

Environmental Health Risks from Abandoned Mines in the Sierra Nevada

*profiles of four pilot projects
conducted by The Sierra Fund*

THE SIERRA FUND



Angler Survey



Trails Assessment



Environmental History Forms



Environmental Health Outreach

The purpose of this document is to profile efforts to assess and reduce human exposure, and share results and lessons learned.

About The Sierra Fund

Founded in 2001, The Sierra Fund is the only nonprofit community foundation dedicated to the Sierra Nevada. Our mission is to increase investment in the natural resources and communities of the region, which is overwhelmingly rural, and underrepresented in proportion to the resources it provides to the State of California. We pursue our mission three ways: through **advocacy** to bring public funding to the region, **philanthropy** to provide a vehicle for private funding in the region, and **strategic campaigns** that pursue critically needed programs in the Sierra.



Reclaiming the Sierra

Since 2006, the “Reclaiming the Sierra” Initiative has been our primary strategic campaign. The goal of this Initiative is to assess and address the ongoing impacts of toxins left over from the Gold Rush and subsequent mining in the Sierra Nevada. The Reclaiming the Sierra Initiative works to:

- Raise public awareness of historic mining activities and their ongoing cultural, human health, and environmental impacts on the region and state. Activities include on-the-ground presentations, an annual conference and an interactive website.
- Increase coordination among the many players in this issue including: indigenous people, policymakers, local officials, state and federal agencies, healthcare providers, research institutions, and community members. The Mining Toxins Working Group provides a forum for dialog and collaboration among four interrelated fields: Human Health, Science and Technology, Outreach, and Policy.
- Provide timely and accurate information. We host a website with a developing library of resources, and have produced important documents to help local governments and nonprofit organizations that have to deal with abandoned mines. Additionally, we sponsor regular events including our bi-annual conference.
- Conduct pilot studies and restoration projects that will stimulate more research, and provide models for addressing key components of mining’s toxic legacy.
- Educate policymakers and participate in the state and national dialog about abandoned mines.

For more information: www.sierrafund.org

Mining's Toxic Legacy in the Sierra Nevada

The widespread pollution from Gold Rush mining activities, including mercury, arsenic and lead, constitutes the oldest and longest neglected environmental justice problem in California. The effects of this pollution on human health and the environment are only now beginning to be addressed.

Today, the effects of historic mining pollution are an invisible but very real threat to people who live, work or recreate in the Sierra Nevada. Toxins of concern include:

- **Mercury:** Millions of pounds of mercury were brought to the Sierra to process gold, and 30% was lost into rivers and streams in the process. Today, mercury is still present throughout Sierra waterways, and affects people who eat local fish, especially young mothers and children because of the documented risk of birth defects and developmental disorders. State health warnings regarding mercury are in effect for every Sierra lake or reservoir, and several advise children and women under 45 to eat none of certain kinds of fish. Despite the recognized health hazards, Sierra residents are largely unaware that eating local fish can be dangerous.
- **Arsenic, Lead and Asbestos:** Arsenic, lead and asbestos are natural elements of rocks in the Sierra Nevada, but are typically not considered a hazard when they are bound up in rock formations. Gold Rush mining activities, however, crushed millions of tons of rock to get the gold out, and left the resulting waste rock including fine "tailings" spread across the surface. Today, people may be exposed to these toxins by breathing dust in the course of everyday activities such as working construction or timber jobs, driving on dusty roads, or recreation such as biking and OHV riding on the numerous trails and roads that go through thousands of abandoned mines.

There is little information about these potential exposures available to Sierra residents. State-issued fish consumption advisories in the region do not provide site-specific advice for many locations people fish, or the species people eat. In 2006, The Sierra Fund, in partnership with California State University Chico, conducted a survey of Sierra clinics. This study found that not one of 13 surveyed clinics included information on mercury in fish as part of their maternal/infant health programs, whether caught locally or not. Additionally, the study learned that none of the clinics surveyed administer an environmental health history form, so it is difficult to connect current health problems to environmental exposures.

In order to address this lack of information and provide a springboard for more research, The Sierra Fund conducted three pilot studies of potential environmental exposures in 2009 and 2010 and a pilot outreach program to present these findings to Sierra communities in 2013-14. This report summarizes findings and recommendations from these efforts, in order to encourage continued research into these potentially serious health exposures.



Problem: Mercury Exposure from Eating Fish Caught in the Sierra

Millions of pounds of mercury (or “quicksilver”) were used during the California Gold Rush in the Sierra Nevada. Much of it was lost into the rivers, lakes and streams, where it remains today.

Mercury is a danger to humans when they eat fish from areas with mercury pollution. Mercury exposure from eating contaminated fish can cause developmental delays in children—this is why women of childbearing age, pregnant women and children under 17 need to avoid eating fish high in mercury. Women over the age of 45 and men should also limit eating fish high in mercury.

Despite the fact that much of this mercury remains in the lakes and rivers in the Sierra, and health warnings have been issued regarding eating fish at nearly every water body that has been tested, limited information is available about mercury levels in many kinds of fish, and also the mercury exposure of people who eat the fish they catch.



Recommendations

The purpose of the Sierra Fund’s Angler Survey was to raise the knowledge about people eating fish from areas with historic mercury pollution from mining, in order to stimulate additional research and policy reform and better public information about mercury in Sierra fish, and help people make good choices about the fish they eat.

Key recommendations include:

1. Existing information about mercury in fish needs to be posted where people are fishing – including both state-issued safe eating guidelines, and general information about mercury.
2. More fish need to be tested from Sierra lakes and rivers in order to complete state-issued safe eating guidelines, and provide more accurate and complete data for calculating mercury exposure of people eating fish caught in the Sierra.
3. More angler surveys need to be collected at target water ways and over a wider area to help get a clear picture of mercury exposure in the Sierra and inform other research efforts, particularly surveys that target women and children, low-income and ethnic populations.
4. Abandoned mine sites need to be remediated to reduce overall mercury in the environment.



Project: Gold Country Angler Survey



In 2009 and 2010, The Sierra Fund conducted a study to learn whether people who eat fish caught in Sierra Nevada lakes and rivers are being exposed to too much mercury. Trained interviewers went to popular fishing spots, and asked people who were fishing a series of questions about their fishing activities, how much fish they ate and what kind, and whether they were aware of any warnings about eating fish. A total of 151 interviews were completed at selected fishing locations in the Deer Creek, Yuba, Bear and American River watersheds. Results of the interviews were used to calculate mercury exposure of the individual participants.

Findings

Over 90% of people surveyed reported eating fish that is locally caught. Many reported feeding the fish they catch to children under 18, women of childbearing age, and to a lesser extent pregnant women in their household.

The most popular fish eaten were bass and trout. This is a concern because bass and brown trout typically have the highest levels of mercury and as a result are the subject of fish consumption advisories for many Sierra water ways.

When anglers' mercury exposure was calculated, 9% of participants were exposed more mercury than state safe eating guidelines recommend, and half of these individuals were exposed to between two and five times safe levels.

There were no warnings about mercury in fish at most of the fishing locations where the survey took place. In some cases, this is because existing state-issued warnings have not been posted, in other cases because more information about mercury in fish needs to be collected before warnings can be developed.

When were asked where they get health information they really trust, participants' top answer was their healthcare providers. This fact is important because no clinics contacted in the Sierra provide information on mercury in fish to their patients, even their maternal health patients according to a 2006 study completed by The Sierra Fund, and confirmed in 2011.

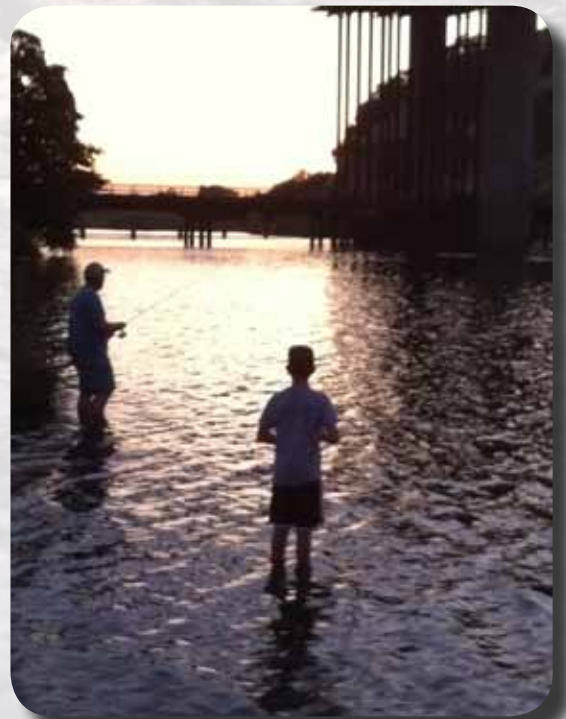


Photo: James Worthy

Problem: Recreational Exposure around Abandoned Mines



The Sierra Nevada is rich with gold, and other heavy metals and minerals—some of which are toxic. Of particular concern in the region are naturally occurring **arsenic, lead, chromium and asbestos**, which people may be exposed to by breathing dust. Historic mining activities made these toxins much more available for human exposure by crushing the rocks, and distributing them over the surface. In addition, roads were constructed to access the mine sites, and many are still used for travel and recreation today. The main exposure route is through breathing dust.

Abandoned mines pose more than just physical hazards. Arsenic, lead and asbestos may also be present in the area.

Recommendations

The Sierra Fund's *Recreational Trails and Abandoned Mines Assessment* was designed to help identify areas that require further evaluation.

Key recommendations from this study include:

1. Clear, visible advisories in areas that are known to be contaminated by substances that are dangerous to human health
2. Additional sampling of contaminated areas
3. A dust exposure study that looks at exposure scenarios of different recreational activities
4. A survey of people recreating in these areas to learn more about their exposure, and effective outreach and education methods

The Marall Chrome Mine pit, in the popular Foresthill OHV area, where samples showed extremely high levels of asbestos and lead.



Project: Recreational Trails and Abandoned Mines Assessment

In 2009, The Sierra Fund initiated a study to learn whether recreational hikers, mountain bikers, horseback riders, and off-highway vehicle (OHV) riders may be exposed to toxins at abandoned mine sites. To learn this:

1. Popular trails in the Downieville, Nevada City, and Foresthill areas were mapped with GIS.
2. Known abandoned mine sites were mapped over the trails, and sites of concern were identified where an abandoned mine was within 30 feet of the popular trail.
3. Scientists took soil samples from the surface of the trail or next to the trail at sites of concern, and sent the samples to labs for analysis.



Scientists took soil samples from trails adjacent to abandoned mines.

Findings

The Recreational Trails Assessment reveals an urgent need for further testing in certain areas to quantify and address likely risks to human health. The most serious problem was found at the Foresthill OHV Area. Other areas of concern were identified with high levels of arsenic, lead and asbestos.

At certain locations, toxins were found at levels that could affect human health:

- In the Nevada City area, arsenic was found at levels of concern on Banner Mountain trails, and asbestos in one location on the Newtown Ditch trail used for biking and hiking.
- At the Foresthill OHV Area in and around the abandoned Marrall Chrome Mine pit, samples showed up to 40% asbestos and off-the-charts levels of lead in the soil on trails where families ride OHVs.
- In the Downieville area, certain biking, hiking and OHV trail locations tested high for arsenic, lead and asbestos.



The goal of this study was to identify safe places for recreation, and to stimulate action to protect human health.

Levels of concern were based on state and federal standards for exposure.

There is also good news: the study found that several popular areas including the “Downieville Downhill” mountain bike trails, the Eureka Diggings OHV Area, and the Western States Trail near Foresthill, while they pass several abandoned mines, do not pose a health threat to recreationists.

Problem: Clinics Not Asking about Environmental Exposures

Although environmental exposures and related diseases are receiving more coverage, environmental history forms are not widely used by clinics. In a 2006 survey of rural Sierra health clinics, The Sierra Fund turned up some shocking results: none of the clinics collected environmental history information from their patients, and none provided information about the dangers of mercury in fish to their maternal patients.

An Environmental History Form is used to collect information about a patient's exposures in the course of their daily activities—for example, what foods they eat, where they live, their occupation, and where they work. Environmental History information can help a doctor accurately diagnose and treat a patient. For example, knowing the age and condition of a patient's house gives the doctor information about whether exposure to lead from paint may be an issue. In the case of Sierra Nevada communities where extensive historic mining occurred, there are two unique environmental exposure issues: eating locally-caught fish high in mercury, and exposure to heavy metals in dust while working or recreating around abandoned mines.



Recommendations

Environmental history forms need to be adopted to give Sierra practitioners and patients the benefits of increased awareness of environmental exposure issues. A pilot study that administered environmental history forms at Sierra clinics affirmed that practitioners have the opportunity to give their patients basic information that can greatly reduce their environmental exposures. This point is underscored by the fact that participants in the Angler Survey (see following page), overwhelmingly reported turning to their healthcare provider for trusted information. Critical information collected using environmental history forms can also help doctors and researchers identify environmental exposures that warrant further investigation.

1. Encourage clinics to adopt the practice of administering environmental history forms
 - Communicate results collected from pilot study and benefits identified to rural clinics and state and county health offices
 - Expand pilot study of the environmental history form to increase interest of clinics
 - Develop incentives for clinics to adopt the environmental history form
 - Put environmental history form into electronic format: many clinics are moving to electronic records, and the information is more accessible
2. Disseminate results of this pilot study to encourage a more comprehensive study of the connection between environmental exposures and human health in the Sierra
3. Revise environmental history form based on lessons learned in pilot study

Project: Administering Environmental History Forms at Sierra Clinics

The Sierra Fund, in partnership with the nursing program at California State University, Chico, developed a project to pilot test environmental history forms at clinics in the region. These activities took place in 2010 and were funded by a grant from the CA Environmental Protection Agency, Environmental Justice Small Grants Program.

The goals of this project were to:

1. Learn whether patients were being exposed to toxins through eating fish or breathing dust around abandoned mines
2. Familiarize Sierra clinics with environmental history forms, and promote establishment of the protocol

The environmental history form was administered at four participating clinics by nurses in the CSU, Chico nursing graduate program. Clinic wait time was used to complete the surveys—individuals waiting for an appointment were approached and asked if they would be willing to participate in the survey. A total of 223 individuals completed the interview.



Findings

The Environmental History pilot project collected information on a wide range of topics that provide insight into the patient's exposures. Analysis of completed environmental history forms also identified ways to improve the form itself by changing some of the survey questions, particularly the questions about abandoned mines.

Following are a few examples of findings, which demonstrate the importance of using environmental history forms, and indicate the need for further investigation into these potential exposures:

Abandoned mine-related exposures *

- 63% of people reported participating in dusty recreational activities including mountain bike, dirt bike, OHV/ATV or horseback riding.
- 78% indicated that women aged 18-49 in their household ate locally caught fish.
- Bass was the most popular fish eaten from local streams – bass are known to have the highest mercury of fish that are locally caught.

General environmental exposures *

- Only a third of people who get their water from a well reported having the well tested.
- Over half of the people reported having smokers in their home.
- 10% of people did not have smoke detectors and 55% did not have carbon monoxide detectors in their homes.
- 40% of responders reported that they never or only sometimes wash fruit and vegetables.
- 23% of responders reported that a family member has been diagnosed with autism, several times the national rate of autism.

* Not every survey participant was asked every question; percentages listed are those who answered.

Problem: Residents and Healthcare Professionals Uninformed

As described in the above studies, Sierra residents, anglers, and the leaders and healthcare professionals serving them, are largely unaware of the environmental health effects of historic mining in the Sierra. Without adequate information, residents risk exposure to mercury, lead or other heavy metals. Until Sierra residents understand these risks and insist on remediation of the legacy mines in the region, nothing will be done to solve this long standing environmental justice issue. Meaningful involvement of residents and leaders is essential to creating effective solutions to environmental health problems, since solutions to these problems may be different for each community.



Recommendations

Through a pilot outreach program, The Sierra Fund identified key recommendations for ways to increase awareness and action on these issues:

1. California state agencies tasked with producing fish consumption advisories need adequate funding to develop, produce and distribute them.
2. Involve community members in raising awareness about mercury in fish, by holding a “Volunteer Postering Day” to post signs with state-issued fish consumption advisories at local water bodies.
3. Tips for continued outreach about legacy mining impacts in Sierra Nevada communities:
 - Involve a wide audience. Many different facets of the community are affected by mining’s toxic legacy. Offering everyone the chance to be involved is the first step to building trust. Be sure to involve Tribal leaders and members, City and County Government, residents and landowners, healthcare providers, school groups and parent groups, recreation clubs, anglers and local community organizations.
 - Integrate outreach to community members with dialog with community leaders including elected officials, tribal leadership, and community organizations.
 - Hold presentations in the evening, when community members can make it.
 - Provide a solid structure and clear information based on locally-specific scientific data.
 - Provide ample time for discussion. At the end of a presentation or meeting, summarize key points; ask participants if they would like additional opportunities to come together and discuss; and provide written feedback forms or questionnaires.
 - Provide refreshments! Coffee and a few cookies go a surprisingly long way in building trust and a positive environment.

Pilot Environmental Health Outreach Program

In 2013-14, The Sierra Fund conducted a public outreach and education program about the environmental health risks of mercury in fish and other heavy metals from abandoned mines, in the rural Sierra communities of Nevada City/Grass Valley, Quincy, Downieville, and Foresthill/Auburn. The program included multiple activities:

- Ten accredited trainings for doctors and clinic staff about the presence of mercury in locally caught and commercial fish, and its danger to sensitive populations
- Collaborative meetings with community leaders and health professionals in historic mining towns and downstream communities
- Tabling, outreach and guest presentations at over 15 events, directly contacting more than 400 individuals
- An online and print media campaign focused on providing accurate and detailed information on mercury in fish and other legacy mining impacts, resulting in over 30 published stories in local media and hundreds of copies of informational materials distributed
- Widely publicized informational Community Meetings in historic mining towns and final “Mercury Health Summit” to bring information on this issue to the State Capitol



The short term goals of this program were to prevent and reduce exposure to mercury from locally caught fish in Sierra communities, and to raise awareness about mercury in the fish and other mine-related toxins among community members, leaders, and healthcare providers. The long term goal is to build a movement to clean up sources of legacy mining pollution in the Sierra.

Findings

The main outcomes of the initial phase of our Health Outreach Program include:

- Based on responses to our final project survey, a majority of the 15 clinics that participated in our pilot training program are now providing information on mercury in fish to their clients, whereas before the training none of the clinics had. This shows that although bringing information to busy health professionals is challenging and time consuming, it is worth the effort.
- Creating an informed and engaged network of community partners, local government officials and leaders in Plumas, Sierra, Nevada and Placer Counties has formed a foundation for action on this issue, including getting information about mercury in fish to anglers at local water bodies.
- Community members are interested in learning more about legacy mining impacts, and how to reduce exposure. Our informational meetings held in the four targeted communities drew a total of 255 participants from diverse community groups. The majority of these participants responded positively to post-event survey questions about the importance of the information presented, and that they were likely to share it with friends, family, and community leadership.



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Further Resources

The Sierra Fund has compiled the following documents as a toolbox for communities to address abandoned mines. These materials can be found online at www.sierrafund.org

(Documents marked with an asterisk (*) were produced by other organizations.)

Mining's Toxic Legacy: An Initiative to Address Legacy Mining Toxins in the Sierra Nevada - March 2008 - This 85-page report is the first-ever comprehensive look at the ongoing environmental, cultural and human health impacts of the Gold Rush.

Protecting Public Health and the Environment from Legacy Mining Toxins: A Primer for Nonprofit Organizations in the Sierra Nevada - March 2010 - This document summarizes the key issues that confront land trusts and land and water conservation organizations working in the Sierra Nevada.

Protecting Public and Environmental Health from Legacy Mining Toxins: A Primer for Local Government Officials in the Sierra Nevada - May 2010 - This document summarizes the key issues that confront local government officials with legacy mining in their jurisdiction.

****Mercury Health Toolkit: Information to Identify, Reduce and Prevent Mercury Toxicity in the Human Body*** - Produced by the California Indian Environmental Alliance (CIEA), this toolkit provides information for health care providers and community advocates.

****Mining & Health: A Community-Centred Health Assessment Toolkit*** - Produced by MiningWatch Canada, this toolkit helps members of mining-affected communities conduct their own assessment of the health of their community and guide them in taking steps towards supporting and improving the conditions for health in their communities.

****Pediatric Environmental Health Toolkit*** - Produced by Physicians for Social Responsibility, this toolkit includes easy-to-use reference guides for health providers and health education materials on preventing exposures to toxic chemicals and other substances that affect infant and child health.

