

The West: The Columbia River and Monterey Bay

The NCSR Pictorial Series of materials are designed to provide faculty, teachers and other natural resource professionals an informal *PowerPoint* presentation on selected environmental settings. The presentations consist of pictures of the natural environment and feature plants, animals and landscapes of the area. The intended theme is to show diverse audiences interesting aspects of various environments. As a result, the presentation can stimulate learning more about the features of various natural settings.

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Introduction

The West: The Columbia River and Monterey Bay is part of the NCSR Pictorial Series designed for presentation to general audiences. It is comprised of images made from photographs of The Columbia River and Monterey Bay presented in a *PowerPoint* format supported by instructor notes. The purpose of the presentation is to explain and illustrate the wildlife and habitats in the region and stimulate interest in the natural environment and factors that affect the environment. The information in the *PowerPoint* is provided in an informal manner and geared toward audiences with a wide range of ages and natural resource backgrounds.

Presentation

The presentation is designed to show the slides accompanied by comments from a “presenter.” Modifying the *PowerPoint* slides as an automated slide show including dubbing of narrative or music is an alternative.

Instructor Notes associated with the *PowerPoint* slides

Slide 1

This series of photos and lecture notes is designed to provide faculty with a presentation illustrating the geographical and wildlife features of two west coast locations. The first location is the lower Columbia River between Oregon and Washington, the second is the Monterey Bay area of California. The purpose of the presentation is to stimulate interest in natural environments and their management. It is designed for non-technical audiences.

Slide 2

The red line delineates our route on the Columbia. The dark green area is the Columbia River Gorge National Scenic Area. For more information on the Columbia Gorge National Scenic Area – go to the following website for a downloadable brochure.

<http://www.fs.fed.us/r6/columbia/forest/documents/GorgeVistas05low-res.pdf>

Slide 3

Portland, Oregon is situated on the confluence of the Columbia and Willamette Rivers approximately 60 aerial miles from the Pacific Ocean (the Willamette is one of three rivers in North America that flows north; the other two are the St. John's River in Florida and the Monongahela River in Pennsylvania and West Virginia). As its name indicates, the city is a major shipping terminal and supports ocean-going ships serving much of Asia. The two rivers divide the city and are spanned by numerous bridges – thus the nickname “city of bridges.” It is the largest city in the state with a population of over 580,000 people in 2009.

Slide 4

In 2006, the city completed construction of a tram from the riverfront to the Oregon Health and Science University to facilitate access and support development of housing along the river. The tram also serves as a “tourist attraction” offering an excellent view of the city.

Slide 5

Among the many attractions in Portland (e.g., the nationally recognized Oregon Zoo, Chinese Garden and a Rose Garden) is the Japanese Garden. The tranquil setting is based on traditional Japanese designs and offers visitors a relaxing and picturesque setting.

Slide 6

The trip is managed by a commercial tour company and is designed to sail the Columbia to its convergence with the Snake River. During the trip, historical information and some landings are provided. This presentation will not duplicate this agenda but focus on information that is relevant to the photos presented.

Slide 7

The construction of dams on the Columbia has converted the waterway from a free flowing river to a series of major lakes managed via their flow through the hydroelectric turbines. A brief description of the Columbia River is presented below.

The Columbia River drains a 259,000 square-mile basin that includes territory in seven states (Oregon, Washington, Idaho, Montana, Nevada, Wyoming, and Utah) and one Canadian province (British Columbia). The river is arguably the most significant environmental force in the Pacific Northwest region of the United States. It flows for more than 1,200 miles, from the base of the Canadian Rockies in southeastern British Columbia to the Pacific Ocean at Astoria, Oregon. Although humans have lived along the river for more than 10,000 years, modern engineering in the 19th and 20th centuries has dramatically altered the Columbia. Some scientists believe that today the river is environmentally threatened and that drastic action should be taken to reverse the changes made to the Columbia during the last 150 years.

The Columbia is a snow-charged river that seasonally fluctuates in volume. Its annual average discharge is 160 million acre-feet of water, with the highest volumes between April and September, the lowest from December to February. From its source at 2,650 feet above sea level, the river drops an average of more than 2 feet per mile, but in some sections it falls nearly 5 feet per mile.

The Columbia has ten major tributaries. Its most important tributary, the Snake, flows across a semi-arid plain and runs through the deepest gorge in North America, Hell's Canyon - 7,900 feet deep.

The Columbia River Basin is the most hydroelectrically developed river system in the world. More than 400 dams -- 11 run-of-the-river dams on the main stem -- and hundreds of major and modest structures on tributaries block river flows. Rock Island Dam completed in 1932 was the first Dam and the Bonneville Dam - the western most dam, was completed in 1938. The last dams built on the Columbia came on-line during the 1960s and 1970s. The dams created large reservoirs that provide flood control and water for vast irrigation systems on the Columbia Plateau. With the completion of four dams on the lower Snake River during the 1970s, the engineers strung together a series of slack water lakes that allowed barges to navigate more than 465 miles from the Pacific to the inland port of Lewiston, Idaho.

Slide 8

This map illustrates the locations of the dams in the Columbia River Basin.

Slide 9

The large hydroelectric dams on the Columbia and Snake are equipped with locks to facilitate barge traffic. The design and construction at different times resulted in a variety of gate designs. The dam in the previous slide (#7) is a swing gate design versus the lifting gate in this photo. However, the basic lock design is to allow gravity-fed water into the closed lock from up-river to raise barges for their trip "up-river" and drain the water out on the down-river side to lower the level. Floating bollards along the sides of the lock raise and lower with the changing water level allowing the ships to be "tied off" during the operation. The ships transiting the lock call the lock masters to inform them of their pending arrival; however, delays often occur for tour boats when barge traffic is heavy as they are given priority.

Slide 10

The production of low-cost electricity is the major reason the dams were constructed and are still their major economic driver. The debate about the Northwest receiving a federal subsidy in the form of cheap hydroelectric power is a contentious issue. The Army Corps of Engineers owns and operates the major dams. An additional driver is barge traffic which is a relatively inexpensive way to ship along the Columbia. Wheat farmers are especially vocal in the need to keep the river friendly for barges along the Snake.

The dams also serve the purpose of “flood control” especially during the spring run-off. Irrigation from the slack lakes is also a major factor in the dam’s contribution to the region’s economy.

Slide 11

As noted earlier, the dams have contributed to the loss of native fish. Although their continued existence provides for contentious debates, it is nearly certain that the major dams will not be removed. Smaller dams and perhaps, major dams on the Snake are more likely to be breached.

Slide 12

Although the dams have dramatically changed the river, they have not altered its beauty. Primarily, the lower river runs through a nationally recognized scenic area – The Columbia River Gorge, which has a special management structure in place to preserve its spectacular views. The Columbia River Gorge is an 80-mile geologic wonder that forms the border between northern Oregon and southern Washington. The gorge represents the unbridled strength of water. Glacial floods thousands of years ago carved this 1,200-mile-long river, which is the only sea-level passage to cross the Cascade Mountains. With cliffs rising as high as 4,000 feet, the Gorge acts as a funnel for North America's fourth largest river. The western gorge is dominated by conifers and deciduous trees such as Big Leaf Maples. The wide range of elevation and precipitation in the gorge creates a diverse collection of ecosystems from the temperate rain forests at the Pacific end (with an average annual precipitation of 75 inches) to dry higher level grasslands (with average annual precipitation of 12 inches) of the upper reaches. There is a transitional dry woodland between these extremes. Due to differing atmospheric pressure east and west of the Cascades, a wind tunnel effect is created in the deep cut of the gorge, generating periods of sustained 35 mph winds that make it a popular windsurfing location. Up-river of the gorge is Hells Canyon, a popular recreation area and one of the deepest canyons in the world. More information on the Hells Canyon area is presented later in this photo tour.

Slide 13

The Columbia River Gorge Commission was authorized by the 1986 Columbia River Gorge National Scenic Area Act, which created a bi-state compact between Oregon and Washington in 1987. The Commission was established to develop and implement policies and programs that protect and enhance the scenic, natural, cultural and recreational resources of the Gorge. The Scenic Area is managed on a partnership basis by the Gorge counties, the states of Oregon and Washington, the U.S. Forest Service, Native American Tribes and the Gorge Commission. As a result of federal involvement, millions of government dollars have flowed into the Scenic Area as a result of Congress’ recognition of its importance as a national resource.

Slide 14

The Columbia River Gorge is famous for its falls - 77 on the Oregon side alone! They come in all shapes and sizes. They can be classified into eight forms: plunge, horsetail, fan, cascade, punchbowl, block, tier, and segmented. (Details about these types of falls can be found in the downloadable brochure referenced in slide 2 and found on this website -

<http://www.fs.fed.us/r6/columbia/forest/documents/GorgeVistas05low-res.pdf>

Access to falls is mostly limited to the Oregon side due to the steep terrain on the Washington side. The entire region's bedrock material is tilted slightly southward. When it is water saturated, the upper basaltic layers on the north side of the river (Washington side) slide into the Gorge. Thus, waterfalls on the Washington side are also fewer and smaller.

Slide 15

Some historians believe that Japanese or Chinese vessels blown off course reached the Northwest coast long before Europeans, possibly as early as 219 B.C. It is unknown whether they landed near the Columbia. Although Lewis and Clark's Corps reached the Columbia in 1805, Europeans may have reached the mouth of the river as early as 1679. Evidence exists that Spanish castaways reached the shore in 1679 and traded with the Clatsop tribe. If these were indeed the first Europeans to see the Columbia, they failed to send word home to Spain. The first documented European discovery of the Columbia River was that of Bruno de Heceta, who in 1775 sighted the river's mouth. Other ships sailed to the river's mouth but failed to enter the river due to the formidable "bar" that still blocks the entrance today. (The "bar" is the result of incoming tides and outflowing river currents.) In 1792, Robert Gray (whose first attempt to enter the river failed and he sailed north), returned south and crossed the Columbia Bar, becoming the first explorer to enter the river. Gray's fur trading mission had been financed by Boston merchants, who outfitted him with a private vessel named *Columbia Rediviva* and he named the river after the ship on May 18. Unfortunately, Gray had not made any formal claims for the Columbia area on behalf of the United States and there were a series of claims and counter claims. In the Treaty of 1818 the United States and Britain agreed that both nations were to enjoy equal rights for 10 years. By 1828, when the so-called "joint occupation" was renewed for an indefinite period, it seemed probable that the lower Columbia River would in time become the border between Canada and the United States. For years, the Hudson's Bay Company successfully maintained control of the Columbia River and American attempts to gain a foothold were fended off. In the 1830s, however, American religious missions were established at several locations in the lower Columbia River region. In the 1840s a mass migration of American settlers undermined British control. British colonization schemes were attempted, but failed to match the scale of American settlement. The hope that the British colonists might dilute the American flavor of the Willamette Valley failed in the face of the overwhelming number of American settlers. These developments rekindled the issue of "joint occupation" and the boundary dispute. While some British interests fought for a boundary along the Columbia River, the Treaty of 1846 set the boundary at the 49th parallel. The Columbia River became the border between the U.S. territories of Oregon and Washington.

The sod hut stems from the period of early U.S. migration in the 1840s.

Slide 16

When the 75-mile Columbia River Highway between Troutdale and The Dalles was officially completed on June 27, 1922, it was hailed as one of the engineering marvels of its age. The first paved highway in the northwestern United States, the Columbia River Highway was conceived, designed, and constructed as both a scenic attraction and as a means of facilitating economic development along the Columbia River corridor between the Pacific Ocean and the areas to the east of the Cascade Mountains. It was heralded as one of the greatest engineering feats of its day, not only for its technological accomplishments but also for its sensitivity to one of the most dramatic and diverse landscapes on the North American continent. From the very beginning, this was to be both a scenic and a modern highway. The challenging requirements were to locate the road in such a way that it would be at least 24 feet wide, have grades no steeper than 5 percent, and have curve radii no less than 100 feet. At the same time, the roadway was to be located so as to provide maximum scenic opportunities, yet do as little damage to the natural environment as possible. Amazingly, Samuel C. Lancaster (the engineer / landscape architect hired by Marion county to design the highway) was able to achieve all these goals, even over the first segment of the highway, which required accomplishing an elevation change of nearly 600 feet in a distance of less than 1 mile. The construction of the highway incorporated a number of features then found only in Europe such as miles of dry masonry walls (built by Italian stone masons) and rock rubble guard walls with arched openings. At Mitchell Point, John Elliott - district engineer, directed the construction of a tunnel bored through solid rock into which were cut five openings of stone observation areas with benches for weary travelers. Extensive use was made of the then new construction material - reinforced concrete for bridges and viaducts, over the length of the highway. Today the original highway has been replaced by a river level highway and rail lines.

Slide 17

The island in the above photo is officially called Eighteenmile Island and borders the Oregon side of the Columbia River. Eighteenmile Island was often called "Chicken Charlie's Island" by local residents. This quote from local sources

(http://www.columbiariverimages.com/Regions/Places/eighteenmile_island.html) states:

“Eighteen Mile Island, west of Mosier, was often called "Chicken Island" or "Chicken Charlie's Island" (or Chick Charley Island) by local residents. Charles Reither lived on Eighteen Mile Island from 1915 up until his death in 1963. Chicken Island is in reference to a chicken ranch around 1904, but Willie Gholston (local historian) claims there were never chickens on the island.”

“From the Journals of Lewis and Clark ... Clark, October 29, 1805, first draft ...

The last River we call Cataract River [Klickitat River] from the number of falls which the Indians inform is on it The Indians are afraid to hunt or be on the Lard Side of this Columbia river for fear of the Snake Ind. who reside on a fork of this river which falls in above the falls a good Situation for winter quarters if game can be had is just below Sepulchar rock [Memaloose Island] on the Lard Side, high & pine and oake timber the rocks ruged above, good hunting Country back, as it appears from the river Indian village opsd. of 2 Lodgs river ½ mile wide at rocks

S. 60° W. 5 miles to a point of rocks Island in a Lard bend [Eighteenmile Island], passed 2 rocks in the river- passed 2 Houses at 1 mile on the Stard Side and 2 at 4 miles on the Stard. Side Country on the Lard. Side has more timber than common and looks well for huntg. high and ruged.-

S. 80° W. 6 <to a point> miles to 4 Houses in a point of a timbered bottom on the Lard. Side at a large creek or River 40 yr. [Hood River] passed a bottom on the Stard Side the distance in which there is 14 Indian houses- The falls mountain covered with Snow is South [Mount Hood]”

Words in brackets [--] are current names of locations.

Slide 18

Hells Canyon, North America's deepest river gorge, encompasses a vast and remote region with dramatic changes in elevation, terrain, climate and vegetation. Carved by the great Snake River, Hells Canyon plunges more than a mile below Oregon's west rim, and 8,000 feet below snowcapped He Devil Peak of Idaho's Seven Devils Mountains. There are no roads across Hells Canyon's 10-mile wide expanse, and only three roads that lead to the Snake River between Hells Canyon Dam and the Oregon-Washington boundary. The earliest known settlers in Hells Canyon were the Nez Perce tribe. The mild winters and ample plant and wildlife attracted human habitation. Pictographs and petrography on the walls of the canyon are a record of the Native American settlements (see photo on slide 22). In the 1860s gold was discovered in river bars near present-day Hells Canyon National Recreation Area, and miners soon penetrated Hells Canyon. Gold mining was not profitable here. Evidence of their endeavors remains visible along the corridor of the Snake River. Later efforts concentrated on hard-rock mining, requiring complex facilities. Evidence of these developments is still visible today although the mining operations are long gone. In the 1880s there was a short-lived homesteading boom, but the weather was too severe for farming and settlers soon gave up. Some ranchers still remain today operating within the boundaries of the National Recreation Area. After years of Congressional hearings, the Hells Canyon National Recreation Area (NRA) Act was signed into law on December 31, 1975. This new law created the 652,000 acre Hells Canyon NRA wherein dam construction was prohibited and visionary mandates were set forth for the protection and enhancement of fish and wildlife habitat, unique ecosystems and wilderness values.

Slide 19

No notes

Slide 20

The canyon is not subject to flood control dams so annual flood levels follow the natural pattern of rain and snow melts that vary from year to year. Mineral deposits reflect flood heights along the canyon walls.

Slide 21

No notes

Slide 22

Native Americans were the first humans to settle in Hells Canyon. For many years the canyon provided a passageway and temporary home for the Nez Perce tribe, most notably, but also the Shoshone-Bannock, Northern Paiute, and Cayute tribes. Evidence of these original settlers is still found in Hells Canyon today, thanks to pictographs (a picture representing a word or idea) and petroglyphs (a carving or line drawing on rock) left behind at various locations along the river and canyon walls. Originally used as markers for river crossings, settlements, and routes, today the pictographs and petroglyphs symbolize the long rich history of these original canyon visitors.

The archeological records in Hells Canyon show that the Nez Perce people had an extensive history of using bighorn sheep. We know they constructed stone corrals for the capture and containment of bighorns and stone blinds for hunting. They used the animals for their meat, hides for warmth, and the horns for spoons (ewes) and bow making (rams). Most petroglyphs and pictographs in Hells Canyon depict scenes of hunters and bighorn sheep. Bighorn sheep were a significant ungulate food item as well as of great cultural value to the Nez Perce Tribe in Hells Canyon.

Note renderings of bighorn sheep at the lower part of the photo.

Slide 23

“Hells Canyon is the result of many geologic movements and changes which occurred over millions of years. The canyon is deep, exposing rocks which tell its geologic story to anyone with the knowledge to read them. This information will help you 'read the rocks' by dividing their story into four stages:”

“STAGE 1: VOLCANIC ARC, 300-130 MILLION YEARS AGO: Most of the dark-colored and massive rocks exposed along the lower walls of Hells Canyon came from volcanoes that erupted on islands in the Pacific Ocean. These volcanoes grew where two or more plates of the earth's crust met, forming a long chain of islands known as a volcanic arc.” Also during this period the rocks folded and faulted, causing mixing of the various rocks. For example, a major fault pushed older granitic rock over much younger sedimentary rock. (See photo on left.)

“STAGE 2: COLLISION AND EROSION, 130-17 MILLION YEARS AGO: During the early part of this stage, continued movement of the earth's crust caused the volcanic arc to collide with and become a part of the North American continent. The area lifted, moving the ocean to the west. The newly-exposed land eroded extensively, with the sediment settling in deep ocean basins.”

“STAGE 3: PLATEAU BASALT, 17 MILLION YEARS AGO: Extensive lava or basalt flows (part of the Columbia River basalt unit) then covered much of the Pacific Northwest. Repeated flows smoothed the topography and created a vast and nearly-level plateau. ... An interesting feature of the basalt flows is columnar jointing, which is responsible for forming bold cliffs or palisades. These are generally located high above the Snake River.”

“STAGE 4: HELLS CANYON, 6 MILLION YEARS AGO TO PRESENT: Hells Canyon was formed by normal stream erosion as the Snake River cut its way through rocks of a rising mountain range. It is still being cut and is probably deeper and more rugged today than at any other time in its history.”

Information quoted above is from the U.S. Forest Service's *Geology of Hells Canyon* (http://www.fs.fed.us/hellscanyon/life_and_the_land/geology/)

Slide 24

Wildlife is abundant in the Hells Canyon Wilderness. Black bear, cougar, elk, deer, mountain goat, chukar, and bighorn sheep are common. There have been reports, though unverified, of grizzly bears in the Wilderness. Reintroduced wolves in Idaho have at least passed through the area, and Peregrine falcon, bald and golden eagles can also be seen.

Slide 25

No notes

Slide 26

The Palouse River is a tributary of the Snake River, approximately 140 miles (230 km) long, located in Washington and Idaho. It is part of the Columbia River Basin, as the Snake River is a tributary of the Columbia River. The area shown in this series of photos are the lower reaches of the Palouse prior to joining the Snake.

Slide 27

Using the Zodiacs and kayaks the passengers got close to the banks of the Palouse. Caution was the word of the day as the bright red bushes are poison ivy and/or poison oak dependent on the results of closer examination - a privilege most of us passed up.

Slide 28

The landscape in the area is a result of the interglacial period flooding. "There have been at least five major ice ages in the past one billion years. The most recent, the Pleistocene Ice Age, began about 2 million years ago. Glaciers did not continually cover the earth during this time; there have been interglacial periods where temperatures warm slightly and the glaciers melt and retreat. In the most recent advance, glaciers reached their maximum extent 15,000 years ago and had almost completely melted by 10,000 years ago." It was during this glacial advance that a finger from the glacial ice sheet moved south into northern Idaho, damming what is now called the Clark Fork River, creating Glacial Lake Missoula. "The water began to build up behind the 2,500-foot ice dam, filled the valleys to the east with water, creating a glacial lake the size of Lake Erie and Lake Ontario combined. The water continued to rise until it reached its maximum height at an elevation of 4,200 feet. As the water rose, the pressure against the ice dam increased, ultimately, causing the dam to fail catastrophically. The failure occurred when the water reached a depth of 2000 feet. The water pressure caused the glacier to become buoyant, and water began to escape beneath the ice dam by carving sub-glacial tunnels at an exponential rate." It is estimated that the maximum rate of flow was equal to a rate 60 times the flow of the Amazon River, the largest river in the world today. At this rate, the lake probably drained in a few days to a week. "Water moving at speeds between 30 and 50 miles per hour raced across eastern Washington. The floodwaters from Glacial Lake Missoula moved through eastern Washington on a 430-mile journey to the Pacific Ocean, forever changing the landscape by stripping away topsoil, and picking apart the bedrock. The floodwater carved an immense channel system across eastern Washington." The results of this event are clearly visible today.

The information on this page is quoted and adapted from: Montana Natural History Center

<http://www.glaciallakemissoula.org/story.html>

Slide 29

The Palouse Falls lie on the Palouse River, about 4 miles upstream of the confluence with the Snake River in southeast Washington. The falls are 184 feet in height. The canyon at the falls is 377 feet deep, exposing a large cross-section of the Columbia River Basalt Group. These falls and the canyon downstream comprise an important feature of the channeled scablands created by the great Missoula Floods that swept periodically across eastern Washington.

Slide 30

No notes

Slide 31

The Missoula flood stripped away all topsoil needed for vegetation. Although large areas are still devoid of vegetation, the passage of time has allowed some breakdown of surface areas and there is now limited plant growth. The banks of the Columbia and Snake support cottonwoods, willows, cattails and sedges, which provide shelter and food to turtles, ducks, geese, eagles, raccoons, and songbirds. Eastern gorge vegetation features abundant wildflowers from April through June, and golden hills and grasses in late summer.

Slide 32

On the left is our ship as viewed from one of our land excursions. As we head down stream we again traverse the dams, only this time we are lowered at each lock.

Slide 33

Returning to Portland we end our exploration of the lower reaches of the Columbia River *The Great River of the West*.

Slide 34

Our next stop is some 700 miles south of Portland in the Monterey Bay area. The area is a popular tourist location. Private and federal shorelines create a hospitable environment for sea mammals, birds and other wildlife. Among these areas is the Monterey Bay National Marine Sanctuary (MBNMS). As a federally protected marine area offshore off California's central coast "the MBNMS encompasses a shoreline length of 276 miles and 6,094 square miles of ocean, extending an average distance of 30 miles from shore. At its deepest point, the MBNMS reaches down 12,713 feet (more than two miles). It is our nation's eleventh marine sanctuary and its largest - larger than Yosemite or Yellowstone National Parks."

"The MBNMS was established for the purpose of resource protection, research, education and public use. Its natural resources include our nation's largest kelp forest, one of North America's largest underwater canyons and the closest-to-shore deep ocean environment in the continental United States. It is home to one of the most diverse marine ecosystems in the world, including 33 species of marine mammals, 94 species of seabirds, 345 species of fishes, and numerous invertebrates and plants. This remarkably productive marine environment is fringed by spectacular coastal scenery, including sandy beaches, rocky cliffs, rolling hills and steep mountains."

Quoted from the Monterey Bay National Marine Sanctuary website:

<http://montereybay.noaa.gov/intro/welcome.html>

Slide 35

No notes

Slide 36

The bay area runs from south of the city of Monterey along an area known as Big Sur and north to Moss Landing State Park. (The area is often referred to as the Monterey Peninsula area. I have chosen to refer to the area as the Monterey Bay area as much of the photo work is associated with the bay and ocean shores.) The rugged Big Sur area is characterized by rocky cliffs ending ocean waves (left photo). Along the cliff tops wind-shaped cyprus trees stand in stark beauty (right photo).

Three tribes of Native Americans were apparently the first people to inhabit the area now known as Big Sur. Archaeological evidence shows that they lived in Big Sur for thousands of years, leading a nomadic, hunter-gatherer existence. The first Europeans to see Big Sur were the Spanish in 1542. Two centuries passed before the Spanish attempted to colonize the area. The Spanish gave Big Sur its name during this period, calling the region *el país grande del sur* (the Big Country of the South). The Spanish colonization devastated the Native American population. Most tribal members died out from European diseases or forced labor and malnutrition at the missions in the eighteenth century. Along with the rest of California, Big Sur became part of Mexico when it gained independence from Spain in 1821. In 1848, as a result of the Mexican-American War, Mexico ceded California to the United States. As late as the 1920s, Big Sur remained a nearly inaccessible wilderness. Completed in 1937, Highway 1 (Coastal Highway) dramatically altered the local economy and brought the outside world much closer and the rural area gave way to tourist venues and second homes. Today Big Sur remains sparsely populated, with about 1000 inhabitants. There are no urban areas, although three small clusters of gas stations, restaurants, and motels are often marked on maps as "towns." The mountainous terrain, environmentally conscious residents, and lack of property available for development have kept Big Sur almost unspoiled, and it retains an isolated, frontier mystique.

Slide 37

The Monterey Peninsula or Bay area is a prime tourist area. The famous 17-Mile Drive remains a good area to observe marine mammals and other wildlife. You'll see black cormorants, brown pelicans, California sea otters, harbor seals, and idle sea lions all in their natural habitat. There are other interesting sights, chief among these is the *Lone Cypress Tree*, the official symbol of Pebble Beach and a frequent fixture of television broadcasts from this area (photo on the right). Many of the following photos were taken along the drive.

Slide 38

Among the many animals, the California and Steller sea lions are the largest and noisiest of the bunch.

California sea lions are known for their intelligence, playfulness, and noisy barking. Their color ranges from chocolate brown in males to a lighter, golden brown in females. Males may reach 1,000 lbs. (more often 850 lbs.) and seven feet in length. Females grow to 220 lbs. and up to six feet in length. These members of the otariid or walking seal family have external ear flaps (and are therefore referred to as “eared seals”) and large flippers that they use to “walk” on land. The trained "seals" in zoos and aquariums are usually California sea lions. California sea lions are very social animals, and groups often rest closely packed together at favored haul-out sites on land, or float together on the ocean's surface in “rafts.”

Steller sea lions are larger than the Californias. Adult animals are lighter in color than most sea lions, ranging from pale yellow to tawny and occasionally reddish (see photo on left). Females tend to be slightly lighter than the males. Steller sea lion pups are born almost black, weighing around 50 lbs, and remain dark for several months. Females on average are 8 feet in length and 660 lbs. Males are only slightly longer than the females. They can grow 11 feet long and have much wider chests, necks and general fore body structure and weigh 1300-2500 lbs. Stellers have a range extending north from central California to Russia and Alaska.

The photo on the right is a sea otter. Additional information about these animals is provided in the following slides.

Slide 39

California sea lions are on the right. The sea lions have had to stake out their territory in recent years as the cormorants have taken over. In California, the common coastal species is Brandt's cormorant, which has taken over the jetty of the Monterey harbor as a breeding locale within the last decade. Seals on the left haul out on rock out-croppings as well as docks, boats and any other convenient location. This habit is not appreciated by everyone.

The growth in numbers of marine mammals in the U.S. is partially the result of the 1972 Marine Mammal Protection Act which established a federal responsibility to conserve marine mammals with management vested in the Department of Interior for sea otter, walrus, polar bear, dugong, and manatee. The Department of Commerce is responsible for cetaceans (whales and dolphins) and pinnipeds (seals and sea lions) other than the walrus.

Unlike other pinnipeds, harbor seals make little noise. On the other hand sea lions never seem to “shut-up.” They are among the most vocal of all mammals. Vocalizations include barks, growls, and grunts. During the breeding season, males bark incessantly when establishing territory. Females use a specific vocalization during the mother-pup recognition sequence. This occurs when a female returns to the rookery after feeding to locate her pup. The female emits a loud trumpeting vocalization, which elicits a bleating response from her pup. This exchange continues until mother and pup find each other.

Slide 40

Perhaps one of the most popular critters along the bay area is the California sea otter. Sea otters are members of the weasel family. They spend most of their time in coastal waters. The range of the California sea otter is concentrated along a 200-mile stretch of the central coast.

Sea otters use rocks as tools to crack hard shells and other invertebrates that they feed on. Otters are equipped with pouches or flaps of skin under each front leg that they use to store food while foraging. Otters sleep by anchoring themselves in giant kelp fronds. Otters often seek refuge among the giant kelp in stormy weather.

Unlike most other sea mammals, sea otters do not have a layer of blubber to keep them warm in the cold coastal waters. Otters have a thick coat of fur, one million hairs per square-inch of fur. Otters constantly fluff their fur (grooming) to trap air, which insulates them against the cold waters. Otters are sizable animals. Large male otters can grow to over 4 feet in length, and weigh nearly 85 pounds. Females are much smaller weighing nearly 60 pounds and reaching a length of 4 feet.

Although protected, the California sea otter has not made the expected comeback that other subspecies have. Research indicates part of the problem is tied to sea otters dying from a brain disease caused by a single-cell deadly parasite, *Toxoplasma gondii*. For eons, this parasite has moved mostly without notice among animals, including humans, on land. But now, it is migrating to the sea, where it is infecting mammals, including sea otters, whose immune systems are unprepared for the assault. In addition, tiny acanthocephalan, or thorny-headed worms kill a large number of sea otters. Many otters develop inflammation of the heart muscle which leads to heart failure after being exposed to domoic acid from toxic algae blooms. All of these factors have depressed the recovery of the California sea otter.

Oh by the way, there are seven otters in the picture on the left.

Slide 41

No notes

Slide 42

As noted previously, grooming is an essential task to maintain body heat. Foraging and eating are other major activities. The otter will use a rock to crack open shellfish.

Slide 43

Although otters are playful and entertaining to watch, they can be very aggressive.

Slide 44

River otters are solitary, except for females with their young. They are known as playful animals, exhibiting behaviors such as mud/snow sliding, burrowing through the snow, and water play. Many "play" activities actually serve a purpose. Some are used to strengthen social bonds, to practice hunting techniques, and to scent mark. North American river otters get their boundless energy from their very high metabolism, which also requires them to eat a great deal. They are excellent swimmers and divers, able to stay underwater for up to 8 minutes. They are also fast on land, capable of running at up to 18 miles/hr. These otters normally hunt at night, but can be seen at all times of day.

Slide 45

A whale watching trip on the bay was very productive. Overnight a large school of anchovies had entered the bay followed by an estimated 50 humpback whales. I was lucky enough to get lots of photos, but none of the whales with heads-up – they were too busy eating. Whale individuals are identified by unique shapes and markings on their flukes (tails). There are several repositories that are collecting data and cataloging the whales identified.

Slide 46

The whales were constantly diving as they fed on the anchovies. Flukes (tails) and dorsal fins were our only view.

Slide 47

On a few occasions I felt the whales run into our small boat, but they knew where they were and avoided us at the last minute. They did however manage to get us wet!

Slide 48

No notes

Slide 49

The odor of dead fish was inescapable as the whales exhaled and the spray became airborne. We were lucky enough to not only smell the spray but were doused a few times so we would be reminded of this event for several hours. In addition to the odor, the blow has a distinct audible rumble similar to bellowing.

Slide 50

Among the whales were dolphins enjoying the feast. The rough-toothed dolphin is a fairly large dolphin that can be found in deep warm and tropical waters around the world. The common name refers to the thin lines of enamel that run vertically down the dolphin's teeth. The characteristic feature of this dolphin is its conical head and slender nose. The flippers are set back further along the body than in other similar dolphins. The dorsal fin is pronounced.

Slide 51

Obviously the word had gotten out as the whales and dolphins were joined by large rafts of sea lions. The mixing of all these various animals did not seem to cause any problems. Perhaps they were too busy catching fish to eat.

Slide 52

Occupied primarily by cormorants this dark rock island has been turned white by guano.

Slide 53

Note the sea lions on the rock in the photo on the right.

Slide 54

It is difficult to get to the tide pools at low tide due to the rugged shoreline. More sea lions are hauled out in the lower left of the photo on the left. My impression - seals and sea lions were everywhere you looked.

Slide 55

No notes

Slide 56

As noted earlier, anything is fair game for a sea lion to climb on.

On the left is an adult harbor seal. These are among the earless seals unlike sea lions, which have an external ear flap. The presence or absence of ear flaps is an indicator of how the animals' flippers work. The seal's large hind flippers cannot be turned forward under the body as in sea lions. Consequently, on land harbor seals can't walk, but must rely on a wriggling style locomotion using its forelimbs to pull it along in quick caterpillar-like jerks. In the water, the harbor seal is a graceful swimmer. They propel themselves by lateral undulations of the hind flippers, which expand when swimming. The front flippers are used for an occasional guiding stroke. Sea lions have external ears and can rotate hind flippers forward. Consequently they can "walk" on land. The flipper allows them to sit-up as the one in the right photo is doing.

Although common along the California coast, harbor seals are rarely found in large numbers. Groups may range from a few individuals to as many as two or three hundred, but they do not exhibit the sort of social behavior characteristic of sea lions, fur seals, and elephant seals. Harbor seals often come into bays and estuaries and may be seen resting on sandbars at low tide. Along the outer coast they also tend to haul out on protected tidal rocks and reefs (as at the Children's Pool in La Jolla). Because their movements on land are clumsy, they seldom venture far from the water, where they take refuge at the first sign of danger. They can remain underwater for as long as 20 minutes. Unlike other pinnipeds, harbor seals make little noise.

Slide 57

These sea lions seemed to be having the time of their life as they splashed around.

Slide 58

The young seal on the right had been caught, tagged (rear flipper) and set to transmit its whereabouts. I watched it for some time and the extra items it carried did not seem to bother it.

Slide 59

Some of the black seals are the younger kids. Others, like the one in the upper part of the photo will be more mottled as it dries. The mother nurses the pup with rich milk for three to six weeks. The highest mortality rate for harbor seals occurs during the first few months of life; pups may starve, since their ability to feed themselves is very limited once the mother leaves. Also storms may sweep them away as the duration and strength of their swimming is limited.

Slide 60

The harbor seal on the left spent a lot of time organizing its fur. The ones in the photo on the right engage in a nap. As noted, they stay close to the water, which is their safety zone.

Slide 61

Note the sea lions in the lower center of the photo on the right. I am not sure what the attraction is since there seemed to be plenty of cleaner rocks to visit. The ability of the sea lions in the bay area to sit-up allows quick identification as opposed to the harbor seals which lie flat when hauled out.

Slide 62

North of the bay is Moss State Park - a favorite location for seeing elephant seals. Elephant seals are large, ocean-going seals. There are two species: the Northern elephant seal and the Southern elephant seal. Both were hunted to the brink of extinction by the end of the nineteenth century, but numbers have since recovered. The Northern elephant seal, somewhat smaller than its southern relative, ranges over the Pacific coast of the U.S., Canada and Mexico. Elephant seals take their name from the large proboscis of the adult males (bulls) which resembles an elephant's trunk. The bull's proboscis is used to produce extraordinarily loud roaring noises, especially during the mating season. More importantly, however, the nose acts as a sort of rebreather, filled with cavities designed to reabsorb moisture from the animals' exhalations. This is important during the mating season when male seals rarely leave the beach to feed, and therefore must conserve body moisture, as they have no incoming source of water. Bulls of both the Northern elephant seal and the southern elephant seal reach a length of 16 feet and a weight of 6,000 lbs. and are much larger than the cows, which typically measure about 10 feet and 2,000 pounds. Elephant seals spend up to 80 percent of their lives in the ocean. They can hold their breath for over 120 minutes—longer than any other non-cetacean mammal. While excellent swimmers, they are even more surprising on land, where they have a higher velocity than the average human when moving over sand dunes. Elephant seals are shielded from extreme cold by their blubber, more so than by fur. The animals' hair and outer layers of skin molt periodically. When molting occurs, the seal is susceptible to the cold, and must rest on land, in a safe place. In fact, northern males haul out in August, and females in May-June. The photos above are of molting female seals.

Slide 63

This is a group of young male elephant seals. This guy seems to be upset and letting us know it. When wet, the seals are black and as they dry out, return to their true brown color. The next slide illustrates this.

Slide 64

Note the position of the rear flippers – as non-eared seals they cannot be rotated forward.

Slide 65

“Oh, a wondrous bird is the pelican!
His bill holds more than his belican.
He can take in his beak
Enough food for a week.
But I'm darned if I know how the helican.”

Dixon Lanier Merritt (1879-1972)

Brown pelicans fly in a line formation along the beach of Monterey Bay. They were heavily impacted by DDT in the 1950s and '60s, and breeding populations plummeted. They once nested north along the Pacific Coast but then disappeared in the early 1950s. They have made a great comeback throughout their range since DDT was banned, and today pelicans are common in Monterey Bay, often remaining year-round.

Unique among the world's seven species of pelicans, the brown pelican is found along the ocean shores and not on inland lakes. It is the only dark pelican, and also the only one that plunges from the air into the water to catch its food.

Slide 66

I came across this ground squirrel who had overcome all fear of humans. He was quite aggressive in his begging for a handout. As is typical for ground squirrels, California ground squirrels live in burrows which they excavate themselves. Some burrows are occupied communally. Although they readily become tame in areas used by humans, and quickly learn to take food left or offered by picnickers, they spend most of their time within 65 feet of their burrow, and rarely go further than 150 feet from it. Although enjoyable to watch the California ground squirrel, it is reported to be one of the most troublesome pests to homeowners and gardeners. Eating from gardens, nut trees, and digging elaborate burrows are the charges brought against the ground squirrel. As a result, management of the squirrel is urged (killing them). As one web posting advises, “Ground squirrels are classified as nongame mammals by the California Fish and Game Code. Nongame mammals injuring growing crops or other property may be controlled in any manner by the owner or tenant.”

Slide 67

No notes

Slide 68

Stripes, polka dots, rainbow rows, jewel-like hues—jellies come in a spectacular array of colors and patterns. Jellies are simple creatures with few specialized organs. Most jellies can detect chemical traces in the water that allow them to locate food, and many are equipped with a gravity-sensitive structure, called a statocyst, that gives them a sense of up and down in the water.

The black sea nettle (*Chrysaora achlyos*) is considered a giant jelly; its distinctive purplish bell can reach over three feet in diameter; its lacy, pinkish oral-arms can reach nearly 20 feet in length and its stinging tentacles 25 feet or more. It probably lives in deeper, calmer waters but has appeared in large blooms in coastal areas off Southern California, most recently in 1999. The black sea nettle provides the Pacific butterfish with food and protection. The silvery butterfish feeds on the plankton gathered by the jelly, and when danger approaches, the butterfish actually hides inside the jelly's bell. The black sea nettle is a mysterious creature; during most years its whereabouts are unknown.

The Pacific sea nettle (*Chrysaora fuscescens*) is smaller than its black cousin but behaves in the same way. It hunts tiny drifting animals by trailing those long tentacles and frilly mouth-arms, all covered with stinging cells. When the tentacles touch prey, the stinging cells paralyze it and stick tight. From there, the prey is moved to the mouth-arms and finally to the mouth, where it is digested.

Slide 69

Although currents often are the main control of jellies' movement, they also have mechanisms to influence their direction. Jellies possess an impressive repertoire of swimming styles—some pulse peacefully like living lava lamps; others beat fast and furiously. Still others row with oar-like paddles or throb forever upside-down.

Spotted Jellies (*Mastigias papua*) swim in huge swarms to stay in the direct rays of the sun—the sun's rays fuel the growth of the symbiotic algae the jellies thrive on. At night, spotted jellies descend to deeper waters, to an anoxic (oxygen-deficient) layer that is high in concentration of hydrogen sulfide. There, the jellies absorb ammonium, which acts just like fertilizer on the algae. Some of the larger spotted jellies actually have small fishes living with them. The fishes use the inside of a jelly's bell as protection from larger predators until they reach maturity.

The Mediterranean Jelly (*Cotylorhiza tuberculata*) unlike many others of its species, is capable of autonomous movement without relying on the current. It is a very large jellyfish of the Mediterranean Sea and Atlantic Ocean where it is observed mostly in summer and autumn. An oceanic species, it comes inshore driven by winds and currents. This jelly fish has only a very mild sting if any at all. It is often accompanied by juvenile fish, which take shelter within its tentacles.

Slide 70

Purple-striped jelly (*Chrysaora Colorata*), sometimes listed as a sea nettle, may not be purple. However, they always have bell shaped caps, four central oral arms and trailing tentacles radiating from the edge of the cap. With large bells, mature adults are usually streaked with a radial pattern of stripes and long, flowing oral arms - they are quite impressive. The four frilly oral arms have a coiled appearance. Eight marginal tentacles alternate with eight sensory rhopalia. The tentacles are well armed with nematocysts and can produce a relatively painful sting. Although large specimens are typically endowed with very distinct purple pigment patterns, younger individuals have a pale pinkish bell that lacks the dramatic stripes and patterns of older adults.

Slide 71

Upside-down jellies (*Cassiopeia xamachana*) are more vulnerable than jelly species that live in the open ocean or the deep sea. They live in mangrove forests and shallow lagoons along tropical coasts. Mangrove forests are among the most threatened ecosystems on Earth; they are constantly under siege from coastal development or questionable farming practices. People clear mangroves to build hotels, housing and fish farms. Pollution flows into mangrove forests from these coastal developments, endangering all life in this rich forest habitat. An upside-down jelly doesn't have a central mouth—instead, the edges of its eight oral-arms are fused and folded into elaborate frills containing hundreds of tiny mouth openings. The mouth openings are connected by channels to its stomach. By pulsing its bell, it forces zooplankton into the nematocysts on its mouth openings. This zooplankton diet is supplemented by food produced by symbiotic algae. This jelly is a favorite meal for ocean sunfish and the endangered leatherback sea turtle.

Mediterranean jellies are also called fried egg jellies, for obvious reasons—namely, their smooth golden globes on top of their brown bells. But despite their good-enough-to-eat appearance, these jellies are no treat in Mar Menor, a coastal lagoon in Spain. Fertilizer runoff there led to an oversupply of the plankton that is a staple of the jellies' diet. Now there is an oversupply of jellies, too, threatening fisheries and tourism.

Slide 72

This was an experimental approach by photographing “out of focus” shots of Jellies. I have included them simply for their “artistic” value.

Slide 73 – 77

No notes