



## **ARROYO HONDO PRESERVE, A SELF-GUIDED TRAIL LESSONS IN NATURAL HISTORY AND FIRE ECOLOGY**

### **1) Arroyo Hondo: A Land of Many Habitats**

Arroyo Hondo Preserve is very rich in plant and animal species. Many different kinds of trees, shrubs, wildflowers and ferns can be seen here. A great variety of mammals, birds, fish, reptiles, amphibians, and insects make their homes in this canyon. One reason for all of this **biodiversity** is that this canyon includes a number of different **habitats**.

#### **Grassland:**

In front of you, the grassland includes many non-native plants as well as some native California species. Most California grasslands on old ranches have lots of non-native plants. Most of these plants originally came from Europe, and some came from other Mediterranean climate areas of the world.

#### **Streamside or Riparian Habitat:**

To your right, you can see the stream corridor with streamside or **riparian** habitat that follows the bottom of the canyon. This area is lined with tall trees, including huge and beautiful Western Sycamores and California Bay trees.

#### **Coastal Sage Scrub:**

To your left, look for small patches of gray-green coastal sage scrub on the hill. This habitat includes different species of shrubs, many of which have soft leaves.

#### **Chaparral:**

Farther on, and high up on the rocky slopes to the left, you will see some dark green areas covered with chaparral. Chaparral habitats occur in tough, dry places, and often on south-facing rocky slopes. Many different shrubs are found here. Most of them have tough dark green leaves and are very tolerant of drought. Many of the recent big California fires have started in chaparral areas.

#### **Oak Woodland:**

Farther up the canyon, you will walk through shady oak woodlands. Oak woodlands in California support a huge diversity of animal and plant life. They are also very important to the Native American people.

#### **Fun Fact:**

Did you know that we live in one of the world's **25 Global Biodiversity Hotspots**? Biodiversity Hotspots are places that have large numbers of **endemic** species (species that are found nowhere else).

*Walk up the road to the next sign.*

## 2) The Alisal Fire: From the Mountains to the Ocean

In October 2021, about 95% of the Arroyo Hondo Watershed burned in the Alisal Fire. The fire burned almost 17,000 acres from the mountains to the ocean along the Gaviota coast.

**Look** all around you and look up to the mountains.

**Question:** Can tell which areas burned in this fire?

Much of the area that was burned in the Alisal Fire was covered with chaparral that had not burned since the 1955 Refugio Fire. That huge fire burned more than 79,000 acres. Chaparral is a vegetation type with many different kinds of woody shrubs. Before the fire, these plants were very dry and had many dead branches due to many years of drought, and so they were very **flammable**. Some chaparral shrubs contain flammable chemical compounds that cause wildfires to burn even hotter.

High up on the left, you can see green, unburned chaparral. This hill top burned in the 2004 Gaviota Fire, and was not as dry and so not as flammable as the old chaparral. Most of the grassland to the left did not burn because it had been intentionally grazed down by cattle and sheep. In California, some people now use grazing animals as tools to protect their land and houses from the effects of fire. This is sometimes called **Prescribed Grazing**. Prescribed grazing also helps to control non-native invasive plants.

*Walk on up the road and through the next gate.*

**Look at the colored flags.**

Since it became a nature preserve, Arroyo Hondo has had a program of **Habitat Restoration**. The goal is to restore areas that were once disturbed when the canyon was a ranch. The small colored flags on both sides of the road show where staff and volunteers have planted different kinds of native plants to help restore the habitat.

## 3) Arroyo Hondo after the Fire: Studying How Native Plants Recover

To the left of the road, **look for posts with blue and orange colored tags**. The posts mark the corners of 15 meter x 15 meter study plots. In these plots, we are studying how plants recover after fire. The plots are in pairs, and one plot of each pair is being weeded. We are comparing how plants recover in the plot that is weeded with the plants in the other plot that is not weeded. Every two months, we make detailed studies of the types of plants in each plot, and how the plants are recovering. Each time, we randomly select three 1 meter x 1meter squares (called **quadrats**) within each larger plot, and we identify and count all of the plants in each small square. We also see how much of the ground they cover.

*Continue along the road.*

**Walk and look**

As you walk, look for plants in bloom. Some plants flower at almost every time of year at Arroyo Hondo Preserve. You may see California Wild Rose, Hummingbird Sage, Snowberry, and other native plants blooming near the trail.

## 4) Burn, Regrowth, and Adaptation: California Bay Trees

Different plant species recover in different ways after a wildfire. California Bay trees have very thin bark, and hot fires often completely kill their trunks and branches. New sprouts grow from the base around the **root-crown**. Bay trees will eventually grow tall, with several new trunks arising from the base. Before the Alisal Fire, most of the bay trees at Arroyo Hondo Preserve already had several trunks, probably due to the fact that they had grown back from previous fires (either the 2004 Gaviota Fire or the 1955 Refugio Fire).

**Look around** at the bay trees to see which ones have new sprouts at the base. Look up to see if any of the trees have green leaves on their higher branches.

**Rub a bay leaf** and smell the strong scent on your fingers.

### **Fun Facts:**

California Bay is a “plant of many uses” for the native Chumash people.

- The wood was used to make bowls.
- Tea from bay leaves was used as a cure for colds and diarrhea.
- Leaves soaked in a hot bath were used to help rheumatism.
- Chumash hunters burned bay and stood in the smoke before a hunt. They believed that the smell of bay would attract deer.
- The fragrant leaves are still used for headaches, to repel fleas, and to flavor food.
- California Bay is related to the European Bay Laurel that is used to flavor foods like spaghetti sauce.

*Walk up the road until you reach the creek.*

## **5) Crossing the Creek: How Has the Streambed Changed?**

Arroyo Hondo Creek has water at all times of year. In the wet season, it flows above ground all the way to the ocean. In the summer, the creek is reduced to pools, but it continues to flow underground all the way to the beach. This stream is a lifeline for all sorts of animals in our summer dry **Mediterranean Climate**.

**Look at the creek bed;** it has changed a lot since the fire. It is made of gravel and small rocks, cobbles and boulders. During the winter of 2021-2022, it rained heavily high up on the burned mountains. There were **debris flows**, and mud and ash washed down from the slopes. As most of the plants were burned, there were few roots left to hold the soil, and so gravel and rocks were carried by the rushing water and mud down the streambed.

**Look for dead branches** that caught on the trees along the creek.

**Question:** Can you see how high the water rose during these floods?

*Continue on along the road until you see the next number sign on your left.*

## **6) The Stream Ecosystem: An Amazing Diversity of Life**

Study the colorful sign that shows many of the plants and animals that can be seen in and around the creek. Many small animals live in the water and are part of the complex **food web** of the stream. Leaves and twigs fall into the stream and provide food. **Algae** and **diatoms** grow in the water and on submerged rocks, and they provide food also. Some **aquatic** animals are **herbivores**, some are **omnivores**, and others are **carnivores**. Top carnivores include Great Blue Herons, Belted Kingfishers, and Black Bears.

Many insects, including Dragonflies, spend their **larval stage** in the stream. They later change (through **metamorphosis**), their wings develop, and then they spend their adult life on land. Other small animals, including Giant Water Bugs or Toe-biters, live their whole lives in the water.

Arroyo Hondo Creek is known to be an important Steelhead Trout stream. **Southern California Steelhead** are endangered and are protected by law. Much work was done on this creek to improve the habitat for the steelhead. We have not seen fish here lately, and we are afraid that they washed out to the ocean during the debris flows that followed the fire. The pools in the stream where fish had lived were destroyed also.

After you have looked at the sign, **walk down to the stream** and look carefully in the water. Can you see any of the animals that you saw on the sign? You may see Water Striders walking on the surface of the water. If you are lucky, you might see a brownish-orange California Newt or a well **camouflaged** Western Pond Turtle. Both of these animals are quite rare. If you see fish, be sure to tell staff or volunteers at the preserve. We would be very excited if you see some.

*Walk on until you see the next number sign.*

## 7) A Firescape View: Turn 360 Degrees Around

**Stand in one spot and turn around all the way** (360 degrees).

**Look up high** the first time you turn around. Now **look low down** and turn around again.

**Question:** Can you tell which areas were burned in the 2021 Alisal Fire?

The Alisal Fire began high in the mountains above Arroyo Hondo. Within a couple of hours, the fire had been driven downhill by very strong winds and it roared all the way to the ocean. Fires also create their own wind, and so the fire moved in many directions and burned hotter in some places than in others. Burning embers were blown in different directions and caused many **spot fires** to start. Trained fire crews of men and women worked very hard to save structures, including the historic Arroyo Hondo Adobe and the barn.

*Walk on to the next number sign.*

## 8) Fire Followed by Flood: Debris Flow from Above

With big rain events for the few winters following wildfires, debris flows often occur. There have been some heavy rains since the Alisal Fire. During each of these, muddy ash, gravel, cobbles, and boulders were washed down from the denuded slopes above. After the first five-inch rain on the mountains above, about one foot of ashy mud flowed across the area where you are standing. The mud dried hard and then it cracked. Soon, new plants were growing up through the cracks in the dry mud. Some of these plants grew here before the fire, but other special **fire-following plants** appeared in the recently burned areas.

**Look for evidence** of the mud flow. The fast-moving mud moved big rocks and broke tree branches.

**Question:** Can you see the corner posts of more study plots here?

*Continue to the next number sign.*

## 9) Coast Live Oak Trees: Important for Wildlife and Humans

Our native Coast Live Oak trees are very resistant to fire. According to the age and size of oak trees, and how hot the fire was, they may regenerate in different ways.

Some coast live oaks sprout from the base, while others grow new shoots with green leaves along their branches. If a fire is very hot, some oak trees will be completely killed.

At Arroyo Hondo, some oaks and other trees that were killed or badly damaged by the fire were cut down. Most of these were trees that might have fallen along the trails. Before cutting down any badly burned trees, an **arborist** checked them to see if they were still alive.

**Fun Facts:**

People from different cultures eat bread, tortillas, rice, beans, and/or potatoes.

These important foods are called **staple foods**.

Oak trees provided the staple food of the Chumash people who lived here.

The Chumash gathered acorns from the oak trees. They dried, shelled, and ground the acorns. Next, the ground acorn meal was leached with water to remove the bitter tannins. Then the meal was cooked with water in special baskets. Hot stones taken from the fire were stirred around to cook the mush which thickened like porridge.

California's oak trees provide food and shelter for many species of wildlife. A wonderful book, *Oaks of California*, notes that "hundreds of vertebrate species and thousands of invertebrate species are associated with California's oak landscapes."

**Question:** What kinds of animals do you think depend on oak trees?

**Answer:** Some examples are Acorn Woodpeckers, Scrub Jays, Lizards, Mule Deer, Bark Beetles.

*Continue along the trail that crosses the meadow.*

**Walk and Look:**

Look carefully for animals in the grass of the meadow. You might see Snakes or Lizards warming themselves in the sun.

**Question:** Do you see Crickets jumping from place to place? Do you see Butterflies and Bees moving from flower to flower to gather nectar and pollen?

## **10) The Oak Woodland: From Sun to Shade**

Walk from the meadow into the shady oak woodland. On a warm day, Mule Deer and other animals move into shady places to stay cool. Walk on a few more steps and stop.

**Feel** how much cooler it is here.

**Close your eyes** for a few minutes and listen. If you cup your hands around your ears you can make "deer ears" and you will hear even more. Listen carefully, and when you open your eyes again, tell the other members of your group about all the sounds that you heard.

**Sounds you might hear:** Wind, water flowing in the creek, different bird songs, tree squirrels moving in the branches, and woodpeckers drumming.

*Continue walking, and then turn left down the hill to the creek.*

**Look** far down to your left and you will see an area where Ferns, Stream Orchids, Horsetails, and Rushes grow. This area is fed by a spring, and so these special moisture-loving plants can grow here.

## 11) Fire Followed by Flood: Erosion and Deposition

**Erosion** is the action of processes that remove soil, rock, and other material from one location on the Earth's crust, and then transport it to another location.

**Deposition** is the process that follows erosion, when the materials that have been moved by water, wind, or ice are deposited in a new place.

Big wildfires have huge effects on streambeds. After a fire, as many plants have been burned, there are less roots to hold the soil. When heavy rains come after a fire, water flows quickly from high, steep places down the canyons towards the ocean. Water can carry huge amounts of eroded material like mud, gravel, and rocks down from high slopes. The transported materials will scour out pools and level the streambed, and will often change the course of a creek.

*(Studies suggest that, after a wildfire, the rates of erosion on burned areas may be more than 50-100 times greater than on an unburned watershed.)*

### **Changes to the stream ecosystem:**

- The streambed is flatter, with lots of gravel and boulders, and it no longer has the pools where fish, frogs, turtles, and newts used to shelter.
- Many trees that lined the creek fell down, and the water is no longer as shaded as it was before. Leaves and twigs that provided food for stream invertebrates are no longer present.
- The water becomes warmer in summer due to loss of shade, and the increased sunlight allows more algae and diatoms to grow in the stream.
- Warmer water holds less oxygen. Fish and many other aquatic animals need high dissolved oxygen levels for reproduction and survival. Therefore, some species may no longer be able to live in these areas.
- All of these changes cause the stream habitat and food web to change dramatically

Since the fire and floods, the streambed in this area is much wider than it was before.

**Walk across the streambed** and count your steps as you go

**Question:** How many steps did you take to reach the other bank?

The streambed is about three times wider now than it was before the fire.

**Question:** How many steps would it have taken you to cross before the fire?

*Find the trail on the other side of the creek and then turn right. Continue on, and cross back over the creek again. Walk up the trail until you reach the next number sign.*

## 12) The Sapsucker Tree: Food for the Birds

**Look** at the rows of holes in the bark of the oak tree to the right of the trail.

**Question:** What do you think made these holes?

**Answer:** These holes were made by special woodpeckers called Sapsuckers that usually live in the mountains. These birds sometimes migrate to the coast, and visit our area in the winter.

### **Fun Facts:**

Sapsuckers drill rows of small holes (called wells) with their sharp, hard beaks. They have stiff tail feathers that they sit on, and, sitting down on the job, they move over sideways to make the next hole. That is why the holes are in rows. Sapsuckers feed on the **tree sap** that rises up and drips out of the holes. They also eat ants and other insects that are attracted to the sweet sap. In this way, they are getting dinner and dessert all at once!

Sometimes Hummingbirds follow Sapsuckers.

**Question:** What do hummingbirds usually feed on, and why do you think hummingbirds follow sapsuckers?

**Answer:** Hummingbirds usually feed on nectar from flowers. They sometimes take some of the sweet sap from the sapsuckers' wells.

People also eat tree sap!

**Question:** Have you ever had delicious maple syrup on your pancakes or waffles?

Maple syrup is sap that is collected from Sugar Maple Trees that grow in the Eastern United States and in Canada.

**Question:** Have you ever seen an Acorn Woodpecker?

Acorn Woodpeckers are more common at Arroyo Hondo than sapsuckers.

Acorn Woodpeckers makes single, larger holes that are not in rows. They push acorns into these holes to store for later. A tree where these birds store many acorns is called an "acorn granary."

*Continue up the trail for a few steps.*

On the left of the trail is a big oak tree with a trunk that leans over the trail. We call this "The Weeping Tree"

**Look up** to see a large swollen growth on its trunk. Sometimes you can see dark stains on the tree trunk and on the ground beneath it.

**Question:** What do you think caused the swollen growth?

**Answer:** We think the swelling was caused by an infection by fungi or bacteria.

As a protective reaction, the tree "weeps" sap. Some sap drips onto the ground and the soil is often wet and darker below the swelling.

### 13) Shady Study Plots: Poison Oak and More

You will see another pair of study plots to your right.

Some plants need to have much more sunlight than others. The shade-loving plants that grow here are different from those that grow in the sunlight. Certain species of plants are **adapted** to life in the shade.

**Question:** Can you see any Poison Oak? What do the leaves look like? Don't Touch!

**Answer:** Poison Oak leaves are divided into 3 leaflets.

**Question:** Can you recognize any other plants here?

#### **Not So Fun Facts:**

Poison Oak may grow like a shrub or a vine. The leaves are green in spring and summer and in fall they turn red or orange and then they fall off. Poison oak is **deciduous**, and so in winter the plants have no leaves. About 90% of people are allergic to poison oak, and if they touch any part of the plant, they suffer from very itchy **contact dermatitis**. As the rhyme says: "Leaves of three, let it be..."

*Continue up the trail. Be very careful as you walk down the steep slope to the creek.*



## 14) Walk Down to the Creek: What Happened to the Steelhead Pool?

If you have been here before, you will remember that this is where there was a big pool in the stream. We called it the "Steelhead Pool" because we often saw trout there. Since the fire and the following floods, the pool has filled in with gravel and rocks. We have not seen any fish since these debris flows.

### Stop and look

Look carefully for animals in the water and on the nearby rocks. You can sometimes see Frogs, Turtles and Newts here.

Carefully examine the tall rock face directly across from where you came down to the creek. You will see that the rock is full of Oyster Shell Fossils.

**Question:** What do these **fossils** tell us about what this area was like thousands of years ago when the rocks were forming?

**Answer:** The area was covered by a shallow sea where lots of oysters lived.

**Look** at the delicate Maidenhair Ferns that grow out of the rock. These ferns grow in wet places and can grow here because fresh water seeps out of a crack in the rock behind them.

*Walk back down the trail and cross the creek onto Brandy's Trail. Turn right at the number post and walk to the fallen tree trunk.*

## 15) The Fern Grotto: Back from the Ashes

**Look** over the tree trunk that fell down during the fire. The big ferns that you see in front of you are called Giant Chain Ferns.

These ferns were completely burned to the ground in the fire. They grew back quickly from underground rhizomes (horizontal stems). The heat from a fire does not go very far underground, and so the rhizomes, which contain stored food, escaped from being burned.

Giant Chain Ferns are the biggest native ferns in California. They grow in damp, shady places. The soil is always moist here because a spring comes out of the hillside above. These ferns are not common in our area and this is one of the biggest patches of giant chain ferns in Santa Barbara County. They are much more common up north where there is more rain and summer fog. You can find them on Big Sur coast growing under the Coast Redwood trees. We sometimes find newts here on the wet soil among these ferns.

**Feel the Ferns:** The leaves of ferns are called **fronds**. Feel underneath some of the fronds. Can you feel bumpy areas? This is where the **spores** are produced?

Ferns are primitive or ancient plants that produce spores. Flowering plants are more advanced or modern and they produce seeds.

*Go back to Brandy's Trail. Turn right and continue walking until you see the next trail marker.*

## 16) The Bathtub Tree: Climb Inside If You Like

**Look** to the right of the trail and you will see the "Bathtub Tree." This tree did not burn in the Alisal Fire.

**Question:** Why do you think the tree has this shape, with many trunks in a circle?



**Answer:** We think that this huge old California Bay tree probably burned down years ago and then it grew up again from the base with several trunks.

Climb up into the bathtub if you like.

**Fun Fact:**

On the back of the tree, away from the trail, is a Shelf Fungus. Look at this, but please do not use it as a step to climb into the bathtub. The fungus, with its huge network of very fine threads (called **mycelium**), is a parasite that is growing all through the inside of the tree. The shelf that you see is the part (like a mushroom) that produces spores that are blown away. If a spore lands in moist soil in the woodland, it may germinate and infect another tree.

*Take a few more steps and look on your right for a sycamore tree that is growing parallel to the ground.*

**Question:** What direction do most tree trunks grow and why? Why do you think this tree is growing like this? Do you think it has roots at both ends?

**Answer:** Trees need sunlight and so they usually grow straight upwards. When it was young, this tree was injured and it fell sideways and continued to grow. We think the tree may have roots at both ends but we would have to dig down into the soil to find out.

*Continue on down the trail.*

**Look** carefully on the ground for animal tracks and for **scat**.

**Question:** Who else walked here?

**Answer:** Lots of animals travel on this trail. Some examples are Bobcats, Foxes, Tree Squirrels, Deer, and sometimes even a Bear.

## 17) The History Tree: How Many Times Burned?

**Look** at this gnarly old California Bay tree. This old tree tells us a lot about the history of the area.

**Question:** Can you see trunks and shoots of three different sizes?

- The largest trunks probably grew back after the 1955 Refugio Fire
- The next biggest trunks grew back after the 2004 Gaviota Fire.
- The newest shoots are growing from the base after the 2021 Alisal Fire

**Question:** How could we tell how old each trunk is?

**Answer:** If we cut the trunk down or drilled a “core” out of the trunk we could count the **annual growth rings**.

Each year, a tree makes smaller (densely packed) cells when it is growing slowly, and larger (loosely packed) cells when it is growing quickly. An annual ring can be seen for each year of growth.

**Fun Fact:**

When bay trees burn, they often sprout back from the base and form many new trunks instead of the original single trunk. They are able to do this because they have **meristems** (areas of special rapidly dividing cells) around their root crowns. Only some trees can resprout in this way and we consider this to be an **adaptation** in areas where fire is common.

*Continue walking down the trail until you reach the next trail marker.*

## 18) Ancient Horsetails, La Cola de Caballo

You will see lots of bright green feathery-looking plants on both sides of the trail. These plants are called Horsetails or La Cola de Caballo in Spanish. Their scientific name is *Equisetum* (*Equus* is the Latin word for horse and *seta* is the name for bristle).

Horsetails and their relatives have been on earth for more than 300 million years. Giant horsetails grew on earth during the Age of Dinosaurs.

**Feel** the Horsetail stems but please do not pick them.

**Question:** What do they feel like?

**Answer:** Horsetails are very scratchy as they have silica (glass-like material) in their cell walls.

We find many very old fossils of animals in rocks, because their hard bones and shells last for thousands of years. Very few plant fossils are found, because plants are so soft that they rot quickly.

**Question:** Horsetail fossils are found in ancient rocks. Why do you think this is?

**Answer:** Horsetails preserve better than other plants in rocks because they contain hard glass-like silica.

**Fun Facts:**

- Horsetails have been used in different ways in many different cultures:
- Horsetails are sometimes called “scouring rushes” because the Pioneers used horsetails to clean pots and pans in the way that we use Ajax or Comet today.
- Chumash people used them like sandpaper to smooth the surfaces of wooden bowls.
- In Mexico and some Central and South American countries, a tea made from horsetails is used as medicine to help cure kidney problems.
- Horsetail has been used medicinally in other parts of the world since ancient Roman and Greek times. It was used to stop bleeding, to heal ulcers and wounds, and to treat tuberculosis and kidney problems.

*Walk on down the trail and look for animal signs as you go.*

## 19) Burn Sculpture: A Tree with Windows

After fires, we find many strange things.

**Look** at the remains of this very old California Bay tree that we call the “burn sculpture.” You can see that it was burned all the way through so now there are windows in the trunk.

Stand behind a window so that a friend can take a photo of you.

**Question:** Do you think this tree is dead or alive? Look up and down. Can you see any green leaves?

*Just around the corner you will see the last number post.*

## 20) A Buried Post: The Last One

When the creek flooded, it brought down lots of sediment. This post has been here since before the fire. It was buried by about three feet of mud and sand.

*Cross the stream again and walk back to the barn.*

**Fires (and floods) are part of the cycle of nature in our area.**

**As you walk back to the barn, think about the many effects of wildfires.**

- What changes do fires cause in nature?
- Do you think that fires are good or bad for native plants?
- How are California's native plants adapted to fire?
- How do fires change habitats on land?
- How are stream ecosystems changed by fires and the floods that follow?