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SILVER-HAIRED BATS (*LASIONYCTERIS NOCTIVAGANS*) FOUND ENSNARED ON BURDOCK (*ARCTIUM MINUS*)

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Key words: *Arctium*, Burdock, *Lasionycteris noctivagans*, Silver-haired Bat

Burdock (*Arctium* spp.) is an invasive species from Eurasia, first reported in New England in 1638. It was common in Ontario by 1860, and is now considered an agricultural pest throughout its North American range (Royer and Dickinson 1999). Burdock's wide range can be attributed, in part, to the distinctive morphology of its seed casing, which has adhesive spines that readily attach to skin, fur, and feathers, enabling animal-based dispersal (Royer and Dickinson 1999). Burdock can pose a threat for small, flying vertebrates if the seed casing becomes entangled with the flight membrane of bats or the primary or secondary feathers of birds (for example, Lyon 1925; McNicholl 1988; Hager and others 2009). There are a number of published accounts of mortality for small birds found ensnared on Burdock including Ruby-throated Hummingbird (*Archilochus colubris*; McNicholl 1988; Nealen and Nealen 2000; Hinam and others 2004); Least Flycatcher (*Empidonax minimus*; Underwood and Underwood 2001; Hager and others 2009); Common Yellowthroat (*Geothlypis trichas*; Brown 1970); Blue-gray Gnatcatcher (*Polioptila caerulea*; Brewer 1994; McNicholl 1994); Ruby-crowned Kinglet (*Regulus calendula*; Van Damme 2005); and Golden-crowned Kinglet (*Regulus satrapa*; Dawe 1974), among others (for example, Burton 1994; Dean 1994; McNicholl 1994; Underwood and Underwood 2001). These accounts suggest that mortality due to Burdock may be relatively common for small birds (3.5–15.2 g; Van Damme 2005), especially since many similar events likely go unreported. Although mortality caused by Burdock has been most widely reported for small birds, Burdock may pose a similar threat for small bats.

In 1892, approximately 12 bats, presumed to be Little Brown Bats (*Myotis lucifugus*) were found dead attached to Burdock in Illinois (Lyon 1925); Johnson (1933) reported a dead Eastern Red Bat (*Lasiurus borealis*) on Burdock in Virginia; Verts (1988) reported 2 dead Little Brown Bats attached to Burdock in Oregon; and Hendricks and others (2003) found 2 desiccated Western Long-eared Bats (*Myotis evotis*) on Burdock in Montana. In addition, unpublished observations of Silver-haired Bats (*Lasionycteris noctivagans*) ensnared on Burdock exist for Manitoba, Canada (SG Sealy and T Underwood, pers. comm.). Virtually all accounts were of dead animals except for a Big Brown Bat (*Eptesicus fuscus*) discovered alive in Illinois by Walley and others (1969); however, they did not report whether this bat survived or was released. Here we report the first published observations of Silver-haired Bats found attached to Burdock, and the first account of live bats found attached to Burdock that were successfully rehabilitated and released.

While radio-tracking Silver-haired Bats on the morning of 6 August 2009 in St. Leon, Manitoba, Canada (UTM: Zone14U, 529600E, 5467908N, NAD83), we found 2 juveniles without radio-transmitters tangled in the spines of seed heads approximately 1.5 m from the ground on 2 adjacent Burdock plants approximately 1.5 m apart. The bats were found in a small (0.02 km^2) woodlot which, based on our radio-telemetry observations, contains a number of Silver-haired Bat roost trees (KJO Norquay and CKR Willis, unpubl. data). Both bats were stuck to the seed heads by their wing and interfemoral membranes, one facing head up and one head down. Each bat had accumulated approximately 20 fecal pellets in their interfemoral membranes, suggesting they were ensnared some-time after foraging the night immediately previous to our discovery.

The bats were held in individual cloth bags and transported less than 0.5 km on foot to our field laboratory. Both bats were juvenile males, with masses of 8.9 and 10.6 g, repspectively. The dry, wrinkled condition of the wing membranes suggested that the bats were dehydrated (Lollar and Schmidt-French 2002). In addition, the spines had caused between 5 and 10 small but visible holes (about 1 mm dia) in each wing membrane. Bats were initially lethargic but readily accepted water from a pipette and were hand-fed Mealworms (*Tenebrio molitor*). They were banded using numbered, lipped aluminium forearm bands (Porzana Ltd. East Sussex, UK), and placed in individual steel mesh bat cages in a quiet, dimly lit room for the rest of the day. Water was provided *ad libitum*. At dusk, the bats were provided additional water from a pipette and Mealworms. Prior to release, a small patch of fur (<0.5 cm^2) was trimmed from the interscapular region of the larger bat, and a 0.53 g radio transmitter (LB-2NT, Holohil Systems Ltd., Carp, ON, Canada) was attached using a non-toxic, latex-based adhesive (Osto-bond, Montreal Ostomy, Vaudreuil, QC, Canada). Both bats were then hand-released at dusk within 20 m of the capture site, taking care to provide them a flight path which avoided the patch of Burdock.

We were able to confirm the survival and movement among roost trees of the radio-tagged individual for the next 4 d. We used a handheld telemetry receiver (R-1000, Communications Specialists Inc., Orange, CA, USA) and 5-element yagi antenna to track this individual each morning. The bat switched roost trees each night, using 3 roost trees before we could no longer detect a transmitter signal. All roost trees were located in the woodlot where we first found the bats. Given that the fall migration of Silver-haired Bats is likely underway in Southwestern Manitoba by early August (Barclay 1984), it is possible that the bat migrated when its signal disappeared.

It remains unclear how small bats and birds become caught in Burdock, but 2 hypotheses have been suggested. First, bats may be foraging for insects that live in or on Burdock or are caught on Burdock (Stager 1943). Bats might land on burrs while attempting to capture prey and become ensnared, or they become ensnared while pursuing insects flying near Burdock. To our knowledge, there are no published observations of Silver-haired Bats gleaning prey from vegetation, but foraging Silver-haired Bats are known to specialize on swarming insects (Barclay 1985) and may become tangled if insects are highly concentrated near the seed heads of Burdock plants. Second, bats may collide with Burdock accidentally during normal flight through cluttered environments. Due to its position on Burdock, Johnson (1933) speculated that the Eastern Red Bat he observed was banking during a right-hand turn and became trapped accidentally. Bats have also been found caught on barbed wire (Johnson 1933), which is unlikely to attract insects, suggesting that foraging behavior alone does not explain the entrapment, and that accidental collision may be a more likely explanation. Juvenile bats are less able to maneuver than adults (Buchler 1980), which may increase their likelihood of collision with objects such as Burdock or barbed wire. Based on radio-tracking observations of other Silver-haired Bats in this woodlot, a roost tree is located within 3 m of the Burdock patch where we found the ensnared bats. The 2 bats we found were facing the roost tree which, along with evidence of recent feeding such as the presence of many fecal pellets, suggests that they were inexperienced juveniles that may have swooped too low when returning to their roost tree and thus became ensnared. The radio-tracked bat returned to that particular roost tree on the 2nd and 4th night following release.

The close proximity of the 2 bats we observed, caught in adjacent plants at approximately the same time, suggests that the 2 capture events might have been related. The calls of bats caught in Burdock may be attractive to conspecifics (Verts 1988), and it is possible that some bats are caught while investigating the vocalizations of other individuals which have already been ensnared. Recorded distress calls of bats are known to be attractive to conspecifics (Fenton and others 1976), and even other bat species (Russ and others 2004). In the case of our observations, once the 1st bat was caught, the 2nd bat may have investigated and been subsequently ensnared.

Mortality of bats due to collision or impalement with common objects in the environment is not only limited to Burdock. Manville (1963) summarized reports of this kind of mortality in bats including impalement on fishhooks, barbed-wire fences, night-blooming Saguaro Cactus spines (*Carnegiea gigantean*), and rosebush thorns, and entrapment of bats by other plants such as Spanish Moss (*Tillandsia usneoides*) and rosebushes. To our knowledge, however, perhaps with the exception of barbed-wire fences (DeBlase and Cope 1967, Iwen 1958, Long 1964), most of these examples represent highly isolated, rare occurrences. The wide-spread range of Burdock and the multiple reports in the literature of bat mortality for as many as 5 species suggest Burdock is a potentially serious, underestimated hazard for small flying vertebrates, including bats. We recommend that the objectives of future studies be to quantify the occurrence of bat and bird entrapment and mortality in areas heavily infested with Burdock, and to determine how and why birds and bats become ensnared. Most accounts of this phenomenon report that the animals failed to survive, so we were encouraged at our success in rehabilitating and releasing these individuals.

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DIEL BEHAVIOR OF REARING FALL CHINOOK SALMON

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Key words: behavior, Columbia River, daytime, fall Chinook Salmon, Hanford Reach, nighttime, *Oncorhynchus tshawytscha*, rearing, stranding, underwater video

In fisheries science, habitat use is often inferred when fish are sampled or observed in a particular location. Physical habitat is typically measured where fish are found, and thus deemed important to habitat use. Although less common, a more informative approach is to measure or observe fish behavior within given habitats to more thoroughly assess their use of those locations. While this approach better reflects how fish use habitat, fish behavior can be difficult to quantify, particularly at night. For example, Tiffan and others (2002, 2006) were able to quantify habitat availability and characteristics that were important for rearing juvenile fall Chinook Salmon (*Oncorhynchus tshawytscha*) in the Hanford Reach of the Columbia River. The authors, however, could only speculate as to how juvenile salmon use habitat and respond to changes in water level fluctuations. Conversely, in this study we provide data on the diel activities of rearing juvenile wild fall Chinook Salmon which provides a better understanding of how fish "use" these rearing habitats. Diel behavior patterns are important because fish in the Hanford Reach are often stranded on shorelines when the water level rapidly recedes because of hydroelectric power generation at upriver dams (Nugent and others 2002; Anglin and others 2006). We hypothesize that juvenile salmon are at greater risk of stranding at night because they are less active and occupy habitat differently than during the day. We used underwater videography to collect behavioral information during the day and night to determine if juvenile fall Chinook Salmon are more susceptible to stranding when water level fluctuations occur at night.

We observed juvenile fall Chinook Salmon near the 100-F island complex (UTM Zone 11N, 314832E, 5169221N, NAD83) of the Hanford Reach from 25 April to 10 May 2003. Our underwater video system consisted of 4 black and white underwater cameras (SeaView Video Technology, St. Petersburg, FL) that were deployed at 9 locations in known fall Chinook Salmon rearing areas. Each camera had a reported resolution of 380 lines and a 95° field-of-view. We deployed the cameras near shore and in pairs to observe 2 adjacent 1-m areas that extended out from shore in a line that was oriented perpendicular to river flow. Cameras in each pair were oriented toward each other and separated by about 1 m. The 1st