Mountain Sheep Responses to Aerial Surveys
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MOUNTAIN SHEEP RESPONSES TO AERIAL SURVEYS

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Aircraft are used widely for radio-tracking animals, and their uses in wildlife management and research are increasing (Gilmer et al. 1981). Additional use of aircraft in wildlife programs may cause harassment of ungulates especially (Geist 1971, MacArthur et al. 1979, Miller and Gunn 1979). In this study, we asked 2 questions: (1) do overflights by light aircraft disturb mountain sheep (*Ovis canadensis mexicana*) enough to cause them to move to new areas, and (2) will such movements and area changes caused by the aircraft be detected by aerial observers? We report the responses of 32 groups of mountain sheep (211 animals in group sizes of 1–18) to low-flying aircraft between March 1980 and July 1982.

METHODS

In an ongoing study on distribution and movement patterns of mountain sheep in western Arizona, 15 sheep were fitted with radio-collars. The sheep were located during weekly flights in a Cessna 172 or 182. The response of sheep to the airplane was evaluated by a ground observer who located a collared sheep and recorded its behavior plus the behavior of others with it prior to, during, and after 32 overflights (Table 1). Without knowing which sheep was being observed from the ground, the aerial crew located animals from 30 to 300 m aboveground (ag) depending on terrain, weather conditions, and location of animals. Up to 10 passes were made directly over the instrumented sheep during the locating process. We conducted aerial searches between 0600 and 1245 hours.

Aircraft elevations were grouped into 3 categories: <50, 50–100, and >100 m ag. Sheep reactions to the aircraft were classified as not disturbed, slightly disturbed, or greatly disturbed. Sheep that continued their

pre-survey behaviors were considered not disturbed. Sheep that moved ≤100 m and continued their pre-survey activities were considered slightly disturbed. Sheep that moved >100 m and changed behaviors were considered greatly disturbed. The response of sheep to overflights was analyzed by elevation classes to evaluate better the effects of the low-flying aircraft on ongoing maintenance activities and distribution.

RESULTS

Activities of sheep (feeding, bedded, standing, walking, or mating) prior to overflights appeared normal for the time of day and season of year (Chilelli and Krausman 1981). However, low-level overflights interrupted activities and sheep moved >100 m 19% of the time (Table 2). Responses by sheep varied by altitude: (1) at <50 m ag all responses were extreme, involving movements ≥1 km from the areas of observation; (2) at 50–100 m ag responses were mixed, some (13%) extreme, more (27%) mild, and most (60%) sheep showed no overt reaction; and (3) at >100 m ag responses ranged from mild (23%) to no overt reaction (77%).

In the 6 cases when aircraft greatly disturbed sheep, 4 occurred when the plane was <50 m ag. One group of 3 rams were feeding on a slope prior to the aerial locations. As the plane appeared over the group, the rams left the slope and moved to another part of the range. Another group of 8 ewes, 6 lambs, plus 4 additional sheep were bedded when located. The sheep got up and ran approximately 1 km to another site where they bedded for 1 hour after being disturbed. In the 2 other instances, groups left small desert mountains they were using and ran up to 2 km to nearby, larger mountains. One group consisted of a ram and 6 ewes, and the other of 2 rams, 3 ewes, and a lamb.

Flights at 50–100 m ag generally did not disturb sheep (Table 2). In the 2 interactions when sheep were greatly disturbed, they ran out of view. One group of 4 ewes, 1 ram, and 1 lamb were moving and feeding across a ridge prior to the survey. As the plane approached, they grouped together, and as it flew overhead they trotted over the ridge. The other observation involved 8 ewes, 1 ram, and 2 lambs. This group was feeding and resting on top of a ridge. As the plane flew overhead, the animals ran down the mountain approximately 1 km and out of view. The aerial crew was not aware of any sheep movement following their location.

Table 1. Time of day and months when mountain sheep-aircraft interactions were observed in western Arizona, March 1980–July 1982.

Time (MST)	No. interactions	Months	No. interactions
0600–0800	4	Jan–Mar	10
0801–1000	22	Apr–Sep	16
1001–1245	6	Oct–Dec	6

Sheep were slightly disturbed during 7 (22%) interactions. In 1 observation a group of 4 rams and 14 ewes were standing on an open slope prior to aerial location. When the plane approached, the herd ran approximately 50 m to the top of the slope and continued to stand in a tight group. Three observations were of bedded sheep. On 1 occasion a group of 3 ewes were bedded prior to disturbance by the plane. When the plane approached at 50–100 m ag, all ran approximately 100 m upslope and bedded within 2 min. On another occasion a group of 9 ewes and 9 lambs arose and moved <10 m into a tight group and browsed as the plane flew overhead. After the plane left, the sheep browsed up to 30 min before they all bedded again. A similar interaction took place with 3 ewes (Table 2). All other slightly disturbed reactions took place as sheep were foraging. Five ewes, 6 lambs, and 1 additional sheep grouped together as the Cessna approached, but resumed their foraging and spacing within 15 min of the overflight. In the other 2 cases sheep moved <50 m initially, then continued foraging.

In 19 (59%) instances sheep occasionally

Table 2. Reaction of mountain sheep to low-flying aircraft in western Arizona, March 1980–July 1982.

Aircraft elevation (m ag)	Sex and age-class of group				Reaction to aircraft		
	Male	Female	Lamb	Unclassified	Not disturbed	Slightly disturbed	Greatly disturbed
<50	3						x
<50	1	6					x
<50	2	3	1				x
<50		8	6	4			x
50–100	1				x		
50–100	1				x		
50–100	1	8	2		x		
50–100	1	8	2		x		
50–100		6			x		
50–100	1	2			x		
50–100		1			x		
50–100	2	5	1		x		
50–100	1	3	1		x		
50–100		9	9			x	
50–100	4	14				x	
50–100		3				x	
50–100	1	1				x	
50–100	1	4	1				x
50–100	1	8	2				x
>100	1	8	2		x		
>100	2	2			x		
>100	2	1			x		
>100	2	2			x		
>100		4	1		x		
>100	1	2			x		
>100	3	5	4		x		
>100	2	3	1		x		
>100		2			x		
>100	1	3			x		
>100		5	6	1		x	
>100		3				x	
>100	3					x	
Totals	38	129	39	5	19	7	6

looked in the direction of the aircraft but appeared undisturbed otherwise.

CONCLUSIONS

Geist (Unpubl. rep., Berger Comm., Univ. Calgary, Calgary, Alta., 1975) found that various factors affect the influence of aircraft on ungulates—including altitude of aircraft, previous activity, sex and age-class, group size, season, surrounding terrain, and type of aircraft (Miller and Gunn 1979). In our study, the different sex and age-classes reacted in a similar fashion to low-flying aircraft. Mountain sheep in western Arizona appear to be accustomed to aircraft flying >100 m ag, whereas flights <50 m ag caused sheep to leave an area.

MacArthur et al. (1979, 1982) demonstrated that low-flying aircraft at 400-m distance do not elicit heart-rate responses in ewes. This suggests that sheep stay in an area with low-flying aircraft at or above this altitude. Aerial surveys of mountain sheep in the western United States usually are made at <400 m ag to obtain data on habitats, sex and age-class, numbers, and other parameters. Our observations suggest that surveys should be made

50–100 m ag to reduce disturbance of sheep, and >100 m ag to minimize disturbance. Data on habitat use or behavior patterns may be misleading if collected from flights at <100 m ag.

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ESTIMATING RIVER OTTER POPULATIONS: THE FEASIBILITY OF ^{65}Zn TO LABEL FECES

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The harvest of river otter (*Lutra canadensis*) in Louisiana has increased dramatically in the last 30 years. The average annual production of otter pelts was approximately 4,760 animals from 1950 through 1970. From 1971 through the 1981–1982 trapping season, the average annual yield was 7,711 pelts, with a record 11,900 otters harvested during the 1976–1977 season (Ensminger and Linscombe 1980, Louisiana Department of Wildlife and Fisheries 1982).

Improved management of the river otter, an important natural fur resource for Louisiana, can now include new monitoring techniques involving radiotracer methodology to estimate population densities of these animals. Nellis et al. (1967), working with captive rabbits (*Sylvilagus* spp.), bobcats (*Felis rufus*), foxes (*Vulpes* spp.), and opossums (*Didelphis virginiana*), found that ^{65}Zn injected intramuscularly or intraperitoneally was detectable in feces 300–400 days post-injection. Equally important, these authors report that long-term weathering and water-leaching of the feces had no significant effect on the ability to detect the radioisotope. Pelton and Marcum (1977) and Kruuk et al. (1980), working with captive and wild European badgers (*Meles meles*) and black bears (*Ursus americanus*), respectively, have demonstrated the useful-