LETHAL EFFECTS OF INTRODUCED GRASSES ON RED-SHOULDERED HAWKS

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Although raptor mortality has been attributed to natural causes (parasitism, disease, predation, etc.), most deaths documented in the literature have been human-related (shooting, pesticide poisoning, electrocution, etc.) (Newton 1979). This paper documents an indirect, but equally human-related, cause of death in the red-shouldered hawk (*Buteo lineatus elegans*) and presents several instances of optic irritation that could have eventually resulted in death.

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STUDY AREA AND METHODS

The study was conducted in Orange and northwest San Diego counties, California, where most birds were trapped on Camp Pendleton Marine Corps Base (San Diego County) and the Starr Ranch Audubon Sanctuary (Orange County). Plant associations within the two areas are virtually identical and include coastal sage scrub, riparian woodlands, oak woodlands, and grasslands. Introduced grasses, such as ripgut brome (*Bromus diandrus*) and foxtail barley (*Hordeum jubatum*), predominate throughout the two study sites and occur in all four plant associations.

We captured red-shouldered hawks with Bal-chatri traps (Berger and Mueller 1959) baited with house mice (*Mus musculus*) and a dho-gaza baited with a live great horned owl (*Bubo virginianus*) (Hamerstrom 1963). After capture, all birds were banded with a U.S. Fish and Wildlife Service band, weighed, measured, and examined carefully for any signs of disease or injury. Before release some of the birds were marked with an additional colored and numbered leg band. We sexed all birds by both size and weight (P. H. Bloom and M. D. McCrary, unpubl. data) and frequently confirmed this by the behavior of marked individuals.

RESULTS

Between August 1970 and November 1982 we trapped and examined 28 immature and 96 adult red-shouldered hawks. Several of these birds were reexamined when subsequently retrapped or when found dead or injured. Some were also closely examined in the field with the aid of a spotting scope. Of these 124 individuals, 18 (14.5%) had one (usually) or more seeds of one of four grass species lodged in the anterior corner of one eye. We use the term "seed" to represent a complete grass floret including palea, lemma, and awn. In all cases the seed was

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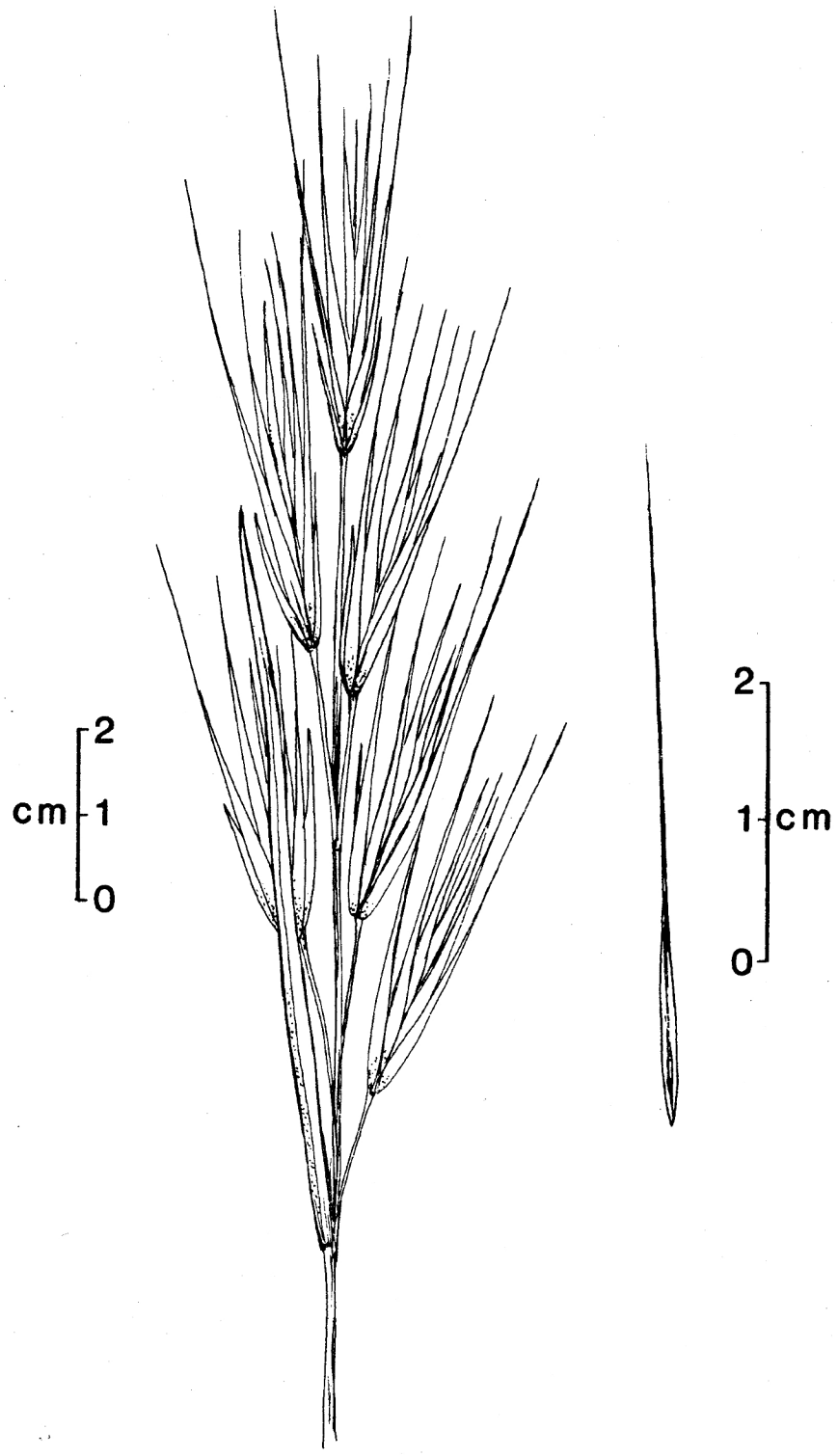

Fig. 1. Introduced ripgut brome grass showing "seed" position and enlarged view of single grass floret.

located between the outer lid and the nictitating membrane and was frequently lodged in the tear duct. This condition was immediately apparent in all cases even though the seed itself was not always visible externally. The affected eye appeared slightly swollen and the feathers surrounding the eye were matted and discolored with mucus. In the more pronounced cases, matted and stained feathers also occurred in the scapular region of the wings where birds frequently rub the affected eye(s). In one instance, it appeared that the seed had migrated from the anterior corner of the eye to the nasal area resulting in both optic and nasal inflammation and fluid drainage. Because of the posteriorly directed minute hairs characteristic of these seeds they could not normally be dislodged; however, we removed the seeds with the aid of tweezers in all except one instance. Seed length averaged 2.4 cm. Of those seeds identified, 90% were ripgut brome (Fig. 1), and the remaining 10% consisted of foxtail barley, foxtail brome (*Bromus rubens*), and slender oat (*Avena barbata*).

We found the incidence of occurrence of seeds by age and sex was not significantly different (χ^2, $P > 0.05$) from the proportions of the birds trapped. Nor was the proportion of birds affected by seeds significantly different (χ^2, $P > 0.05$) from the numbers of birds trapped in each season of the year.

We determined that three (16.7%) of the affected birds apparently died as an indirect result of grass seed irritation. One of these birds was found dead after a radiotelemetry study of red-shouldered hawks conducted by McCrary on Camp Pendleton Marine Corps Base (McCrary 1981*a*). When found, the bird was extremely emaciated and weighed only 450 g; a weight loss of 23% from when trapped and radiotagged 23 months earlier. Because the fresh condition of the bird indicated that it had died within the previous 24 hours, this is probably close to the actual weight of the bird at the time of death. At first we believed that the transmitter and harness may have, in some manner, resulted in the bird's death. However, this was not indicated in an analysis of other radio-tagged red-shouldered hawks (McCrary 1981*b*). There was no sign of external abrasions from the harness material, and the bird had not become entangled in the harness. After observing the wet and matted condition of

the feathers in both the scapular region and around the eyes, we found two large grass seeds in one of the bird's eyes and a single seed in the other. Veterinary examination of the bird indicated that the inflammation and probable visual impairment of both eyes caused by these seeds may have been the major factor leading to the bird's death from extreme malnutrition (K. P. Svedeen, pers. commun.). No additional signs of disease or injury were found, nor any indication that the transmitter had influenced the bird's death.

We believe a second bird may have also died as an indirect result of multiple grass seed irritants, although we were unable to confirm the actual cause of death. We trapped and color-banded this bird on 28 February 1981 and recorded no indication of optic irritation or injury. Three weeks later we examined this bird with a 40× spotting scope and noted that it frequently held both eyes closed; the feathers around one eye were distinctly wet and matted. During our observations the bird rubbed its left eye on the scapular region of the left wing approximately once per minute, and it kept its right eye closed for extended periods. Atypically, it held its wings drooped and resting on its perch. The general health of the bird seemed poor compared to when initially trapped; we were able to approach quite closely before it took flight, which was not the case when it was first trapped. Although we were never able to retrap the bird to determine the cause of its illness, from all appearances the bird was suffering from at least one grass seed in each eye. This opinion is supported by similar observations from a distance of several other birds, which, upon being trapped, were found to be suffering from a grass seed irritant. These birds also frequently rubbed the affected eye, and with a spotting scope we were able to detect the stained and matted feathers around the eye. By September, the color-banded red-shouldered hawk had disappeared, and an unbanded male was trapped in the same territory.

We also suspect that another color-banded adult red-shouldered hawk died as a result of optic irritation, although apparently for more indirect reasons than the above. This bird was found dead on 11 November 1981, and during a thorough examination (K. P. Svedeen, pers. commun.) one grass seed (3 cm in length) was removed from the anterior corner of the bird's right eye. The actual cause of death was a severe traumatic injury to the right inner shoulder and corresponding major cardiopulmonary damage. The confined nature of this injury and the lack of additional severe injuries indicates that the bird probably struck a very narrow object, possibly a utility wire. We believe the grass seed may have impaired the bird's vision causing it to strike a utility wire located just above where the bird was found. A small trauma to the bird's head was apparently caused by its fall.

The radio-tagged hawk found dead and apparently the one that disappeared were affected by grass seed irritants in both eyes. Mortality probably occurs more frequently from this condition, with death resulting from starvation or other causes. When a bird is affected by only one seed, the condition may eventually correct itself. We removed seeds from all except one of the first birds we found with this condition. We originally trapped this individual on 20 October 1974 at which time it had one seed lodged in the corner of its right eye; however, we neglected to remove it before releasing the bird. We retrapped this same individual on 9 April 1981, and at this time its right eye appeared normal, with no signs of irritation or injury. Also, seeds we removed from some of the birds appeared partially decomposed indicating

that they may have eventually dissolved. Two birds recaptured 7 months and 2½ years after we removed single seeds showed no signs of permanent eye injury.

DISCUSSION

Red-shouldered hawks in our southern California study area are regularly affected by grass seed irritants resulting in at least some mortality. However, from the results of this study it is difficult to assess the actual degree of mortality involved because in almost all cases we removed the seeds when we trapped affected birds. Also, as is the case with most wild birds, mortality usually goes undocumented. The condition we describe here is apparently reversible as long as only one seed is involved. After an unknown period of time the seed is probably dissolved. However, if a second seed is lodged in the unaffected eye death may result.

For undetermined reasons, this condition seems to be confined to red-shouldered hawks. Bloom has trapped approximately 1,000 raptors of four species in our two study areas (great horned owl; barn owl, *Tyto alba*; red-tailed hawk, *Buteo jamaicensis*; and American kestrel, *Falco sparverius*) and has never observed an instance of eye irritation induced by grass seeds. The occurrence of grass seed eye irritants in red-shouldered hawks may be related to some unique aspect of their hunting behavior, although the nature of this difference is not clear at this time. Red-shouldered hawks typically hunt by plunging, often vertically, from a perch at least several meters above the ground (M. D. McCrary, unpubl. data). This, and differences in morphology of the orbital region, may play some part in their increased susceptibility to certain grass seeds.

The four grasses producing eye irritation in red-shouldered hawks are all introduced European species. These grasses were probably introduced to southern California by early Spanish settlers more than 300 years ago. Before this time there was probably only one native species, purple needlegrass (*Stipa pulchra*), which may have potentially caused similar eye problems. The seeds of this species are similar to those of the problem grasses but are even more needlelike. However, this species is rare over much of its former range in southern California and usually occurs in more open situations where red-shouldered hawks do not normally hunt (i.e., chaparral and coastal sage scrub). Because of the introduced status of the grasses involved, we classify this form of mortality in the red-shouldered hawk as at least indirectly human related. It would be interesting to determine if this problem exists in any of the European birds of prey where these grasses normally occur.

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