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A pressure-operated drop net for capturing Greater Sage-Grouse

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ABSTRACT. A pressure-operated drop net was developed to capture endangered Greater Sage-Grouse (*Centrocercus urophasianus*) in Alberta, Canada. A drop net was developed because other capture methods, such as night lighting and walk-in traps, have largely been unsuccessful in Alberta, and rocket netting was too dangerous to be used with an endangered population. Nets (one black and one gray) were used to capture 13 birds (12 males and 1 female) in six attempts. Nets dropped quickly (about 1 s) and quietly and captured all birds under the net. More birds ($N = 12$) were captured using a gray net than a black net, probably because it was less conspicuous. The presence of a drop net on the lek did not alter the behavior of the birds at the lek or influence lek attendance. The cost of a net, including all supplies, tools, and equipment needed, was $790 US ($900 CAN). This pressure-operated drop net system should prove effective for capturing other lekking species and other ground-dwelling birds that will respond to baiting.

SINOPSIS. **Una red que cae a presión para capturar *Centrocercus urophasianus***

Una red que cae a presión fue desarrollada para capturar la especie *Centrocercus urophasianus*, cual se encuentra en peligro de extinción, en Alberta, Canadá. Una red que cae fue desarrollada porque otros métodos de captura como alumbrando de noche o trampas jaula han sido poco éxitosos en Alberta. El uso de trampas con cohetes fue demasiado riesgoso para utilizar con una población en peligro de extinción. Redes (una negra y otra gris) fueron utilizados para capturar 13 individuos (12 machos y una hembra) en seis intentos. Las redes cayeron rápidamente (en aproximadamente un segundo) y silenciosamente y capturaron todos los individuos debajo de la red. Mas individuos ($N = 12$) fueron capturados utilizando una red gris que una red negra, probablemente porque fue menos conspicua. La presencia de una red en el lek no afecto el comportamiento de las aves en el lek, ni influenció el número de individuos visitando el lek. El costo de una red, incluyendo todos los materiales, herramientas y equipamiento necesario fue de $790 ($900 Canadiense). Este sistema de red que cae a presión podría ser efectivo para capturar otras especies que utilizan leks, así como para especies que viven sobre el suelo y cuales son atraídas por el cebo.

Key words: capture, drop net, greater Sage-Grouse, pressure operated, Sage-Grouse

Greater Sage-Grouse (*Centrocercus urophasianus*), hereafter Sage-Grouse, are endangered in Canada and the current Canadian population is estimated at about 400 birds, with about 250 in Alberta. The lek breeding system of Sage-Grouse provides a unique capture opportunity because birds are concentrated at a few locations. Adult Sage-Grouse in Alberta have been captured using walk-in funnel traps (Schroeder and Braun 1991) and by night lighting (Wakkinen et al. 1992). However, night lighting can only be done on foot in Alberta because of landowner vehicle restrictions and the absence of birds near roads or trails. Walk-in traps can be set up by one person and are inexpensive, but capture primarily females, are time-consuming to set up, and are made of chicken wire that can injure birds. Although rocket or cannon nets have been used to capture grouse in areas of high density (Walker et al. 2004, Naugle et al. 2005, Moynahan et al. 2006), governmental and private landowner restrictions precluded the use of this method in Alberta because of the associated fire hazard and risk of injury or death to the birds (Silvy et al. 1990).

Drop nets have been used to capture Sage-Grouse with mixed success (Giesen et al. 1982, Leonard et al. 2000). Previous trigger-release drop-net designs relied on pulleys (Conner et al. 1987, Aruch et al. 2003, Jedrzejewski and Kamler 2004), pull-pins (Jacobs 1958, Ellis 1961, Lopez et al. 1998), pull-pin pulleys (Glazener et al. 1964), remote-controlled trigger releases (Kock et al. 1987), and explosive releases (Ramsey 1967). Pull-pins and pulleys often stick (Jacobs 1958, Ellis 1961) and systems

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involving explosives and multiple mechanisms can be expensive and difficult to set (Glazener et al. 1964, Ramsey 1967). However, a pressure-operated system includes no integral parts that can seize in cold weather or malfunction like trigger-release models. Using the system used by Silvy et al. (1990) to capture Attwater Prairie Chickens (*Tympanuchus cupido attwateri*) and King Rails (*Rallus elegans*) as a starting point, my objective was to design a pressure-operated drop net to capture male and female Sage-Grouse on leks.

METHODS

I used drop nets to capture Sage-Grouse on five leks with 7–25 males per lek (J. Nicholson, pers. comm.) in southeastern Alberta, Canada, in April 2006. The area is primarily a silver sagebrush (*Artemisia cana*) grassland community, and leks were generally on mud flats with short vegetation.

Net design. My drop net was altered from the design of Silvy et al. (1990). Because most products are sold using imperial measurements, I provide both metric and imperial measurements to facilitate locating the products listed below. Drop nets were 15.2 m (50 ft) × 15.2 m (50 ft), black, 5.08-cm (2-in) plastic knotted netting mesh (BF Products Inc., Harrisburg, PA). Plastic-knotted netting is lighter, more durable, and tangles less easily than knitted netting. Black 0.95-cm (3/8-in) diameter polypropylene rope was woven around the periphery of the net through every link and fastened in place using 1.3-cm (0.5-in) hog rings about every 2.5 cm (1 in). This prevented the rope from slipping, kept the net straight and taut, and added weight so the net dropped quickly and evenly. Across the back of the net, 15.24-cm (6-in) rope loops with 1.9-cm (0.75-in) bolt snap/swivel hooks were created every 3.05 m (10 ft) as the rope was woven through the net and secured using 0.48-cm (3/16-in) wire rope clips and hog rings (Fig. 1A). Each swivel hook was hooked onto a 3.8-cm (1.5-in) metal harness ring that slipped over the back poles (Fig. 1A). Across the front of the net, 30.5 cm (12 in) rope loops were made every 3.05 m with the woven rope and secured using wire rope clips and hog rings (Fig. 1B). The ends of the rope were fastened using two wire rope clips along the side of the net to minimize pressure on the joint. One strand of green, 0.64-cm (1/4-in) diameter rope was run horizontally at 7.6 m (25 ft) and secured with wire rope clips at both the left and right sides and was hog-ringed the entire length (Fig. 1). Four strands of green rope were run vertically every 3.05 m from the front loop to the back loop to support the net and aid in squaring off the net for hole drilling in the field. Each strand was attached using a wire rope clip at each end and was hog-ringed the entire length of the rope.

The lead rope was made of black polypropylene. Six short leads (two outside = 10.15 m [33.3 ft], two middle = 8.3 m [27.2 ft], and two center = 7.6 m [24.8 ft]) were created so that one end contained a swivel hook attached via a small loop in the rope secured with a wire rope clip and the other end was attached to a 5.1-cm (2-in) metal harness ring using a small loop in the rope secured with a wire rope clip. The swivel hook ends attach the 30.5-cm (12-in) rope loops at the front of the net (Fig. 1B). Numbering the loops across the front as 1–6 from left to right, the two longest ropes were attached to loops 1 and 6, the two mid-range ropes to loops 2 and 5, and the two shortest ropes to loops 3 and 4 (Fig. 1). The main lead rope was 31 m (51 ft) long with swivel hooks secured with wire rope clips at both ends. One swivel hook attached to the metal harness ring and one attached to the web puller set up.

The web puller set up consisted of a 2-ton web hand puller (Power First®, Sydney, Australia) with a swivel hook at the back and a 2.7-cm (1.06-in) wide and 3.7-m (12-ft) long polyester web strap with a swivel hook at the front. The swivel hook at the back was attached to a rope loop wrapped around a 0.9-m (3-ft) galvanized metal pole (2.5 cm [1 in] diameter) driven at least 0.6 m (2 ft) into the ground at an angle facing away from the net (Fig. 1C). The swivel hook on the web strap at the front was attached to a 15.2-cm (6-in) rope loop that also attached to the swivel hook of the main lead rope (Fig. 1C). The rope loop was created using a wire rope clip. This rope loop was a vital part of the net set up because cutting the loop released the pressure and allowed the net to drop.

Three types of poles were used for the drop net. The six back poles were 1.5-m (5 -ft) electrical conduit (2.5 cm [1 in] diameter) with 2-mm deep grooves around the top, 2.5 cm from the edge. The grooves held the harness rings in place while pressure was exerted on the net. The six

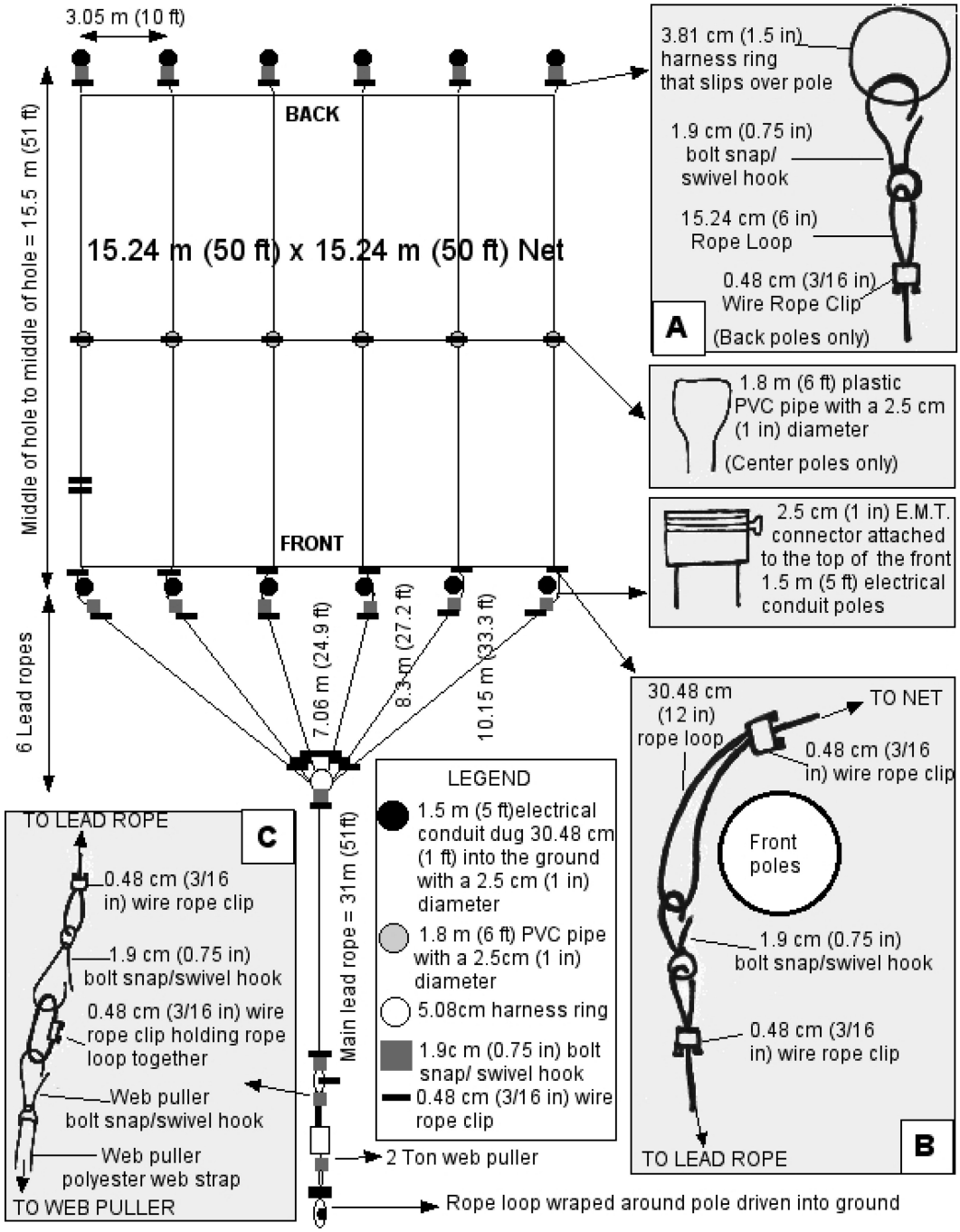

Fig. 1. Diagram of the pressure-operated drop-net system with locations for all of the poles, harness rings, bolt snaps/swivel hooks, wire rope clips, and the 2-ton web puller. Insets include a close up of (A) back pole-ring set up, (B) front pole-rope set up, and (C) lead rope—cut loop—web puller set up.

middle poles were 1.8-m (6-ft) plastic, polyvinyl chloride (PVC) pipe (2.5 cm diameter) with a bulbous head (Fig. 1). The front six poles were 1.5-m (5-ft) electrical conduit poles (2.5-cm diameter) with 2.5-cm electrical metal tubing (EMT) connectors attached to the top of the pole (Fig. 1). These connectors were fastened to the pole with a single screw to hold the 30.5-cm rope loops and prevent them from slipping down the pole.

Two drop net set ups were constructed, one with a black net and the other with a net painted silver sagebrush gray (to match a vegetation sample collected from a local lek) to make it less conspicuous. An entire net, including all supplies, power tools, and equipment needed to make and set up one net, cost about $900 Canadian ($790 U.S.; January/February 2006 prices).

Field preparation and set-up. Based on the size, shape, and location of the center of a lek, a 15.2-m (50-ft) × 15.5-m (51-ft) area was delineated and holes drilled at 3.05 m intervals across the front and back. Poles were drilled into the ground using a 3.8-cm (1.5-in) diameter × 45.7 cm (18 in) long auger drill bit (DeWalt, Lancaster, PA) attached to a 19.2V cordless drill. Smart pole sockets 30.5 cm (12 in; BF Products Inc., Harrisburg, PA) were then driven into the holes with rubber mallets and poles were slid into the sockets. The six front pole holes were perpendicular to the ground and the back six holes were drilled at an 80° angle outward to provide extra pressure and ensure that the net dropped rapidly once pressure was released. Once the 12 front and back poles were in place, harness rings were slipped over the back poles, fit into the grooves in the poles, and held in place with C-clamps until the net was lifted and pressure was sufficient to hold the net up. The six ropes of the lead rope set up were attached to the rope loops at the front of the net and the rope loops were hooked over the screws (facing left on three front left poles and right on the three front right poles) until pressure was applied to the net. The lead rope lines were pulled by 1–4 people to mark how far back the main lead rope reached with pressure exerted. This point was marked and allowed for the web hand puller set up to be laid out and the back pole driven into the ground. The lead rope lines were pulled once again and the main lead rope was hooked to the rope loop that was also attached to the web puller. At this point, minimum pressure was being applied to the net. The web puller was tightened until all lead ropes were taut and the six 30.5-cm (12-in) rope loops at the front of the net were almost completely pulled past the front poles (the net was almost at the front poles). Once the desired pressure was obtained, the six middle PVC poles were placed under the net every 3.05 m down the middle rope line at about a 70° angle to the ground facing backwards. The PVC poles (605 g) hold the middle of the net up until pressure is released, then fall to the ground. Once all the poles are up, the C-clamps are taken off of the back poles so that the net can drop once released.

The final step was setting the 1.2 m (4 ft) × 1.2 m (4 ft) × 1.2 m (4 ft) wooden blind on top of the web puller system so the rope was cut from inside the blind at the front. When both nets were set up, one blind was set up for each net, but when only one net was set up, one blind was on the web puller system and the second blind was placed adjacent to the first blind to ensure that four people (two per blind) were present when the net was dropped.

Manpower required. The net could be set up with two people, but was easiest with 3–5 because of the amount of force required to hook the lead rope to the web puller. Time to set up the net was about 60 min, including transporting materials from trucks to the leks (distance of 300 m–1 km). Bird processing could be accomplished with two trained individuals, but 4–5 people were on site for all capture attempts for increased bird safety and to expedite bird processing.

Baiting. Two mounted female Sage-Grouse and five life-sized female silhouettes (cutouts of life-sized pictures) were used in an attempt to lure males under the net, and tomato wedges were used to lure both sexes under the nets.

Net dropping procedure. The gray net was set up at small leks, and both nets were set up at the two largest leks (25 and 18 males, respectively). Nets were set up in the afternoon and a first drop net attempt was made the next morning. Every morning the net was set up, four observers entered blinds prior to first light and a video camera was set up to record each attempt and the birds' response to the net. After the net was dropped, observers left the blinds and held down captured birds while someone else unhooked the net from the harness rings at the back and folded the net toward the birds

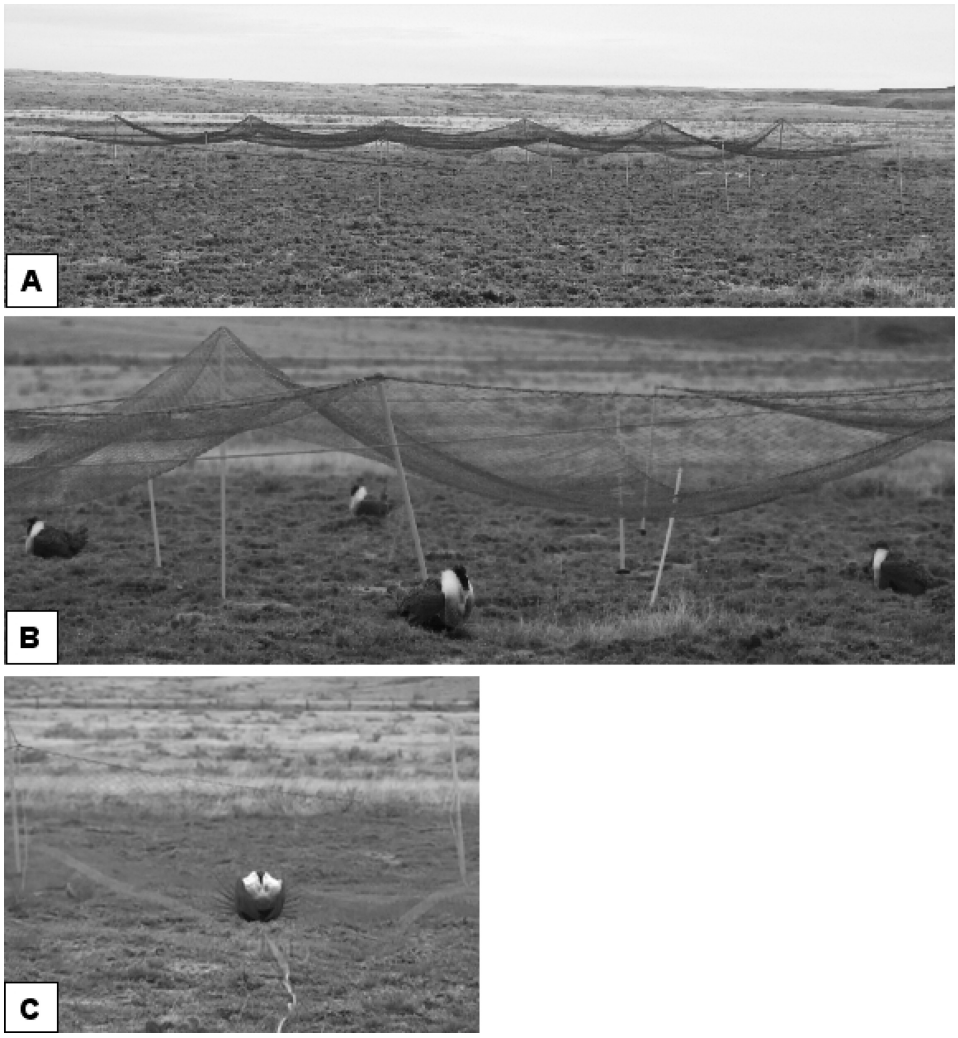

Fig. 2. Photographs of (A) the black drop net set up, (B) two Sage-Grouse males under the gray drop net and males in front of and behind the net, and (C) the drop net falling on a male Sage-Grouse.

to gain access. Birds were placed in bags and then weighed, measured, and sampled. After processing, birds were released. Video footage was used to determine (1) the location of territories relative to nets, (2) bird behavior around the net, (3) the effectiveness of baiting, and (4) whether the number of males on a lek changed when a drop net was set up for more than a day.

RESULTS

Of 14 attempts to drop net leks, six were successful and 13 grouse (0.93 birds per morning; 12 males and one female) were captured (Fig. 1). Using the gray net, 12 birds (11 males and 1 female) were captured. One male was captured with the black net. No birds were injured.

Two grouse went under the black net during two of nine capture attempts (22.2%), whereas grouse went under the gray net during nine of 11 capture attempts (81.8%; Fig. 2B). If not for human error during two attempts and unusual events (only banded males under the net and a juvenile male landing on the net and scaring a male from under the net), more

Table 1. Success of pressure operated drop nets at capturing Greater Sage-Grouse on leks in Alberta, Canada, March and April 2006.

Date	Number (and sex) of birds under nets	Nets used	Successful net color	Baiting method	Number of birds captured
31 March	1 (1M)	Black	Black	None	0
1 April	0	Black	-	None	0
2 April	0	Black	- -	Tomatoes & female mounts	0
15 April	0	Grey	-	Tomatoes, female mounts, & life size cutouts	0
17 April	4 (3M, 1F)	Both	Grey	Tomatoes	4
18 April	4 (3M, 1F)	Both	Grey	Tomatoes	0
19 April	2 (2M)	Both	Grey	Tomatoes	2
20 April	1 (1M)	Both	Black	Tomatoes	1
21 April	3 (3M)	Grey	Grey	None	3
26 April	2 (2M)	Grey	Grey	None	0
27 April	1 (1M)	Grey	Grey	None	0
28 April	1 (1M)	Grey	Grey	None	1
29 April	2 (2M)	Grey	Grey	None	2
30 April	2 (1M, 1F)	Grey	Grey	None	0

grouse would have been captured with the gray net.

Between one to three males had territories and displayed under the gray net on eight mornings. Males displayed between 0.5 and 10 m from the edge of the net on 12 of 14 mornings. Males closest to the net usually had territories next to a pole and would move under the net within 1 m of the edge (too close to the edge to drop the net and ensure capture).

Males and females ignored the presence of both nets. However, males and females appeared to avoid nets when female mounts or life-size cutouts were placed under the net, with territories located 10–30 m away from the edge of the nets. Males displayed regardless of their proximity to the net and females, when present, visited male territories. No bird flushed from the lek even when the winds were greater than 50 km per h, causing the net and poles to move. Nets dropped quickly (1 ± 0.1 s [SE]) and quietly and grouse outside the net did not flush until researchers left the blinds and ran toward the lek.

Attempts to lure grouse under the drop net with tomatoes was successful once when a female walked toward a pile of tomato wedges and pecked at them with three males in pursuit. Two other grouse (one female and one nonterritorial male) were observed eating tomatoes the day after the net was removed. On days when tomatoes were present, seven birds were captured (six males and one female; Table 1). Tomatoes were chosen because every species of captive galliform I tested ($N = 27$ species) preferentially selected red fruit when given a choice, and red berries have been used to successfully bait Sharp-tailed Grouse (*Tympanuchus phasianellus*; M. R. Matchett, pers. comm.).

DISCUSSION

The success rate of the drop net in my study (0.93 birds per morning) was higher than the 1998–2006 Alberta averages for trapping females with walk-in traps (0.45 ± 0.48 [SE]) or night lighting on leks (0.46 ± 0.26 [SE]). In addition, handling time was minimized because the processing station was set up near nets, and erecting and dropping the net did not disrupt the function or behavior of birds at the lek.

More males than females were captured because the nets were only used prior to and following the 2-week peak in female attendance. If the net had been set up during peak female

attendance, more birds (both females and males) would probably have been captured.

Baiting was more effective at luring females because two of three birds observed either investigating or eating tomatoes were females. Territorial males appeared to ignore the tomatoes. One nonterritorial adult male was observed eating the tomatoes. However, six of 12 males were captured when the net was baited, suggesting some form of attraction. Mounts and life-sized cutouts did not attract birds under the net.

In conclusion, pressure operated drop nets proved to be a safe and efficient method for capturing Sage-Grouse in Alberta. Drop nets may be even more effective on larger leks because male territories are less spread out than on small leks. This type of drop net should also work for other species where birds concentrate at sites where ground vegetation would not prevent the periphery of the net from reaching the ground and for species that can be baited in large concentrations (e.g., waterfowl, turkeys, and pheasants).

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