USE OF TIME-LAPSE PHOTOGRAPHY TO DETERMINE CARCASS DISPOSITION

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ABSTRACT: A portable time lapse aerial photographic camera system was adapted to record carcass removal by scavengers. The system, which will take photographs at adjustable, pre-determined intervals during daylight and darkness regardless of temperature, is described and plans for its assembly are given. Results of scavenging on 4 carcasses are described including species scavenging and average daily removal rate.

ALCES VOL. 25 (1989) pp. 112-117

It is difficult and time consuming to establish which species and numbers of individuals are scavenging carcasses under natural conditions. Observing from blinds is limited to daylight hours, while visiting the carcass at frequent intervals may leave human scent and discourage normal scavenging activities. Time-lapse photography however, accurately records presence of scavengers over extended periods.

Time lapse photography has been utilized to record wildlife activity since at least 1971 (Temple, 1972), but could not guarantee cold weather operation or the use of flash during the dark hours. I wished to study scavenging during all seasons and be able to record activities of nocturnal as well as diurnal species.

DESIGN OF CAMERA DEVICE

The device consists of five components: the camera, a flash attachment with voltage transformer, a timing-triggering device (intervalometer), a weather proof box in which to mount the camera, and an external power source.

The camera used was a Pentax MX 35 mm with a 50 mm lens, equipped with bulk back and motor drive. Bulk back allows for the use of sufficient bulk film to obtain up to 250 exposures with a single loading; while motor drive allows electronic triggering and remote film advance. With this camera, which is equipped with a hot or live accessory shoe, synchrony between flash and shutter is obtained at shutter speeds of 1/60 s and slower.

The flash attachment used was a Vivitar 283 electronic flash equipped with auto thyristor - a sensor which allows for different pre-set flash intensity depending upon film speed, distance to subject and F stop setting. A voltage transformer (Syscomp Electronic Design Ltd.) was used to reduce electric current to the flash attachment from the external power source from 12 V to 6 V.

The timing-triggering device (intervalometer) (Syscomp Electronic Design Ltd.) was originally manufactured for use in aerial photography but in this case had additional circuitry built in which extended the maximum interval to 10000 s (2.78 h). The intervalometer also converts 12 V input current to 6 V output current.

The weather-proof box in which the camera was mounted included two plate glass windows in the front separated by a partition which extended beyond the glass and prevented light from the flash from reflecting into the camera. A single removable plate glasswindow at the rear of the box allowed access to the box for mounting and sighting the camera. Holes drilled near the top of the box coupled with an open bottom allowed free air circulation to minimize condensation during weather changes.

The power source used was a 12 V wet cell rechargeable automotive battery. To ensure continuous operation two batteries were necessary; one to operate the system, and one to replace it during recharging. A good quality battery charger which charged at a limited current of 5A maximum to 14.4 V D.C. ensured maximum battery life.

Cables from the power source to the intervalometer and electronic flash, as well as from the intervalometer to the camera were all 8 m in length to facilitate remote power and triggering.

ASSEMBLY OF CAMERA DEVICE

A schematic diagram (Fig. 1) illustrates the electrical relationship between the various components of the system.

To obtain a downward angle from the camera to the carcass for best photographic coverage, the camera and flash were always mounted in the weatherproof box and attached 3 m above the ground to a vertical pole or tree trunk (Fig. 2). This arrangement also isolated the camera from inquisitive or destructive animals.

During the spring, summer and fall the battery and intervalometer were buried beneath the ground in a wooden box and covered by rocks large enough to discourage a black bear (*Ursus americanus*) from disturbing it. The remote electrical cables connecting the battery and intervalometer to the camera were fed through a length of protective galvanized pipe which was fastened to the pole or tree trunk. In addition, nails were hammered through thin pieces of lumber which were then wired to the pole or tree trunk, nail side out, to discourage animals from climbing to the camera.

During the winter the battery and intervalometer were buried beneath the snow in a styrofoam cooler. The insulation provided by the snow and styrofoam maintained battery life by providing protection from extreme cold temperatures. Neither the galvanized pipe nor the lumber with nails were felt to be necessary during the bear denning period.

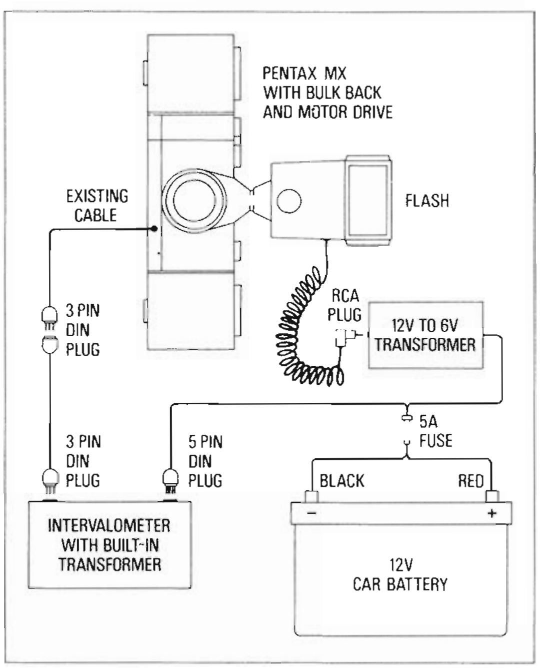

Fig. 1. Schematic electrical diagram.

Fig. 2. Camera device in place to photograph scavenging activities.

RESULTS

I obtained good colour photographic results using Kodak Ektachrome Colour Slide Film with an ASA number of 200 at 1/60s with an F stop setting of 4.0 during the snow free period and 4.5 during the snow period; and good black and white results using Kodak Plus X Pan film with an ASA number of 125 at 1/60 s with an F stop setting of 4.0 in all seasons. To obtain good nighttime pictures it was necessary to set the flash at the full power (manual) setting. I found that regardless of season a maximum of 85 - 100 photos could be expected per battery charging. There was no indication of system failure to temperatures of -40°C, although changing weather conditions occasionally caused condensation on the box windows, blurring pictures. Best consistent results were obtained when the camera was set up with the sun arcing to the rear with the carcass, in a shaded location to prevent "washout" on bright days.

Results of scavenging on one white-tailed deer (*Odocoileus virginianus*) and three moose (*Alces alces*) carcasses are summarized in Table 1. Weights were obtained for road killed animals utilizing a block and tackle coupled to a hanging scale, prior to placement of the carcass for photographic recording. Percent utilization refers to the approximate percentage of organs and muscle tissue removed from the carcass, and is subjective. Examples of photographic results and quality are illustrated in Figs. 3 and 4.

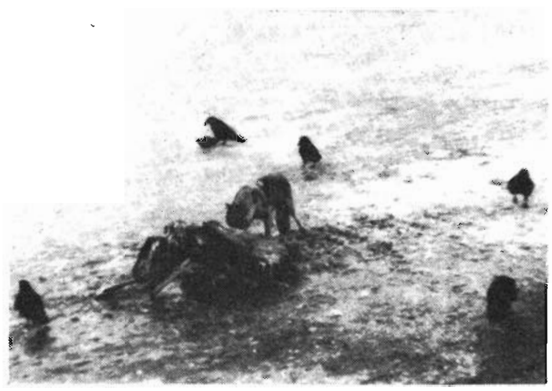

Fig. 3. Algonquin wolf and ravens share a carcass.

Table 1. Summary of carcasses photographed at regular intervals utilizing time-lapse photography, showing occurrence of individual scavengers numerically and as a percentage of the total.

Spp.	Approx. Weight (kg.)	Total Frames	Approx. % Utilized	Raven (*Corvus corax*)		Fox (*Vulpus fulva*)		Black Bear (*Ursus americanus*)		Turkey Vulture (*Cathartes aura*)		wolf (*Canis lupus*)		Otter (*Lutra canadensis*)		Unknown		Zero (No.)	Removal Rate (kg/day)
				#	%	#	%	#	%	#	%	#	%	#	%	#	%		
White-tailed Deer[1]	113	115	100	12	66.7					3	16.7	3	16.7					99	22.6
Moose[2]	210	541	50	61	66.3	29	31.5							1	1.1	1	1.1	489	1.2
Moose[3]	480	181	100	11	28.9			27	71.1									149	30.0
Moose[4]	190	86	75					3	100.0									83	17.8
Total				84	55.6	29	19.2	30	19.9	3	2.0	3	2.0	1	0.7	1	0.7		7.4

[1]05/06/87 to 10/06/87; interval 3600s
[2]30/01/88 to 25/04/88; interval 9000s
[3]30/05/88 to 16/06/88; interval 7000s
[4]19/06/88 to 28/06/88; interval 10000s

Costs of assembling such a time lapse camera system may be prohibitive unless access to aerial photographic equipment is available; in which case conversion costs may be more acceptable. The weatherproof wooden box to house the camera may be made from scrap lumber and good quality plate glass and should not cost more than $10. Following are material lists including approximate costs for initial purchase of all components and for conversion from aerial to time-lapse.

MATERIAL COSTS

COMPONENT	INITIAL	CONVERSION
Pentax Mx (Used)	200	-
Bulk Back and motor drive	1000	-
Vivitar 283 Flash	-	150
Voltage transformer	-	100
Intervalometer	600	-
Additional circuitry (Intervalometer)	-	350
Weatherproof camera box	-	-
Additional cables	-	100
Power Source	-	100
	(Aircraft 12V)	(Automotive battery x2)
Total	**1800**	**800**

DISCUSSION

Distance from camera to carcass with this system should not exceed 8 m, since there is not reflective background and light from the flash dissipates very rapidly. For the same reason it was necessary to set the flash at maximum output which created the maximum drain on power supply. Use of a heavier duty battery such as a 12 V marine battery could double the number of pictures per charging but would also double initial battery costs. The Pentax MX does not have automatic F stop adjustment, so the best setting to obtain acceptable quality daytime and nighttime photos must be established for various film types through experimentation. I found that a broader range of F stop settings gave acceptable results with black and white film than with colour; but colour is advantageous for differentiation of species with similar appearance such as raven (*Corvus corax*) and turkey vulture (*Cathartes aura*). The purchase and developing of bulk film in 30.5 m rolls is considerably less expensive per frame than standard film; black and white is considerably less expensive than colour.

To adequately monitor scavenging it is necessary to record activities in all types of weather under all light conditions. The system described yields an accurate photographic record of scavenger visitation at carcasses, but may yield greater or less accuracy as to total scavenging activity depending upon the time interval between pictures. Total activity might be possible through continuous visual recording, but this would require continuous light during the dark hours and could change scavenger activity patterns. I was unable to establish whether or not time intervals used in this study affected scavenger activity patterns.

Considerable effort has been expended to document carcass removal by scavengers. Many workers have recorded scavenging activities either as incidental observations (Bowen 1980, Kolenosky 1972, Ballard *et al.* 1981, Smith 1980), or as methodical documentation (Magoun 1976, Eide and Ballard 1982, Andriashek et al. 1984, Houston 1978). All these observations were made in daylight, however, and have not accounted for scavenging activities during hours of darkness.

Some workers have estimated consumption rate of carcasses without apparent consideration for coincidental and subsequent removal of flesh by scavengers (Peterson et al. 1984, Peterson 1977, Jolicoeur pers. comm.). Through the assembling of this camera system which potentially records scavenging activities at all times I have attempted to point up the important influence that scavengers may have on the removal rate of carcasses (Table 1). Also, by recording

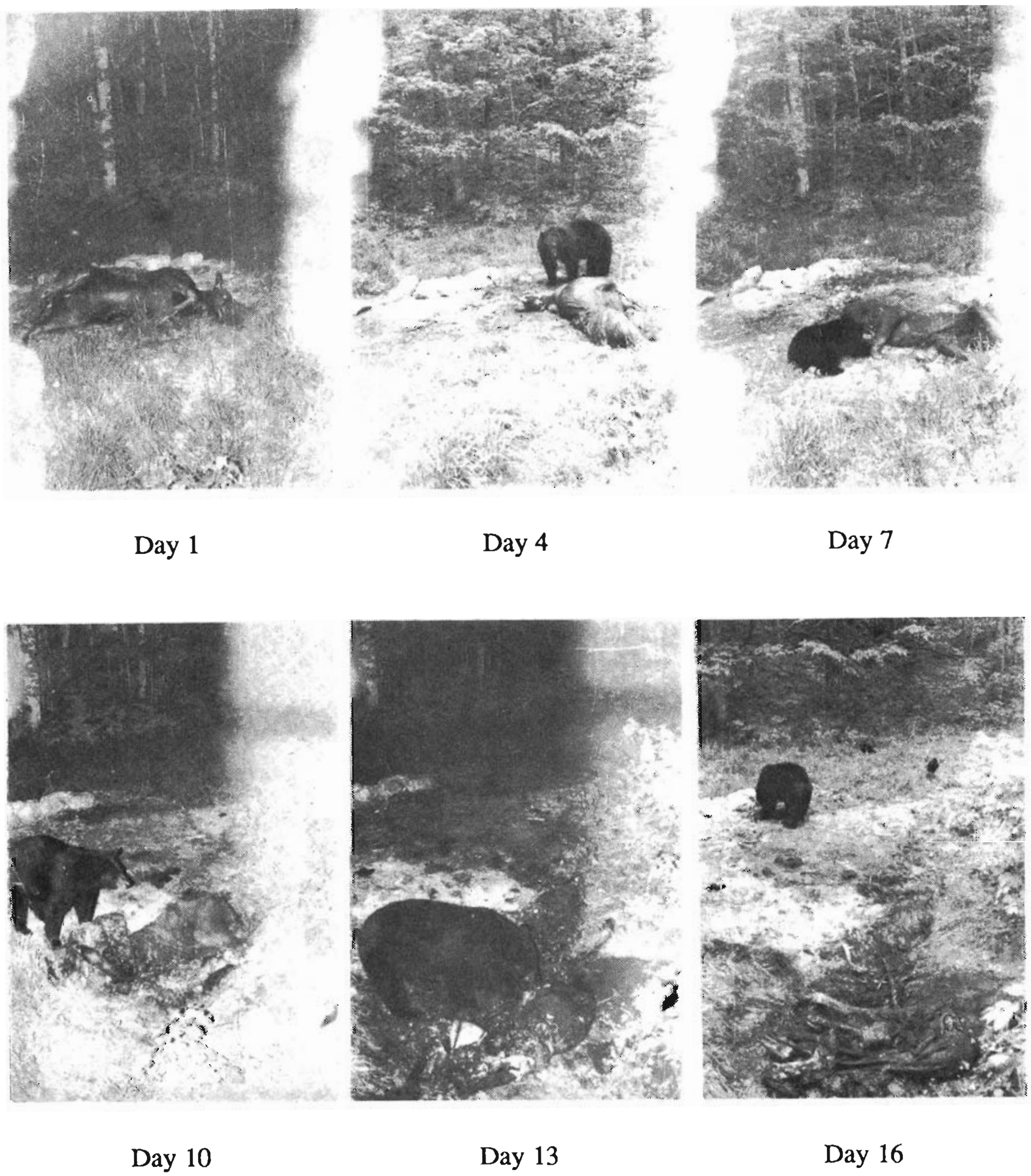

Fig. 4. Bull moose carcass scavenged in 16 days by black bear and ravens.

scavenging activities of such predators as wolves and black bear (Figs. 3 and 4), we may infer that predation rate may be influenced by scavenging; either decreased because of scavenging by predators, or, increased because of competition for, or displacement of predator from, carcasses by scavengers (Cole 1972, Ballard 1982).

ACKNOWLEDGEMENTS

Sincerest thanks are extended to the many District staff members of the Ontario Ministry of Natural Resources who provided knowledge of wolf kills and road kills; but particularly to W.M. Lintack and J.E. Inglis of Huronia District and Algonquin Park District respectively for the provision of carcasses. Sincere thanks also to P.D. Hiscocks and B.M. Whelpton of Syscomp Electronic Design Limited, Toronto, Ontario, for their creative for their creative equipment design modifications.

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