

The page features decorative illustrations of leafy branches in the corners. In the top-left and bottom-left corners, there are light gray, semi-transparent illustrations of branches with elongated, pointed leaves. In the top-right corner, there is a similar illustration of a branch with leaves, also in a light gray, semi-transparent style. The central text is positioned between these decorative elements.

Appendix

Core Student Readings

Module 1 Appendix: KWL Chart - Temperate Forests

Name _____ Date _____

Class _____

What I know about temperate forests:

What I want to learn:

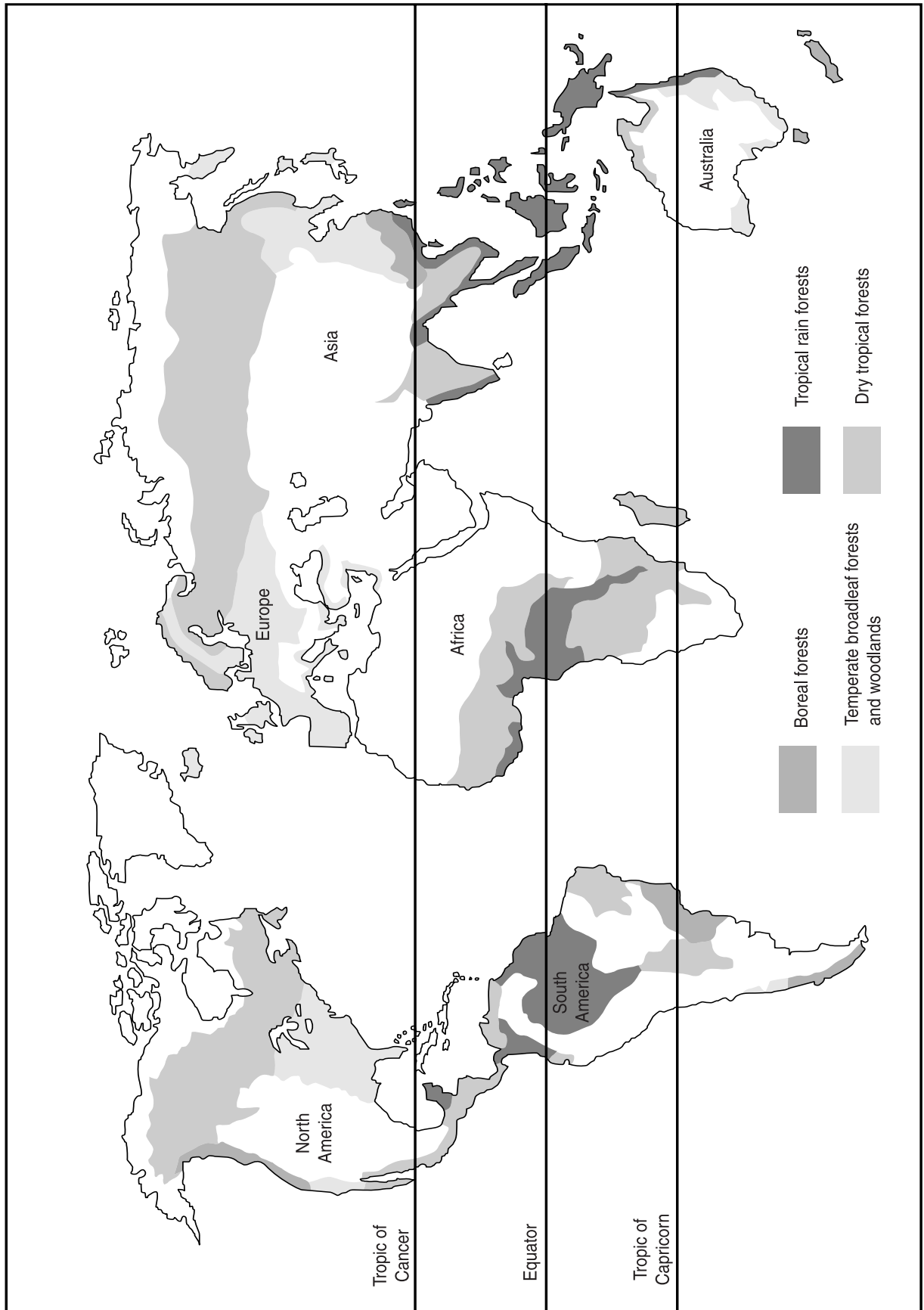
What I learned:



Some other things I would also like to learn about temperate forests are: _____



Module 2 Appendix: Forest Biomes Map



Module 2 Appendix: Temperate-Forest Facts at a Glance

WHAT IS THE TEMPERATE-FOREST BIOME?

Temperate forests occur in the temperate zone, with taiga or boreal forests to the north and rainforests to the south. Climates may vary, but all temperate forests have four distinct seasons: spring, summer, winter, and fall.

WHERE IS IT LOCATED?

Temperate forests form bands across North America, Europe, and Asia, with scattered patches in South America, Africa, and Australia and nearby islands.

WEATHER & CLIMATE

Summers are warm and winters are cold, with snow cover toward the northern end of the range

yearly precipitation: 51–200 centimeters (20–80 inches), evenly distributed

growing season: 4–6 months

average temperature: 24 C (75 F) (can reach as high as 30 C (86 F) depending on altitude)

average annual humidity: 60–80 percent

SEASONAL CHANGE

Temperate forests experience four distinct seasons. Plants and animals adjust their growth and activity to the seasons.

spring snapshot – snow begins to melt; wildflowers and spring ephemerals take advantage of sunlight before trees leaf out; sap begins to rise; buds grow on shrubs and trees (first shrubs leaf out, then understory, then canopy); mating calls of spring peepers and songs of returning migratory birds

summer snapshot – trees fully leafed out; flourishing plant life, plentiful food; amphibians escape day’s heat by burying themselves in the cool mud by lakes, streams, or ponds; trees grow abscission layer between twig and leaf stem

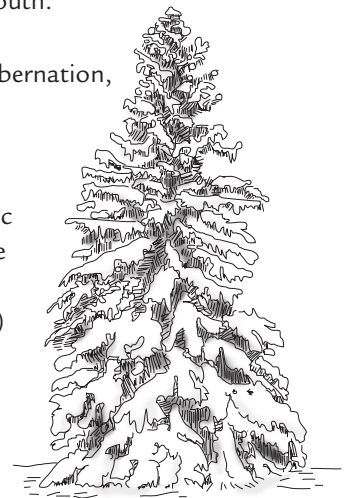
fall snapshot – Shrubs and understory trees form berries; days get shorter and temperatures drop; chlorophyll gets used up in leaves and colors are revealed; leaves turn brown and fall, breaking off at abscission layer; trees begin to harden to prepare for winter’s temperature-induced drought. Many animals prepare for a long winter by putting on layers of fat to use as energy during their winter fast, collecting food stores, or migrating south.

winter snapshot – Plants enter a period of dormancy; animals have migrated, gone into hibernation, or endure the winter; snow falls in the northern regions.

FOREST TYPES & ASSOCIATIONS

Temperate-forest composition—the trees that comprise it—vary with the region and specific climatic and soil conditions. Other conditions such as drainage, the path of water, and fire can all change forest composition. There are four major types:

- temperate deciduous forest - trees that lose their leaves (oak, maple, beech, hickory)
- evergreen forest - trees that keep their needlelike leaves (pine, fir, spruce, hemlock)
- mixed forest - deciduous and evergreen trees
- temperate rainforests - marked by a cool, moist climate (ancient redwoods and giant sequoia on the Pacific Coast of the United States)



Scientists further divide temperate forests into associations, according to the dominant tree species. Dominant tree species are those that have the greatest influence in composition of a community, and are usually the most prevalent. Many plants and animals “associate” or interact and depend on these trees for food and shelter. Common associations are oak/hickory and beech/maple.

FOREST STRUCTURE

Different organisms live in different layers of the forest. Like an apartment building, the vertical structure of a forest allows many animals to live on a relatively small piece of land, each within its own microclimate. Some animals stay in one layer, others, like squirrels, move between layers. Not all forests have every layer.

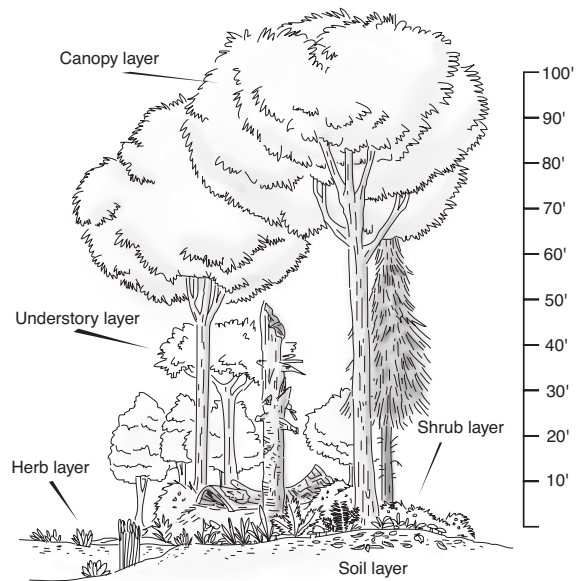
canopy – the tallest layer, ranging from 18.3 to 30.5 meters (60–100 feet high) with large oak, maple, beech, chestnut, hickory, elm, basswood, linden, walnut, or sweet gum trees; catches precipitation, acts as a wind barrier, provides shade

understory – young trees and short tree species (dogwoods, redbuds, American holly)

shrub layer – woody plants, taller than 1 meter (3 feet), with many stems (witch hazel, spicebush, or Hercules club)

herb layer – non-woody, herbaceous plants less than 1 meter (3 feet) (ferns and wildflowers)

ground layer – low-growing plants such as mosses



soil layer – leaves → humus → soil (fertile and rich in nutrients and organic matter)

CHARACTERISTICS

Known for:

- its deciduousness
- high diversity of tree species
- leaves “turning” shades of red, gold, and orange in fall
- layered structure
- moderate animal species diversity
- distinct seasons and lack of a dry season
- fertile soil
- layer of leaf litter and decaying organic matter
- even distribution of precipitation throughout year

MAIN THREATS TO FOREST ECOSYSTEM & SPECIES BIODIVERSITY

Find out more about these threats to forests in your area:

- degradation and fragmentation
- high levels of human consumption
- pollution by acid rain
- introduced species
- deforestation (logging for timber and clearing for agriculture)
- development (roads and infrastructure)
- global climate change
- mining and oil operations
- unsustainable forest management practices
- illegal harvesting of plants and animals
- water pollution
- off-road vehicles

Module 3 Appendix: Temperate-Forest Flora and Fauna

Kingdom Animalia: China

Wolong Nature Reserve

takin (*Budorcas taxicolor*)

http://www.mnzoo.com/animals/northern_trail/talkin_1.asp

*giant panda (*Ailuropoda melanoleuca*)

<http://nationalzoo.si.edu/Animals/GiantPandas/PandaFacts/default.cfm>

red panda (*Ailurus fulgens*)

<http://nationalzoo.si.edu/Publications/ZooGoer/1992/2/redpandasfirecat.cfm>

musk deer (*Moschus sp.*)

http://www.panda.org/resources/publications/species/cites/fs_mskdeer.html

tufted deer (*Elaphodus cephalophus*)

http://www.ultimateungulate.com/Artiodactyla/Elaphodus_cepbalophus.html

red fox (*Vulpes vulpes*)

gray wolf (*Canis lupus*)

clouded leopard (*Neofelis nebulosa*)

<http://www.cloudedleopard.org/>

Asiatic black bear (*Ursus thibetanus*)

http://www.grizzlybear.org/bearbook/asiatic_black_bear.htm

dhole (*Cuon alpinus*)

<http://www.enchantedlearning.com/subjects/mammals/dog/Dholeprintout.shtml>

golden snub-nosed monkey (*Pygathrix roxellana*)

http://www.wcmc.org.uk/species/data/species_sheets/goldensn.htm

Himalayan vulture/griffon (*Cyps himalayensis*)

Oriental cuckoo (*Cuculus saturatus*)

Eurasian sparrowhawk (*Accipiter nisus*)

*golden pheasant (*Chrysolophus pictus*)

*copper pheasant (*C. amherstiae*)

*Reeve's pheasant (*Syrmaticus reevesi*)

*Temminck's tragopan (*Tragopan temminckii*)

<http://www.chinaenvironment.com/english/channel/nature/bird.html>

Western Chinese mountain salamander (*Batrachuperus pinchonii*)

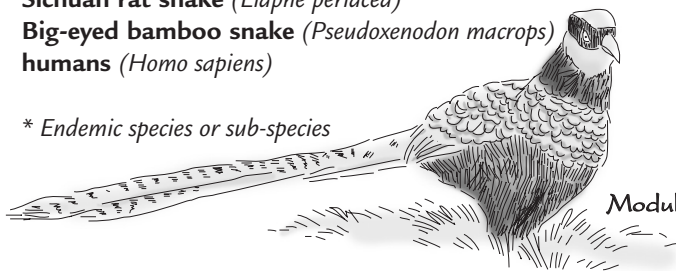
Tibetan mountain salamander (*B. tibetanus*)

Sichuan rat snake (*Elaphe perlacea*)

Big-eyed bamboo snake (*Pseudoxenodon macrops*)

humans (*Homo sapiens*)

* Endemic species or sub-species



Kingdom Animalia: United States

Smoky Mountains National Park

Eastern chipmunk (*Tamias striatus*)

gray squirrel (*Sciurus carolinensis*)

common raccoon (*Procyon lotor*)

white-tailed deer (*Odocoileus virginianus*)

red fox (*Vulpes vulpes*)

coyote (*Canis latrans*)

American black bear (*Ursus americanus*)

cardinal (*Cardinalis cardinalis*)

wild turkey (*Meleagris gallopavo*)

yellow-billed cuckoo (*Coccyzus americanus*)

turkey vulture (*Cathartes aura*)

red-tailed hawk (*Buteo jamaicensis*)

bald eagle (*Haliaeetus leucocephalus*)

ring-necked pheasant
(*Phasianus colchicus*)

ruffed grouse
(*Bonasa umbellus*)

timber rattlesnake
(*Crotalus horridus*)

common snapping turtle (*Chelydra serpentina*)

*Jordans salamander (*P. jordani*)

*Black Mountain salamander (*Desmognathus welten*)

*Cheat Mountain salamander (*P. nettingi*)

southern dusky salamander (*D. auriculatus*)

black rat snake (*Elaphe obsoleta*)

humans (*Homo sapiens*)



Kingdom Plantae:

Tree Families Found in Both Central China & Appalachia¹

dogwood	oak
sassafras	basswood
maple	fir
birch	hemlock
larch	spruce
poplar	dawn redwood
cherry	yew
apple	rhododendron (<i>shrub</i>)

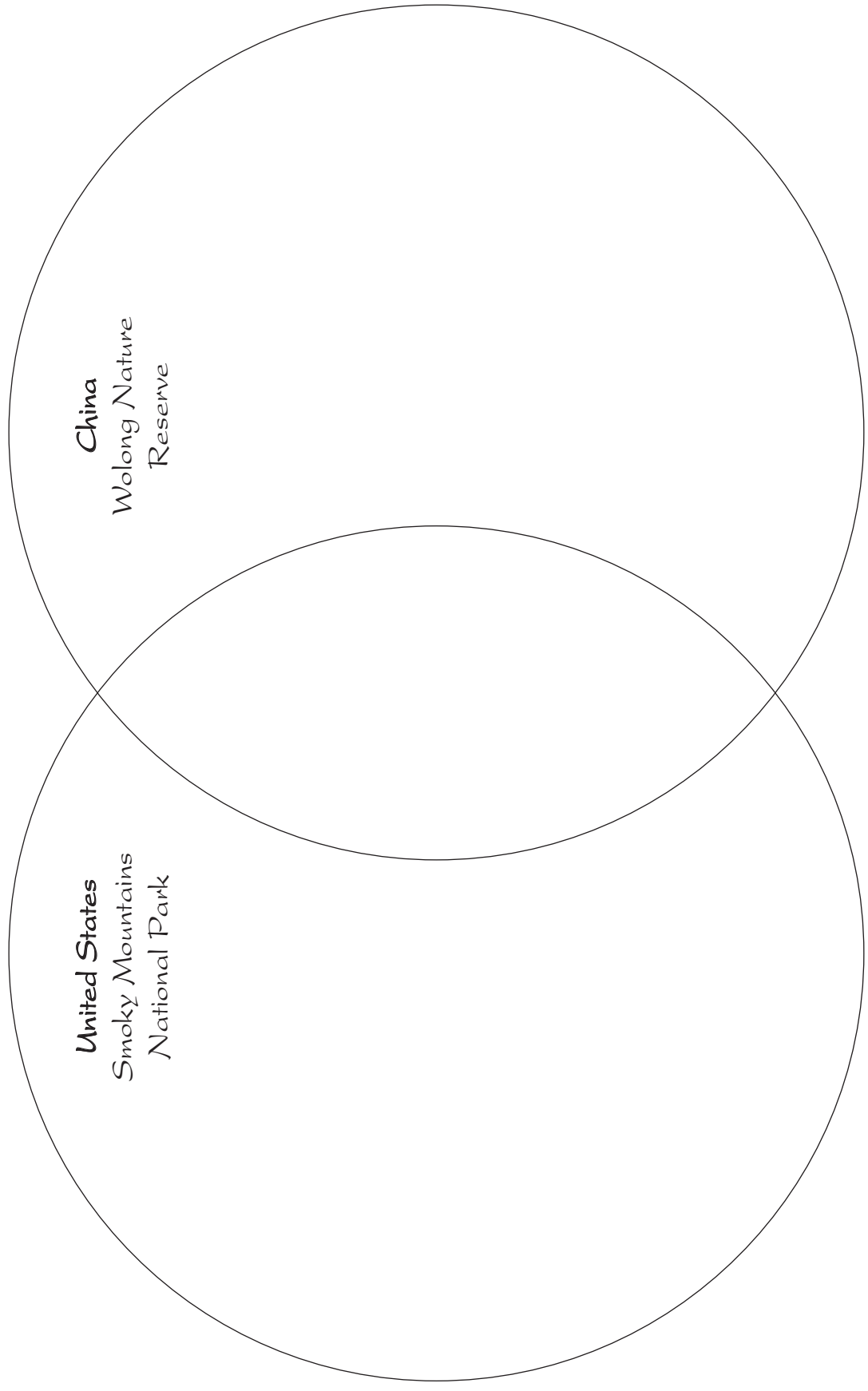


Consult these web links for tree species in each region:

Appalachia - <http://www.panda.org/resources/programmes/global200/pages/regions/region069.htm>

China - <http://www.panda.org/resources/programmes/global200/pages/regions/region080.htm>

Temperate Forests



Module 4 Appendix: Behind the Scenes - Research and Conservation at the National Zoo

There's a lot more to a zoo than exhibiting animals. Scientists from the Smithsonian's National Zoo work with international collaborators at field sites around the world to conduct research to learn more about animals and their habitats to help conserve them in zoos and in the wild!

ANIMAL RESEARCH

- **White-Tailed Deer – *Are deer destabilizing forest ecosystems?***
National Zoo scientists are studying the impact of white-tailed deer on North American eastern deciduous forests by using long-term deer exclosures, or fenced-off areas. The study monitors small mammal, bird, vegetation, and acorn production at 12 sites in Virginia. Half of the sites are fenced-off so deer cannot browse, or eat, vegetation. These sites help scientists explore the role of deer in ecosystems and their impact on forest food webs. Scientists are also researching ways to control white-tailed deer populations in eastern deciduous forests.¹
- **Aves (Birds) – *Is forest fragmentation harming bird populations?***
Zoo scientists are studying the effects of forest fragmentation on bird mating habits and population size, and how certain types of agriculture impacts migratory bird habitat. They are also monitoring annual trends for migratory species and their populations to assess forest health in eastern forests. They will use changes in the abundance of certain birds to track the impact of forestry activities (such as timber removal and road construction) on forest biodiversity.
- **Red Panda – *The Red Panda Species Survival Program (SSP)*** of the American Zoo and Aquarium Association (AZA) helps conserve red pandas in zoos and in the wild. The National Zoo coordinates conservation activities in 56 zoos in North America through a program of captive population management, field research, training, and education.
- **Giant Panda Biology and Reproductive Science – *How can we increase breeding success?***
The National Zoo is conducting several studies to help pandas survive. National Zoo researchers are evaluating how well giant pandas reproduce in zoos and in the wild and are trying to understand how their reproductive endocrinology (hormonal make-up) may impair or aid reproductive success. Zoo scientists are also devising a way to monitor reproductive and stress hormone levels from giant panda feces, or poop. They are also conducting research in the areas of artificial insemination (AI). Cryobiologists are creating a “frozen zoo” to preserve genetic biodiversity for endangered species. The Zoo's current Genome Resource Bank (GRB) contains more than 1,100 samples of frozen sperm or embryos from 69 species!²

Bamboo Preference, Foraging Study, Environmental and Social Preference Study – *Did you know that Mei Xiang and Tian Tian prefer to munch on different bamboo species?* Research has helped Zoo scientists better understand panda preferences for bamboo. They are studying the different nutrient levels in different bamboo species, as well as how pandas forage for food using their eyes, noses, and spatial awareness skills. Conservationists in China can use this information to protect the right bamboo forests. An environmental and social preference study is also trying to determine the preferences of captive giant pandas for exhibit features, microclimate, social contact, bamboo, and housing. Scientists and exhibit planners will use preference data to design the new Fujifilm Giant Panda Conservation Habitat. The study uses remote-sensing surveillance cameras and a weather sensor system to collect data on the two pandas.³

Giant Pandas: The Science of Finding Food – *Do they smell it, see it, or remember where to find it?*

This 30 minute video demonstrates how scientists apply each step of the scientific method in the Giant Panda Foraging Study. The video follows National Zoo scientists as they study the foraging behaviors of Tian Tian and Mei Xiang to learn how giant pandas find food. <http://www.fcps.edu/fairfaxnetwork/pandas/index.shtml>

Learn more about the *Bamboo Preference Study*.

<http://nationalzoo.si.edu/Animals/GiantPandas/PandaConservation/BambooPreference/default.cfm>

Learn more about the *Giant Panda Foraging Study*.

<http://nationalzoo.si.edu/Animals/GiantPandas/PandaConservation/ForagingStudy/default.cfm>

Learn more about *Environmental and Social Preferences of Captive Giant Pandas*.

<http://nationalzoo.si.edu/Publications/ZooGoer/2002/1/pandagallery.cfm>

TEMPERATE-FOREST HABITAT CONSERVATION

Habitat and Species Monitoring – *What other animals live in giant panda reserves?*

Survey and Habitat and Mammal Populations in Tangjiahe Nature Reserve uses GIS mapping and remote trip cameras to survey habitat and mammal populations in this giant panda reserve. GIS is an important tool for decision-making and applied natural resources management. The National Zoo is training Chinese conservationists and reserve managers to increase their capacity for conservation.⁴

Forest Mapping – *How is logging affecting forest ecosystems?*

Forest mapping studies are trying to determine how forest ecosystems are being affected by logging, mining, road construction, and other large-scale development and how logging alters forest structure. Scientists are using Landsat satellite imagery and GIS to create maps that will provide detailed information on the condition of remaining intact forests. They will also analyze potential development threats to the forest ecosystems, such as the effects of logging on small mammal and songbird communities in a managed forest mosaic of the Appalachian Mountains. They demonstrated that certain birds are affected by changes in the forest mosaic. National Zoo scientists are also mapping forests around the world—such as mapping the remaining intact forests and tracking the increase in deforestation in Myanmar since the 1990s.⁵

Learn more about the Smithsonian’s Conservation & Research Program:

<http://nationalzoo.si.edu/ConservationAndScience/CRC/>

Support of Reserves

The National Zoo is providing \$10 million over a ten-year period to support habitat conservation in China’s giant panda nature reserves through the Panda Loan Program. See “Research and Conservation: Map of giant panda reserves in China” for descriptions of the National Zoo’s work in specific panda reserves.

<http://nationalzoo.si.edu/Animals/GiantPandas/PandaHabitat/default.cfm>

TRAINING AND CAPACITY-BUILDING

The National Zoo is conducting conservation biology, wildlife management, GIS methods, and community education training programs for the personnel of several giant panda reserves in China including Qianfoshan Reserve, Yele Reserve, and Meigu-Dafengding Reserve. These programs include the transfer of technology and techniques, the sharing of scientific expertise, and the initiation of field research projects to improve management practices within the reserve system. These training courses help the Zoo’s Chinese colleagues make better conservation management decisions.

EDUCATION AND COMMUNITY OUTREACH AT THE NATIONAL ZOO

Friends of the National Zoo (FONZ) provides biological and environmental education and high-quality recreation to National Zoo visitors. Each year, FONZ provides education programs to thousands of children. FONZ education programs include informal activities such as exhibit interpretation for visitors to the zoo, as well as formal education programs, including nature camp, classes, and resources for teachers. Community outreach activities include “Zoo on Wheels” visits to hospitals and senior centers, as well as outreach to the African American and Hispanic communities through special events such as “African-American Family Celebration” and “Fiesta Musical” that integrate science into cultural activities.

Learn more about National Zoo research in temperate ecosystems:

<http://nationalzoo.si.edu/ConservationAndScience/TemperateEcosystems/>.

Module 4 Appendix: What Do You Do at the Zoo?



Dr. Lucy Spelman

D.V.M., Smithsonian's National Zoological Park Director

A zoo director oversees all operations of a zoological park, including how the animals are housed and cared for, as well as what research and conservation projects are being conducted.

Describe any giant panda research, or other temperate forest-related research that you have conducted.

One of our research interests in giant pandas is in the area of preventive medicine, meaning the study of what diseases this species could get, and how to prevent them. The two major ways to prevent diseases in giant pandas, as in all species, are providing the best possible environment for them, and monitoring them for exposure to diseases caused by parasites or viruses. In some cases, treatments such as vaccines can be given. For example, the Zoo's pathology department has long been a leader in the study of canine distemper and the type of vaccine that should be used to prevent this viral disease in giant pandas.

How have you been involved in the design of the current or the new, expanded panda enclosure?

I became National Zoo Director just as plans were underway to renovate our panda house. We are now actively planning a new conservation habitat for Mei Xiang and Tian Tian, which will be part of the Zoo's new Asia Trail Exhibit. <http://nationalzoo.si.edu/Animals/AsiaTrail/>

What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

Both giant pandas are extremely healthy, and this is largely because the current exhibit provides an excellent environment that encourages activity, including climbing and interaction with each other. It also provides them with choices about temperature and water, and supplies a steady stream of bamboo. As we design their new habitat, we plan to include more of their favorite things, such as water, and place these features closer to our visitors so they can observe the giant pandas as closely as possible. When thinking about how to design a habitat for any species, it helps to first think of where they live in the wild including what types of plants they live with, temperature, and geography. But just as important, it helps to remember that zoo animals do not come from the wild, they are born in captivity. Zoo animals, like the giant pandas, rely very much on their keepers, and they follow regular routines for cleaning and feeding. The exhibit must be designed to support the animal keepers as well as the animals and the public.

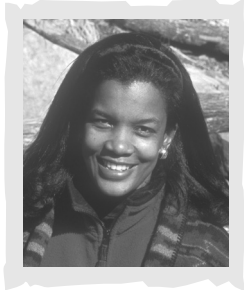
What do you like most about your job?

I enjoy the animal world, regardless of the species. At the same time, I get my motivation from the people who work at the National Zoo; they are a talented and dedicated staff, and I learn from them every day.

Learn more about National Zoo Director, Dr. Lucy H. Spelman, D.V.M.:

<http://nationalzoo.si.edu/AboutUs/Directors/Spelman.cfm>.

What Do You Do at the Zoo?



Lisa Stevens

Curator

As curator, I manage a section of the Smithsonian's National Zoo, which includes giant pandas, great apes, gibbons, lemurs, and Think Tank, an exhibit devoted to studying animal cognition.

How have you been involved in the design of the current or the new, expanded panda enclosure?

I planned the improvements to the current panda exhibit working with a team of people that included keepers, horticulturists, exhibit designers, architects, and contractors. I based the design on my 15 years of experience working with pandas and visiting their habitat in China. I am also involved in the plans for a new panda enclosure. We observed and collected research data on Tian and Mei in their current enclosures over the past year.

What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

Air-cooled and water-cooled grottos had never been provided to zoo pandas before. We tested misting and fogging systems and different diameter climbing trees. We learned that the pandas favor their water pools and trees with diameters of two feet or more. They also prefer the water-cooled grotto, probably because it maintains a lower temperature. We also know the keepers prefer the fogging system because it is less muddy. When you design animal enclosures you must consider the needs of the keepers and other staff. We also found that the number of visitors has no apparent impact on the pandas. We are still learning about our pandas. They were young and playful when they arrived, but they may become more solitary as adults.

What do you like most about your job?

I like working at the Zoo because I love wildlife and the outdoors. It is challenging to manage the animals with the goal of keeping them healthy, both mentally and physically. I also like teaching visitors about animals. I hope our Zoo will make a lasting impression on people, so that they will care about conservation.

What Do You Do at the Zoo?



Brenda Morgan

Keeper

Keepers feed, train, observe animals' daily behaviors, and clean their enclosures.

How have you been involved in the design of the current or the new, expanded panda enclosure?

Keepers have a unique understanding of the needs of the animals under their care because they work with them and see them every day. I provided the exhibit designers with information about how the pandas use the old yards and what is, or is not, working well for them.

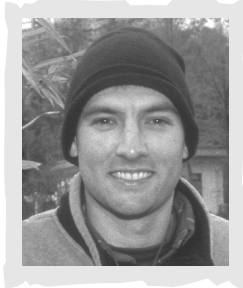
What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

Giant pandas need an environment that is diverse. The exhibit must be functional for pandas in both hot and cold weather. Pandas enjoy cold weather during the winter. In the summer, Mei Xiang and Tian Tian keep cool in the water pools and cooled caves.

What do you like most about your job?

I really enjoy getting to know the personalities of Mei Xiang and Tian Tian. I enjoy providing them with a healthy, enriched environment that suits their individual differences.

What Do You Do at the Zoo?



David Powell

Ph.D., Behavioral Scientist

A life scientist studies organisms or phenomena in the natural world to gain a better understanding of how the natural world functions and the role that organisms play in the environment.

Describe any giant panda research, or other temperate forest-related research that you have conducted.

My research topics focus on the preferences giant pandas have for exhibit features, bamboo species, and social contact. My research also involves determining what skills captive pandas do and do not have that they would need to have before being reintroduced to the wild.

How have you been involved in the design of the current or the new, expanded panda enclosure?

My studies of giant pandas have allowed me to be able to provide information about what the pandas' needs are in captivity and how we can provide the best living environment for them.

What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

We have learned that giant pandas need access to exhibit features that allow them to stay cool in warm weather, such as shade trees, pools of water, and temperature-controlled spaces. We now know that when pandas are young, they need to have opportunities to climb. They also need access to one another for most of the year to develop a social bond. We have also learned that pandas like objects or substrates that have a strong smell, for example, they love rotting logs. From our observations, Mei Xiang and Tian Tian don't seem to mind large crowds of people, but some pandas may not like to be very close to people and may need to have places in their exhibits where they can find shelter or refuge.

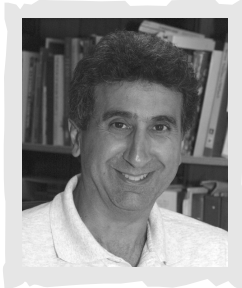
What do you like most about your job?

I like learning more about an animal that is not very well known, but the most rewarding part of my job is when my research results can be used to improve the lives of pandas in captivity around the world.

Learn more about Dr. David Powell's work at the National Zoo:

<http://nationalzoo.si.edu/AboutUs/Staff/Interviews/PowellDavid.cfm>.

What Do You Do at the Zoo?



Chuck Fillah

Horticulturist

Horticulturists manage and maintain all of the “green life” —plants and landscape—at the National Zoo.

Describe any giant panda research, or other temperate forest-related research that you have conducted.

My research involves working with other Zoo staff experts, managing our previous panda habitat’s landscape for 17 years, studying plants from China that grow in our region, and managing and studying bamboo that supports our pandas.

How have you been involved in the design of the current or the new, expanded panda enclosure?

I am part of the Zoo staff team that developed this panda design and habitat. The team made a list of what they wanted and from this I designed the landscape. This design included selecting the trees, shrubs, and other plants and how they are arranged in this exhibit.

What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

Mei Xiang and Tian Tian like to climb and “hang out”—rest, sleep, observe—in trees above ground so we added large trees and tree parts for them to climb on. We piled up large tree trunks and limbs to make interesting places where they could play or rest together or alone. The sloping hill at the front of the exhibits is great for their interaction as they roll down and wrestle with each other. For interest and complexity in the habitat, we added many different types of plants, small pools, sandy areas, and rocks. To provide a good home or habitat for them, we selected plants that are like the plants they live with in China. The horticulture staff is surprised and pleased that Mei Xiang and Tian Tian have explored their habitat but have only minimally damaged the plants.

What do you like most about your job?

The National Zoo is an exciting, living environment with interesting challenges. I enjoy managing and working with the horticulture staff, diverse plants/landscapes, and the plant and animal interactions.

Read more about Chuck Fillah’s work at the National Zoo.

<http://nationalzoo.si.edu/AboutUs/Staff/Interviews/FillahChuck.cfm>

What Do You Do at the Zoo?



Susan Ades

Exhibit Developer

An exhibit developer pulls an exhibit team together and sets major goals, determines messages, and ensures visitors have positive experiences.

How have you been involved in the design of the current or the new, expanded panda enclosure?

I am part of the team that designed the current panda enclosure and that is designing the new panda enclosures. I decide, with a larger team of Zoo staff, what visitors will learn about the pandas. I make sure that visitors will have great opportunities to view and photograph the pandas and that their overall experience is positive. A positive visit is one in which visitors can see the pandas, have their questions answered by a panda expert, find a place to sit, and learn something new about giant pandas and their home in the wild in China.

What have you learned about the needs and preferences of giant pandas, including Mei Xiang and Tian Tian?

When designing animal exhibits, it's important to incorporate the work of scientists. For example, our behavioral scientists found that Mei Xiang and Tian Tian don't spend much time in their pools, possibly because the water is too deep. This information will help us design better water features for them in their new yards. As you design an exhibit it's important to balance visitors' needs for viewing, shade, enjoyment, and space, with the animals' needs for food, cool areas, climbing structures, and refuge.

What do you like most about your job?

What I like most is the chance to plan new homes for animals and new ways for visitors to enjoy our animals and find out more about the natural world.

Module 5 Appendix: Challenges and Promising Developments in Temperate-Forest and Giant Panda Conservation

Challenges to:

1. Forest Ecosystem of Central China

- ***balancing human and wildlife needs***

Development, the desire for rapid economic growth, and industrial and agricultural resource and land-use practices are pressures on habitat for wildlife. Hundreds of species depend on the forest habitat. Along with the giant panda, the golden snub-nosed monkey, takin, and several species of pheasant are also disappearing. Thousands of plant species, including many useful to humans, also grow in this biodiverse mountainous area. Globally, we depend on at least 40,000 plants, animals, fungi, and microbes in daily life for food, medicine, and vital ecosystem functions such as purifying our air and water.¹

- ***impact of agricultural practices and past timber harvest on habitats***

Converting forests to agricultural lands provides local populations with cash crops while reducing forest habitat for wildlife. Conversion of forested steep slopes to farmland has increased erosional runoff, the silting of rivers, and catastrophic flooding. Logging natural forests and replanting them with monocultures (single tree species) of alien species had decreased biodiversity as many organisms depend on certain native tree species for their survival.

- ***demand for non-timber forest and wildlife products***

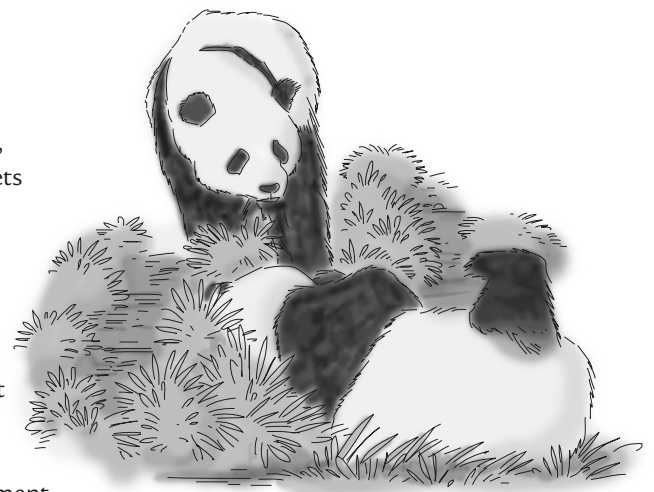
Despite laws protecting the giant panda, snow leopard, tiger, and black bear, pelts and parts such as gall bladders and bones, and illegally harvested herbs, are increasingly sold in local markets and are in demand in the international marketplace.

- ***consequences of logging ban and development policies***

The logging ban has increased China's demand for imported timber and timber products. Imports from Indonesia, Myanmar (Burma), and Malaysia have had a negative impact on the forest ecosystems of these countries. Former loggers may also turn to poaching to make ends meet. The Western China Development Plan (2001-2005) is a large-scale effort to attract foreign investment and build infrastructure such as highways, railroads, power plants, airports, and pipelines in the poor, resource-rich western regions of China. This plan aims to raise the standard of living of local people, but critics say it poses significant challenges to integrated conservation development and does not give enough consideration to environmental impacts and negative impacts to the local ethnic minority.

- ***assigning monetary value to ecosystem services***

Past economic models have not factored in the trillions of dollars contributed to the world economy from ecosystem services such as wetlands that purify our water, and forests that filter pollutants from our air. A 1997 study by environmental economists and environmental scientists estimated that ecosystem services provided \$33 trillion or more each year, free-of-charge.²



2. Endangered Giant Panda

- **loss of habitat due to grazing, farming, fuel-wood collection, logging, and development**

From the early 1970s to the mid-1980s suitable panda habitat shrunk by 50 percent. Giant pandas once lived in lowland areas, but farming and development now restrict them to the mountains in Sichuan, Shaanxi, and Gansu provinces of central China. Due to habitat fragmentation, they live in small, hemmed-in, isolated populations in mixed forests with a dense understory of bamboo.³ Small, isolated populations are more vulnerable to inbreeding, and may decline or vanish due to events such as epidemic disease, fire, floods, or other catastrophes.

- **poaching**

Penalties are severe, but pelts can fetch up to \$300,000 in Hong Kong and Japan, making it worth the risk for some poachers. Displaced loggers may also turn to poaching to make ends meet.

- **accidental trapping of giant pandas in snares set for animals such as musk deer and takin**

Snaring of takin and musk deer for food and other products has a long tradition among communities living in and around Chinese forests.

- **periodic bamboo die-off; fire and other human-induced disturbances**

Fragmented habitat makes it more difficult for giant pandas to migrate to other areas to feed on other bamboo species.

See Map of Historic Range of Giant Pandas

http://www.worldwildlife.org/pandas/images/map_panda1_lg.gif

See Current Map of Giant Panda Distribution

http://www.worldwildlife.org/pandas/images/map_panda2_lg.gif

The new 1999-2002 joint panda survey found 60 percent more giant pandas, across six mountain ranges, than was previously known to exist.

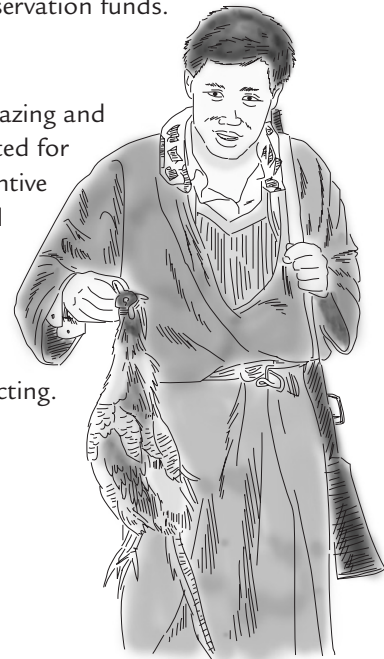
3. Protected Areas

- **lack of a consistent funding source**

In China funding for the nature reserve system isn't always available, making it difficult to support anti-poaching patrols and to hire and train staff.⁴ Most reserves are dependent on local governments for support. However local governments must make difficult decisions when allocating scarce conservation funds.

- **income-generating activities that compete with wildlife for forest resources**

When reserves are established, local people lose access to forest lands for grazing and resources such as fuel-wood and medicinal herbs. They are rarely compensated for this loss, resulting in economic hardship, and providing them with little incentive to participate in conservation efforts when their main focus is survival. Local subsistence hunters may continue to illegally hunt and trap birds and other animals for food. Reserve personnel, faced with chronic financial shortages, need to make up for the lack of money in their budgets, forcing some personnel to engage in income-generating activities such as illegal logging or illegal harvesting that exploit the resources they are supposed to be protecting.



See also Panda Conservation Current Challenges (WWF)

<http://www.worldwildlife.org/pandas/conservation.cfm>

Promising Steps

The national government has made it a priority to reduce the risk of flooding and produced historic changes in logging and land-use policy as a result of the catastrophic floods of 1998.

China's forested uplands provide watershed protection to lowland river valleys, absorbing rainfall, slowing the rate of runoff, preventing soil erosion, and reducing the intensity of both droughts and floods. The floods of 1998 cost many lives and billions in damage to crops and infrastructure. The monetary value of the ecosystem services (water and soil conservation, air purification, acid rain buffering, protection against downstream flooding, etc.) provided China's forests has been estimated at 7.5 trillion yuan, three times the value of all the wood in these forests.⁵

New, participatory conservation models involve local people as stewards of the environment.

For development to be considered sustainable, economic well-being, social development, and environmental stability must be addressed together.⁶ Forest practices that involve and benefit local people are crucial to long-term habitat and wildlife conservation, thus securing a future for the giant panda and other large carnivores in the wild.⁷ The 4Cs of conservation include:

1. setting aside **core** habitat areas for giant pandas and other large **carnivores**.
2. creating **corridors** between core areas.
3. providing incentives for local human **communities** to preserve middle landscapes (the habitat connections between the core reserves), core habitat, and buffer zones by creating sustainable, income-generating activities that minimize negative impacts to forest habitat.⁸

The input of local people and reliable social and economic incentives benefits people, habitats, and wildlife.

If people are aware of the economic benefits of intact forest ecosystems, and are compensated for their losses, they will protect the resources that enhance their own lives. A farmer who is compensated for goats killed by a giant panda whose pathway passes through her farm is more likely to conserve this middle landscape connection over the long term if she is compensated for her loss.⁹

Human population needs are integrated into forest ecosystem management.

People who live in the forests of central China rely heavily on the resources around them and on native biodiversity; they are the first to feel the effects of habitat degradation when the natural systems that purify our water or help prevent erosion, drought, or flooding are thrown out of balance. Natural Forest Conservation Program (NFCP) and Grain-for-Green are two programs that factor in the needs of local people. Grain-for-Green (Returning Steep Agriculture Slopes to Forest Program) may improve degraded panda habitat, especially in areas outside of reserves, and could eventually link core habitats, reduce forest fragmentation, and reconnect isolated panda populations. As farmers receive a cash subsidy based on the amount of land converted, this could provide greater incentives for afforestation and preservation of middle landscapes, the key habitat connections between core reserves.¹⁰ NFCP, which incorporates the 1998 logging ban, will protect all remaining forests in the giant pandas' range and reduce potential floods by increasing forest cover in critical river basins. It could also increase forest biodiversity since it focuses on replanting native species versus monoculture tree plantations.

Communication and Education Opportunities are Improving.

The Chinese government, the National Zoo, and international organizations such as World Wildlife Fund are working to increase communication, conservation education, and training. Improving access to scientific expertise and current research will help people create and carry out effective conservation strategies in the field.

Learn about the research and training National Zoo scientists are conducting in the Tangjiahe Nature Reserve:

<http://nationalzoo.si.edu/weblet.cfm?url=/Publications/OnlineFeatures/AroundtheRim2001/tangday1.htm>

Integrated Conservation Development Programs (ICDPs) are in place.

ICDPs recognize that in order for conservation strategies to be effective, they need to provide economic and social benefits for local people. Involving local people as participatory conservation partners and decision-makers invests them in the process and the outcome—conserving the forest for the long-term benefit of people, pandas, and the diversity of forest life. Creating economic incentives to raise the standard of living for local people also increases the likelihood that they will carry out effective conservation strategies over the long term. Some examples include:

1. ecotourism and sustainable bioprospecting,
2. beekeeping for honey,
3. sustainable wild mushroom harvesting,
4. planting of mulberry and walnut trees, and afforestation projects that plant native species.

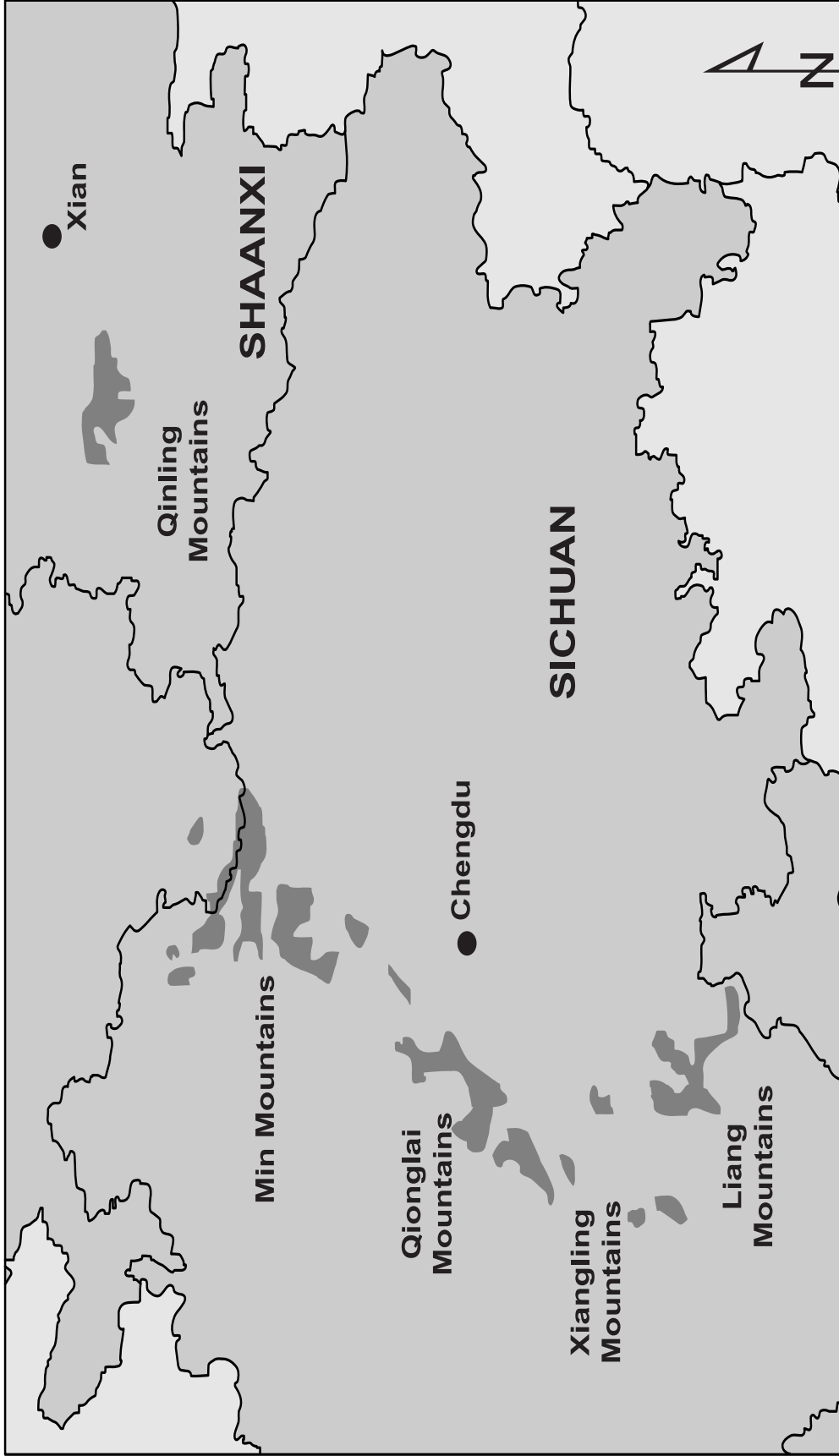
Economic opportunities such as sustainable bioprospecting and ecotourism have the potential to yield more income than clearing land and logging.

Learn about the ICDPs such as the Pingwu Integrated Conservation and Development Project in the Wanglang Nature Reserve in Pingwu County. http://www.panda.org/resources/publications/species/pandas/gp_work.htm

See also Future [Panda Conservation] Outlook: Reasons for Optimism (WWF)

<http://www.worldwildlife.org/pandas/future.cfm>

Module 5 Appendix: Giant Panda Distribution Map



China's Third National Panda Survey

A joint study conducted from 1999 to 2002 by World Wildlife Fund (WWF) and China's State Forestry Administration (SFA) found 60 percent more giant pandas than were previously known to exist, across six mountain ranges. Survey data are revealing for the first time in 10 years how giant pandas in the wild are doing across their range. Scientists are using this data to form a national GIS database on existing panda habitat. This giant panda conservation database will be used for tracking and analyzing information critical to the long-term protection of giant pandas such as populations and distribution areas, habitat, and threats. Visit <http://www.worldwildlife.org/pandas/> for more information on the National Panda Survey.

Map of Historic Range for Giant Pandas (WWF)

http://www.worldwildlife.org/pandas/images/map_panda1_lg.gif Giant pandas once roamed much of southern China, but are now confined to isolated patches on six mountain ranges.

Module 6 Optional Handout: Conservation Kids

Conservation Kids

Kids across the nation are doing their part to conserve the environment!

Earth Day in the Bag! — Shawmont School, PA

To promote Earth Day, students sent environmentally friendly messages home on grocery bags. They created more than 500 messages, such as “Be an Environmental Shopper,” and “Please recycle this bag,” to educate shoppers. Their messages reached hundreds of local shoppers!

Water Week — Sheridan Middle School, CO

The sixth-grade after-school girls program looked at water use inside and outside of their school, measured water quality, and monitored water use at home. They created a “Water Week” to educate others about water issues. They had demonstrations on groundwater pollution, Jeopardy-like competitions based on water facts, and put water-conservation messages on the back of bathroom doors. They even handed out reusable water bottles and booklets of water-saving hints.

Creating Green Space — Grant Community School, OR

Students researched their community and noticed few open green spaces for people to connect with nature. They worked with neighbors to develop a seven-step action plan including removing alien species and planting native trees in an abandoned lot. Seventh graders are now working to get another abandoned lot donated to the city. They hope to work with neighbors to turn it into a community garden or a wildlife refuge.

Tune In and Tune Up! — Kids for Saving Earth

The “Tune Up the Earth” Challenge motivates families, schools, and businesses to work together to help take excess carbon dioxide emissions out of the air through simple Earth-saving practices. Join the “E-pal Challenge” to protect wildlife and wild lands. <http://www.kidsforsavingearth.org/>

Blueprint for a Better City — Kids Across the Nation

Students used the power of creative thinking to fuel visions of cities powered by renewable energy sources. The national Future City Engineering Competition challenges students to design futuristic city models that solve real-world problems. Read about other ideas for futuristic cities at <http://www.futurecity.org/> (click on “Alumni”).

The Global Habitat Project

<http://www.greenscreen.org/GHP/GHP.html>

Get the word out by putting your environmental ideas in writing. Share your ideas about the environment with other kids by writing newsletters, stories, poems, and action alerts!

Fujifilm and Friends of the National Zoo: Partners in Conservation Education

<http://pictures.fujifilm.com/pandas/>

Join with other young people to make a difference in helping the environment.



Module 6 Appendix: Basic Guidelines for Developing Your Class Conservation Action Plan



Setting the Stage

1. Set Goals & Objectives

As a class, decide on your objectives and final goal. Break your final goal into smaller benchmarks so students can track their progress. Breaking a goal into manageable steps will empower and continually motivate students. Acknowledge and celebrate their achievements, big and small, along the way.

2. Determine Scope and Timeline

Determine the scope and decide how long you can/will spend on the project. *Will this be a month-long or an on-going project that students can continue to work on after the year is over by forming a school conservation club?* Giving students a timeline will help them understand that they have a finite period to accomplish certain goals. This in turn will help determine the scope of their plan.

3. If Necessary, Create a Budget and Invite Businesses to Sponsor Your Project

Will your action plan require money for supplies? If necessary, determine a rough budget and ways to raise the money you will need to accomplish your goal. *Is a local or national business interested in collaborating with your school by sponsoring an event or by donating supplies?*

4. Involve Community Members & Conservation Organizations

Involving your community will add to your base of support and resources. Students can take field trips to local nurseries, wildlife organizations and zoos, and invite scientists, amateur naturalists, and garden club members to class. Partner with a local conservation organization.

The Process

1. Build On Action Steps

Build on the concrete action steps you have already taken, or incorporate ideas from the **Student Overview Sheet**. *What has interested and inspired your students the most? Which action steps have the greatest momentum and will most likely engage students in an on-going way?* Address one, specific conservation issue to make your project manageable.

2. Create Strategy Groups

This can help you manage the process. Some students prefer to research, others to write letters, others to create posters for a public awareness campaign, and still others will be more interested in public speaking. Organize groups to include students with a combination of complementary skills.

3. Strategy Groups Devise an Action Plan

Based on one of the three choices students voted on, each group creates a specific plan of action. Their plans should incorporate action steps they have already taken, or ideas from the **Student Overview Sheet**. Plans should contain the group's final goal and benchmarks, and should also consider your timeline and budget.

4. Students Vote for One Action Plan

The whole class votes to choose one Conservation Action Plan. Students will have a chance to amend the plan.

5. Strategy Groups Amend Action Plan and Vote on Amendments to Create Final Plan

Groups can add “amendments” (additions, changes, deletions) to the plan. Each group will have a chance to incorporate an idea or action step that motivates them (they will be more invested in a plan that reflects their interests). The class then votes to keep or strike “amendments” to create the final action plan.

Tell us about your **Class Conservation Action Plan!** E-mail us your Plan at fonz_programs@nzp.si.edu. We'll post selected plans in our Habitat Gallery.

Below is a sample framework for a Class Conservation Action Plan outline based on the action steps you took in the **Planning New Habitat** lesson plan (see <http://nationalzoo.si.edu/education/conservationcentral/teacher/resources/>).

Framework for Our Class Conservation Action Plan

Conservation Goal: create a schoolyard wildlife habitat

Duration: six to seven class periods (four to five days for planning, two days for implementation)

Possible Project Partners: local nursery or garden shop or department store (for plant donations), amateur botanist or volunteer from local nature center (for guidance in plant selection, preparation, and planting techniques).

Ideas for Getting the Supplies We Will Need: 1. donations, 2. fundraiser (car wash, bake sale, etc.)

Benchmarks:

Planning Phase

1. Review biology inventory.
2. Decide on wildlife we want to attract.
3. Determine native species that attract this wildlife and are suited to conditions of our plot.
4. Form partnerships to obtain donations and expertise.
5. Determine number of plants and other supplies and cost and set budget.
6. If necessary, hold a fundraiser to raise necessary funds.
7. Purchase plants and supplies.

Implementation Phase

8. Prepare and plant new habitat.

Action Steps We Can Take to Meet Our Goal:

- **Action Step 1:** Determine the soil, moisture, and light conditions of our plot (one class period).
See Planning New Habitat for a lesson plan.
- **Action Step 2:** Invite a volunteer from our local nature center to class to discuss native plant species that would be best suited to our habitat, and to learn about the wildlife these plants attract (one class period).
- **Action Step 3:** Decide what wildlife we want to attract. Choose native plant species that will attract this wildlife and that are suited to the abiotic conditions of our habitat (one class period). *See Planning New Habitat for a lesson plan.*
- **Action Step 4:** Determine the number of plants we will need, their cost, and other supplies such as bird, bat, or toad houses we plan to purchase or make. Set our budget. Request donations from a local nursery, garden shop, or arboretum, and ask to borrow other habitat enhancements from a local nature center (one to two class periods).
- **Action Step 5:** Purchase/pick up donations of plants and supplies (after school time).
- **Action Step 6:** Prepare and plant our wildlife garden. Include other activities to enhance wildlife habitat such as herp coverboards (salamander boards), pvc pipes for making toad houses, bat or bird houses, etc. (two class periods).