height per mound of 17.9 cm ($n = 20$). The average area around the mound cleared of vegetation by the ants was about 7 m^2 ($n = 20$).

Again, on 9 and 11 April at approximately the same time period as on the 7th, male Sage Grouse were observed strutting on the ant mounds and in the clearings around the mounds. Patterson (1952) found that on two occasions Sage Grouse utilized "abandoned rodent or ant colonies" as strutting grounds. Midday examination of the ant mounds used by the grouse indicated that all were viable colonies (ants observed on and around the nest). Observations made on the ant nests just after the termination of the morning strutting activities revealed that no ants were outside the mounds. Comanor and Clark (unpubl. data) have found that during this time of year in this region *P. occidentalis* begins daily aboveground activity ranging from 08:45 to 09:30, hence the ants were not active during the strutting period. Whitaker (1957) states "it appears that birds use (for anting) only those ants incapable of stinging." *P. occidentalis* is noted for its severe sting (Weber 1959; Wheeler and Wheeler 1963). These above factors exclude the possible use of the mounds by the grouse for any anting behavior.

An examination of the *P. occidentalis* mounds and clearings in the strutting area indicated that they were all used by the grouse during that spring. Sage Grouse tracks, feathers, and droppings were abundant on these areas. Other small, cleared areas were more frequently used for strutting than the ant mounds; however, the visibility of the birds was enhanced by the height of the mound. Due to the late date, the females were not present and it was not possible to ascertain if the males using the ant mounds were the dominant males of the strutting grounds. Although several aposematic attacks similar to those described by Bent (1932) were noticed on flat areas, none was observed on the ant mounds.

Sand and gravel from the apex and sides of the mounds were removed by the trampling action of the Sage Grouse and occasionally chambers near the mound surface were exposed. These were the only visible adverse effects of the strutting activities on the ant mounds.

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FUNCTION OF EYE COLORATION IN NORTH AMERICAN ACCIPITERS

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Roberts (Ontario Bird Banding 3:95, 1967) presents evidence for a general developmental change in iris coloration of Sharp-shinned Hawks (*Accipiter striatus*). The progression is from gray in nestlings to yellow in young adults, to orange in middle-aged adults, and finally to red in elderly adults. Judging from our observations of Goshawks (*Accipiter gentilis*) and Cooper's Hawks (*Accipiter cooperii*) in Arizona and New Mexico, this progression of iris colors may be characteristic for all North American accipiters. We have observed most of the above progression in one female Cooper's Hawk and have observed the above range of iris colors in different individuals of Goshawks and Cooper's Hawks. Though our data are insufficient to document how many years the full progression takes in these species, we have observed some breeding Cooper's Hawks in adult plumage with yellow irises at a presumed age of 2 years. The eye color of the above female Cooper's Hawk changed from yellow to light orange to orange-red in 3 years. Evidently, in Cooper's Hawks, as in Sharp-shinned Hawks, it takes on the order of 5 years until red iris coloration is achieved. Meng (The Cooper's Hawk. Ph.D. dissertation, Cornell University, Ithaca. 1951) and Grossman and Hamlet (Birds of prey of the world. C. N. Potter, Inc., New York. 1964) give supporting evidence for the above progression of iris colors in North American accipiters.

Curiously, Roberts' (op. cit.) data strongly suggest that females take about a year longer than males to complete the transition to red eyes, and Meng (op. cit.) mentions a similar sexual difference in rate of darkening of the iris in his study of Cooper's Hawks. This rate difference may lie behind our observation that it is very rare to find a male accipiter with iris color lighter than that of his mate. In many dozens of pairs of accipiters, we have only once found a pair in which the male's iris was lighter than that of the female, and only twice have we found pairs in which iris coloration appeared to be the same in both sexes.

The significance of the above developmental changes in eye coloration forms the subject of this paper. We are particularly concerned with the following questions:

1. Why is there a progressive change from yellow to red in iris color of adult accipiters?
2. Why do males achieve red eyes faster than females?
3. Why do adults ever have red eyes?

The last question arises as a result of observations we made on a particular adult male Cooper's Hawk with dark red eyes in the summer of 1971. This male took over the normally feminine role of ripping apart prey for the chicks when his mate was killed, and his eyes were repeatedly subjected to pecking by the bills of the chicks (fig. 1). It appeared that the red coloration of his eyes might be a powerful releaser of the pecking response.

FIGURE 1. Nestling Cooper's Hawk pecking at eye of adult male during feeding.

In feeding chicks, a female accipiter stands with the prey under her feet on the edge of the nest. With her bill, she tears off bits of meat and holds them over the chicks who stretch up and grab the meat from her bill. When the above red-eyed male took over the duties of feeding chicks, his efforts were at first only approximations of a normal feeding sequence. One of his more troublesome errors was that he held his head too low when he offered meat to the chicks, leaving his eyes within reach of their bills. The chicks responded by pecking at his eyes almost as often as at his bill tip. Apparently the male was inhibited from avoiding the thrusts of the chicks, and he did not noticeably flinch as his eyes were pecked. Whether his eyes were damaged by the chicks was unclear. He obviously was not blinded, but lesser damage may have occurred. The male never developed a completely normal "female" feeding stance, though his overall facility in feeding chicks showed gradual improvement. Eventually the chicks stopped pecking at his eyes and concentrated their attention on his bill tip.

In over 2500 hr of observation of 19 accipiter nests, we had not previously observed a male accipiter dismember prey for chicks. During the nestling period, a male accipiter normally visits the nesting area only to drop off food. Early in the nestling period this food is torn apart for the young by the adult female; late in the nestling period the young are able to perform this task themselves.

MATERIALS AND METHODS

To see what parameters appeared to be most important in eliciting the pecking response, we ran a series of trials with young Cooper's Hawks. These experiments were run as follows: 12 chicks from various Cooper's Hawk nests were removed temporarily from their nests at times when their crops were empty or nearly empty (i.e., at times when they could be assumed to be hungry). All chicks were between 1 and 4 days from hatching. Each chick was presented with a life-size, two-dimensional model of a Cooper's Hawk head in profile (fig. 2). The model was colored so as to approximate a normal adult head. The eye of the model was made from a thumbtack which could be removed and replaced with eyes of other colors. Similarly, there was a tiny hole near the bill tip of the model into which various colored and shaped objects made from thumbtacks could be fitted. The model

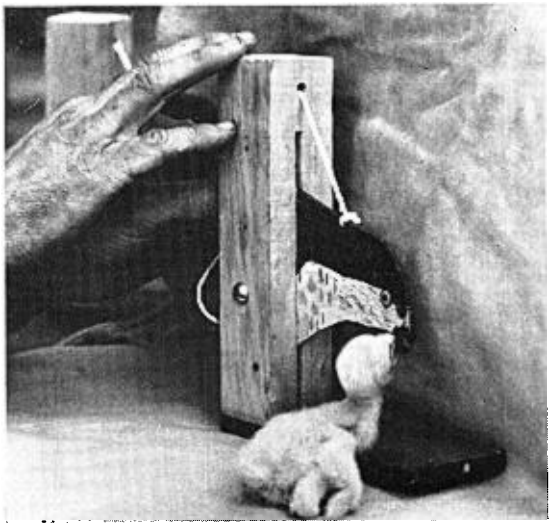

FIGURE 2. Experimental apparatus for testing pecking preferences of young Cooper's Hawk chicks. The head of the model could be raised and lowered by means of a string to simulate the normal movements of a female hawk in feeding chicks.

was built so that the head could be raised and lowered by a string at a rate and manner simulating the normal motions of an adult female ripping a chunk of food from prey and holding it motionless in profile in front of the chick.

Five different stimulus situations were presented to each chick as follows:

1. Normal yellow eye (including black pupil and black rim) in the eye position and another normal yellow eye in the bill tip.
2. Normal yellow eye in the eye position and a normal red eye (including black pupil and black rim) in the bill tip (fig. 2).
3. Normal yellow eye in the eye position and a red disc (same size as an eye but lacking dark pupil or rim) in the bill tip.
4. Normal yellow eye in the eye position and a red rectangular bar (cut from a normal-sized thumbtack) in the bill tip.
5. Normal red eye in the eye position and a normal yellow eye in the bill tip.

For all five stimulus situations the chicks viewed the model against a plain green cloth background in open shade.

Situations 1, 2, 3, and 4 were chosen to give some idea as to what stimulus objects were capable of eliciting pecking when positioned in the bill tip where food is usually offered in nature. Stimulus situation 5 was chosen for comparison with stimulus situation 2 to see if position of a red object on the head of the model appeared to make any difference. For each chick the above five stimulus situations were presented in random order following an initial bite of food (road-killed rabbit) presented on the bill tip of the model. For each stimulus situation the head of the model was raised 10 times to a constant height in front of the unrestrained chick (fig. 2). If the chick responded by pecking during a 3-sec interval after raising of the model, its response was recorded as positive; if no pecking was seen, its response was recorded as negative. The total response to a given

TABLE 1. Pecking responses of young Cooper's Hawk nestlings.

No.	Stimulus situation: In eye	Stimulus situation: In bill tip	Mean response	Range of responses	No. of chicks	Pecks directed at
1.	yellow eye	yellow eye	0	0–0	12	—
2.	yellow eye	red eye	6.17	2–10	12	red eye
3.	yellow eye	red disc	6.13	1.5–10	11[a]	red disc
4.	yellow eye	red bar	7.46	5–10	12	red bar
5.	red eye	yellow eye	5.75	.5–10	12	red eye

[a] Red disc stimulus situation omitted for one chick.

stimulus situation was the number of positive trials out of 10 raisings of the model's head. Each chick was run through the five stimulus situations twice (in different random orders) and its score for each stimulus situation was the average for the two replicates.

RESULTS

In table 1 we present the average responses for the 12 chicks to the five stimulus situations. The chicks responded readily in the experimental situation and showed no fear of the model or experimenter. In general, they pecked at any red object, whether it was an eye, a red disc the same size as an eye, or a red bar cut from a red disc. The general response to red objects seems reasonable as this is the normal color of food offered to young hawks in nature. No responses were ever directed at a yellow eye, regardless of position on the model, and response to a red eye was essentially the same whether the eye was in the eye position or in the bill tip. There was no sign of any difference in response to the red disc and red eye stimulus situations. By a Duncan New Multiple Range Test, there were no significant differences between responses to stimulus situation 2, 3, 4, and 5 though all these situations differed significantly from stimulus situation 1. Parenthetically, we noted that newly-hatched chicks responded strongly to orange-colored discs in a few preliminary trials.

The colors of the experimental stimulus objects were only visually matched to the colors of hawk eyes in nature, so the question as to whether their spectral reflectances were truly similar to spectral reflectances of hawk eye colors is unevaluated. Nevertheless, the results of the experiment are consistent with our observations of pecking behavior of chicks in nature. Aside from the case of the above-described male Cooper's Hawk, we have observed chicks pecking at the eyes of an adult accipiter on only one other occasion. This was a case of an adult female goshawk with orange eyes. Also, we have noted a reluctance of young chicks to strike at food offered to them that was not red in color. This reluctance was especially noticeable with lizard meat which is often white. As chicks become older, their reluctance to strike at non-red objects disappears.

DISCUSSION

The experiment was not designed to test the role of experience in pecking preferences of young chicks, but simply to examine what preferences are normally found. The chicks tested had parents whose eye colors ranged from yellow to red, yet all chicks consistently struck at red objects and none struck at yellow objects. Though the response to red is very likely innate, the hypothesis we develop below does not depend critically on this question.

The lack of response to yellow eyes in the experimental trials is interesting in view of the apparent vulnerability of eyes of adults to thrusts of bills of their chicks, and in view of differences in rate of eye darkening in adults of differing sex. As mentioned earlier, an adult female at the age of first breeding (normally 2 years old) has a yellow iris coloration. Perhaps it is important for a female to have this safety factor during her first attempts at feeding chicks, as she may well be learning the appropriate way to interact with the chicks, especially with regard to holding her head in a position which reduces threat of damage to her eyes. As evidence for this possibility, we have observed four cases of female accipiters with yellow eyes (one Sharp-shinned Hawk and three Cooper's Hawks) in what was likely their first interactions with chicks. At two of the Cooper's Hawk nests, females were clearly nesting for the first time as they had streaked first-year plumage. In the cases of the Sharp-shinned Hawk and the two first-year Cooper's Hawk females, the initial feedings of young were noticeably awkward, although they became proficient in the course of a few days. These females had difficulty in positioning their heads so that their newly hatched young could take food. Usually they erred in holding their heads too high, but sometimes their heads were too low. In the case of the female Cooper's Hawk with adult plumage and yellow eyes, initial feedings proceeded smoothly. It is possible that this was not her first nesting attempt.

As male accipiters do not normally feed chicks, there may be little selective advantage to a slow rate of change to the red-eyed condition. However, one wonders why selection has permitted the retention of red eyes in either sex at any age, as there would seem to be a certain amount of danger to eyes regardless of the proficiency of a bird in interacting with chicks. The very existence of red eyes in accipiters suggests that there may be some compensating advantage to this coloration.

Since both sexes of all three accipiters apparently go through the same sequence of eye color changes, it seems unlikely that eye coloration might function in sex or species recognition. The variability in iris colors could, however, be important in individual or age recognition. If individual recognition were the primary function, it would be difficult to explain the existence of red eyes, as presumably variability could be achieved without resort to this apparently dangerous color. On the other hand, if age recognition were the primary function of having a variety of eye colors, it would be possible to explain the use of the color red. Red eyes are characteristic of elderly adults, and age in itself could be a good indicator of quality of a mate. Hunting skills may improve progressively over the

lifetime of a bird, as all three accipiters hunt rather elusive prey (primarily birds), and the gradual improvement of hunting techniques seems especially plausible for such prey. Though we have no evidence for or against it, there could be a preferential mating system in which adults with the darkest red eyes could have the greatest success in gaining mates. The disadvantages inherent in red eye coloration might prevent any tendency toward early assumption of this color in inexperienced birds, and the relatively greater danger to eyes of females (the sex that normally feeds chicks) could explain the relatively slow transition to red eyes in this sex.

Though one might suggest that age recognition could be achieved without employing the color red, it is questionable whether a preferential mating system based on differences in eye coloration could be sustained if the preferred color did not also have disadvantages to its bearer at least at some age in life. Otherwise, selection would presumably lead to a uniform population with preferred eye coloration.

The above hypothesis is not without difficulties. It is relevant to note that iris color changes of Marsh Hawks (*Circus cyaneus*), as intensively studied by Hamerstrom (Inland Bird Banding News 40:43, 1968) and Balfour (Bird Study 17:47, 1970), also occur faster in males than in females. In this species the transition from an initial brown coloration to a final yellow coloration takes approximately 1 year for males and up to 6 or 7 years for females. It seems unlikely that the hypothesis developed above could be directly applied to Marsh Hawks, though pecking preferences of Marsh Hawk chicks remain to be explored.

A second difficulty concerns the role of an experience factor in delaying red eye coloration in male accipiters. As an order of magnitude guess, the chances of a male losing his mate during the breeding cycle and carrying on alone in feeding chicks might be on the order of one in a hundred breeding attempts. The question arises whether an older (red-eyed) male would be any more proficient in interacting with chicks than a younger (yellow-eyed) male, as the chances of a male losing a mate and feeding chicks more than once in a lifetime would presumably be rather smaller than having this happen even once. If there is no significant difference in proficiency between young and old males in interacting with chicks, it is difficult to see why red eye coloration might be delayed as long as it is.

In defense of the hypothesis developed above, one might suggest that learning of a proper way to interact with chicks may not be limited to situations where adults are actually feeding chicks. Though males do not normally rip apart prey for chicks, they do commonly bring food to the nest from the mid-nestling stage onward and they are normally faced with close contact with hungry chicks even though they are not directly feeding them. The chance of a stray blow to an inexperienced eye may supply a selective pressure against early adoption of red iris coloration even in males.

SUMMARY

Young nestling Cooper's Hawks peck vigorously at red objects but do not peck at yellow objects. The significance of this response is discussed in relation to developmental changes in iris coloration in adult hawks.

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BARRED OWL RECORDS IN WESTERN MONTANA

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The Barred Owl (*Strix varia varia*) is considered to be a rare, permanent resident of the eastern part of Montana. Saunders (A distributional list of the birds of Montana, Pacific Coast Avifauna No. 14, 1921) lists only three records, all from well east of the Continental Divide.

Recent observations may indicate a southwestern extension of range. On 30 July 1966, an injured Barred Owl was found west of the Divide near Lake McDonald in Glacier National Park, Flathead County. This bird was cared for and, in June 1967, released in the park headquarters area by Roberta Seibel, then museum curator. The photographs that were taken of this owl were compared with specimens at the University of Montana to verify identification and are permanently on file at Glacier National Park Headquarters.

Winton Weydemeyer (unpubl. data) reports five separate sightings in 1969 and 1972 in the months of October and November, all west of the Divide near Fortine, Montana.

In the years 1968–71, while working as the seasonal biologist and back-country ranger, I either saw or heard Barred Owls on at least 13 different occasions. These records were obtained in the Douglas fir-lodgepole pine-western larch forests of the North Fork area or near West Glacier, all west of the Divide in Glacier National Park. On 13 September 1969, I saw an adult at close range being harassed by a Sharp-shinned Hawk (*Accipiter striatus*) and two Gray Jays (*Perisoreus canadensis*). On 13 August 1971, Roberta Seibel and I saw two immature birds in the West Glacier area. I have occasionally heard the distinctive call of the Barred Owl at dusk near West Glacier, especially during the summer.

In summary, I have seen or heard Barred Owls over a 5-year period on dates ranging from 22 February until 7 October. Thus there is good evidence for a southwestern extension of range and that this species is a permanent resident within Glacier National Park.

I wish to thank P. L. Wright of the University of Montana for his interest and suggestions, and representatives of Glacier National Park for use of their photograph of the injured owl.

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