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SILVER-HAIRED BAT

(*Lasionycteris noctivagans*)

Silver-haired bats have been turning up in winter in Center City.

Figure 24.1 Female silver-haired bat hanging head down on trunk of Norway maple on Pine Street in Center City, December 27, 2012. Rain has turned the lichens green, revealing the bat. All bat photos in this chapter are of this individual.

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Around 1796, the French naturalist Baron Palisot de Beauvois identified one kind of bat as the most common in Philadelphia. He named it after the Latin word for brown, *fuscus,* which designates this species (*Eptesicus fuscus*). His description, published initially in French[1] and later in English,[2] was part of a catalog of Charles Willson Peale's museum in Philadelphia. It stands as the first systematic account of this species.[3]

Today Palisot de Beauvois' bat is known by several common names: big brown bat, barn bat, and house bat.[4] It flies into attics and chimneys.[5] In eighteenth-century Philadelphia, it must also have flown through open windows, which then were unscreened. With a wingspan of 32 centimeters (1 foot), it would have been hard to miss.

Collection of bats in nineteenth-century Philadelphia

Peale's museum housed a collection of bats. One of Peale's sons, Titian Ramsay Peale, described the journey of two red bats (currently named *Lasiurus borealis*) to the museum:

> In June 1823, the son of Mr Gillespie, keeper of the city square, caught a young red bat, (*Vespertilio noveboracensis L.*) which he took home with him. Three hours afterwards, in the evening, as he was conveying it to the Museum in his hand, while passing near the place where it was caught, the mother made her appearance, followed the boy for two squares, flying around him, and finally alighted on his breast, such was her anxiety to save her offspring. Both were brought to the Museum, the young one firmly adhering to its mother's teat. This faithful creature lived two days in the Museum, and then died of injuries received from her captor. The young one, being but half grown, was still too young to take care of itself, and died shortly after.[6]

Peale's museum occupied Independence Hall, known then as the State House, where the Declaration of Independence and the Constitution of the United States were debated and adopted. Despite the prestige attached to this building and the honor attached to describing new species, only three of Pennsylvania's eleven species of bats had been described by 1825 when the museum's curator, Richard Harlan, completed his treatise on North American mammals.[7] In Pennsylvania some of these eleven species remain poorly understood. An example is the silver-haired bat.

Silver-haired bat in Center City

On December 27, 2012, I found a silver-haired bat hanging head down on the trunk of a Norway maple a few doors up from our row house in Center City. The bat did not move for five days, despite freezing temperatures and snow. Passersby did not notice it, even though it was only a meter off the ground, facing the sidewalk. Concerned that a child might find it and suffer a bite, I captured it. It opened its wings and its mouth, baring its teeth, moments after I dislodged it safely into a secure plastic container. I transported it to the Schuylkill Wildlife Rehabilitation Clinic in Philadelphia.

Brenda Malinics, specialist in bat rehabilitation at the clinic, told me that people had brought in six silver-haired bats from Center City in the past month, including two

Figure 24.2 Silver-haired bat hanging by its hind claws.

the past week, one from Rittenhouse Square and another from the former Wannamaker's building, now Macy's. She reported that the bat was female, weighed 11 grams, readily ate mealworms and drank water, and appeared healthy.

Silver-haired bat in North America

The only published record of this bat in Philadelphia dates to before 1864.[8] First described in 1831,[9] it is widely distributed in North America from the Atlantic to the Pacific coast.[10] Unlike communal bats in caves, this bat is usually solitary and difficult to find, although it has been noted to form maternity colonies.[11] The bat is called a "tree bat" because it typically roosts in trees.[12] It breeds in Canada and southern Michigan and migrates south in the fall.[13] In the eastern United States, it overwinters from New York City to Georgia.[14] Whether it breeds in Pennsylvania is unknown.

Center City as thermal refuge

For a bat migrating south or hibernating, Center City's heat island offers a thermal refuge. On clear calm winter nights, Center City is commonly 5.6–11°C (10–20°F) warmer than nearby rural areas.[15] In New York City the bat has been reported hibernating in skyscrapers, churches, wharf houses, and the hulls of ships.[16] It occasionally overwinters in caves.[17] In a forest in Arkansas in winter, almost all silver-haired bats roosted in terrain facing south.[18] The bat I found was hanging on the south side of its tree trunk.

Regulation of body temperature

Despite Center City's heat island, this bat encountered subfreezing temperatures, snow, and no food for at least five days before I took it to the clinic. Bats cope with low temperatures and shortages of food by entering into a state of torpor, or inactivity. Their metabolic rates drop and their body temperatures fall to levels almost matching those of their surroundings. When body temperatures fall sufficiently low, however, metabolism increases and produces body heat, at a cost of energy stored as body fat.[19]

Caves buffer bats from freezing temperatures; roosts in trees offer no such protection. Robert M. R. Barclay at the University of Calgary in Alberta, Canada, and colleagues noted that silver-haired bats roosting in trees during the day in cold weather in Manitoba, Canada, felt cold to the touch and were sluggish and unable to fly. They used flat telethermometers attached to the bats' abdomens to measure their body surface temperatures. They found that body surface temperature matched environmental temperature within 1–2°C. The two measurements coincided over a broad range of environmental temperatures, from 4 to 20°C (39 to 68°F).[20]

Miranda B. Dunbar at the University of Regina in Saskatchewan demonstrated that metabolic rates of torpid silver-haired bats fell with decreasing temperatures in the environment until these temperatures reached 5°C, at which point further decreases in environmental temperature caused metabolic rates to rise. Dunbar concluded that, for the silver-haired bat, 5°C (41°F) is the energetically optimal environmental temperature for hibernation.[21] At this environmental temperature, the bat is drawing the least energy from its reserves of fat, which must last until it can once again draw energy from insect prey.

Comparison with birds

The strategy that the silver-haired bat uses to cope with falling temperatures in winter is opposite that of birds overwintering in our backyard. As winter approaches and outside temperatures begin to fall, the bat lowers its intake of calories, drops its metabolic rate, decreases its body temperature, and enters a state of inactivity, or torpor. In contrast, the white-throated sparrow (*Zonotrichia albicollis*), slate-colored junco (*Junco hyemalis*), and house sparrow (*Passer domesticus*) consume more calories, increase their metabolic rates, and forage for food.[22]

Figure 24.3 White-throated sparrows (*Zonotrichia albicollis*), house finches (*Haemorhous mexicanus*), and a northern cardinal (*Cardinalis cardinalis*) eating sunflower seeds in our backyard, January 26, 2013. Their metabolic approach to cold contrasts with that of the silver-haired bat.

Health of the bat found on the tree

The silver-haired bat I observed on the tree trunk was probably in a normal state of torpor. It was conserving energy in the absence of food. The arousal behavior that it exhibited when I captured it is typical of bats disturbed in hibernation,[23] which is an extended state of torpor. Torpor occurs in the course of both migration[24] and hibernation, but the timing and duration of torpor in this case suggest that the bat was hibernating.

Despite the apparently healthy state of this bat after capture, its choice of an exposed site for roosting raises the possibility that it was sick. Silver-haired bats roosting in trees in forests wedge themselves in narrow crevices, such as splits or forks,[25] or they enter cavities.[26] The scarcity of trees downtown may have prevented this bat from

finding a roosting site that was more secure. Acoustic artifacts produced by row houses on either side of the street may have disturbed the bat's echolocation and its search for a better site. Alternatively, an illness such as rabies could have impaired its judgment. An apparently healthy bat may actually be infected with the rabies virus.[27]

Figure 24.4 Snow piled on top of silver-haired bat on tree trunk.

Figure 24.5 Snow on back of silver-haired bat.

To what extent silver-haired bats ordinarily overwinter in Center City is unclear. The monitoring of populations of bats downtown is as primitive today as it was in 1823 when Mr. Gillespie's son brought his red bat to the Peale Museum. Silver-haired bats are well camouflaged against bark. In Center City, a large population of hibernating silver-haired bats could escape detection.

Figure 24.6 Silver-haired bat camouflaged after lichens have dried out and turned gray.

White-nose syndrome

In 2006, a novel disease began killing massive numbers of bats in caves. Called white-nose syndrome, the epidemic rapidly spread from a single cave in New York State to caves throughout much of the eastern United States and adjacent Canada. It has killed over 5 million bats belonging to at least six species, especially the little brown bat (*Myotis lucifugus*),[28] until recently the most common bat in Pennsylvania.[29] An analysis of the high mortality and low rates of reproduction of this bat led to a prediction that this bat would become extinct in the region by the year 2026.[30] The pathogen is a fungus (*Pseudogymnoascus [Geomyces] destructans*) introduced from Europe, where it infects bats but does not cause mass mortality.[31] The fungus grows on the muzzle, wings, and ears of bats hibernating in caves. It arouses bats from torpor and depletes their stores of energy in the form of fat.[32]

So far, silver-haired bats have escaped white-nose syndrome, probably because their usual hibernacula are in trees rather than caves, and they are mostly solitary. Physiological constraints of the fungus have confined white-nose syndrome to caves.[33]

Rabies

Concern that a child might disturb the bat and incur a bite prompted me to remove it. Rabies virus strains tied specifically to the silver-haired bat and one other species of bat (tricolored bat, *Perimyotis subflavus*) account for 70 percent of deaths due to rabies in this country.[34] Most people who die of rabies contracted in the United States have no history of a bite from a rabid animal.[35] Unrecognized exposure leaves victims of rabies clueless about the need to seek timely rabies vaccination and rabies immune globulin, which are lifesaving when administered soon after exposure.[36] High infectivity of rabies virus strains from these particular two species of bat probably contributes to "cryptic" cases of rabies, in which no evidence of exposure can be found.[37]

Despite the importance of the silver-haired bat in fatal human rabies, the risk of death from this bat is low. Only 6.9 percent of silver-haired bats submitted to health departments in the United States tested positive for rabies virus,[38] and only 1 percent of a random sample of silver-haired bats in the wild tested positive.[39] Among all identified species of bat submitted for testing and found to be positive for rabies virus in the United States, the silver-haired bat accounted for only 1 percent.[40] In Pennsylvania in 2011, seven times more raccoons tested positive than did bats, which tested positive less often than did cats, skunks and foxes.[41]

In the United States in the last half century, the incidence of bat rabies in humans was 3.9 cases per billion person-years,[42] about a thousand times less than the incidence of people killed or injured by lightning.[43] The incidence of bat rabies (i.e., rabies with a viral strain specific to bats) in the absence of a history of direct contact with a bat was 0.6 per billion person-years.[44] These figures are based on diagnosed rabies and underestimate the true incidence of rabies. Rabies masquerades as other conditions and can be difficult to diagnose.[45]

Relationship of white-nose syndrome to rabies

Were white-nose syndrome to extirpate populations of Pennsylvania's most common bat (the little brown bat), would Center City experience an increase in other bats, such as the silver-haired bat, increasing the risk of human rabies? Acoustical activity was used to track changes in populations of bats foraging at ponds and streams at Fort Drum in northern New York State before and after the discovery of white-nose syndrome, which first appeared in a cave near Albany. Acoustical activity decreased for little brown bats, but increased for silver-haired bats.[46]

Brenda Malinics told me that the six silver-haired bats that she received in 2012 was a record. A survey of all bat rehabilitation specialists in the state turned up no comparable reports of this bat.

The chance that white-nose syndrome could endanger public health due to a surge in cases of rabies from silver-haired bats is low. Neither Pennsylvania nor New York has ever had a case of diagnosed rabies due to viral strains associated with the silver-haired bat. These strains of rabies virus have caused only eight documented cases of human rabies nationwide, and no clusters of cases.[47] All but one occurred in states

that so far have not harbored white-nose syndrome.[48] White-nose syndrome does attack the tricolored bat,[49] the other species of bat that harbors a rabies virus strain linked to human rabies.[50]

Potential harms and benefits of overwintering in Center City

White-nose syndrome is only one of many environmental dangers facing bats.[51] Silver-haired bats migrate along the United States' eastern seaboard,[52] which offers promising sites for offshore energy development, particularly wind farms.[53] Wind turbines have killed large numbers of migrating bats, including silver-haired,[54] due to fatal collisions with rotors.[55] Many of the factors that will determine whether offshore wind farms along the East Coast threaten populations of silver-haired bats remain unknown.[56]

Center City's heat island poses a theoretical hazard to silver-haired bats. Thermoregulation of bats in this country is tuned to the latitude where they overwinter.[57] It controls utilization of energy (fat) stored in the summer and fall and consumed in the winter.[58] Silver-haired bats in Missouri occasionally interrupt hibernation and forage for insects during the winter.[59] The heat island that Center City presents to silver-haired bats could, in theory, desynchronize their thermoregulation from latitude and season.

Would silver-haired bats hibernating in Center City's heat island adjust their metabolic rates appropriately? Would they arouse from torpor and forage when insect prey is on the wing? Depending on the answers to these questions, Center City could serve as either thermal refuge or thermal trap.

I suspect silver-haired bats hibernating in Center City will adapt. During winter they occasionally inhabit other thermal refuges, such as caves and mines.[60]