Sullivan et al. 2000, page 2-2.
11 McCullough 1999, page 168.

TABLE 2.2
TEMPERATURE REQUIREMENTS FOR COHO (Bjornn and Reiser 1991, Spence et al. 1996, McCullough 1999, Sullivan 2000)

Temperature (°C)	Adult Migration	Spawning	Egg & Alevin Incubation	Preferred Juvenile Rearing	Smoltification & Outmigration	Lethal Limits
25						**Upper Lethal**
24						
23						**Cease Growth**
22						
21						
20						
19						
18						
17						
16						
15	**15.6**					
14				**14.6**		
13			**13.3**			
12					**12**	
11				**11.8**		
10						
9		**9.4**				
8						
7	**7.2**					
6						
5						
4		**4.4**	**4.4**		**4.5**	
3						
2						
1						**Lower Lethal**
0						

The shaded areas refer to the upper and lower temperature range limits.

Stream temperature also determines the amount of dissolved oxygen ("D.O.") that can be carried by a stream, with higher temperatures resulting in lower dissolved oxygen concentrations. Salmonids require well-oxygenated water. Spence et al. (1996) report that greater than 6 mg/l D.O. is a general requirement and that levels below saturation can be harmful.

Excess sediment in streams can affect salmonids at every life stage. Spawning and incubation are most directly affected by deposited sediments -- decreasing flow of water through the gravel interstices, thereby reducing the dissolved oxygen, raising the temperature, and physically blocking emergence of fry from the redd (Spence et al. 1996). Rhodes (1994) states, "The negative correlation of salmonid survival and production to fine sediment has been mainly attributed to reduced survival-to-emergence

Clear-cut logging offers a great deal more opportunity for surface erosion and a higher likelihood of landsliding because of loss of root strength (Ziemer, **1981)** and changes in hillslope drainage. Spacek (1997) noted that slope failures in clear-cut areas may contribute a significant portion of sediment to streams during large storm events and cited a study Aerial Reconnaissance Evaluation of 1996: Storm Effects on Upland Mountainous Watersheds of Oregon and Southwest Washington (PWA, 1996c). Much of the logging currently conducted in the Gualala River basin is selective harvest that poses substantially less erosion risk (CFL, 1997). Although widespread timber harvest has taken place in the North Fork Garcia River, the use of selective harvest and road improvements have prevented additional major incursions of sediment (Hagans and Higgins, 1996).

The California Forest Practice rules allow timber harvest in riparian zones that may not be sufficient to allow recovery of coho salmon and steelhead (Spence et al, 1996). While at least 50% canopy must be maintained under the rules, only 25% of that must be conifers. In order to bring temperatures down to the range optimal for salmonids, a secondary over-story of conifers is needed (Spence et al, 1996).

Water Temperature: Although the Gualala River is not currently listed as impaired with regard to water temperature, available data suggests that temperatures are much higher than optimal for salmon and steelhead. The Oregon Department of Environmental Quality (ODEQ, 1995) states that optimal temperatures for rearing coho salmon is between 11.8-14.60 C (53-580 F). Juvenile coho salmon cease growth at 20.30 C (690 F) and their upper lethal limit is 250 C (770 F). Temperature data from Fuller Creek, Buckeye Creek, Rockpile Creek and the Wheatfield Fork of the Gualala River all exceeded optimal.

Doug Simmonds monitored both the North Fork and South Fork of Fuller Creek in 1997 (Figures 16 and 17) using automated temperature sensing devices provided by the NCRWQCB. The probes were placed in a shaded portion of the stream in flowing water, as opposed to pools which may stratify. The North Fork attained a maximum water temperature of 740 F while the South Fork water temperature reached as high as 760 F. Both creeks were over 700 F for at least some portion of the day during most of June and July. While Fuller Creek still supports steelhead trout (Cox, 1989, 1995), it is still too warm at present to be suitable for coho salmon.

Temperature data from Gualala Redwoods was available in the NCRWQCB files for Rockpile Creek at two locations and Buckeye Creek at three locations. Rockpile Creek reached a maximum of approximately 740 F in the middle reach of the stream while the maximum temperature of the lower reach was a degree cooler (730 F). Both these stream reaches exceeded stressful temperatures for salmonids for several days in June and July of 1995. Temperature sensors in Buckeye Creek showed a similar trend toward cooling in lower reaches. Maximum water temperatures in 1995 were 760 F in the upper reach, 750 F in the middle reach and 730 F in the lower reach.

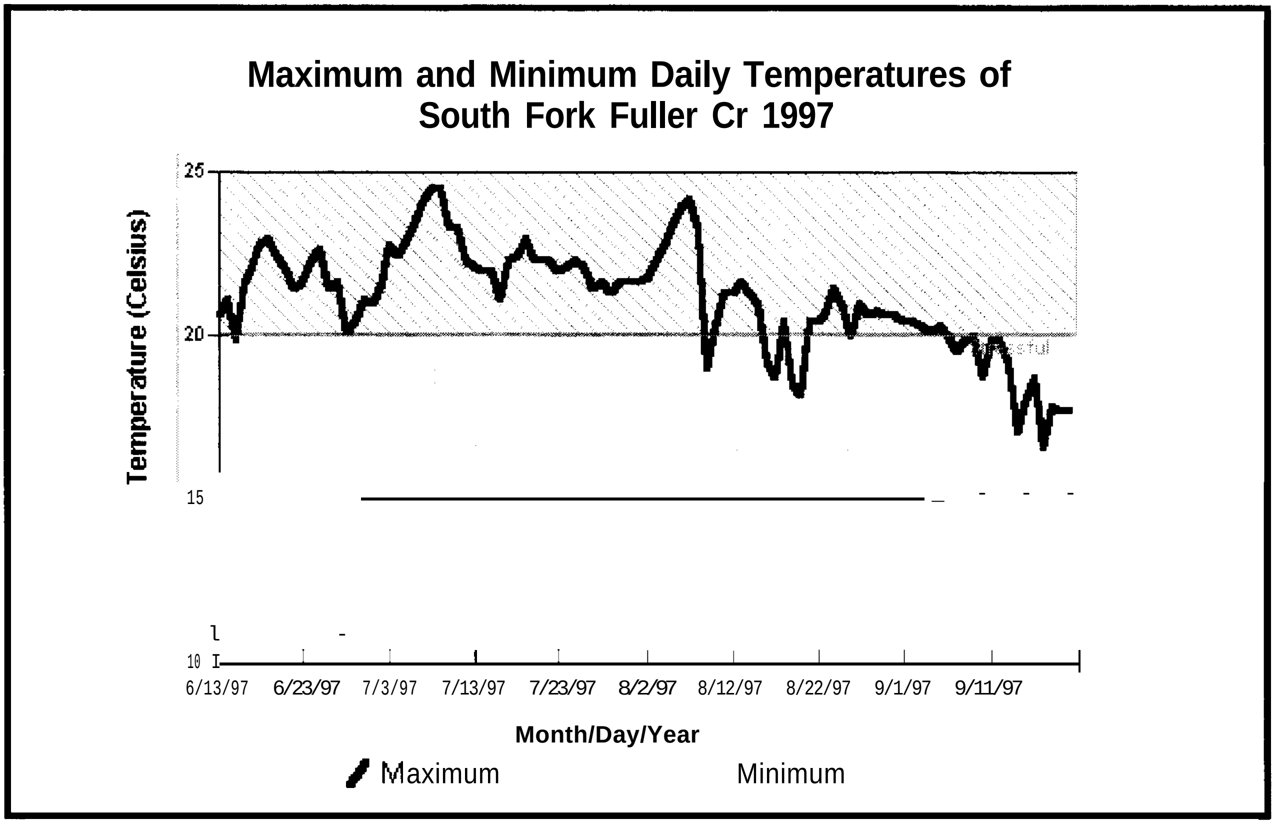


Figure 16A. Temperature graph from Hobotemp placed in S.F. Fuller From Doug Simmonds.

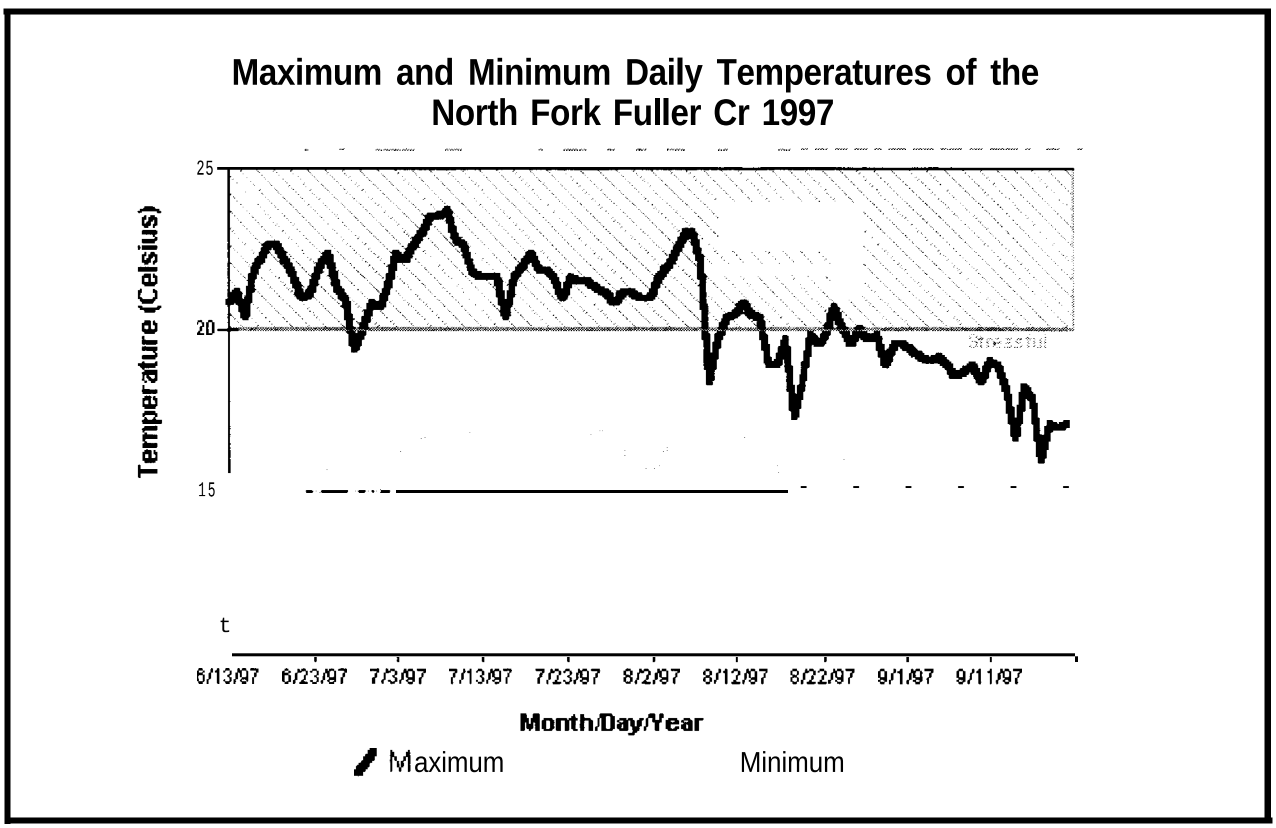


Figure 17. Water temperature from Hobotemp placed in N.F. Fuller Creek by Doug Simmonak

The highest water temperatures discovered during this project were collected by Doug Simmonds in the Wheatfield Fork of the Gualala just above Fuller Creek. The maximum water temperature recorded in 1997 was 83^0 F, which is lethal for salmonids. Water temperatures exceeded 800 F during several intervals in June, July and early August. Klein (1997), in comments on the draft of this report, noted that the Wheatfield Fork of the Gualala runs through sparsely vegetated earthflow terrain which may contribute naturally to its warming.

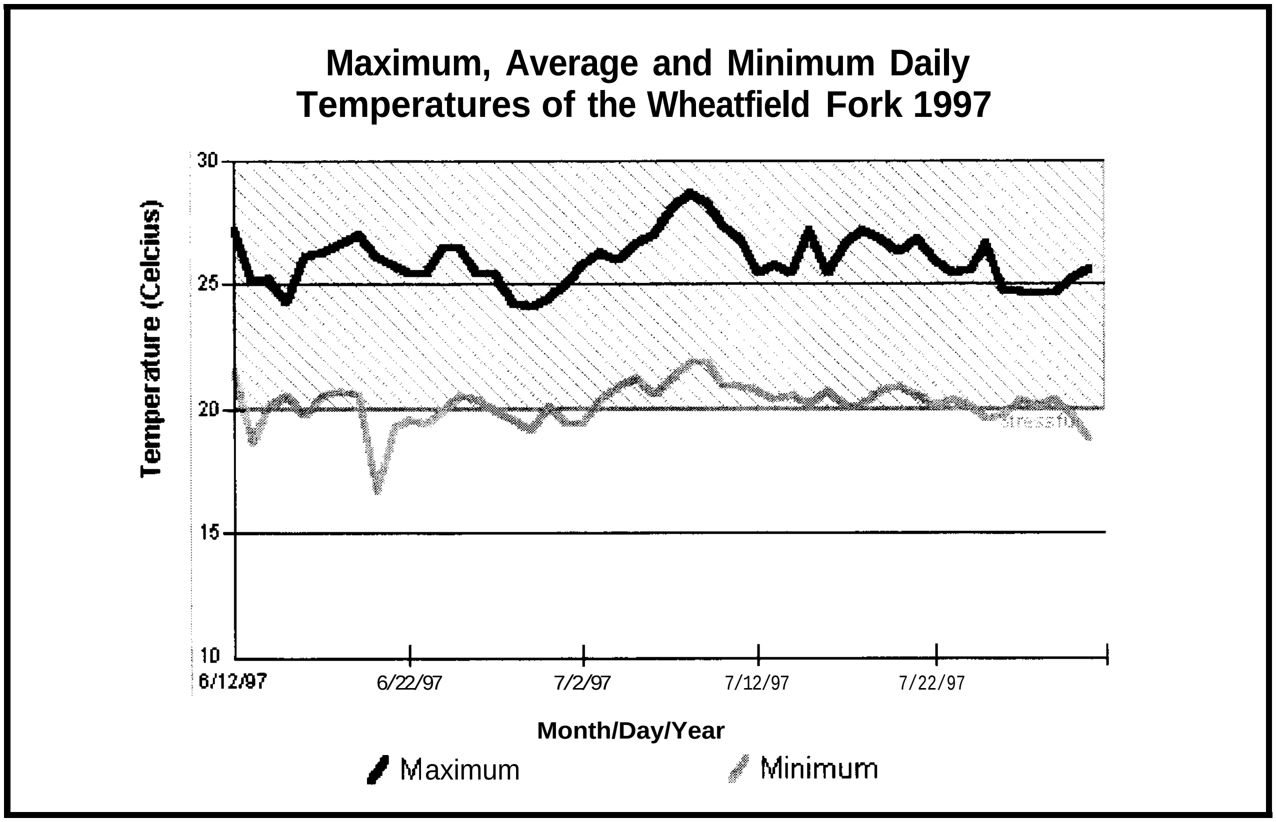


Figure 18. *Water temperature of Wheatfield Fork Gualala River as recorded by a Hobotemp placed by Doug Simmonds.*

TMDL: Water pollution has been successfully abated in the eastern United States through use of regulatory mechanism under the Clean Water Act known as Total Maximum Daily Loads (TMDL). Recently a lawsuit was brought against the U.S. Environmental Protection Agency (EPA) and the California State Water Resources Control Board for failure to enforce statutes of the Clean Water Act. Numerous northern California rivers had been recognized as impaired but no deadlines had been set to abate sources of pollution to these water bodies. The action was settled out of court when the EPA and SWRCB set a timeline for implementation of TMDL standards. The first watershed that must come into compliance is the Garcia River and a draft Garcia River Water Oualitv Attainment Stratew for Sediment (Mangelesdorf, in press). The Gualala River must have an attainment strategy by 200 1.

Executive Summary

The Scientific Review Panel (SRP) was created under the auspices of the Watershed Protection and Restoration Council, as required by the March 1998 Memorandum of Agreement (MOA) between the National Marine Fisheries Service (NMFS) and The Resources Agency of California. Under this agreement the state agreed to organize an independent panel of scientists to undertake a comprehensive review of the California Forest Practice Rules (FPRs), with regard to their adequacy for the protection of salmonid species.

NMFS and The Resources Agency jointly developed a letter that posed a series of questions regarding a review of the FPRs, the THP review and approval process, and the rule-making process. They also requested that the public be involved and provide comments and information to the SRP. Beyond this input, no state or federal agency provided any direction to, or had any control over, the SRP. The state and federal MOA specifically addressed steelhead in the Northern California and Klamath Mountains Province ESUs within California. Considerations and recommendations presented in this report apply to this geographic area and are not necessarily applicable to other areas.

Approach

To implement the project, the SRP (first convening in November 1998) agreed to operate by consensus, with one member serving as coordinator. The SRP also developed a plan to involve the public, state and federal agencies, landowners, and other interested parties. A total of 29 constituency groups (comprising 128 interviewees) interested in salmonid issues was invited to meet with the SRP. Interviewees included state and federal agency representatives, environmental representatives, large and small landowners, foresters, geologists, watershed specialists, fisheries representatives, fish/habitat restorationists, South of San Francisco ("856 counties") representatives, and fish biologists. Following the interviews, the SRP visited THP sites in Humboldt and Mendocino counties.

Overall Conclusions

The SRP concluded that the FPRs, including their implementation (the "THP process") do not ensure protection of anadromous salmonid populations. The primary deficiency of the FPRs is the lack of a watershed analysis approach capable of assessing cumulative effects attributable to timber harvesting and other non-forestry activities on a watershed scale. As currently applied, Technical Rule Addendum No. 2 does not provide the necessary cumulative effects assessment at the appropriate temporal and spatial scales. Therefore, with regard to the SRP's mandate, the state will need to sponsor and conduct watershed analyses in all watersheds within both steelhead ESUs. Also, specific rules governing onsite operations and road maintenance need stronger enforcement and/or modification to further minimize sediment production, improve stream habitat, and guarantee unrestricted passage by migrating juvenile and adult salmonids. The SRP focused on the following rule sections: watercourse protection measures, road construction and maintenance, and winter operations limitations. Finally, the SRP reviewed Timber Harvesting Plan (THP) implementation issues, especially RPF involvement throughout the THP process as well as THP review and approval procedures, and developed recommendations for improving this process.

Watershed Analysis

The SRP recommends watershed analysis as the best available tool to evaluate past, ongoing, and potential future cumulative watershed effects (CWEs) resulting from forest management and