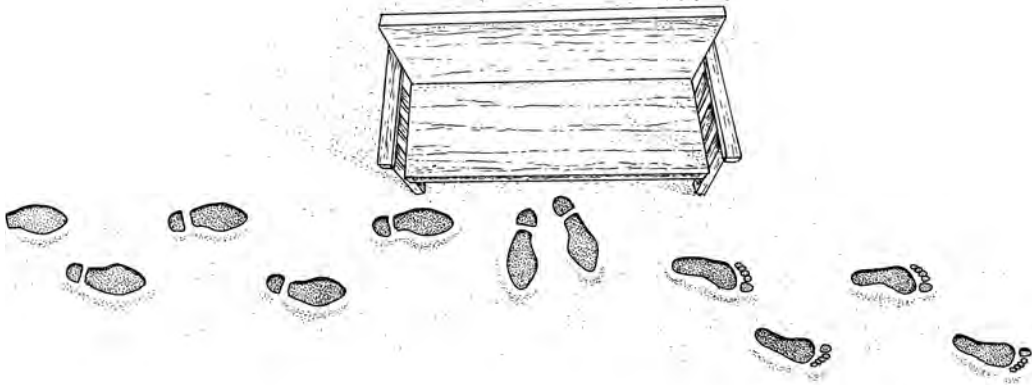


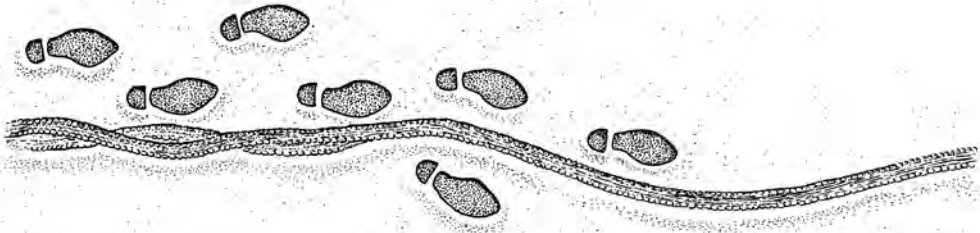
Handout 8-A

Mystery Track Pattern Cards

1



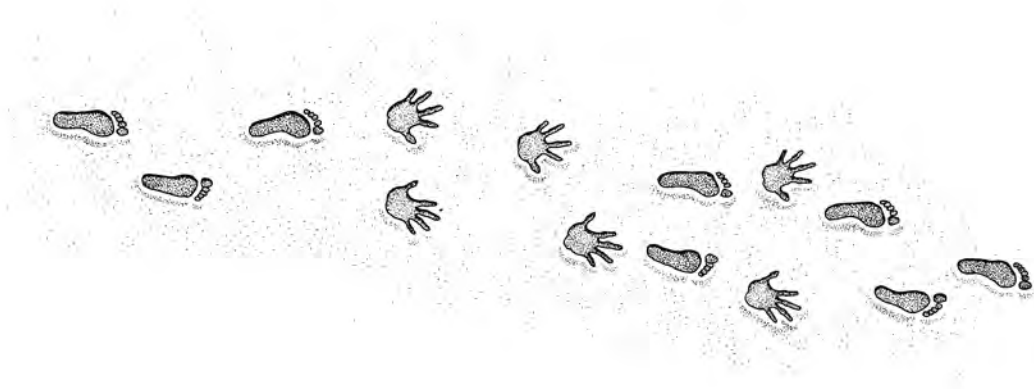
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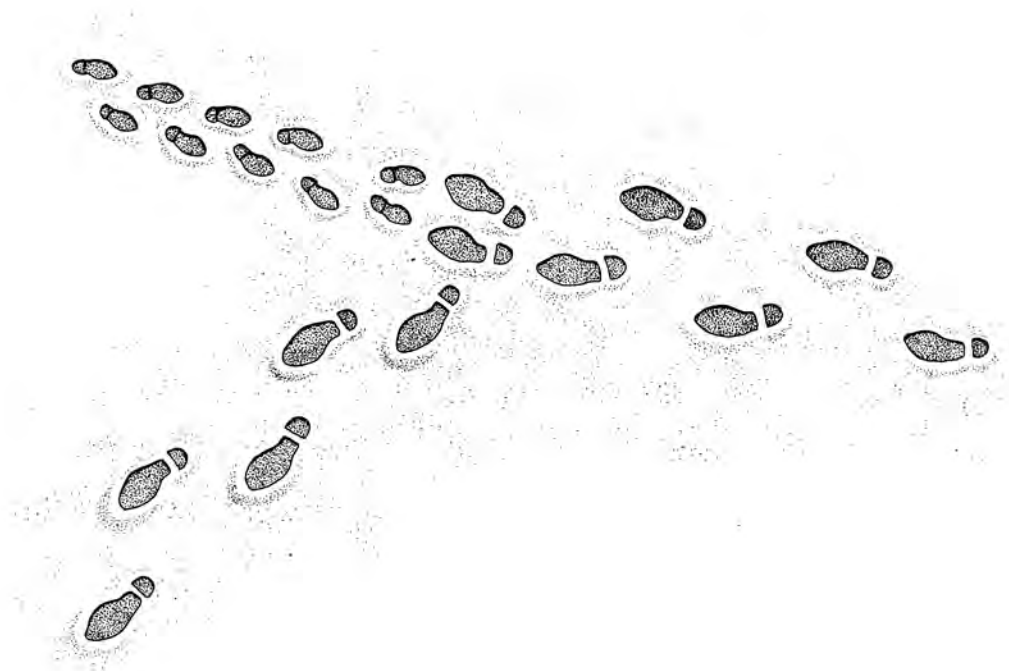
Handout 8-A

Mystery Track Pattern Cards

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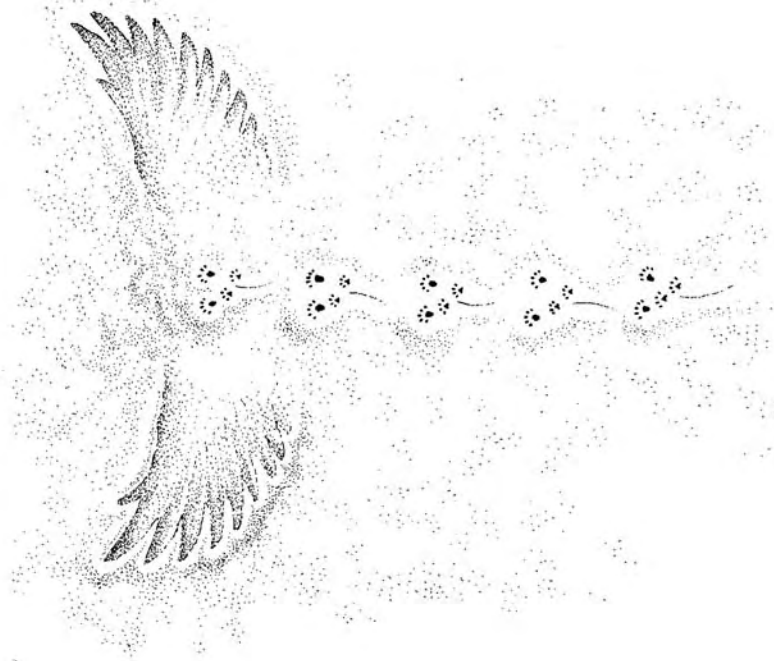
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Handout 8-A

Mystery Track Pattern Cards

5



6



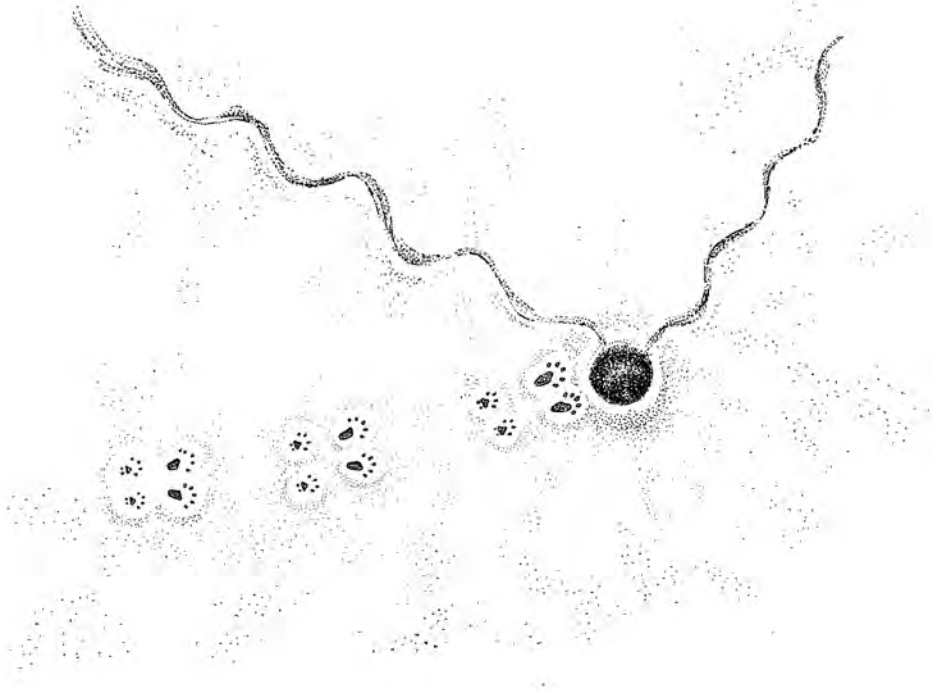
Handout 8-A

Mystery Track Pattern Cards

7



8



Handout 8-A

Mystery Track Pattern Cards

Answers to “Mystery Track Pattern Cards”

Below are the stories told by the track patterns:

1. A person walks, sits down, takes off shoes, stands up, and walks away.
2. A person is walking a bike, swings her leg over the bike, pushes off, and rides away.
3. A barefooted person walks into a handstand, walks on his hands, comes back down onto his feet, and walks away.
4. A child and adult walk toward each other and stop. The adult picks up the child and walks away.
5. A mouse is running. A raptor (hawk, owl) flies down and carries away the mouse, leaving only wing prints in the snow.
6. A rabbit runs down a hole. A fox follows, stops at the hole, then walks away. The rabbit escapes out another hole.
7. A person is walking and stops when she sees a skunk walking toward her. The skunk also stops. The person runs in another direction.
8. A ground squirrel runs into a hole. A snake follows the squirrel into the hole. The snake comes back out. The squirrel is either hiding in the hole or has been eaten.

Handout 8-B

Tracking Trace Fossils

Name _____ Date _____

- CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS -

All of the following people must be observers of the fleeting, subtle signs left by the animals they are tracking:

- A wildlife officer trying to find a bear that has been raiding garbage cans and bird feeders in a neighborhood
- A hunter searching for a deer in a forested area
- A wildlife biologist tracking the movement of wolves that have been reintroduced into an area to bring balance back to the ecosystem
- A park ranger walking a trail trying to confirm a visitor's report of a mountain lion
- A search-and-rescue team looking for a lost hiker

The most familiar indicator, footprints, is only one of many types of temporary animal signs, called trace fossils.

What Does a Forensic Scientist Need to Know?

There is an art to finding tracks and other trace fossils in nature or a crime scene. Investigators and scientists need to recognize subtle impressions from tracks and know where to look for other trace (temporary) fossils that an animal has left behind. Knowledge of the animals that naturally live in the ecosystem is essential. Once the

evidence is collected, the scientist can make measurements and look for distinguishing characteristics to identify the animal. Telling the "story" behind the trace fossils is helped by the scientist's knowledge of the animal's natural behaviors.

What Is a Track?

A track usually refers to a footprint, but it can also be a mark on the ground left from an animal's tail, wing, hand, or other body part. People leave other unique tracks from objects like tires, skis, or snowmobiles.

What Are Trace Fossils?

Trace fossils are temporary pieces of evidence, including tracks, bones, shells, feathers, impressions, trails, burrows, nests, borings, and scat. Each can give clues about who was where and what happened.

Why Are Animal Tracks Important?

Human and other animal tracks are studied for many different reasons. Besides the situations listed at the beginning of this handout, law enforcement officers can follow the tracks of a suspect or victim and use tracks or other trace fossils to identify someone involved in a crime.

Handout 8-B

Tracking Trace Fossils

A single animal footprint can tell the tracker the species, the animal's age and gender, the direction of travel, and the approximate time or day the animal was there. A more detailed story of the animal becomes clear when a series of tracks is found. This group of footprints and other signs could show how the animal was moving (running, walking, trotting), as well as its speed, health, or behavior.

Are All Trace Fossils Useful Evidence?

Not all trace fossils are equal in a wildlife crime investigator's eye. The most powerful evidence comes from the body of the animal victim or human suspect. Feathers, hair, blood, and bones all contain cells with DNA that, when tested, can be matched to a single individual. Body cells, and DNA, can often be collected from clothes, blankets, and other materials that touched the body of the animal or person.

Other trace fossils like burrows, nests, and tree scrapings are helpful in identifying a species of ani-

mal, but unless DNA is found, the evidence would describe a group instead of an individual. Another type of indirect, or circumstantial, evidence is from tracks. Footprints, shoe prints, and tire tracks again narrow the focus and can eliminate animal species or human individuals, but they are not a direct link to an individual. It is possible to convict a suspect with a large body of indirect evidence, though DNA is evidence of choice.

What Did You Discover About Tracks and Trace Fossils?

1. What is the difference between a track and a trace fossil?
2. What additional information could you gather from a series of tracks that you could not get from a single track?
3. Name an animal that lives in your community. Describe several kinds of trace evidence it might leave and where you would look to find that trace evidence.

STUDENTS: TAKE A CLOSER LOOK

- Which trace fossil evidence would crime investigators prefer to find at a crime scene: hair or a footprint? A nest or a feather? Justify your answers.
- Can you identify an individual from a shoeprint? Defend your answer.

Handout 8-C

Making Tracks to Protect Land: Student Lab Investigation

Name _____ Date _____

- CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS -

Your Job

As a wildlife biologist, you have been asked to identify the tracks of wildlife species living in a new protected wilderness area. After identifying these tracks, you will research and design a visitors' field guide to the area, giving information about each species.

Your Steps

1. Your teacher will give you "Tracks Found in a New Protected Wilderness" (Handout 8-D). Measure and record the length and width of each track. (Do not include claws/nails in measurement.) Then use the "Field Guide to Mammal Tracks" (Handout 8-E) to identify them.
2. Design a field guide that includes all of the following parts or selected parts (as specified by your teacher):
 - Cover: Title of field guide
 - Introduction:
 - title of field guide and the name you are giving to the wilderness area
 - an overall and specific explanation of what visitors can expect to see when they visit the wilderness area
 - an explanation of possible reasons why this area is now protected from development
 - Animal Pages (include the following information for each animal):
 - name of animal and drawing of animal track (*Optional*: picture of animal)
 - measurements of track
 - written description of (a) how the track can be distinguished from other similar tracks, (b) what other trace fossils (signs) the animal might leave, and (c) where visitors should look for these trace fossils
 - Predator/Prey Table: Make a table that lists the animals and what they eat. Are there any predator/prey relationships among the animals you are researching?
 - Food Relationships Table: Use the "Field Guide to Mammal Tracks" to make a table explaining the food relationships among all the animals in the area. The column headings in your table should be "Animal name," "Type of eater (herbivore/carnivore/omnivore)," and "What the animal eats."

Handout 8-C

Making Tracks to Protect Land:
Student Lab Investigation

3. Animal Inventory and Management Plan: Write an animal inventory and management plan in which you include the following information:
 - a. Diversity of wildlife species in the area (number and names of species)
 - b. Number of species that are herbivores, carnivores, and omnivores
 - c. Why it is important to know the eating behavior of the species before deciding how to improve the balance and health of the ecosystem
 - d. Suggestions for improving the health and balance of the wilderness area
 - e. Suggestions for other types of information that should be examined to learn more about the health of the ecosystem

Optional Activities for the Student-Designed Field Guide

Option 1: Wilderness Area Food Web

Create a food web showing the connections among the animals in the wilderness area you have chosen for your field guide and make predictions of what other animals or plants must also be in the area to support these identified animals.

Option 2: Is This a Balanced Ecosystem?

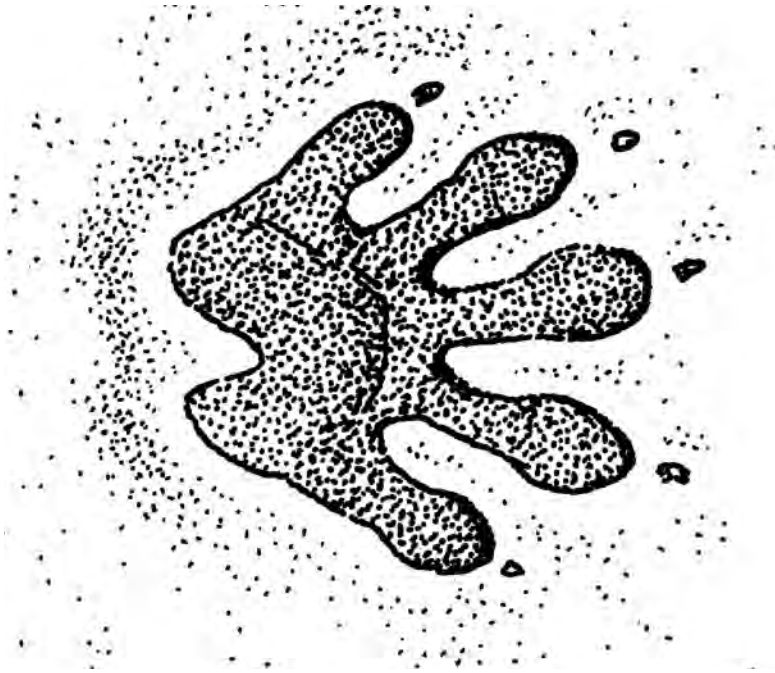
Write a report in which you advise the conservation organizations and government agencies that are managing the wilderness area about ways to keep balance in the ecosystem. Use information gathered for your Animal Inventory and Management Plan (step 3 above) in your report.

Handout 8-D

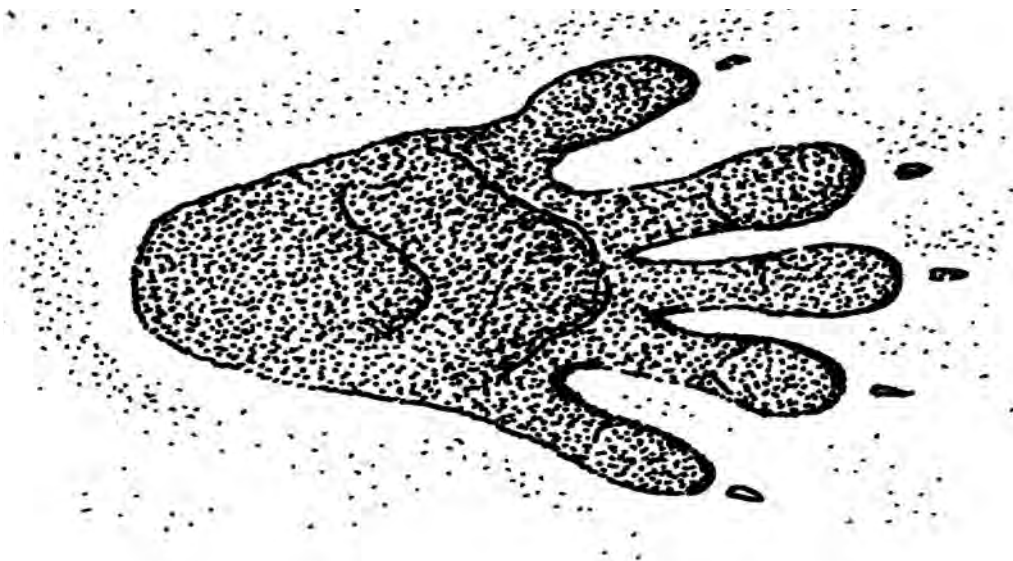
Tracks Found in a New
Protected Wilderness Area

Name _____ Date _____

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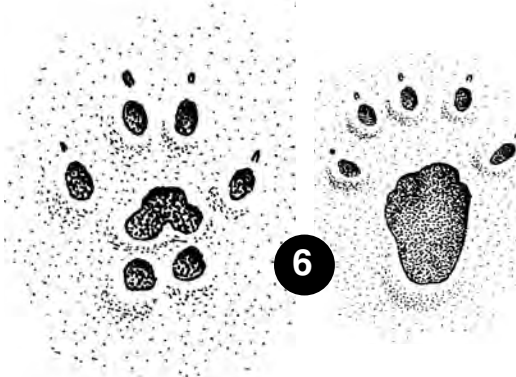
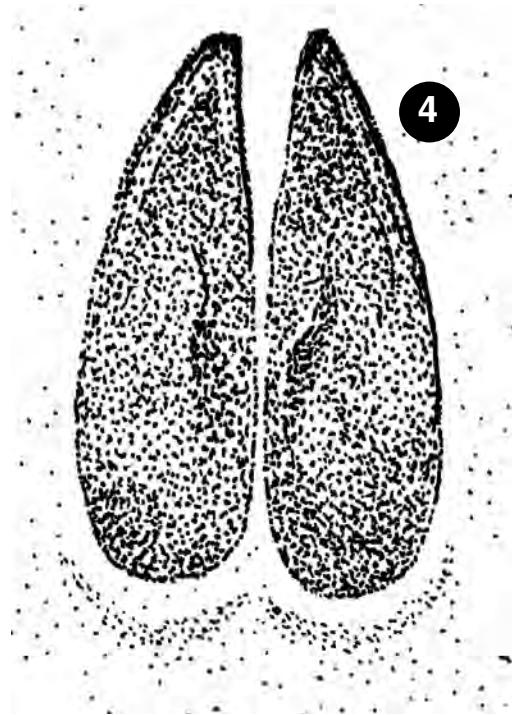
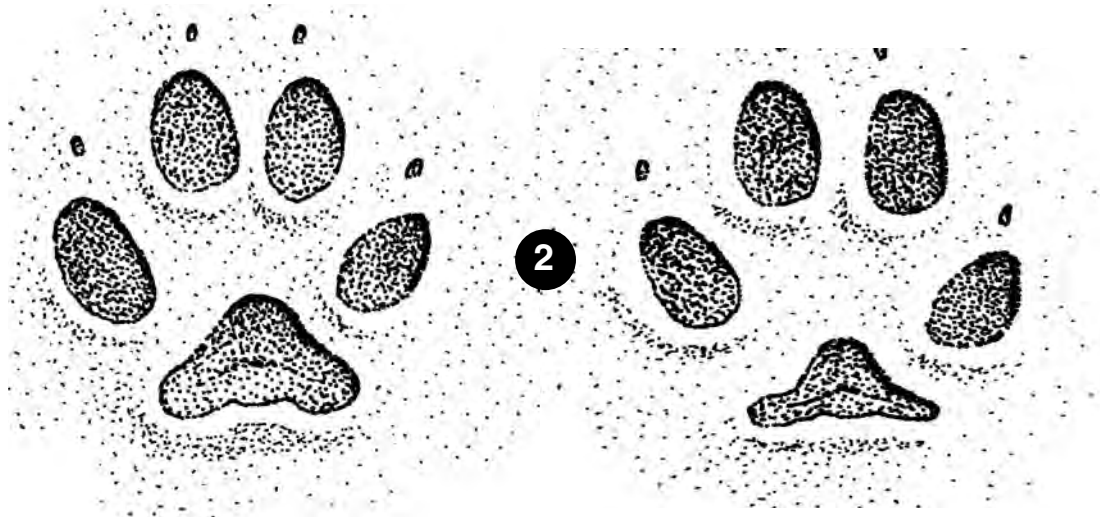


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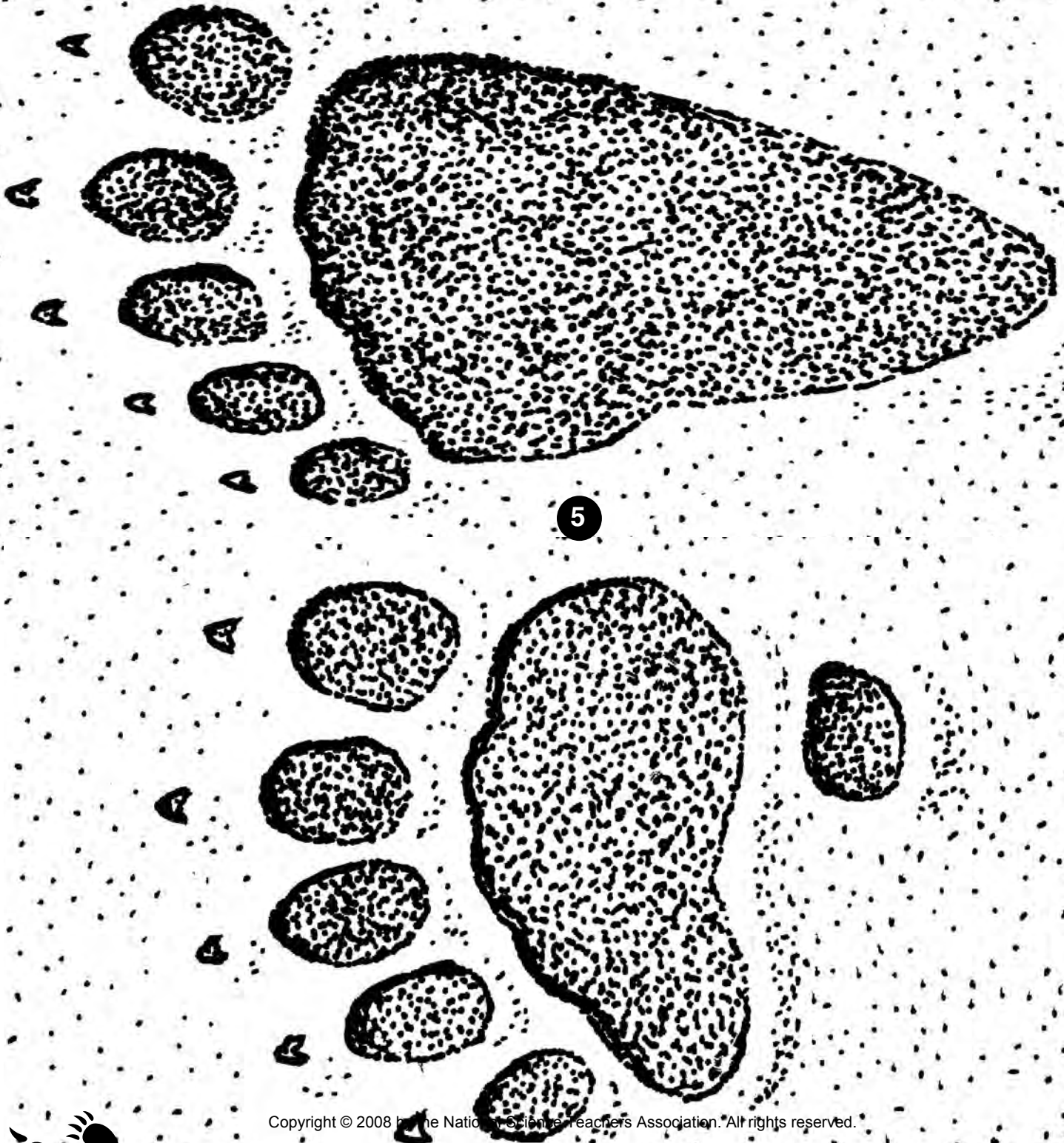
Handout 8-D

Tracks Found in a New
Protected Wilderness Area



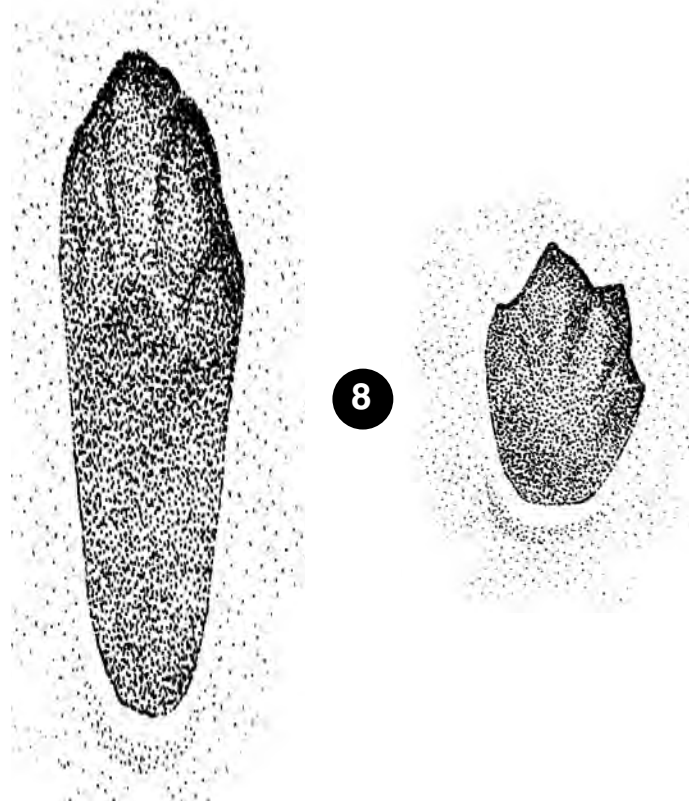
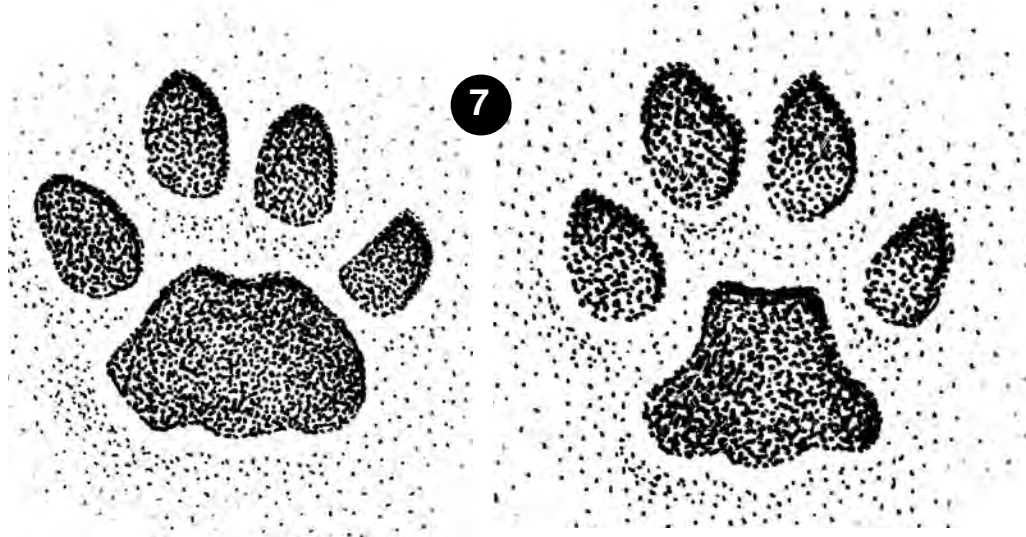
Handout 8-D

Tracks Found in a New
Protected Wilderness Area



Handout 8-D

Tracks Found in a New
Protected Wilderness Area



Handout 8-D

Tracks Found in a New
Protected Wilderness Area

Name _____ Date _____

**Answers to Tracks Found in New Protected
Wilderness Area**

(Give this answer sheet to students **after** they have identified the tracks in Handout 8-D by using the “Field Guide to Mammal Tracks” [Handout 8-E]).

- 1 Raccoon
- 2 Fox
- 3 Mouse
- 4 Deer
- 5 Black bear
- 6 Squirrel
- 7 Bobcat
- 8 Rabbit

Handout 8-E'

Field Guide to Mammal Tracks

Name _____ Date _____

- CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS - CRIME SCENE - DO NOT CROSS -

- | | |
|----------------------|-------------------|
| 1. Black bear | 8. Mountain lion |
| 2. Bobcat | 9. Mouse |
| 3. Cottontail rabbit | 10. Porcupine |
| 4. Coyote | 11. Raccoon |
| 5. Deer | 12. Squirrel |
| 6. Elk (Wapiti) | 13. Striped skunk |
| 7. Fox | |

All track measurements are average sizes as reported in James C. Halfpenny, 2001. *Scat and Tracks of the Rocky Mountains*, 2nd ed. Guilford, CT: The Globe Pequot Press.

1. Black Bear (*Ursus americanus*)

Front	Hind
4.5 × 4 in	7 × 3.5 in
(11.3 × 10 cm)	(17.8 × 8.8 cm)



Track: Five toes. Claws on front foot. Hind foot looks like human print because of distinct heel.

Other animals with similar tracks: Grizzly bear and Alaskan brown bear are larger.

Habitat: Forests and swamps in eastern United States; mountains and foothills of the western United States.

Habits: Usually active at night, but can be seen during the day. Eats berries, nuts, insects, small mammals, eggs, and honey. Also scavenges dead animals, human garbage, and birdseed from feeders. Adaptable to living around people and towns. Climbs trees.

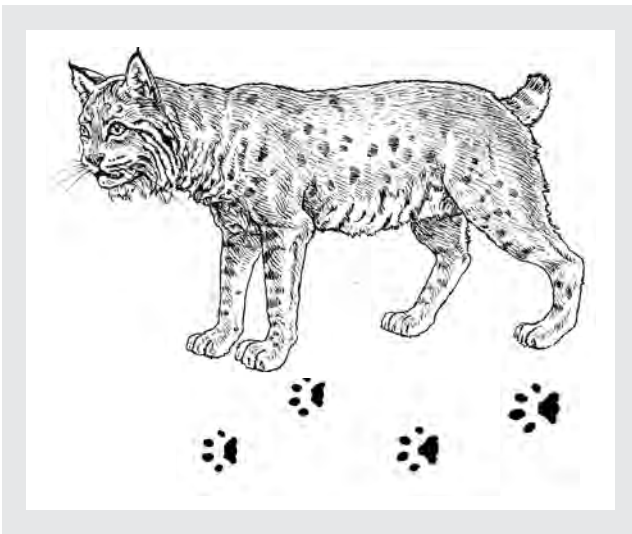
Other Signs (trace fossils): Claw marks on trees to mark territory, signs of digging into ant mounds and open logs, large scat piles often full of seed pits from native berry bushes and sunflower-seed shells from bird feeders.

Handout 8-E'

Field Guide to Mammal Tracks

2. Bobcat (*Lynx rufus*)

Front	Hind
2 × 2.1 in	2.1 × 1.9 in
(5 × 5.3 cm)	(5.3 × 4.8 cm)



Track: Round. Four toes. Usually does not show claws.

Other animals with similar tracks: Lynx and mountain lion are larger. Coyote more oval and shows claws.

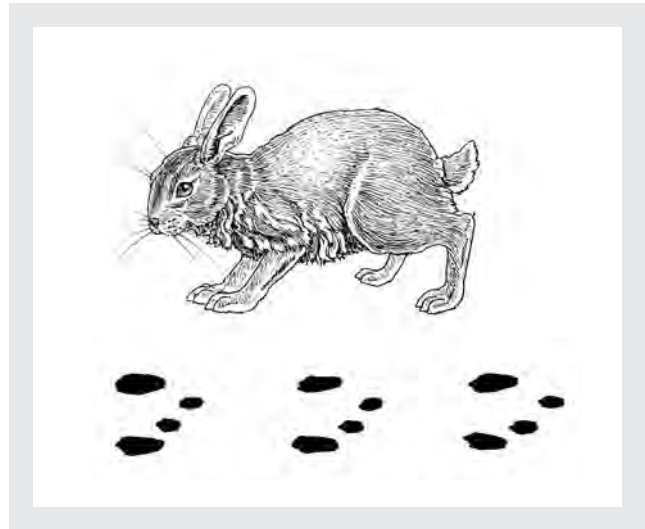
Habitat: Rock ledges, forests, swamps, and caves.

Habits: Mostly active at night. Solitary. Eats small mammals and birds. Dens found in hollow logs and rock crevices.

Other Signs (trace fossils): Covers scat with dirt. Food covered to return to later.

3. Cottontail Rabbit (*Sylvilagus ssp.*)

Front	Hind
1.25 × 1 in	3.5 × 1 in
(3.2 × 2.5 cm)	(8.8 × 2.5 cm)



Track: Hind foot about more than twice as long as front foot. Toes hard to distinguish because the foot is covered with fur. Track pattern when hopping has the larger hind feet prints in front of the smaller front feet prints.

Other animals with similar tracks: Jackrabbit and snowshoe hare have larger feet.

Habitat: Very adaptable. Lives wherever there is grass and cover.

Habits: Dens in the ground or in a brush pile. Active day and evening all year round.

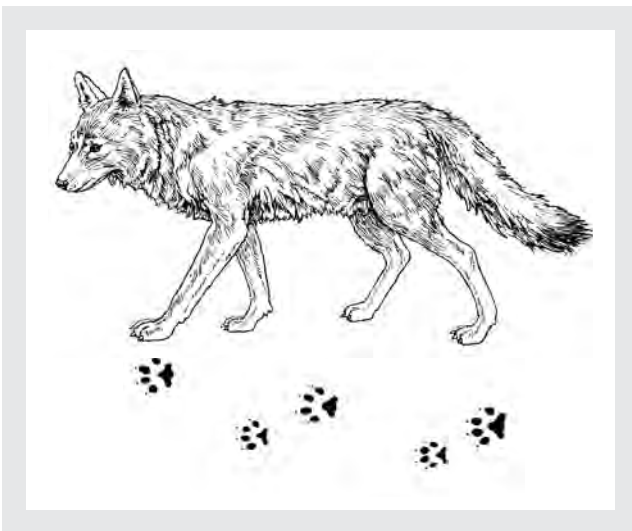
Handout 8-E

Field Guide to Mammal Tracks

Other Signs (trace fossils): Tops of grasses and other green-stemmed plants bitten off. Tips of new growth on plants bitten off. Hole in ground leads to burrow.

4. Coyote (*Canis latrans*)

Front	Hind
2.5 × 2.35 in	2.25 × 1.9 in
(6.3 × 5.8 cm)	(5.7 × 4.8 cm)



Track: Oval-shaped, claws usually show.

Other animals with similar tracks: Wolves are larger. Foxes are smaller.

Habitat: Prairies, open woodlands. Very adaptable—has been seen in cities, deserts, and alpine areas.

Habits: Often nocturnal, but can be seen at any time. Omnivore scavenger (eats almost anything). Eats mostly small rodents, rabbits, and berries. Lives in a ground den.

Other Signs (trace fossils): Territory marked with scat piles. Hole in ground or hillside leads to den.

5. Deer

5a. Mule deer (*Odocoileus hemionus*)

Front	Hind
3.25 × 2.6 in	3.1 × 2.5 in
(8.2 × 6.5 cm)	(7.8 × 6.3 cm)



Handout 8-E

Field Guide to Mammal Tracks

**5b. White-tail deer
(*Odocoileus virginianus*)**

Front	Hind
3 × 1.9 in	2.6 × 1.5 in
(7.5 × 4.8 cm)	(6.5 × 3.8 cm)



Track: Heart-shaped with slightly convex sides. Pointed tip of the “heart” points in the direction of travel, like an arrow.

Other animals with similar tracks: Pronghorns, goats, and sheep have concave sides. Elk is larger and wider.

Habitat: Wooded areas for cover. Moves into meadows to feed at twilight. Found in all types of habitat except arctic and desert.

Habits: Most active in the early mornings and evenings. Eats mostly twigs and shrubs (browser). Will eat grasses and other green-stemmed plants.

Other Signs (trace fossils): Creates a flattened bowl-shaped area the size of the animal when it beds down. Antlers may leave imprints in the snow when feeding. Males shed antlers in January and February. Mule deer antlers are branched in pairs. Whitetail deer antlers have prongs that extend singly from a main beam.

**6. Elk (Wapiti)
(*Cervus canadensis*)**

Front	Hind
4.75 × 3 in	4.25 × 2.9 in
(11.8 × 7.5 cm)	(10.7 × 7.3 cm)



Handout 8-E

Field Guide to Mammal Tracks

Track: Blocky heart shape with front tip split and wider. Rounded, convex sides. The narrower tip points in the direction of travel.

Other animals with similar tracks: Deer and pronghorn have narrower, smaller pads with tips coming to more of a point. The outer edge curves outward and is rounder than moose, sheep, deer, and pronghorn.

Habitat: Forests, mountain meadows, and high plains.

Habits: Active in early mornings and evenings. Beds down in trees during the day. Eats grasses, herb, twigs, and bark. Usually seen in groups of 25 or more.

Other Signs (trace fossils): Chew marks on trunks of trees. Males shed antlers from February through March. Creates a flattened bowl-shaped area the size of the animal where it beds down.

7. Fox

7a. Red fox (*Vulpes vulpes*)

Front	Hind
2 × 1.8 in	1.9 × 1.7 in
(5 × 4.5 cm)	(4.8 × 4.3 cm)

7b. Gray fox (*Urocyon cinereoargenteus*)

Front	Hind
1.8 × 1.6 in	1.7 × 1.6 in
(4.5 × 4.0 cm)	(4.3 × 4.0 cm)



Track: Usually shows claws. Slightly oval print. Large spaces between toe pads.

Other animals with similar tracks: Coyote and wolf larger; dog toes more splayed versus forward pointing

Habitat: Variety of habitats—brush, farm crops, combination of forest and open areas, cities.

Habits: Most active at night and early morning but seen at all times of day. Omnivore that eats insects, rabbits, mice, berries, and fruits.

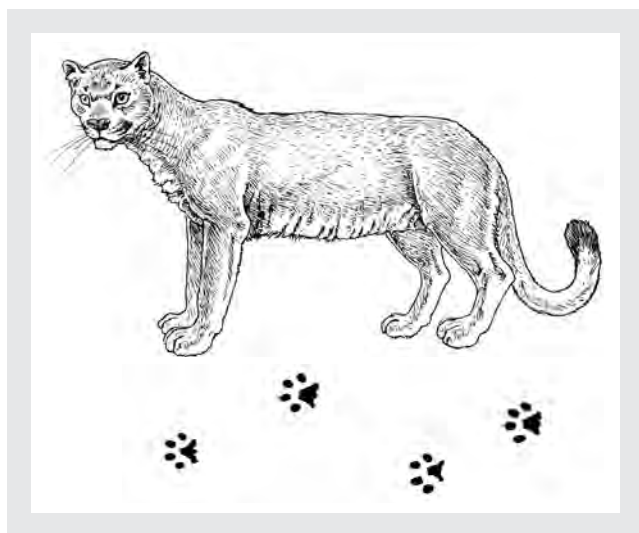
Other Signs (trace fossils): Holes in ground leading to den, small bones around den entrance, musky-smelling scat.

Handout 8-E

Field Guide to Mammal Tracks

**8. Mountain Lion
(*Puma concolor*)**

Front	Hind
3.5 × 3.6 in	3.25 × 3 in
(8.8 × 9.0 cm)	(8.2 × 7.5 cm)



Track: Size of baseball. Four toes. Track appears round. Claws are usually not seen. Large toe marks.

Other animals with similar tracks: Wolves have claw marks and their track is more oval. Bears have five toes.

Habitat: Open woodland, riparian areas with trees, and rocky cliffs and ledges with good cover.

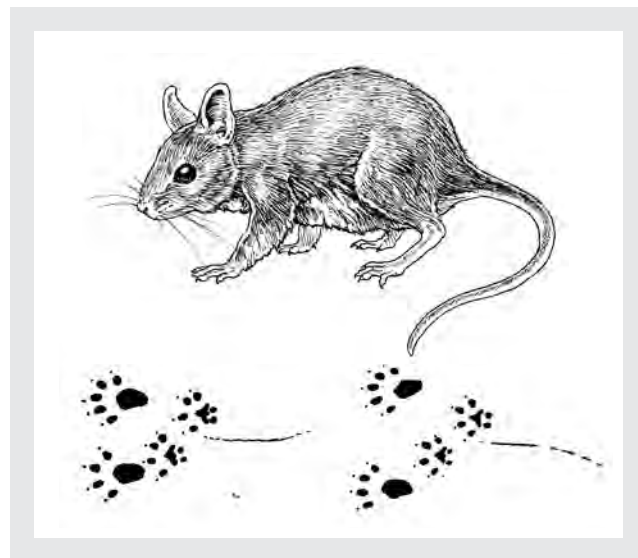
Habits: Follow the deer they prey upon, even into neighborhoods. They also eat porcupines. Solitary animals. Most active at night, but can be seen anytime.

Other Signs (trace fossils): Often covers scat with dirt. Hides food. Marks territory with scrapes (piles of plant parts and dirt).

9. Mouse

Deer mouse (*P. maniculatus*)

Front	Hind
0.3 × 0.3 in	0.4 × 0.3 in
(0.8 × 0.8 cm)	(1 × 0.8 cm)



Track: Track is smaller than a fingerprint. Four toes are in the front foot; five toes are on the back foot. Hopping track patterns show the larger back feet immediately in front of the smaller front feet. Leaping distances are 3–17". A tail drag may be visible.

Other animals with similar tracks: Shrew tracks are larger and have

Handout 8-E

Field Guide to Mammal Tracks

five toes on the front feet. The vole does not show a tail drag mark. Usually trots instead of jumping.

Habitat: Different species of mice are found in almost any habitat.

Habits: Active at night. Lives in burrows or sheltered ground nests of grass, sometimes around houses. Stashes seeds in different locations near nest.

Other Signs (trace fossils): Nests of grass and leaves are found in burrows, wood piles, and tree cavities. Piles of nuts, seeds, and empty shells. Tiny, oval-shaped scat pellets.

10. Porcupine (*Erethozon dorsatum*)

Front	Hind
1.7 × 1.3 in	2.7 × 1.7 in
(4.3 × 3.3 cm)	(6.8 × 4.3 cm)

Track: Track leaves a rough texture because the sole is covered with small nubs. The front foot has four toes; the hind foot has five. The track pattern often shows a pigeon-toed walk, with the toes turned slightly inward. The tail drag may be continuous between feet. Belly drag marks may be visible in the snow.

Other animals with similar tracks: Rough texture of tracks make them unique.

Habitat: Lives in forested areas or places with shrubs.



Habits: Most active at night. Spends most of its time in the tops of trees chewing bark. Awkward on the ground. Eats small twigs, inside of bark, and leaf buds. Likes salt. Does not hibernate. Dens found in rock caves and hollow trees.

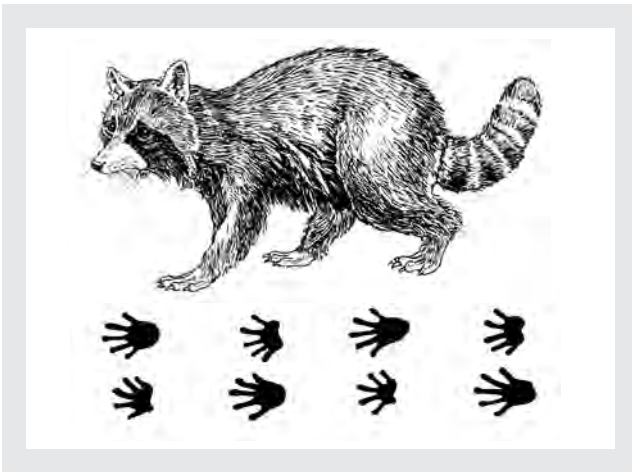
Other Signs (trace fossils): Pieces of chewed-off green twigs scattered around the base of a tree. Patches of bark missing from the trunk and branches.

Handout 8-E

Field Guide to Mammal Tracks

11. Raccoon (*Procyon lotor*)

Front	Hind
2.5 × 2.5 in	4 × 2.3 in
(6.3 × 6.3 cm)	(10 × 5.8 cm)



Track: Five slender toes, larger rounded tips, long slender heel. Looks like small human hands and feet.

Other animals with similar tracks: River otter has toe webbing. Mink is smaller.

Habitat: Banks of lakes and streams, storm drains in cities.

Habits: Common visitor to trash cans and bird feeders. Nocturnal omnivore that eats many types of plants, seeds, and animals—fruits, nuts, insects, crayfish, eggs, and frogs. Lives in dens made in dead trees, hollow logs, and the ground.

Other Signs (trace fossils): Scrape marks and holes beside streams from digging for crayfish. Piles of crayfish

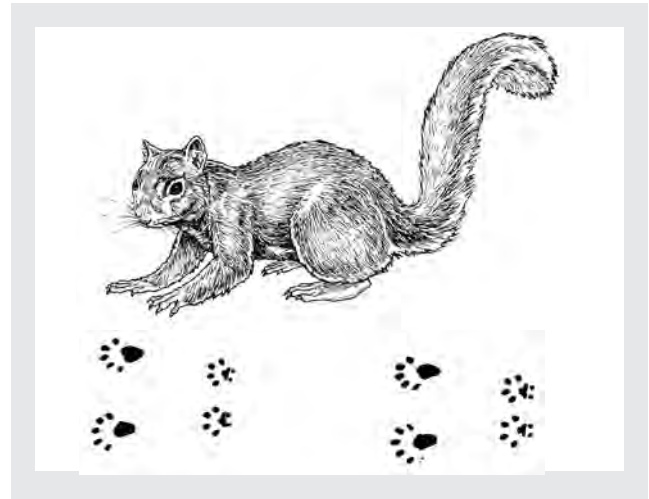
exoskeletons. Holes in dirt from digging for worms.

12. Squirrel

12a. Red squirrel (*Tamiasciurus hudsonicus*)

12b. Eastern gray squirrel (*Sciurus carolinensis*)

Front	Hind
1 × 1 in	0.9 × 1 in
(2.5 × 2.5 cm)	(2.3 × 2.5 cm)



Track: Track is the size of a thumbprint. The front foot has four toes; the back foot has five toes. Can leap up to three feet. Track patterns show the larger back feet in front of the smaller back feet between leaps.

Other animals with similar tracks: Chipmunks have smaller tracks; marmots have larger tracks. The prairie dog and ground squirrel have long claws.

Handout 8-E'

Field Guide to Mammal Tracks

Habitat: Red squirrels live in coniferous forests of the United States, Canada, and Alaska. Eastern gray squirrels live in deciduous forests, parks, and communities in the eastern and southern United States.

Habits: Active during the day all year. Makes nests of grass, sticks, and leaves in trees or under stumps or logs. Feeds on a wide variety of plant parts (seeds, nuts, conifer cones), eggs, and fungi.

Other Signs (trace fossils): Tunnel runways under the snow. Nut stashes. Leave piles of pinecone scales and partially eaten cones at the base of trees.

13. Striped Skunk (*Mephitis mephitis*)

Front	Hind
1.5 × 1.25 in	1.9 × 1.4 in
(3.8 × 3.1 cm)	(4.8 × 3.5 cm)

Track: This track is about the size of a teaspoon. Each foot has five long toes, with the front having long claws.

Other animals with similar tracks: Badgers have bigger tracks.



Habitat: Found in many different habitats, including grasslands and deserts. Lives in abandoned dens or hollow logs. Can live next to and under buildings.

Habits: Mostly active at night and early in the morning. Can dig out small rodents. Eats insects as well as small mammal and bird eggs. Does not hibernate.

Other Signs (trace fossils): Musky odor carried long distances and easy to identify. Remains of insects, a torn up nest, or punctured eggs. Up to 8" diameter conical holes left after digging for insects.