Shasta Watershed Restoration Plan

Shasta River Coordinated Resources Management and Planning Committee

Shasta Watershed Plan

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SHASTA RIVER CRMP ACTION PLAN

In order to write an action plan like this, there seems to be no way to avoid taking an unbalanced approach-- everything written here focuses entirely on problems. Yet the truth is that every industry has its impacts. Our purpose is to identify what negative impacts there are on water quality in the Shasta River, and find ways to minimize them. To the extent that we are successful in doing that, we will make agriculture in Siskiyou County stronger in the long run.

We have made an effort to keep this document brief and readable. One of the unfortunate consequences of this is that we make no mention of the beneficial uses that the river and its water have been put to--farming, ranching, etc., with its resulting set of jobs created, bills paid, spin-off jobs, and ultimately food for many people. In the end, there is no discussion at all of the various cultural, social, or economic values that absolutely depend on access to water to make otherwise dry land productive, and economic survival in the Shasta Valley possible for many of the people now living there.

Yet at the same time, we must also fail to explain and describe the benefits of improving salmon production, and assume that everyone understands the key role the Shasta plays in a $50,000,000/year fishing industry. An industry financially benefiting both residents of Siskiyou County through sportfishing camping and tourism, and also people downriver and on the coast. The fishing industry also directly translates into jobs for families, bill payments, and food for people.

Finally, by focusing only on problems, this plan creates an image of a river in which nothing is right from a fishery standpoint, when in fact the whole point of the overall effort is that there is so much that is "right" with the river that returning it to economic production appears to be quite possible by reasonable means.

We recognize all these shortcomings, but have chosen to accept them as the necessary cost of developing an action plan that is brief and concise enough to be easily read, understood and discussed by people living and working in the Shasta Valley.

We trust that each person reading this will recognize, as we do, that this document presents only part of the whole picture. And that to succeed, any changes that we might suggest will somehow have to meet the needs and desires of all the people who are going to be affected.

Introduction:

The Shasta River Coordinated Resources Management and Planning Committee is a group made up of all landowners from the Shasta Valley, along with representatives of the Calif. Dept. of Fish and Game, Natural Resources Conservation Service, Bureau of Land Management and the Klamath River Basin Fishery Task Force. All meetings are open to the public, and business will be conducted only with a minimum of five members present.

As a group, active members of the CRMP are committed to both identifying and assisting with actions that landowners in the Shasta Valley can voluntarily take that will result in an improvement in the survival of anadromous fish in the Shasta River. Each of the active members of, the CRMP urges other landowners throughout the Shasta Valley to work cooperatively with those agencies involved in the protection of fish, wildlife, and other public trust resources. It is their belief that all of us working together on these resource issues will do the most to preserve and strengthen agriculture as an integral part of life in Siskiyou county.

While the Shasta River CRMP includes the entire watershed, the primary focus at present is the portion that is either accessible to or directly affects anadromous fish (the Shasta below Dwinnell Dam, Parks Creek, Little Shasta River and Yreka Creek). As needs for planning become apparent in other areas of the watershed, other sub-basin groups can be formed to develop sections to be added to this plan. Eventually this is expected to result in sub-basin groups each with its own sphere of influence and expertise, collectively planning for the needs of the watershed.

Action Plan Format:

This document is divided into sections. On the following pages is the C R P Action Plan, presented with as little explanatory text as possible. Following that is the Calif. Department of Fish and Game's Biological Needs Assessment that is attached as a separate document. The Biological Needs Assessment consists of a description of the conditions desirable for salmon and steelhead, along with a summary of current conditions in the Shasta River. The Biological Needs Assessment should provide enough information to understand the need for the actions called for in the CRMP Action Plan.

Other background and supporting information is provided for those topics not completely covered by the Biological Needs Assessment.

Plans for revisions:

As additional information becomes available, or as conditions change, this plan will be changed or expanded. When the need arises, discussion of changes will take place as agenda items at ordinary CRMP meetings. Changes to the plan will be made by majority vote only after discussion of any change at three consecutive meetings. Those persons voting must have attended at least two of those meetings.

Draft Shasta CRMP Action Plan:

I Water

A. Observed Problems

1. Surface Water

a. low flows during some of the summer irrigation season (April I-Oct. 1)
b. rapid reduction in flow at start of irrigation season in some years
c. difficulties in regulating flow consistently throughout the irrigation season
d inadequate flows in winter to maintain gravel in suitable condition for successful incubation of salmon eggs
e. high water temperatures in summer
f. low levels of dissolved oxygen in summer
g. nutrient loading
h. urban contamination-street runoff, sewage, toxic spills
i difficulties in closely controlling irrigation water distributed via open ditches and flood irrigation
j. lack of regulation under the Shasta River Adjudication of riparian and groundwater rights
k data gaps relating to above problems

2. Ground Water

a uncontrolled groundwater withdrawal has impacted surface flows, and can be expected to do so increasingly in the future

B. Recommended Actions

1. Continue program of riparian fencing and native tree planting. Benefits:
   a shade water to minimize temperature gain.
   b. stabilize banks to minimize erosion
   c. filter nutrients
   d. avoid future problems by re-creating diverse, natural conditions

2. Continue pulsed flow program. Benefits:
   a. provides short term solution to lethal water conditions for salmon residing in Shasta River in early summer
   b. boosts salmon production in the short term while waiting for long-term habitat improvements to take effect.

3. Assist with screening of diversions. Benefits:
   a protect salmon
   b. protect water users from Endangered Species Act problems

4. Provide real-time access to river flow information. Benefits:
   a help water-master avoid drawdowns below normal levels.
   b. help to develop staggered start-up at the start of the irrigation season
   c. better position people to manage water locally should water-master service be discontinued.

5. Support creation of dedicated instream flows **for** fish and wildlife (if done on a voluntary basis) through purchase or conservation measures. (with provision that all or most of conserved water be dedicated to instream flows). Benefits:
   a reduce temperature and nutrient levels
   b. increase habitat and cover, reducing salmon losses to predators.
   c. protect water rights of other water users **by** developing dedicated insream flows through voluntary measures

6. Continue efforts to substitute pumps for existing diversion dams. Benefits:
   a reduce temperature gains
   b. reduce erosion
   c. increase levels of dissolved oxygen

7. Seek ways to reduce irrigation tailwater, or capture it for re-use. Benefits:
   a reduce contribution to daytime water temperature build-up
   b. Reduce nutrient loading
   c. Reduce input of fine sediment.

8. Comment where appropriate on CEQA, NEPA, and local planning actions. Also applications for water rights, and other regional planning efforts. Benefits:
   a. to be certain that new development doesn't transfer costs to existing water users
   b. to increase awareness of our goals and efforts.

9. Should re-adjudication occur, insist that it include both surface and ground water wherever they are in communication with each other.
   a to insure that it is truly comprehensive, and won't have to be redone again
   b. to protect the rights of both surface and ground water users
   c. to protect gains in instream flows.

10. Seek funding for studies to fill data gaps
   a. hydrologic study of the river, defining importance of existing meander pattern, gravel budget, flows for channel and gravel maintenance.
   b. continue gathering data to create water model capable of predicting effects of various restoration efforts.
   c. create good photographic/map base on which to document progress to date, key areas, plans and baseline conditions.
   d. further study early life history of salmon use of the Shasta to better understand and meet their habitat needs

e. evaluate existing irrigation diversion impoundments to determine to what extent they are functioning as sediment traps, areas of surrogate rearing habitat, or barriers to fish migration.

II Erosion

A. Observed Problems

1. Bank erosion leads to loss of good agricultural land.
2. Sediment in river settles out in spawning gravel, reducing survival of salmon eggs.
3. River tends to get shallower and wider, leading to increased water temperatures.

B. Recommended actions

1. Continue program of riparian livestock control fencing and re-planting.
   a. stabilize banks with roots of woody plants.
   b. minimize hoof impacts by creating graveled stockwater access areas.
2. Focus erosion controls on methods that will be both effective and will result soonest in ongoing vegetative bank protection.
   a. vegetation will be not require ongoing maintenance
   b. vegetation will produce other benefits--shading, improved rearing habitat, other wildlife habitat.
   c. cost will be lower and permitting will be substantially easier.
   d. vegetation will allow the river to adjust to changing conditions.

3. Seek information to fill data gaps:
   a. gather descriptions and photographs to try to develop a historical perspective of bank vegetation
   b. develop baseline information of current spawning gravel condition.
   c. investigate possibilities of mechanically cleaning existing gravels in place.
   d. secure a hydrological review of the river to determine what is a stable meander pattern for various reaches, and how can that be maintained.
   e. investigate role of impoundments as sediment traps.

III Fish needs

A. Observed problems:

1. Summertime water temperature and dissolved oxygen often at stressful, and sometimes at lethal, levels.
2. Apparent loss of rearing habitat through loss of woody vegetation on banks.
3. Loss of spawning habitat due to reduced instream flows near the end of the irrigation season (September)

4. Loss of rearing habitat due to reduced flows during the irrigation season (April through October 1).
5. Fish passage problems:
   a. for adults going upstream, including low flows, obstructions and high velocity water
   b. for juveniles going upstream and downstream, including low flows, obstructions, high velocity water, lack of suitable fish ladders,
6 Delays in spawning due to low water and high temperatures prior to end of the irrigation season (September and early October).
7. Reduced egg survival due to fine sediment in spawning gravel.
8. Reduced spawning gravel availability due to lack of gravel recruitment.
9. Inability to estimate production of salmon or steelhead smolts.

B. Recommended actions:
1. Fish screens:
   a screen unscreened diversions and pumps.
   b. improve or replace inadequate screens.
2. Impoundments:
   a. Investigate and recommend improvements to fish passage.
3. Continue pulsed flows until water quality is adequately improved
4. Continue riparian fencing and native tree replanting
   a increase shade
   b. improve rearing habitat
   c. reduce sediment in spawning gravels.
5. Continue efforts to modify DFG counting weir.
   a. continue to press for modifications to weir that will make it more fish friendly as long as it is there.
   b. continue to try to develop alternate method of getting accurate spawner counts and other biological information so weir can be eliminated completely.
6. Seek funding for purchase of water for instream flows from willing sellers.
7. Where other means of adequate protection is unlikely, support the purchase of key areas from voluntary sellers whose sale would protect remaining land uses in the Shasta Valley.
8. Seek funding to fill data gaps:
   a. develop water model to use in evaluating effectiveness of various restoration measures
   b. support early life history study of salmonids in the Shasta to determine current and future needs for spawning and rearing habitat, and amounts now present.
   c. investigate flows required to clean spawning gravels. Evaluate impact of those flows on juvenile salmon rearing in river, on the river itself, and on water users.
   d. develop gravel budget for the river. Seek funding and methods to meet it
9. Develop mechanism to produce count or index of production.

The following occur outside of the Shasta Valley, but directly affect Shasta River fish. There is much that residents of the Shasta Valley can and must do to improve salmon survival in the following areas. Solutions to these problems must be found for us to be successful, and we should press for improvement whenever possible.

IV Harvest

A. Observed problems
1. Human overharvest
2. Non-human predation
3. Timing of in-river harvest

B Recommended actions
1. Continue to submit comments on all fishery harvest plans requesting appropriate restraint. Press for greater recognition of spawner needs during the allocation process.
2. Maintain fishing closure at the mouth of the Shasta River. Take steps necessary to be certain that it isn't dropped from regulations again.
3. Avoid drastic reductions in Klamath River flow, since predation increases as flows decrease.
4. Request continued efforts to evaluate impacts of various predators. Support steps necessary to limit predation to reasonable levels
5. Support efforts calling for marking of all hatchery fish to allow selective harvest and better run size estimation.
6. Request that hatchery production be reduced until natural production catches up in order to reduce demands to overharvest natural stocks, and to make food and habitat more available to natural stocks.
7. Maintain contacts with tribes to encourage them to spread their harvest impact over the full duration of the run in order to eliminate excessive impacts on any single stock of salmon.

V. Klamath River

A. Observed problems for Shasta River fish:
1. Water Quality problems
a. High water temperatures
b. Low levels of dissolved oxygen
c. Low flows during outmigration and spawning
2. Habitat problems
a. Degraded rearing habitat
b. Reduced or dewatered spawning habitat
c. Loss of habitat in estuary

d. Loss of nutrient imputs normally associated with decay of spawned fish..

3. Iron Gate Hatchery impacts
   a. Predation by residualized “steelhead”
   b. Competition for available food and rearing habitat
   c. Impacts on the fitness to survive of Shasta River fish from influx of domesticated hatchery fish straying into the Shasta.
   d. difficult to resist demands from fishing interests to harvest all available hatchery fish, leading to overharvest of naturally spawning fish.

B. Recommended actions:
   1. Maintain communications with Klamath River Basin Fishery Task Force.
   2. Continue pressing for better management of the Klamath fishery, including but not limited to:
      a. marking of all hatchery fish
      b. define impact of Iron Gate Hatchery “steelhead” predation
      c. re-examine hatchery production targets and releases in light of existing habitat and food availability
      d. keep hatchery fish ladders open 24 hrs. per day through the entire spawning season, and do not return any live hatchery fish to the river.
      e. Join the Scott CRMP to press for reductions in harvest of wild fish
   3. Support investigations of ways to improve water quality in the Klamath, including cold water releases from Iron Gate Dam.
   4. Support development of gravel budget for the Klamath River.
   5. Participate in the development of flow targets for Klamath River.
   6. Support efforts to reduce sediment throughout Klamath Basin

Section 2

CDFG

A Biological Needs Assessment
for
Anadromous Fish
in the
Shasta River
Siskiyou County, California

Section 3

State Water Resources Control Board
Division of Water Quality
Nonpoint Source Program

CALIFORNIA RANGELAND WATER QUALITY MANAGEMENT PLAN

July 1995

Section 4

Yreka Creek Greenway Master Plan Report

Although included in Shasta CRMP plan, not included in KRIS bibliography.
Originally prepared for City of Yreka, 701 Fourth Street, Yreka, CA 96097

May 26, 1989

Shasta CRMP Mid-term Goals

1. Construct a minimum of 3 miles of livestock control fence annually along the Shasta River or its tributaries accessible to anadromous fish.

2. Plant a minimum of 1.5 miles of native trees annually, or use other vegetative bank stabilization methods as site conditions dictate.

3. Reduce the maximum water temperature (as measured at the Montague-Grenada Road Bridge) by 5 degrees F. in 10 years. (The baseline maximum shall be from 1996--80.6 degrees F.

4. Dedicate enough water to instream flows to assure a minimum of 20 cfs within 10 years.

5. Raise the levels of dissolved oxygen to above 6 mg/l at all times, as measured anywhere along the main Shasta.

6. Within 3 years develop a mechanism to produce an index of outmigration numbers.

Activities and Projects	GENERAL WORK PLAN											
	1997				1998				1999			
	1	2	3	4	1	2	3	4	1	2	3	4
Coordinate Sub-basin Restoration Activities	X											X
Construct Three Miles of Riparian Livestock Control Fences per Year	X											X
Plant One and One-half Miles of Fenced Area to Native Riparian Trees per Year	X			X	X			X	X			X
Install One Irrigation Tailwater System		X	X							X	X	
Assist USFWS in KRIS Development	X			X								
Install 750 Feet of Biotechnical Bank Protection per Year		X	X			X	X			X	X	
Contact landowners along the River	X											X
Secure Funding for Future Work	X											X
Maintain Real-time Temperature and Flow Monitoring Station	X											X
Attend Two Klamath River Basin Fishery Task Force Meetings/Year	X		X		X		X		X		X	
Attend Two KRBFTF Tech Work Group Meetings/Year		X		X		X		X		X		X
Make Presentation at Klamath River Basin Symposium	X								X			
Attend Salmonid Restoration Federation Symposium		X				X				X		
Attend Continuing Education Events	X		X		X				X			

Activities and Projects	DETAILED WORK PLAN--SCHEDULE											
	1997				1998				1999			
	1	2	3	4	1	2	3	4	1	2	3	4
Expand and update subbasin plans and submit for review	X---------	----------	---------X				X---------	---------X			X---------	---------X
Himmel Fence (1/2) mile		X---------	---------X									
Norman Fiock fence (3/4 mile)	X---------	---------X										
Freeman Fence (1.5 mile)	X---------	---------X										
B/B Fiock Fence (1/4 Mile)		X---------	---------X									
Assist and coordinate school monitoring of projects	X---------	---------X		X---------	----------	---------X						
Secure Aerial Photos		X---------	----------									
Digitize ownership layer	X---------	----------	----------	---------X								
Hold Public Info/education Mtgs.	X	X	X		X	X	X		X	X	X	
Attend Monthly CRMP Meetings	X-X-X	X-X-X	X-X	X-X	X-X-X	X-X-X	X-X	X-X	X-X-X	X-X-X	X-X	X-X
Public Relations (newsletter, public presentations, press releases, etc.)	X---------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	---------X
Outmigrant Assisting Pulsed Flows		X-X				X-X				X-X		
Inspection of all Projects			X				X				X	
Monitor underflow temperatures at Meamber tailwater infiltration pond		X-X-X	X-X-X									

Activities and Projects	DETAILED WORK PLAN--SCHEDULE											
	1997				1998				1999			
	1	2	3	4	1	2	3	4	1	2	3	4
Re-photograph Completed Restoration Project Photopoints:												
Ordway Fence 1			X				X				X	
Ordway Fence 2			X				X				X	
H. Terry Fence		X				X				X		
Peters Fence				X				X				X
Meamber Fence 1	X				X				X			
Meamber Fence 2				X				X				X
Ekstrom Fence				X				X				X
Parker Fence				X				X				X
Wah Lee Fence				X				X				X
Kuck Fence			X				X				X	
Karlsson Fence				X				X				X
B&B Fiock Fence 1			X				X				X	
Lemos Fence 1	X				X				X			
Easton Fence		X				X				X		
Marion Fence				X				X				X
Linquist Fence			X				X				X	
Eagan Fence		X				X				X		
Peters Bank Sloping			X				X				X	
Easton Bioengineered Bank Protect.			X				X				X	
Meamber Bioengineered Bank Prot.			X				X				X	
Peters Bioengineered Bank Protect.			X				X				X	
Ekstrom Tailwater Project	X											
Meamber Tailwater Projects			X				X				X	
Webb Planting		X				X				X		
BLM Planting		X				X				X		

SHASTA VALLEY RESOURCE CONSERVATION DISTRICT
215 EXECUTIVE COURT. YREKA. CALIF. 96097

SHASTA RIVER COORDINATED RESOURCE MANAGEMENT PLAN

AREA OF COVERAGE: The Shasta River from below Dwinell Reservoir downstream to the confluence with the Klamath River and all tributaries in this section.

OBJECTIVE: To improve riparian habitat while maintaining Agricultural uses.

GOALS :

1. Identify and prioritize the problems

   A. Develop "riparian rating system

   B. Survey Shasta River and tributary riparian condition/land owner cooperation.

   C. Define "workable" segments

2. Tp develop improved riparian conditions while having the lowest possible impact (least intrusive) to landowners.

   A. Provide "immediate" assistance to cooperators wishing to do restoration work.

   B. Implement existing grant projects

   C. Continue to seek funds

   D. Gather "library" of technology/alternatives for fisheries restoration projects.-

3. Improve landowner awareness of the problems along and in the Shasta River and the benefit potential for improvements.

   A. Publish Shasta River CRMP newsletter

      1. Minimum of two times per year

      2. Distribute to land owners, agencies, legislators

   B. Provide news articles/fact sheets for publication

   C. Hold an annual field tour of area projects/concerns.

'SHASTA VALLEY RESOURCE CONSERVATION DISTRICT

215 EXECUTIVE COURT. YREKA, CALIF. 96097

4-. Coordinate agency activities and funding for projects and actions on the Shasta River.

A. CRMP coordinator will "gather" proposals to see that duplication of effort does not occur.

B. Invite interested Tribes to participate in CRMP

1. Contact the following persons
   a. Hoopa -- Mike Orcut
   b. Karuk -- Leaf Hillman
   c Yurok -- Walt Lara
   d. Other -- . ???? ????

Karuk Tribe of Shasta Valley

C. Keep other interested "Fish Groups" informed via Newsletters and minutes

D. Continue to seek funding for position which is oniy funded for FY 92.

5. Improve publ ic awareness of the work being done.

A. Coordinate public information with KRBFTF

B. Determine target audiences
ie., Kids, decision makers, etc.

C. Seek out Volunteers to do public information program

6. Evaluate all restoration efforts (in CRMP area)

A. CRMP supported oject-; wi ll contain formal monitoring and evaluation criteria.

1 Add to Memorandum of Understanding between agencies, groups and the CRMP

= Proposals will need to def ine expected results/goal s and the method of proposed ovaiuation.

B. Encourage Non-CRMP sponsored projects contractors to inc l ued eva l uat i ion and mon i tor i in projects and encourage sharing of results with CRMP group.

Shasta River Telephone Access Monitoring Station

Careful management of the Shasta River is becoming increasingly necessary to protect all water uses. Probably the single most important factor that will make this possible is the ability of any water user to quickly and easily access information about the river's flow and water temperature.

In order to make this possible, the Shasta CRMP now operates a river monitoring station that will provide temperature and flow information 24 hours per day, via voice telephone line.

The monitoring station can be reached at: 916-459-0416.

In addition to the voice accessible information, stored data can be downloaded via a computer and modem, if you have proper software. Minimum system requirements are an IBM compatible 286 (or higher) computer, and a 1200 baud modem. Contact Dave Webb (916-926-2460) for further information and free software.

It is our hope that by making this information accessible to everyone, we will create the environment where water management decisions will come be made at least in part on the flow and temperature conditions in the river.

On the following page is the conversion table used by the watermaster to convert the staff gauge height to flow. Use this to convert the staff gauge height reported by the monitor to flow.

The Department of Fish and Game Biological Needs Assessment contains information on critical temperatures for salmon and steelhead. Temperatures above 70 degrees Fahrenheit are increasingly stressful to these fish. Temperatures above 78 degrees are lethal.

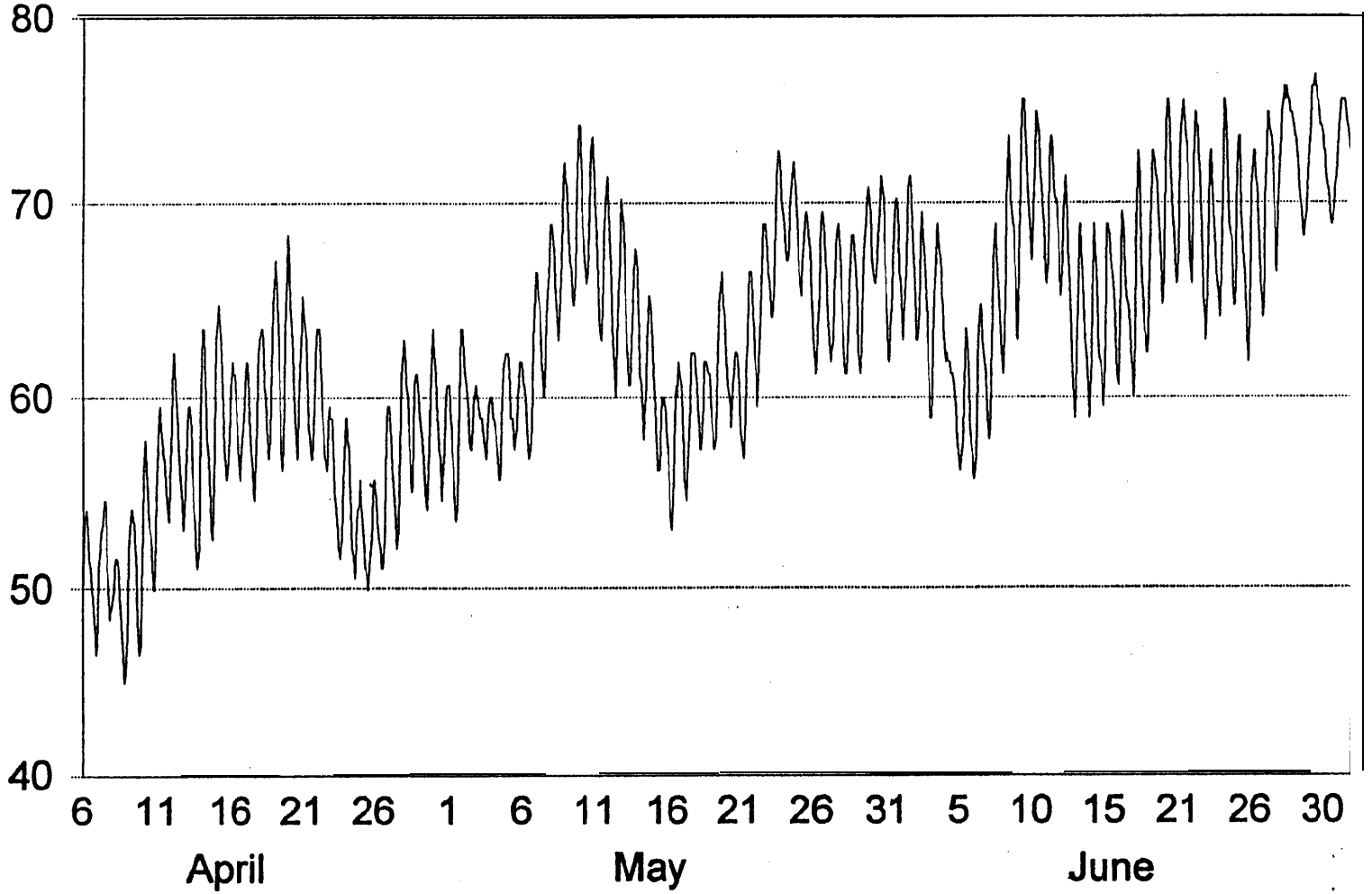
Whenever possible, minimize irrigation activities that will result in the return of tailwater to the river during daylight hours when the water temperatures are above 70 degrees.

Flow in the Shasta River at the Montague-Grenada Road Bridge

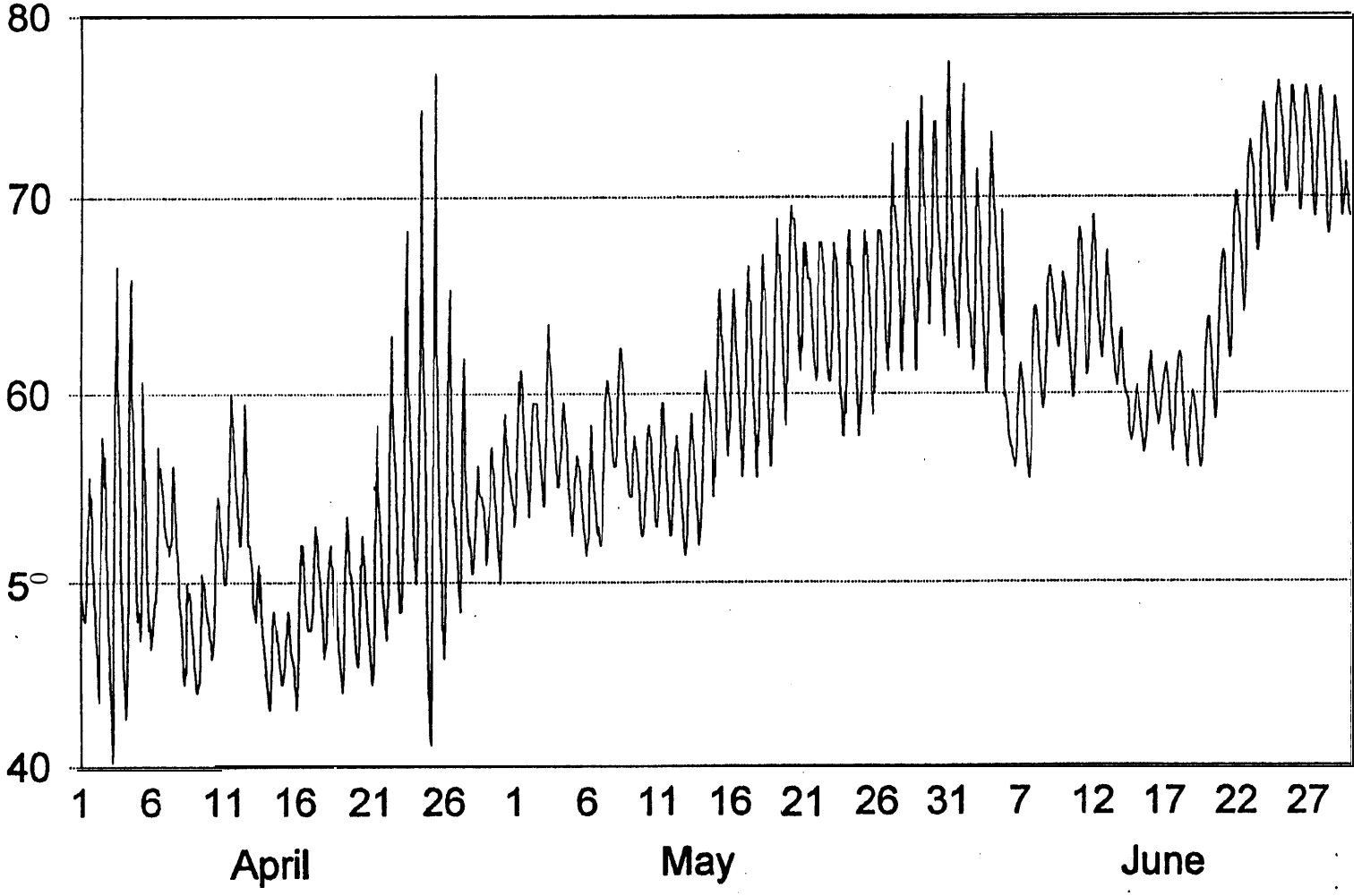
Gauge Height	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
1.5	7	7.6	8.2	8.8	9.4	10	10.6	11.2	11.8	12.4
1.6	13	14.43	15.86	17.29	18.72	20.15	21.58	23.01	24.44	25.87
1.7	27.3	29.7	30.84	32.61	34.38	36.15	37.92	39.69	41.46	43.23
1.8	45	48.2	51.4	54.6	57.8	61	64.2	67.4	70.6	73.8
1.9	77	80.3	83.6	86.9	90.2	93.5	96.8	100.1	103.4	106.7
2	110	113.4	116.8	120.2	123.6	127	130.4	133.8	137.2	140.6
2.1	144	147.5	151	154.5	158	161.5	165	168.5	172	175.5
2.2	179	182	186.2	189.8	193.4	197	200.6	204.2	207.8	211.4
2.3	2.15	218.7	222.4	226.1	229.8	233.5	237.2	240.9	244.6	248.3
2.4	252	255.8	259.6	263.4	267.2	271	274.8	278.6	282.4	286.2
2.5	290	294	298	302	306	310	314	318	322	326
2.6	330	334.2	338.4	342.6	346.8	351	355	359.4	363.6	367.8
2.7	372									
2.8	416									
2.9	462									
3	510									

Example: if the monitor reports a gauge height of 1.84 feet, the flow in the river is 57.8 cubic feet per second.

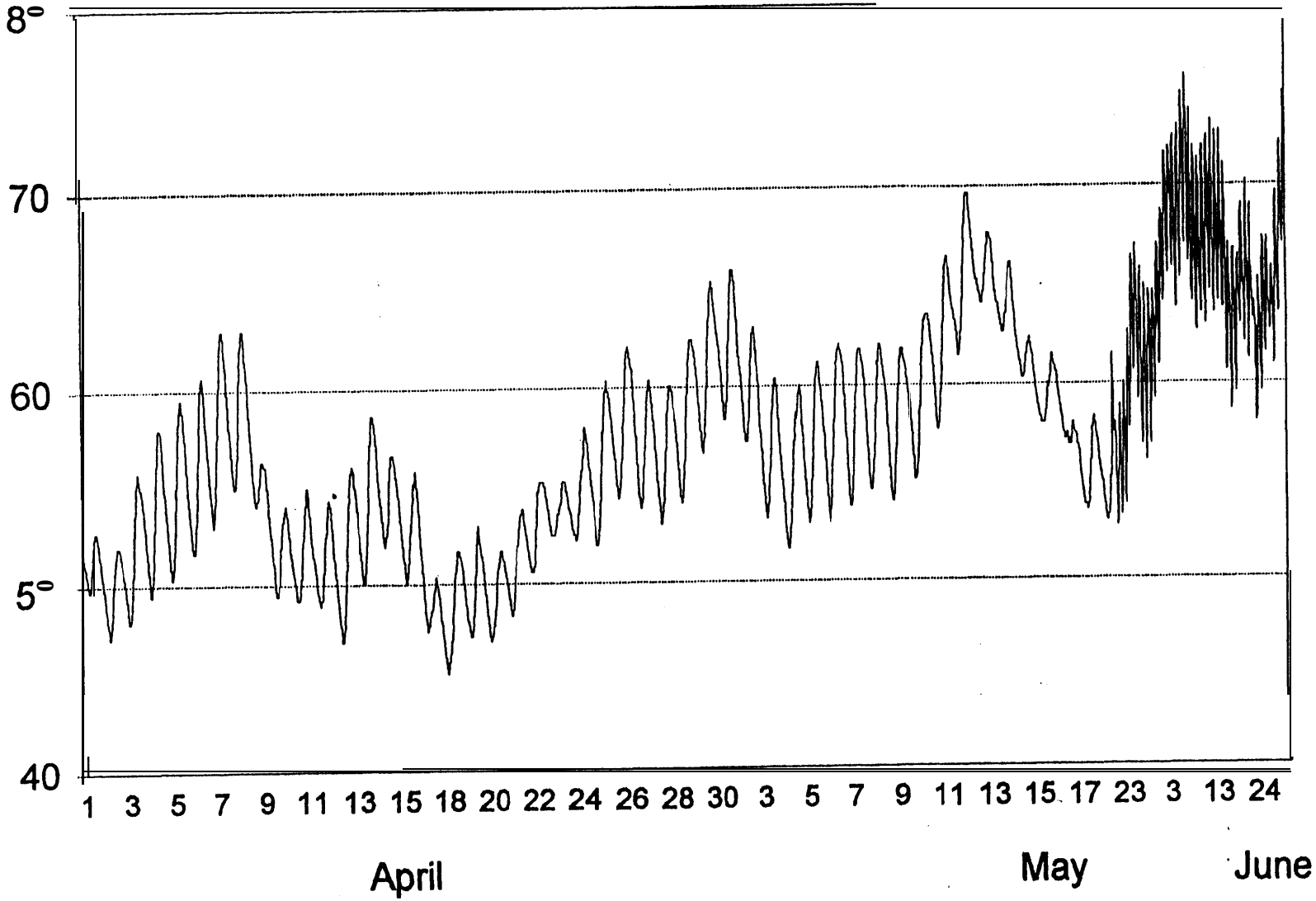
Shasta River 1994
Highway 263



Shasta River 1995
Highway 263



Shasta River 1996
Highway 263



Shasta River Flow Data

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
Minimum											**Minimum**
Oct	102.0	96.0	116.0	74.0	86.0	97.0	133.0	166.0	108.0	87.0	Oct
Nov	163.0	132.0	166.0	163.0	172.0	154.0	192.0	209.0	200.0	171.0	Nov
Dec	155.0	161.0	184.0	172.0	178.0	222.0	211.0	263.0	243.0	162.0	Dec
Jan	154.0	231.0	180.0	199.0	169.0	270.0	235.0	310.0	218.0	168.0	Jan
Feb	143.0	240.0	177.0	264.0	184.0	244.0	307.0	289.0	212.0	199.0	Feb
Mar	58.0	253.0	140.0	207.0	174.0	360.0	484.0	293.0	189.0	214.0	Mar
Apr	37.0	192.0	100.0	100.0	45.0	184.0	224.0	172.0	76.0	124.0	Apr
May	51.0	93.0	54.0	81.0	29.0	90.0	175.0	142.0	33.0	103.0	May
Jun	6.1	66.0	11.0	54.0	12.0	85.0	127.0	40.0	15.0	48.0	Jun
Jul	6.0	40.0	11.0	19.0	2.2	35.0	60.0	32.0	1.5	26.0	Jul
Aug	6.8	27.0	7.9	11.0	1.5	28.0	45.0	18.0	11.0	17.0	Aug
Sep	9.2	80.0	49.0	30.0	4.5	52.0	85.0	66.0	18.0	17.0	Sep
Year	6.0	27.0	7.9	11.0	1.5	28.0	45.0	18.0	1.5	17.0	Year

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
Average											**Average**
Oct	136.3	116.7	148.6	141.5	146.2	135.2	178.4	195.1	188.1	151.4	Oct
Nov	175.3	154.9	185.8	233.0	182.2	289.3	212.3	656.6	360.7	180.7	Nov
Dec	162.0	306.0	203.3	221.1	205.8	588.4	371.1	[illegible]	279.3	180.7	Dec
Jan	162.4	436.3	207.9	524.8	186.3	334.4	362.5	472.0	231.3	239.9	Jan
Feb	166.4	298.7	201.9	394.0	222.8	670.6	671.5	340.7	292.3	639.5	Feb
Mar	97.7	343.7	210.4	289.6	189.3	587.0	946.3	330.7	225.1	367.6	Mar
Apr	73.5	351.1	133.2	180.4	120.8	376.2	417.0	269.2	121.9	168.9	Apr
May	85.5	132.8	133.5	107.9	79.0	127.9	307.7	169.3	73.5	144.9	May
Jun	44.3	100.5	31.5	121.8	35.7	135.1	294.4	97.0	69.6	74.4	Jun
Jul	19.1	77.6	21.7	36.5	13.7	136.5	105.3	44.6	18.3	40.6	Jul
Aug	17.3	70.8	30.8	29.2	9.5	47.3	91.4	36.5	24.9	35.6	Aug
Sep	30.9	182.3	70.6	62.3	26.7	96.1	116.7	87.5	115.2	102.6	Sep
Year	97.2	213.8	131.3	194.6	117.6	291.4	339.4	250.8	165.6	190.91	Year

Shasta River Flow Data

nimum	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Minimum
t	139.0	89.0	34.0	140.0	54.0	32.0	52.0	106.0	69.0	93.0	107.0	Oct
v	188.0	157.0	129.0	161.0	150.0	134.0	137.0	157.0	123.0	152.0	163.0	Nov
c	196.0	185.0	164.0	157.0	140.0	149.0	136.0	157.0	132.0	173.0	192.0	Dec
n	199.0	180.0	170.0	159.0	140.0	153.0	151.0	167.0	139.0	230.0	437.0	Jan
b	206.0	183.0	157.0	171.0	148.0	137.0	175.0	165.0	146.0	420.0		Feb
r	107.0	46.0	178.0	171.0	124.0	97.0	166.0	109.0	155.0	293.0		Mar
r	32.0	33.0	132.0	44.0	17.0	18.0	93.0	27.0	224.0	140.0		Apr
y	25.0	34.0	61.0	20.0	36.0	12.0	48.0	42.0	115.0	91.0		May
n	22.0	18.0	27.0	16.0	15.0	13.0	44.0	18.0	112.0	56.0		Jun
l	13.0	14.0	11.0	11.0	16.0	10.0	23.0	9.6	82.0	49.0		Jul
g	9.0	12.0	17.0	12.0	12.0	6.2	20.0	11.0	35.0	23.0		Aug
p	16.0	14.0	26.0	14.0	12.0	18.0	38.0	13.0	47.0	39.0		Sep
ar	9.0	12.0	11.0	11.0	12.0	6.2	20.0	9.6	35.0	23.0		Year

erage	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Average
t	166.1	131.0	90.7	154.9	108.0	93.9	103.0	145.0	104.0	141.0	146.0	Oct
v	204.6	174.7	185.7	165.6	159.0	151.0	140.0	161.0	144.0	164.0	201.0	Nov
c	203.6	219.0	171.6	162.2	154.0	157.0	159.0	169.0	136.0	346.0	464.0	Dec
n	224.9	213.2	193.8	208.7	153.0	160.0	263.0	174.0	257.0	497.0	1234.0	Jan
b	233.3	190.1	175.3	183.6	170.0	155.0	196.0	179.0	237.0	642.0		Feb
r	190.4	130.6	348.2	236.9	153.0	124.0	277.0	142.0	486.0	369.0		Mar
r	61.4	86.9	210.1	83.2	54.3	32.4	190.0	51.2	331.0	239.0		Apr
y	46.5	65.4	133.6	93.9	123.0	24.5	75.4	78.2	261.0	168.0		May
n	44.7	89.9	66.9	74.6	44.8	27.3	166.0	27.0	162.0	90.2		Jun
l	35.4	23.1	27.2	28.0	34.7	25.2	40.2	16.8	147.0	74.1		Jul
g	23.0	27.9	36.7	22.5	22.0	12.3	45.9	14.1	54.8	35.0		Aug
p	57.1	35.9	103.7	41.3	31.2	32.6	55.1	30.0	62.9	78.0		Sep
ar	123.7	115.4	145.1									Year

Shasta River Flow Data

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	
Maximum											**Maximum**
Oct	164	145	174	249	187	153	239	230	237	231	Oct
Nov	208	226	228	629	199	812	281	420	669	239	Nov
Dec	174	1090	225	595	395	3620	1310	1490	363	215	Dec
Jan	174	1570	364	2410	263	613	1200	995	252	862	Jan
Feb	178	479	280	688	332	2440	1290	441	498	2440	Feb
Mar	156	591	358	393	234	1570	2600	426	257	821	Mar
Apr	133	688	177	301	252	750	1110	376	199	304	Apr
May	148	203	282	137	175	188	614	205	125	244	May
Jun	115	144	60	223	61	354	617	140	198	134	Jun
Jul	37	137	32	67	21	272	152	70	65	59	Jul
Aug	33	234	124	53	21	67	186	155	60	53	Aug
Sep	129	453	119	99	102	148	168	144	208	189	Sep
Year	208	1570	364	2410	395	3620	2600	1490	669	2440	Year

Shasta River Flow Data

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	
ximum												**Maximum**
t	193	153	134	210	155	148	145	166	119	166	177	Oct
v	235	189	439	179	181	172	145	173	157	171	389	Nov
c	219	309	184	170	175	188	252	189	155	1750	2510	Dec
n	281	309	297	628	182	181	1080	184	847	969	8420	Jan
b	270	205	209	214	205	209	265	202	688	1250		Feb
ır	228	190	756	302	249	152	637	174	1170	457		Mar
r	112	200	312	158	124	84	283	120	559	337		Apr
ıy	86	112	354	300	354	42	243	197	445	275		May
n	66	261	143	262	88	47	466	61	292	136		Jun
l	70	33	52	67	87	54	75	34	241	102		Jul
ıg	45	71	124	35	35	39	91	20	79	58		Aug
:p	92	63	368	96	99	50	87	66	87	117		Sep
ar	281	309	756	628	354	209	1080	202	1170	1750		Year

	A	B	C	D	E	F	G	H	I
1			Klamath Basin Ocean Harvest Summary						
2									
3									
4									
5		OCEAN	OCEAN	HOOKING MORTALITY	HOOKING MORTALITY	TOTAL OCEAN			SPORT
6		HARVEST	HARVEST	(Ocean Troll--	(Ocean Sportfishing--	IMPACT			HARVEST
7		3 Year-olds	4 Year-olds	3 & 4 year-olds only.	3 & 4 year-olds only.	Catch + Hooking			(2 Year-olds)
8				Est. at 31%.)	Est. at 13%.)	Mortality			
9									
10	1978						1978		2,082
11	1979						1979		2,181
12	1980						1980		5,891
13	1981						1981		7,252
14	1982						1982		12,484
15	1983						1983		351
16	1984						1984		952
17	1985						1985		11,195
18	1986	195,000	29,100	62,400	3,000	289,500	1986		9,400
19	1987	158,800	102,100	71,500	3,500	335,900	1987		5,436
20	1988	238,200	49,000	65,700	4,500	357,400	1988		5,411
21	1989	28,600	83,600	26,600	3,500	142,300	1989		2,267
22	1990	73,200	42,000	43,600	2,800	161,600	1990		2,100
23	1991	7,800	5,200	2,600	600	16,200	1991		627
24	1992	500	900	400	-	1,800	1992		3,677
25	1993	11,200	1,100	3,000	300	15,600	1993		2,593
26	1994	3,800	2,100	1,300	100	7,300	1994		2,660
27	1995	44,300	3,900	13,000	800	62,000	1995		4,344
28	1996	11,400	36,400	10,000	600	58,400	1996		2,929
29									
30									
31									
32									
33									
34									
35									
36									

	A	J	K	L	M	N	O	P	Q	R
1				Klamath Basin In-River Sport Harvest Summary						
2										
3										
4										
5		SPORT	SPORT	SPORT	SPORT	TOTAL SPORT	HOOKING	TOTAL SPORT		
6		HARVEST	HARVEST	HARVEST	HARVEST	HARVEST	MORTALITY	IMPACT		
7		(3 Year-olds)	(4 Year-olds)	(5 Year-olds)	(Adults--	(Age 2,3,4,5+)	(Est. at 2%)	(harvest + hooking		
8					Age 3,4,5+)			mortality)		
9										
10	1978				1,694	3,776	76	3,852	1978	
11	1979				2,141	4,322	86	4,408	1979	
12	1980				4,496	10,387	208	10,595	1980	
13	1981				5,983	13,235	265	13,500	1981	
14	1982				8,339	20,823	416	21,239	1982	
15	1983				4,235	4,586	92	4,678	1983	
16	1984				3,340	4,292	86	4,378	1984	
17	1985				3,582	14,777	296	15,073	1985	
18	1986	18,100	2,900		21,027	30,435	609	31,044	1986	
19	1987	11,400	8,500		20,169	25,605	512	26,117	1987	
20	1988	15,600	6,200		22,203	27,614	552	28,166	1988	
21	1989	900	7,700		8,775	11,042	221	11,263	1989	
22	1990	1,400	2,200		3,553	5,653	113	5,766	1990	
23	1991	1,719	1,187	26	2,932	3,559	71	3,630	1991	
24	1992	834	437	39	1,310	4,987	100	5,087	1992	
25	1993	3,397	178	12	3,587	6,180	124	6,304	1993	
26	1994	971	813	48	1,832	4,388	88	4,476	1994	
27	1995	4,128	377	53	4,558	8,902	178	9,080	1995	
28	1996	3,845	9,042	24	12,911	15,840	317	16,157	1996	
29								-		
30										
31										
32										
33										
34										
35										
36										

	A	S	T	U	V	W	X	Y	Z	AA
1			Klamath Basin In-River Tribal Harvest Summary							
2										
3										
4										
5		TRIBAL	TRIBAL	TRIBAL	TRIBAL	TRIBAL	GILL NET	TOTAL TRIBAL	TOTAL TRIBAL	
6		HARVEST	HARVEST	HARVEST	HARVEST	HARVEST	MORTALITY	HARVEST	IMPACT	
7		(2 Year-olds)	(3 Year-olds)	(4 Year-olds)	(5 Year-olds)	(Adults--	(Est. @ 8%)		(Harvest plus gill-	
8						Age 3,4,5+)			net mortality)	
9										
10	1978	1,800				18,200	1,600	20,000	21,600	1978
11	1979	1,350				13,650	1,200	15,000	16,200	1979
12	1980	987				12,013	1,040	13,000	14,040	1980
13	1981	2,465				33,033	2,840	35,498	38,338	1981
14	1982	1,799				14,482	1,302	16,281	17,583	1982
15	1983	163				7,890	644	8,053	8,697	1983
16	1984	455				18,670	1,530	19,125	20,655	1984
17	1985	1,555				11,566	1,050	13,121	14,171	1985
18	1986	854	8,100	17,000		25,127	2,078	25,981	28,059	1986
19	1987	415	11,400	41,000		53,096	4,281	53,511	57,792	1987
20	1988	578	12,500	38,600		51,651	4,178	52,229	56,407	1988
21	1989	191	2,700	41,000		45,565	3,660	45,756	49,416	1989
22	1990	187	1,300	6,000		7,794	638	7,981	8,619	1990
23	1991	95	2,118	7,569	480	10,167	821	10,262	11,083	1991
24	1992	366	970	4,360	455	5,785	492	6,151	6,643	1992
25	1993	175	5,426	3,786	424	9,636	785	9,811	10,596	1993
26	1994	253	4,490	6,616	489	11,595	948	11,848	12,796	1994
27	1995	557	11,839	2,957	760	15,556	1,289	16,113	17,402	1995
28	1996	195	12,234	43,540	152	55,926	4,490	56,121	60,611	1996
29						-	-			
30										
31										
32										
33										
34										
35										
36										

	A	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1				Klamath Basin All Harvest Summary							
2											
3											
4		tribal									
5		Calculated harvest		TOTAL	TOTAL	TOTAL	TOTAL	TOTAL--			NATURAL
6		(2,3,4,&5)		OCEAN	SPORT	TRIBAL	IN-RIVER	ALL HARVEST			SPAWNERS
7				IMPACT	IMPACT	IMPACT	IMPACTS	IMPACTS			2 Year-olds
8					(INRIVER)						
9											
10	1978				3,852	21,600	25,452		1978		16,414
11	1979				4,408	16,200	20,608		1979		6,761
12	1980				10,595	14,040	24,635		1980		26,982
13	1981				13,500	38,338	51,838		1981		16,507
14	1982				21,239	17,583	38,823		1982		18,646
15	1983				4,678	8,697	13,375		1983		2,526
16	1984				4,378	20,655	25,033		1984		5,285
17	1985				15,073	14,171	29,243		1985		35,951
18	1986	27,205		289,500	31,044	28,059	59,103	348,603	1986		28,942
19	1987	57,377		335,900	26,117	57,792	83,909	419,809	1987		8,772
20	1988	55,829		357,400	28,166	56,407	84,574	441,974	1988		12,544
21	1989	49,225		142,300	11,263	49,416	60,679	202,979	1989		5,509
22	1990	8,432		161,600	5,766	8,619	14,386	175,986	1990		1,350
23	1991	21,730		16,200	3,630	11,083	14,713	30,913	1991		1,017
24	1992	12,883		1,800	5,087	6,643	11,730	13,530	1992		4,855
25	1993	20,656		15,600	6,304	10,596	16,899	32,499	1993		3,204
26	1994	24,880		7,300	4,476	12,796	17,272	24,572	1994		6,842
27	1995	33,718		62,000	9,080	17,402	26,482	88,482	1995		21,548
28	1996	116,689		58,400	16,157	60,611	76,767	135,167	1996		8,083
29					-	-					
30					-	-					
31					-	-					
32					-	-					
33					-	-					
34					-	-					
35					-	-					
36					-	-					

	A	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1		Klamath Basin Natural Spawners Summary										
2												
3												
4												
5		NATURAL	NATURAL	NATURAL	NATURAL	NATURAL				calc nat		
6		SPAWNERS	SPAWNERS	SPAWNERS	SPAWNERS	SPAWNERS				total		
7		3 Year-olds	4 Year-olds	5 Year-olds	Adults-	TOTAL						
8					Age 3,4,5+							
9												
10	1978				58,492	74,906	1978			-		
11	1979				30,637	37,398	1979			-		
12	1980				21,483	48,465	1980			-		
13	1981				33,857	50,364	1981			-		
14	1982				31,951	50,597	1982			-		
15	1983				30,784	33,310	1983			-		
16	1984				16,064	21,349	1984			-		
17	1985				25,677	61,628	1985			-		
18	1986				113,360	142,302	1986			-		
19	1987				101,717	110,489	1987			-		
20	1988				78,886	91,430	1988			-		
21	1989				43,868	49,377	1989			-		
22	1990				15,598	16,948	1990			-		
23	1991	3,745	6,576	233	10,554	11,571	1991		22,125	22,358		
24	1992	2,836	7,987	297	11,120	15,975	1992		27,095	27,392		
25	1993	17,823	2,895	162	20,880	24,084	1993		44,964	45,126		
26	1994	19,809	13,168	384	33,361	40,203	1994		73,564	73,948		
27	1995	138,894	10,676	1,071	150,641	172,189	1995		322,830	323,901		
28	1996	16,887	64,083	45	81,016	89,099	1996		170,115	170,160		
29									-	-		
30												
31												
32												
33												
34												
35												
36												

	A	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF
1			Klamath Basin Hatchery Spawners Summary								Klamath Ba
2											
3											
4											
5		HATCHERY	HATCHERY	HATCHERY	HATCHERY	HATCHERY	HATCHERY			NATURAL	HATCHERY
6		SPAWNERS	SPAWNERS	SPAWNERS	SPAWNERS	SPAWNERS	SPAWNERS			SPAWNERS	SPAWNERS
7		2 Year-olds	3 Year-olds	4 Year-olds	5 Year-olds	Adults	TOTAL			TOTAL	TOTAL
8						Age 3,4,5 +					
9											
10	1978	2,240				12,959	15,199	1978		74,906	15,199
11	1979	1,221				3,636	4,857	1979		37,398	4,857
12	1980	2,707				6,511	9,218	1980		48,465	9,218
13	1981	1,544				4,425	5,969	1981		50,364	5,969
14	1982	6,068				10,411	16,479	1982		50,597	16,479
15	1983	785				13,865	14,650	1983		33,310	14,650
16	1984	1,530				7,496	9,026	1984		21,349	9,026
17	1985	20,325				22,534	42,859	1985		61,628	42,859
18	1986	5,070				32,891	37,961	1986		142,302	37,961
19	1987	4,278				29,123	33,401	1987		110,489	33,401
20	1988	5,361				33,458	38,819	1988		91,430	38,819
21	1989	1,070				21,991	23,061	1989		49,377	23,061
22	1990	692				8,052	8,744	1990		16,948	8,744
23	1991	135	2,491	3,904	235	6,630	6,765	1991		11,571	6,765
24	1992	3,962	2,515	4,566	157	7,238	11,200	1992		15,975	11,200
25	1993	1,538	20,732	836	-	21,568	23,106	1993		24,084	23,106
26	1994	5,009	6,671	7,677	188	14,536	19,545	1994		40,203	19,545
27	1995	368	26,401	1,969	255	28,625	28,993	1995		172,189	28,993
28	1996	792	4,360	15,649	24	20,033	20,825	1996		89,099	20,825
29											
30											
31											
32											
33											
34											
35											
36											

	A	BG	BH	BI	BJ
1		sin Spawner Summary			
2					
3					
4					
5		TOTAL	TOTAL	Total In-River	
6		SPAWNERS	SPAWNERS	Run--Spawners	
7		Adults	Ages 2,3,4,5+	plus Harvest	
8				Inriver	
9					
10	1978	71,451	90,105	115,557	1978
11	1979	34,273	42,255	62,864	1979
12	1980	27,994	57,683	82,318	1980
13	1981	38,282	56,333	108,171	1981
14	1982	42,362	67,076	105,900	1982
15	1983	44,649	47,960	61,335	1983
16	1984	23,560	30,375	55,408	1984
17	1985	48,211	104,487	133,730	1985
18	1986	146,251	180,263	239,366	1986
19	1987	130,840	143,890	227,799	1987
20	1988	112,344	130,249	215,322	1988
21	1989	65,790	72,438	133,117	1989
22	1990	21,103	22,817	40,199	1990
23	1991	17,631	18,336	34,353	1991
24	1992	18,358	27,175	40,348	1992
25	1993	42,448	47,190	64,740	1993
26	1994	47,897	59,748	75,936	1994
27	1995	179,268	201,182	236,495	1995
28	1996	101,049	109,924	186,689	1996
29					
30					
31					
32					
33					
34					
35					
36					

Section 8

The Unique Shasta Geology

Gigantic Debris Avalanche of Pleistocene Age from Ancestral Mount Shasta Volcano, California, and Debris-Avalanche Hazard Zonation

US Geological Survey Bulletin 1861