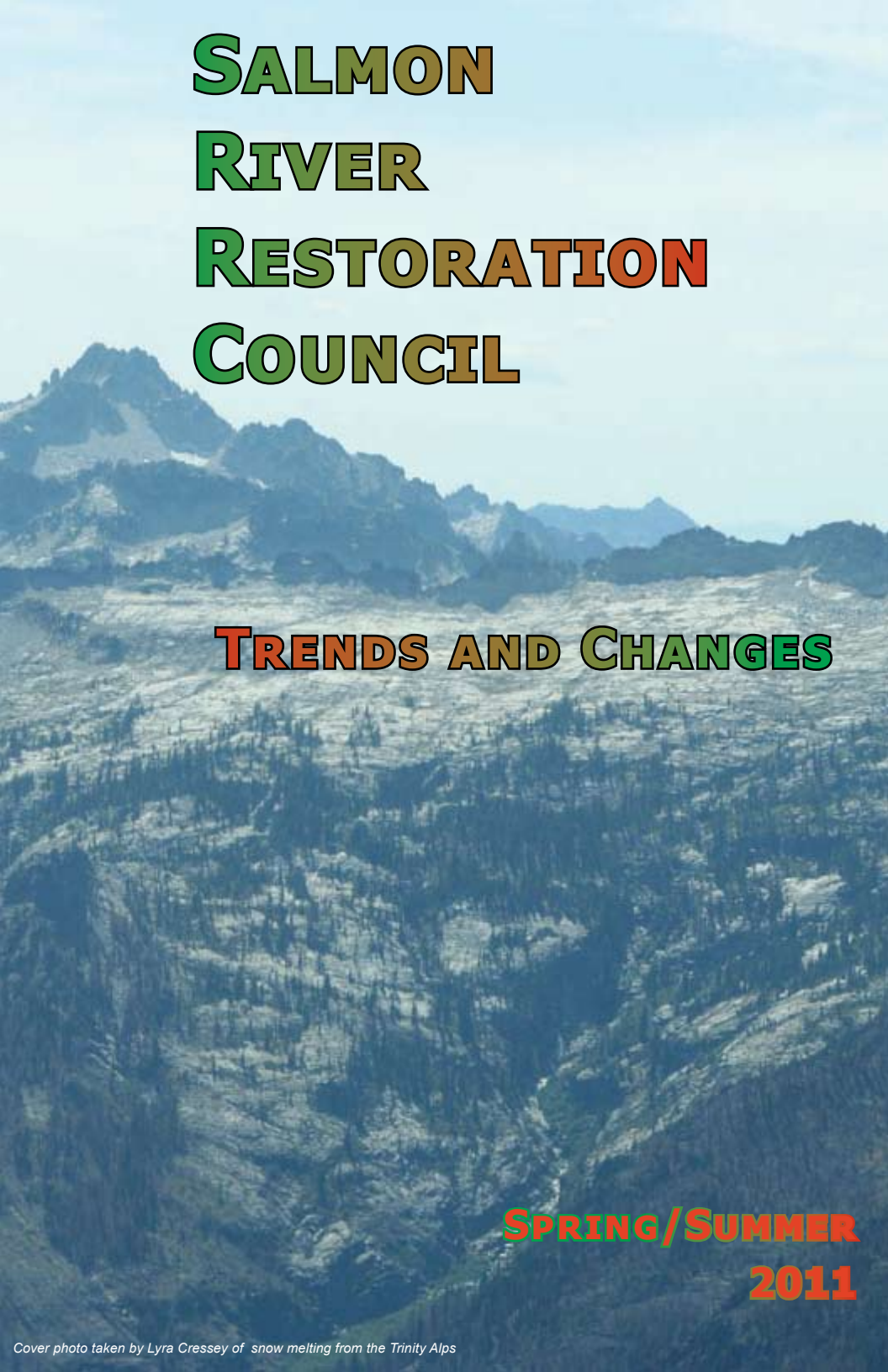
Salmon River Restoration Council

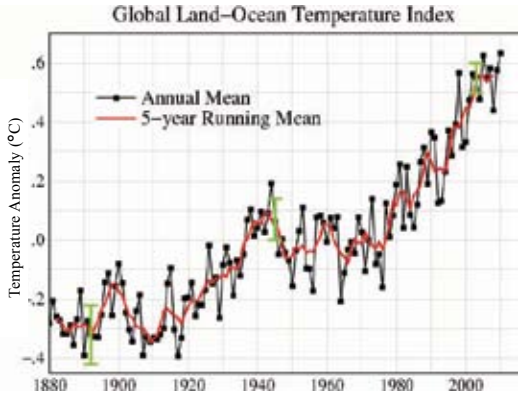
Trends and Changes

Spring/Summer 2011

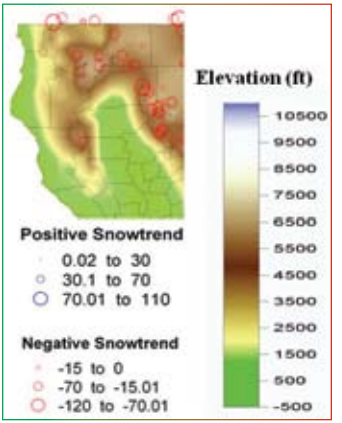


Cover photo taken by Lyra Cressey of snow melting from the Trinity Alps

As the SRRC approaches its 20th year, it seems appropriate to think about what the future holds for our watershed. The focus of our work needs to reflect the trends and changes in the place we are trying to care for. One of the major challenges that we are facing is the effect that climate change is likely to have on our forests and rivers. After two cool, wet springs in a row and an abundance of snow in the mountains, it is hard to imagine that the world is warming. But look at the data.



In 2010, global temperatures continued to rise. A new analysis from the NASA Goddard Institute for Space Studies shows that 2010 tied with 2005 as the warmest year on record, and was part of the warmest decade on record.



April 1 snow level trends 1950-1997. Red points indicate % decrease in snow levels, blue points indicate % increase. Adapted from Moser et al.2005.

It is hard to predict exactly what we might experience in the next 50 years here on the Salmon River. As global temperatures continue to rise, there are likely to be changes in climate patterns that effect land and water resources and the human and natural communities that rely on them.

Some of the impacts from climate change that will affect us the most are already apparent, such as increasing temperature, decrease in the precipitation falling as snow, earlier snow melt, and changing precipitation patterns. A recent publication on climate change in the Klamath Basin (Barr et al 2010) looked at different global climate change models to project future temperature, precipitation, vegetation, runoff, and wildfire in the Klamath Basin. Although the models varied in their predictions, they agreed that in the next 50 years, annual average temperatures are likely to increase by 2.1°F to 3.6°F. Summer warming is projected to be greater than warming during other seasons and future summers are likely to be drier than past summers.

If changes such as these happen, they will have major impacts on many of the natural systems that SRRC strives to preserve. Fisheries will be affected by changes in water quality and quantity. Forests will experience increasing wildfires and changing vegetation patterns. Invasive species will spread and become harder to manage. Preparing for, and mitigating the effects of these changes needs to be a priority. Much of our work is already accomplishing that. By removing noxious weeds, preparing for natural fire through strategic fuels reduction and increasing fish and wildlife habitat, we are striving to improve the overall health and resilience of the Salmon River's aquatic and terrestrial ecosystems. By doing so, we can help

 the Salmon River adapt to the inevitable changes that the future will bring.

Post '77 fire photo from Thalia Truesdale

In its natural state, the Salmon River watershed is a fire-adapted landscape that has evolved with a relatively common recurrence of non-catastrophic wildfires every 10-25 years. A century of fire suppression and increasing fuel loads however, have lead to more frequently occurring severe wildfires.

Catastrophic wildfire is one of the greatest threats to fisheries, ecosystem health, and biodiversity in the Salmon River watershed. High intensity fires can denude riparian and upslope areas, which raises water temperature, and greatly increases the amount of sediment entering the streams and rivers below.

The Salmon River is known to be one of the highest wildfire risk watersheds in the Klamath Basin. An analysis completed as part of the Fire Safe Council of Siskiyou County Community Wildfire Protection Plan found that 408,000 acres of the 480,000 acre Salmon River watershed have burned since 1911. More than 30% of this watershed has burned just since the 1970's, much of it at a higher intensity. Climate change will only exacerbate this trend.

Research shows that temperatures are warming, variability in precipitation is increasing (higher highs and lower lows), and snowpack is decreasing. The combination of these factors will result in longer, drier summers (Safford 2010). Fire season will likely be extended, with more fires occurring both earlier and later than has been typical in the past.

Forest fire frequency, size, total area burned, and severity all show strong increases in California over the last three decades. The increasing frequency of large fires since the 1980's is strongly linked to increasing temperatures and earlier spring snowmelt. Northern CA forests have had substantially increased wildfire activity, with most wildfires occurring in years with early springs (Butz and Safford 2011).

As these trends continue, fire is likely to interact with climate and other factors to create major changes in vegetation. Conifer regeneration could become progressively more difficult, and hardwood species could replace lower elevation conifer forests after disturbances. Some of these projected changes are already occurring in areas of Calif. (Safford 2010).

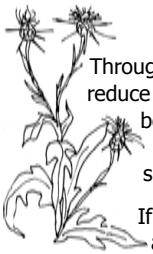
The reality of these conditions and threats in the watershed mandate that the SRRC prioritize and complete strategic projects that are designed to protect the natural and cultural resources in the Salmon River's unique ecosystem. We must move towards the reintroduction of a natural fire regime to the Salmon River. Fuels reduction activities are currently being used in the watershed to reduce fuel loading and improve forest health. The SRRC completed nearly 150 acres of fuels reduction on private property this year, and the USFS has many projects in progress on public property. There is a critical need for more fire planning and fuels management to promote watershed health at a landscape level. It will take an ongoing cooperative effort between the Salmon River Fire Safe Council, land managers, and local landowners to achieve these goals.


Wyatt McBroom, SRRC Fuels reduction crew working on private land

- Lyra Cressey

B.R.Barr, M.E.Koopman, C.D.Williams, S.J.Vynne, R.Hamilton, and B.Doppelt. 2010. Preparing for climate change in the Klamath Basin. Univ. of Oregon Climate Leadership Initiative and National Center for Conservation Science and Policy
..... continued on page 9

Climate effects on Vegetation and Invasive Species



Through the Salmon River Cooperative Noxious Weeds Program (CNWP) we strive to reduce the impact that invasive plants have on the watershed. Invasive species can be intensely destructive to biodiversity, ecosystem function, agriculture, and even human health. In the USA, estimated annual cost of managing invasive species exceeds $120 billion.

If we look at climate predictions there are a wide range of changes that may take place. It will be beneficial to know what plants are in danger of being affected by climate change, and even more importantly, what plants will be 'refugees' from other sites. Part of the explanation for the Salmon River's extraordinary biodiversity is that it has served as plant refugia in the past. During a previous period of climate change - the Wisconsin Glaciation from about 25,000 to 13,000 years ago - this area escaped the burden of both alpine and continental ice coverage and served as a biologic refugia for plant and animal species not adapted to glacial climates. After the glaciers retreated, these species remained in the cool, high elevations of the Klamath Mountains where they can still be found. Many species, such as the Brewer Spruce *(photo right by Michael Kauffmann)*, Port Orford Cedar, and Sadler Oak no longer exist anywhere else.

This watershed is uniquely suited to serve as a key plant refugia during our current episode of climate change as well. Many plants and animals find the combination of our geology, climate and biology to be ideal habitat. It is an important biological corridor connecting interior Basin and Range biomes with the Pacific Coast. One way to prepare for climate change is by protecting corridors through which plants migrate, and maybe even by assisting plants in reestablishing themselves into new regions. Climate change refugia are places where large numbers of the plants hit the hardest by climate change are projected to relocate and hang on. Many of these refugia are in coastal mountain areas such as the Salmon River. If they are kept wild and if plants can reach them in time, they have good potential for sheltering a large portion of the flora. Planning for plant "refugees" may become a new but important concept for natural resource managers.

Models and research predict that in response to rising temperatures and altered rainfall, many plants could move northward and toward the coast, following the shifts in their preferred climate, while other plants may move up mountains into cool but highly vulnerable refugia – places where large numbers of plants hit hardest by climate change are projected to survive. If plants are able to disperse toward suitable habitat, they could shift by an average of 95 miles, often with no overlap between the old and new ranges.

Paradoxically, this may separate species that now live together. Substantial numbers of floral communities may be split up as some species move

left, Youngest SRRC knapweeder standing with a spotted knapweed plant taller than himself

south and uphill while others move north and towards the coast. Range change may separate a pollinator from its preferred plant. Coast Redwoods may range farther north, while California oaks could disappear from central CA in favor of cooler weather in the Klamath Mountains along the California-Oregon border.

Non-native plants, and especially invasive species, appear to thrive during times of climate change because they're better able to adjust the timing of annual activities like flowering and fruiting. Just as native species are expected to shift in range and relative competitiveness with climate change, the same should be expected of invasive species. Certain plants could become invasive if they spread to places that were previously too cold for them. Predictive models are being used to assess the threat of future invasive species, which may become greatly exacerbated in the face of continued climate change. Climate change predictions indicate that in the Salmon River, invasive or non-native plants are likely to expand their ranges. The tracking and inventory data that the SRRC keeps associated with CNWP could be very useful for predicting and preventing the success of future invaders.

SRRC Noxious Weed Crew working on eliminating invasive weeds along roads and at trailheads to slow its spread.

Maps of how invasion risk is likely to change with global warming are also important for land managers designing long-term protocols for fighting invasive plants. Through the SRRC's CNWP, we will continue to monitor the implementation, effectiveness and validation of our work annually and over time, as well as look for climate change effects on vegetation. If you have thoughts on how we should approach climate change please let us know.

- Petey Brucker

Be on the Lookout For Oblong Spurge *Euphorbia oblongata*

Description: A conspicuous perennial plant growing up to 3' tall. Red stems present, leaves bright green to yellow green, oblong to narrow in shape with finely toothed edges, showy yellow bracts surround the small flowers, whorl of yellow leaves found beneath the flowers, fruit is a spherical capsule about half a centimeter long containing smooth brown seeds.

This is a close relative of leafy spurge, which has devastated rangelands across Montana, the Dakotas and other western states. The plant reproduces both by seed and through a vigorous root system so dig the entire root! Mowing will spread new shoots. Oblong spurge produces a toxic white latex sap when the stems are broken so wear gloves if you touch it.

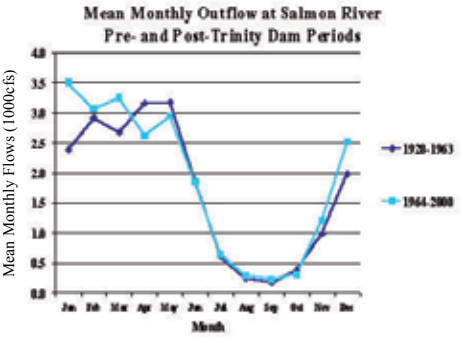
Info about oblong spurge and other noxious weeds - identification, treatment or how to get involved with what we're doing in the CNWP go to our website: www.srrc.org or give us a call at 530-462-4665.

The Klamath Mountains have been an ancient meeting ground for millions of years of climatic fluctuations. Will climate be more moderated across northwest California as it has over the past 60 million years? Will this wild landscape be able to absorb some of the impacts of global change? Will species continue to be able to hold out, survive, and evolve to fit these changing conditions? Clearly, there are more questions than answers but at least the questions are being asked. - Michael Kauffmann from an essay in process "The past, present and future: climate change and the foxtail pines and whitebark pines in the Klamath Mountains."

A Trend Towards Altered Snowpack and the Timing of Spring Runoff

Thompson Glacier lies below the North Face of Thompson Peak. Like all glaciers, the melt rate has accelerated dramatically since the mid-1990s, which was the hottest decade in a thousand years, according to data from ancient ice cores & tree rings.
Photo by Melissa Schroeder 2003

Climate change can have an effect on every part of an ecosystem. The Salmon River is a Wild and Scenic River system that's base flow is mainly fed by snowpack. As the climate changes, so does the water storage system in the mountains. Even a small amount of temperature increase can dramatically alter snowmelt driven watersheds and their delicate balance. Climate change trends are moving toward lesser amounts of precipitation falling as snow, which results in a reduced snowpack and earlier spring runoff. This causes lower levels of warmer water during the summer flow. Wildlife, forest vegetation, riparian habitat, aquatic life and especially threatened salmonids are all affected. Climate calculations for Western North America show that an increase of 1-3°C for winter and spring temperatures is a primary cause for earlier snowmelt and spring flow timing.



Studies have found that the maximum average flow has moved 10-30 days earlier in the water year over the last 55 years. When local temperatures rise and fall with Pacific Decadal Oscillation (PDO) earlier snowmelt and maximum average flow exist even during the colder parts of the PDO cycles. After this year's storms at the end of February and March the measured snowpack in the Salmon/Scott River Ranger District was 176% above normal since recorded history. It is melting fast though. Since January of 2011 the Salmon River has had 3 high peaks from rain on snow events that averaged around 10,000cfs. Future climate change progression will further the trends of less snowpack, earlier spring runoff and hydrologic system changes. Projections from climatologists show the earlier snow runoff continuing over time as temperatures keep increasing globally and locally. The freezing levels in of the region are predicted to increase in elevation to the point where by 2100 there may not be an annual snowpack. Warmer temperatures will affect the snow even at higher elevations and episodic events will change the snowpack pattern from steady accumulation to alternating accumulation and loss. The effects of such changes will radiate throughout the river system. Spring fed creeks may begin to dry up earlier in the year, providing animals and humans with less water. Riparian zones may be damaged during higher spring flood events, and less underground water will make it more difficult to replenish seedlings to shade the river. As the river decreases in volume and flow, so does the habitat for the salmon and other aquatic species.

As scientists continue to monitor snowpack and hydrologic runoff in the Northwest, we will have a better idea of what changes to expect and how to mitigate for the potential warmer climate with a less consistent water supply. Climate change and rising temperature is a global issue that affects everyone on slightly different levels. For the Salmon River it seems that the direct annual hydrograph changes will be a major influence on the health of the wildlife, plant life, aquatic species and human communities.

- Bonnie Bennett, WSP

P.Mote. 2005. Climate-Driven Variability and Trends in Mountain Snowpack in Western N. America
I.Stewart, D.Cayan, M.Dettinger. 2005 Changes toward Earlier Streamflow Timing across Western N. America

Tree Tree TREE Tree Encroachment on Alpine Meadows

Salt Log Meadow in the Marble Mts.Meadows such as this can disappear into conifer forest without the benefit of natural fire and wildlife grazing. photo from Melissa Schroeder 2004.

Alpine meadows in the Klamath Mountains are ecosystems which contain a high diversity of rare life. They serve as biologically rich refuges to many different species, home to a mixture of vegetation originating from the Cascade, Sierra, and Rocky Mountain ranges, and the Great Basin. Each meadow type varies in flora composition, depending on elevation, soil pH and composition, mycelial composition, etc. The flora community types include sedge, dry meadow, sedge-bunchgrass, lush-herbaceous, corn-lily, and bentgrass (Murray, 2003). The high mountain meadows are also important habitat for grazing animals, bear, rare amphibians, lizards, and many different pollinating insects. The meadows are some of the most inspiring and beautiful places in the Klamaths, many containing deep lakes and sharp contrast to the surrounding forests.

Meadow plants can grow in these areas because they receive light that is not filtered by trees and other competitors, but recently, researchers have found ever-increasing numbers of extensive patches of young, healthy conifer trees. When these conifer trees establish themselves in the meadows, they have the potential to change the delicate soil composition. As conifers move in, the new soil chemistry welcomes herbs from the surrounding forests to dominate the understory. As these herbs move in, tree establishment becomes much more rapid. The soil change and newly-formed shade combine to slowly get rid of the rare meadow plants that are so important to these ecosystems. Also, after tree encroachment, researchers have found that the number of viable seeds of the meadow plants is severely decreased (Swanson, 2007). Besides affecting the fragile flora, tree establishment creates loss of habitat, and changes in fire dynamics and hydrology (Murray, 2003).

Although it is hard to pinpoint exact causes for the increasing occurrences of tree encroachment, climate change seems to be one of the most important factors. Conifer seedlings are known to proliferate during the cool, wet summers at these elevations. Also, the decreasing levels of snowpack in the spring are not able to keep the conifers seedlings out of the meadows.

Besides climate change, fire exclusion at lower elevation meadows and decreased amounts of grazing have been identified as factors further influencing the amount of tree encroachment. In order to properly restore these meadows, each meadow type has to be individually researched, because of the high level of variability between them. Swanson (2007) and others have found that at a majority of meadows, the best restoration efforts are those that target tree removal at the earliest stages of encroachment.

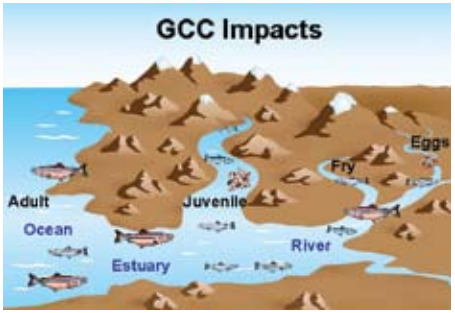
- Isaac Baker, WSP

M. P. Murray - Tree Encroachment on Klamath Mountain Meadows. Fremontia, 31(2), 13-18.
F. Swanson - Mountain Meadows: Here Today Gone Tomorrow? Meadow Science and Restoration. Science Findings, 94, 1-5.
C. Halpern & F. Swanson - Restoring Mountain Meadows: Using Fire, Vegetation, and Fuel Management in Western Oregon. Fire Science Brief, 1(75), 1-6.

After the Spring Chinook Dives last year we were fortunate enough to host a couple of honorable guests in the Forks of Salmon Community Club: Dr. Amy Sprowles of HSU and Rebecca Quinones (*left*) of UC Davis and the Klamath National Forest.

A question and answer session followed both presentations that day, and it was apparent that the Salmon River community lives close to the heart of larger issues affecting the greater natural world. Below I have attempted to reproduce Becca's presentation,

"Climate change in California (How can salmonids persist?)"



Some of the climate changes predicted to affect California's rivers include:

Precipitation - +/- 10% change
More rain, less snow (Below 9000 ft. estimated to experience 80% loss)

Hydrograph - Earlier peak flows (30 days), Higher peak flows and Reduced base flows

Water temperature - Klamath River Basin water temperatures have already risen 2 °C

Cumulatively, these changes could reduce the amount of suitable in-river fisheries habitat by as much as 42% by 2090. Estuaries may experience similar losses in habitat due to the effects of sea level rises. Tidal flats and salt marshes may experience a 29 to 55% reduction in size. Reduction in suitable habitat in the Pacific Ocean will be caused by stratification, acidification, and the potential for more upwelling off the coast of California. These changes in the ocean affect the timing and productivity of fish cycles.

Given this broad spectrum of change, responses will be felt at both spatial and temporal scales. There will also be changes in species abundance. Salmonid responses to change can be simplified to 4 basic categories (Waples et al. in progress). Over time, populations may move (shift range and distribution), die (change in abundance), adapt (change in phenotypic and genetic diversity) or evolve (change their DNA).

Some response mechanisms that can facilitate these types of change include:

1. Faster developmental rates
2. Shorter life history stages
3. Changes in migration patterns and timing
4. Increased incidence of disease, mortality
5. Reduction in fecundity, egg size
6. Increased vulnerability to competition, predation
7. Novel interactions

Salmonids may respond with these mechanisms to changes in climate by:

- Shift in distribution (spatial scale)
- Shift in timing (temporal scale)
- Reduction in abundance (50%)

SRRC collecting otoliths

There are three fisheries studies currently happening in the Klamath River Basin that shed light on what changes are happening now, and what kind of changes we can prepare for in the future. These are studies of otolith microchemistry, scale microchemistry, and abundance factors analysis.

If you have been on a spawning survey, you are familiar with collecting otolith and scale samples. These samples go to biologists for scientific research, increasing our understanding of salmonid dynamics in the Klamath Basin. An otolith (a tiny "ear bone" the size of a fingernail) contains growth rings similar to the age rings of a tree. In these bones is also a chemical signature from the fish's natal stream. With the

info that can be gathered from an otolith, a biologist can tell the life history of a given fish. An important focus of Becca's research is looking for a correlation between habitat conditions, migration patterns and natal origin, which allows for a comparison of changes in spatial scale associated with global climate change. In other words, studying these otoliths could help determine if fish are moving (shifts in habitat use, distribution, and range) because of changes in climate.

Scale samples can be used to determine age and growth models for salmonids. The scale samples taken during annual spawning surveys are used to determine the age-class composition of a run of salmon. In addition, scales can be utilized to compare developmental timing (incubation, hatch, outmigration etc.) with habitat conditions. So, this type of study could be useful in determining any changes in run-timing that may occur due to climate change. Scale samples of Salmon River Spring Run Chinook have been collected every year since 1978!

left, SRRC's Watershed Education Program introduces school kids to scale sampling during the annual Fall Chinook Population Count

The Abundance Factors Analysis study is probably the most complex. It looks at "what the synergistic impacts of climate change are on salmonid abundance." The short answer may include climate, fisheries management, and land practices. But even these three factors have many components. For example, climate includes snow depth, water temp., flow, Pacific Decadal Oscillation (PDO), and something referred to by scientists as MEI, (Multivariate El Niño / Southern Oscillation Index). From what I understand, MEI is "the most important ocean-atmosphere phenomenon to cause global climate variability on inter-annual time scales." Of course, fisheries management and land practices also include many components. Fisheries management = Iron Gate Hatchery runs, Iron gate releases, commercial harvest, in-river harvest, etc. Land practices = Roads, Logging, Mining, Agriculture, etc. And of course none of these factors or any of their components act individually.

How do we integrate all of this info into management practices?
How do we bolster Klamath River Basin salmonids?

In order to help salmon shift their range if they need to, we can encourage the protection of cold water refugia, and remove fish barriers and dams throughout the basin. To help salmon adapt or evolve, we can address factors decreasing survival and diversity, curtail hatchery operations, better manage harvest and disease vectors, and restore spring-fed watersheds such as the Scott and Shasta rivers.

SRRC has been working since 1992 to monitor and restore the Salmon River's fisheries. Many of the otoliths collected for Becca's research of Salmon River Spring Run Chinook have been collected by the Salmon River community. For more information regarding community fisheries, or to get involved in local activities, contact fisheries@srrc.org. Thanks for all the support.

-Tom Hotaling

Spring Chinook spawning in the Salmon River in August from the SRRC archives

References continued from page 6 -

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D.McKenzie et al. 2004. Climatic Change, Wildfire and Conservation. Conservation Biology, Vol. 18, #4.
Hugh Safford. 2010. Climate, forests, and fire: issues in current and future resource management in the CA National Forests. Biological Sciences lecture series, San José State University, CA
J.Villeponteaux. 2007. Salmon River Community Wildfire Protection Plan. Salmon River Fire Safe Council. Forks of Salmon, CA

Watershed Education Highlights

above, As part of the Watershed Fair, volunteers from the Karuk Tribe Department of Natural Resources set up a display table of juvenile anadromous fish.

left, Always a favorite learning tool, this year Junction School set up the aquarium for incubating of salmon eggs from the Iron Gate Hatchery.

Upper grade students at Forks of Salmon and Junction Schools studied weather as part of their Watershed Education Program this year. They learned about the Water Cycle and how the movement of water from the oceans to the atmosphere and back to the Earth causes weather patterns and what happens to the water that falls back to the Earth. How some is stored as ice and snow, some in freshwater lakes, some absorbed into the ground, and some becomes groundwater runoff, moving as streams and rivers. They related this knowledge to conditions in the Salmon River watershed and discussed the effect that various snow levels on the surrounding mountains have on the watershed, particularly in the following warm months. They also discussed what kinds of things might be done to protect the watershed during adverse weather.

Upper grade students also learned about plotting on maps by longitude and latitude. They had been introduced to this during their study of Plate Tectonics. Students got familiarized with topographic maps of the Salmon River watershed This led into the study of local geology. They visited several locations on the Salmon River to learn about the rocks and minerals to be seen.

One of Watershed Ed's highlights is the annual Watershed Fair. The kids research watershed related subjects and create displays for this event. A reptile and amphibian expert was on hand this year. He had many varieties of both local and exotic animals that had the kids in awe. There was a resident elk expert and a couple birders giving slide shows, a rock lover showing off local samples (some that were luminescent) and many more interesting and fun displays and activities.

- Lorelei Diamond-Holzem

From National Geographic magazine 12/2008 Reuniting a River - *"The perils to the nation's rivers are growing dramatically, as population growth and rising water usage overtax watersheds and deplete aquifers. In the western U.S., that skyrocketing demand is on a crash course with the alarming effects of climate change. In response to warming temperatures, winters are bringing less and less snow to the American West, and snowpack is mother's milk to rivers like the Klamath. The Cascades and other NW mountains whose snowmelt feeds the river are the harbingers of what's to come elsewhere. Since the 1940s they have seen a significant decline in total snow accumulation because they are lower in elevation and so more susceptible to the region's rising temperatures than other western mountains. All of which makes the decisions over how to handle the competing needs for the Klamath's waters even more crucial. In coming decades, as governmental agencies turn increased attention to rescuing the world's riverine ecologies, they may cast an eye back to the way the small and relatively isolated communities of the Klamath River watershed negotiated their entrenched local issues and resolved historic antagonisms."*

The Salmon River Cooperative Spring Chinook & Summer Steelhead Dives You are invited to participate Aug 9-11, 2011. If you are a first year volunteer, training for White Water Safety and Fish Identification is mandatory. If you are a tenth year volunteer, it is recommended. A downloadable RSVP will be available at www.srrc.org. Past Population Count results are posted on our webpage as well. Contact fisheries@srrc.org or call 530-462-4665 for more info on the Dives.

Divers setting out snorkeling and counting. Detail of a photo by Stormy Staats, Klamath-Salmon Media Collaborative

Salmon River Restoration Council

www.srrc.org

25631 Sawyers Bar RD

Sawyers Bar, CA 96027

530-462-4665 info@srrc.org

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SRRC Staff, Project Leaders and Crews

Rattlesnake orchid growing in the Marble Mountains

from the SRRC Archives

Lyra Cressey - Associate Director & Water Monitoring Coordinator
Kathy McBroom - Office Manager
Petey Brucker - Klamath Coordinator & CNWP Coordinator
Tom Hotaling - Fisheries Coordinator
Robert Will - Fuels Reduction Field Coordinator
Lorelei Diamond-Holzem - Watershed Ed Coordinator
Sarah Hugdahl - Program Technical Assistant, Outreach
Brenda Hurlimann - Bookkeeper
Bonnie Bennett & Isaac Baker - AmeriCorps Watershed Stewards
Steve Adams - Power & Watershed Center Maintenance
CNWP Crew - Timothy (Lino) Darling, Irie Swift, Bob Webster, Jessica Hanscom, Warren Jones, and many more wonderful volunteers as well as help from our cooperative partners
Fuels Crew - Mike Kerrick, Steve Gunther, Mike Hill, Sherri Campbell, Wyatt McBroom, Riley O'Brien, Robert Cousineau, Eric Cousineau, Kyle Cousineau, Garry Collins, Steve Adams, Daniel Adams, Kevin Dunbar
Screwtrap & Fish Survey Crew - Joe Stoltz, Scott Kingery, Laurissa Gough, Irie Swift, Nat Pennington and Nathan Donnelly

Salmon River Restoration Council
PO Box 1089
Sawyers Bar, CA 96027
www.srrc.org

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The Salmon River Cooperative Spring Chinook & Summer Steelhead Dives

in Forks of Salmon
August 9th to the 11th