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AGE AND MOUTH COLOR IN COMMON RAVENS[1]

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Age is a critical factor in many avian social interactions, often making it crucial in studies of social biology. Plumage, iris color, and bill color are well-known characteristics that can be used to determine age in many species of birds. In many corvids, all three characteristics change with age during the first two years of life, but then remain constant (Skutch 1935, Brown 1963, Ligon and White 1974, Rowley 1970, Dorn 1972).

In numerous studies on the Common Raven, *Corvus corax,* age of birds has been assigned to juvenile, immature or yearling, subadult (2–3 years) and adult (3 plus years of age). These determinations all rely primarily on one criterion: mouth and tongue color (Mahringer 1970, Dorn 1972, Kerttu 1973, Stiehl 1978, Huber 1988, Heinrich 1988). The mouth color of juveniles is pink, that of adults is blue-black, and that of those in between is assumed to vary in a gradual progression that is strictly a function of age. In no instance, however, has the assumption of a gradual color change with age been tested. We have raised 17 ravens from fledglings and here show that mouth color is a function of age only in very young and possibly old birds. Some birds retain pink mouths long into adulthood and mouth color may be related more to social status than to age.

Young ravens were taken from nests in Vermont and Maine and reared by hand in outdoor aviaries. All were fed the same diet consisting primarily of road-killed animals, meat scraps, and occasional kitchen scraps. All the birds fledged in May. They were kept in family groups (3–6 individuals) until fall, at which time some were kept in company of up to 20 others. We assessed dominance among these birds as described previously (Heinrich and Marzluff 1991) and recorded mouth color at approximately monthly intervals.

In a total of 17 birds fledged in May, none had black mouth linings by the first fall (November). However, four of the 17 already had mottled mouth linings (corresponding to presumed 1–2 year-old birds) at that time (six months post-fledging). These four birds were highly dominant individuals. All of the 13 pink-mouthed birds were subordinate individuals. By January (eight months after fledging) four birds already had fully black mouth linings like "adults" (i.e., 3 plus years old), two had mottled mouths, and 11 still had pink mouths. The six black or mottled-mouthed individuals were still the most dominant birds and all were socially bonded with each other in pairs. No black-mouthed individual was bonded to a pink-mouthed individual.

By the second November (18 months after fledging), only eight birds remained in our possession. Of these eight, the five birds that remained unpaired and subordinate still had pink mouths, and the three dominant birds had black mouths (one of these was unpaired). By the second March (22 months post-fledging) only two pink-mouthed individuals (corresponding to presumed <1 year old) remained the five dominant birds (one was unbonded) had black mouths. A third subordinate bird that was observed until September (28 months post-fledging) still had only a mottled, nearly pink mouth when last seen in the wild following release. These data show that although the dominant individuals changed from pink to black mouths within several months, the color change in the subordinate birds is a very long process that can be both greatly delayed and greatly prolonged.

Our data show that some birds may acquire black mouth linings even in their first winter (eight months after fledging), provided they are highly dominant individuals. On the other hand, highly subordinate birds can retain pink or mottled mouths even at the beginning of their third winter. We saw no reversal of mouth lining from black back to pink. We conclude that status (and possibly pair bonding which is related to status, Gwinner 1964), is a very strong modifying factor that may make some birds appear like adults at about a half year after fledging, while making others that are at least two and one-half years old look like juveniles. We do not know the significance of these results. They pose numerous questions. For example, since dominance in ravens is apparently a prerequisite for sexual attraction (Gwinner 1964), the linking of mouth color with status could serve as a sexual signal that advertises at least one level of suitability in a potential mate.

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EVALUATING HABITAT SUITABILITY USING RELATIVE ABUNDANCE AND FLEDGING SUCCESS OF RED-NAPED SAPSUCKERS[1]

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Key words: *Red-naped Sapsucker;* Sphyrapicus nuchalis; *abundance; fledging; logging.*

To provide nesting and foraging trees for woodpeckers and other cavity-nesting wildlife, forest management objectives on public lands generally include some level of snag (standing, dead tree) and live-tree retention within cutting units (McClelland 1975, Connor 1978, Thomas et al. 1979). Numerous studies show that some smaller woodpeckers will readily nest and forage in logged stands as long as some trees are left standing (Connor and Crawford 1974, Connor et al. 1975, Franzreb and Ohmart 1978, Dickson et al. 1983, Tobalske et al. 1991).

The drastic alterations of forest composition and structure that occur from logging may alter habitat quality for nesting woodpeckers. Although a species may continue to use logged habitat because proximate cues such as a suitable nest tree are present (Hildén 1965), the ultimate factors to consider are fitness parameters (Van Horne 1983). In this study, I examined the relative abundance of Red-naped Sapsuckers (*Sphyrapicus nuchalis*) in unlogged and recently logged coniferous forest. I augmented this effort with an analysis of fledging success to determine whether such modified habitats provide suitable nesting opportunities for this species.

STUDY AREA

This study was conducted at Coram Experimental Forest (CEF) and on nearby, similarly managed portions of the Flathead National Forest, northwestern Montana. Regulated by the Intermountain Research Station of the U.S. Forest Service, CEF covers 3,000 ha and ranges from 1,000–2,000 m above sea level. Western larch (*Larix occidentalis*) and Douglas-fir (*Pseudotsuga menziesii*) are the dominant trees; Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) are common. At lower elevations, often in association with riparian areas, paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*) are present. Unlogged stands are primarily even-aged and standing old-growth larch are over 300 years old. Timber harvesting began in the 1940s and continues today, through clearcutting and various partial-cutting methods. Since the mid-1970s, snags of all tree species as well as living paper birch and quaking aspen have been retained within cutting units in order to conserve cavity-nesting wildlife, based on the guidelines in McClelland and Frissell (1975).

The Terrace Hill Sale Area (THSA) and the Coram Research Natural Area (CRNA) comprise the southern quarter of CEF. Logged stands within the THSA include five clearcuts ranging from 6–14 ha in size (with some snags and live trees reserved) and nine partial cuts ranging from 2–28 ha. Unlogged forest consists of

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