The Birds of North America, No. 298, 1997 (Excerpts)
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Northern Goshawk

Accipiter gentilis

FRENCH: *Autour des palombes*
SPANISH: *Gavilán azor*

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BEHAVIOR

LOCOMOTION

Walking, hopping, climbing, etc. Pursues prey by running into thick underbrush when necessary; even chases poultry into buildings. May wade into shallow water after prey such as ducklings (Schnell 1958).

Flight. Flight pattern typical of the genus; several rapid flaps followed by a glide, although wing beats are slower, deeper, and more direct than those of the Eurasian Sparrowhawk (*Accipiter nisus*; Cramp and Simmons 1980) and other North American accipiters (Kaufman 1990). Soars occasionally during migration and during courtship over nest stands. Highly agile when chasing prey; speed of flight through forests is astonishing, given the large size of this species. Also see Food Habits: feeding.

SELF-MAINTENANCE

Preening, head-scratching, stretching, bathing, anting, etc. Preening similar to that of other raptors. Stretches by spreading tail sideways and holding it rigid, while leg is extended stiffly backward and held parallel

under the tail; wing is extended downward and back while primaries are spread, partially covering the tail (Schnell 1958). Tail, leg, and wing are held taut for 3–5 s before regaining normal perched position.

Sleeping, roosting, sunbathing. Roosts alone in tree canopy. Several sites used for roosting, but roosting habitat not described. In early nesting phase, female roosts on nest while brooding young (Schnell 1958). Roosting birds readily fly when approached at night and can detect human intruders >100 m away on moonlit nights (JRS). Perched birds stand on one leg with the other drawn close to the breast between the feather tracts (Schnell 1958). The leg, with toes clenched, is raised and lowered, striking the perch several times, until it is abruptly drawn into the breast feathers.

Daily time budget. Diurnal. Activity begins approximately at first light (Schnell 1958); exact time varies according to season and latitude. Total percentage of time in flight for Goshawks nesting in New Mexico averaged 18.2% (3.8 CI) for males and 6.1% (3.4 CI) for females (Kennedy 1991). No diurnal rhythms of foraging activity; timing of hunting forays depend on the species and diurnal activity patterns of prey. In Utah, a male Goshawk spent approximately 108 min in direct flights and 67 min soaring per day (Fischer 1986).

No data on time budgets during the nonbreeding season for North American populations. During winter in Sweden, females become active 27 min before sunrise; males, 21 min before sunrise (Widén 1982). Male flight activity distributed throughout the day, totaling 7.1% of the daily activity pattern. Female flight activity peaked between 08:00 and 09:00; total flight time slightly less than that of males (Widén 1982). Female activity coincided with squirrel activity (Widén 1984). Total flight time increased with time since last kill, especially for females.

AGONISTIC BEHAVIOR

Physical interactions. Intraspecific interactions not well understood.

Communicative interactions. Secretive throughout the year; often extremely aggressive when defending nests from

intruders. High-circling displays (see Sexual Behavior: pair bond, below); neighboring pairs may circle together above their territories without apparent hostility (Forsman and Solonen 1984). Soaring occurs throughout breeding season but especially common during incubation in mid-to-late mornings. Adjacent territorial males soar above territories and approach one another mid-way between nests; soaring may function as territorial display (RTR). During incubation, males are secretive and females rarely flush to defend the site even when intruders are directly below the nest (Speiser and Bosakowski 1991, JRS). Aggression peaks during early-nestling stage, then wanes as young fledge (JRS).

Threat displays are similar to those of other hawks (Brown and Amadon 1968). Adults threaten by lowering their heads and crouching forward, raising crest feathers, partially spreading their wings and tail. Often accompanied by alarm calls. Large nestlings threaten intruders at nests by sitting back on tibiotarsal joint and tail, with wings spread, contour feathers erect (especially on head), gape open, and tongue protruding; may talon intruders if handled.

SPACING

Territoriality. Territorial against raptors, including other Goshawks, during nesting (Beebe 1974, Kostrzewa 1991). Readily kills neighboring raptors (Kostrzewa 1991), but may have little affect on productivity of some raptor populations (Dobler 1990). Postfledging area (PFA) may represent defended portion of territory (Reynolds et al. 1992), which includes approximately 170 ha surrounding the nest (Kennedy et al. 1994). Can strike and draw blood from persons approaching nests (Dixon and Dixon 1938, Zirrer 1947); attacks on a single person are usually more severe than those on two or more persons (Gromme 1935, Speiser and Bosakowski 1991). European Goshawks less aggressive toward human intruders, possibly due to long-term persecution. No data concerning winter territoriality.

425 ac

Individual distance. Intraspecific nest

spacing tends to be regular (Widén 1985, Dobler 1990, Kostrzewa 1991, Reynolds et al. 1994); clumping occurs near meadows and riparian systems (Woodbridge and Detrich 1994). Mean nearest-neighbor distance between nests 3.0 km ± 0.83 SD (range 1.6–6.4 km, *n* = 59) in Arizona (Reynolds et al. 1994) and 3.3 km ± 0.3 SE (range 1.3–6.1 km, *n* = 21) in California (Woodbridge and Detrich 1994). Average distance between nests in Oregon 5.6 km (Reynolds and Wight 1978), similar to spacing in Sweden (5.5 km, Hoglund 1964; 6.3 km, *n* = 4–9 pairs, 1977–1982, Widén 1985).

SEXUAL BEHAVIOR

Mating system and sex ratio. Apparently monogamous. Sex ratio 1:1 prior to fledging (*n* = 23 broods; Reynolds et al. 1994) and among adults (Mueller and Berger 1968, Marcström and Kenward 1981b, Widén 1985). Juvenile sex ratio, however, favors males (2.2 males, Mueller and Berger 1968; 1.9 males, Widén 1985; 1.4 males, Marcström and Kenward 1981b), perhaps owing to differences in trap vulnerability, habitat preference, or migratory habits (Widén 1985).

Pair bond. *Courtship displays and mate guarding.* During nest repair and construction, both pair members engage in Sky-Dance Display (Beebe 1974, Palmer 1988). From brief soaring flights, male dives at female with closed wings well above the forest canopy or initiates a direct aerial chase below tree canopy. Both birds then fly slowly about 1 m apart, with deep, slow wingbeats, wings held above body dihedral. Initial flight undulations may be shallow or can consist of spectacular dives. Zirrer (1947) describes this flight as wavy gliding approximately 3–6 m above the canopy; at times, pair members are close together and then far apart. Pair members may be silent during the display or may be highly vocal, uttering wails and chatters. White undertail-coverts may also be flared 10 cm on either side of the tail (Beebe 1974). Prey plucking (Schnell 1958), frequent copulations (Møller 1987), and conspicuous perching (Lee 1981) may also serve courtship functions.

Copulation and copulatory displays. From

Møller (1987), Palmer (1988). Copulations are short (9.3 s ± 0.7 SD, n = 10) and frequent; approximately 518 copulations/clutch, among the most numerous reported for birds. High copulation frequency may be an adaptation to help ensure paternity, because male is often away from female when foraging during egg laying. Only one case of extra-pair fertilization reported (Gavin et al. in press). Female solicits copulations by facing away from male with drooped wings and flared tail-coverts. Male, wings drooped and tail-coverts flared, drops from a branch to gain momentum, then swoops upward and mounts her back. Both birds usually call while mating. Two major peaks in copulation frequency, one 30–40 d before laying, the other immediately before and during egg laying. Copulations most frequent in the morning when egg laying occurs; minor activity peak in afternoon. Copulation rate not related to prey delivery rate. *Duration and maintenance of pair bond.* Few data; probably variable. In California, mates retained in 18 of 25 instances when mates were identified in consecutive years (Detrich and Woodbridge 1994). Mate retention similar for both sexes. One male bred with 3 different females during a 6-yr period; 1 female was present in 3 nonconsecutive years. In a 6-yr (1991–1996) mark- recapture study of 107 pairs of nesting goshawks on the Kaibab Plateau, AZ, both mate and territory fidelity were high (R. T. Reynolds and S. M. Joy unpubl. data). Mate retention was 91.3 % (21 of 23 instances in which both pair members were trapped in subsequent years) and 77.8% for females (21 of 27 instances). Only one case of divorce (both hawks confirmed alive in subsequent years). Two males and five females changed territories; none retained mates after move. Annual replacement rate of breeding hawks on territories was 42% for males and 25% for females. However, turnover rate may be high for some populations. In California, 30% of territories (n = 27) were occupied by new females the year following marking, and 23% were occupied by new males (Detrich and Woodbridge 1994).

SOCIAL AND INTERSPECIFIC BEHAVIOR

Degree of sociality. Solitary outside the breeding season. Pair members winter separately (JRS). After fledging, siblings of both sexes remain together as cohesive group near the nest until dispersal (Reynolds and Wight 1978, Kenward et al. 1993b).

Play. Young birds appear to play by "attacking" leaves, sticks, pebbles, and perches (Schnell 1958).

Nonpredatory interspecific interactions. Few data. Associates with other raptors during migration, but not considered social. Mobbed by small birds on occasion. Interactions may occur when nest site is occupied by another raptor.

PREDATION

Will attack Red-tailed Hawks (*Buteo jamaicensis;*, Crannell and DeStefano 1992), Short-eared Owls (*Asio flammeus*; Lindberg 1977), and Great Horned Owls struck when near nests. In Germany, territories defended against con- and interspecifics throughout the year, including Common Buzzards (*Buteo buteo*; Kostrzewa 1991). Raptors killed by Goshawks include Long-eared Owls (*Asio otus*), Tawny Owls (*Strix aluco*), nestling Honey Buzzards (*Pernis apivorus*), nestling and adult Common Buzzards, nestling and adult Sparrowhawks (*Accipiter nisus*), other Goshawks (Kostrzewa 1991), and Red-tailed Hawks (Reynolds et al. 1994). See also Demography and Populations: causes of mortality, below.

CONSERVATION AND MANAGEMENT

EFFECTS OF HUMAN ACTIVITY

Shooting and trapping. In North America, not considered an important mortality factor. Some states, like Pennsylvania, paid $5 bounties on Goshawks in 1930s (Anonymous 1930); the effect that shooting and trapping had on populations during the 1900s is unknown. European populations were more actively persecuted in efforts to protect private game-bird farms. On the Baltic island of Gotland, 36% of mortalities of radio-tagged birds ($n = 67$) were killed by humans (Kenward et al. 1991); juveniles were more likely to be shot than adults.

***Pesticides and other contaminants*.** In early 1970s pesticide levels in U.S. Goshawks were low (Snyder et al. 1973). Eggshell thinning has not been a problem for most populations, although California eggshells (weight and thickness index) pre-1947 (pre-DDT, $n = 23$) to 1947–1964 (DDT in use, $n = 34$) declined 8–12% (Anderson and Hickey 1972). In Illinois, wintering Goshawks during 1972–1973 invasion year contained less organochlorine and PCB residues than did other raptors (Havera and Duzan 1986). These birds were probably from nonagricultural, northern forests. In Sweden, mercury levels in feathers, nineteenth century to 1940, were approximately 2 ppm ($n = 16$); increased to approximately 20 ppm during the 1940–1965 period as methyl mercury was applied as seed dressing (Johnels et al. 1979); dropped after 1966 to approximately 3 ppm ($n = 27$) as alkyl mercury compounds as seed dressings were banned and replaced by alkoxy-alkyl mercury compounds.

***Degradation of habitat*.** Timber harvest is a primary threat to nesting populations (Reynolds 1989, Crocker-Bedford 1990). Each year nests are destroyed by logging operations, but impacts to nesting populations are unknown; breeding densities may be lowered or individuals may redistribute to adjacent areas. Harvest methods that create large areas of reduced forest canopy cover (<35–40%) may be especially detrimental (Bright-Smith and Mannan 1994, Beier and Drennan 1997); some forest managers mistakenly view low forest canopies as desired conditions rather than minimum values (Arizona Game and Fish Department 1993). However, forest harvest may be compatible with Goshawk management provided that habitat needs are provided at multiple spatial scales (Reynolds et al. 1992, see Management, below). In harvest areas where overstory trees were removed but numerous mature stands were retained, birds still nested approximately two-thirds of the time ($n = 14$ yr) and produced typically 2–3 young/nest (Hargis et al. 1994). In California, nesting densities remained fairly high despite fragmentation of mature forests through timber harvest (Woodbridge and Detrich 1994);

however, territories associated with large contiguous forest patches were more consistently occupied compared to highly fragmented stands. Although nesting frequently occurs in areas impacted by timber harvest, the long-term viability of these populations is unknown. In New Jersey and New York, nests were further from human habitation than expected on the basis of available habitat (Speiser and Bosakowski 1987), an observation suggesting that disturbance reduces habitat quality. Winter habitat use is so poorly understood that potential impacts of human activities cannot be assessed.

Sensitivity to disturbance at nest and roost sites. Timbering activities near nests can cause failure, especially during incubation (Anonymous 1989, Boal and Mannan 1994). Logging activities, such as loading and skidding, within 50–100 m of nest can cause abandonment, even with 20-d-old nestlings present (JRS). However, see Zirrer (1947) for descriptions of repeated renesting attempts despite extreme disturbance. Camping near nests has also caused failures ($n = 2$; Speiser 1992).

Research impacts. Disturbances associated with research are usually of short duration, apparently having little impact on nesting birds. Viewing nests for short periods after young have hatched does not cause desertion. Trapping adults during nesting for banding or attaching transmitters apparently does not cause abandonment. The percentage of nesting pairs with radios that successfully raised young (83%, $n = 8$, 1988–1989) was similar to those without radios (82%, $n = 10$, 1987–1990; Austin 1993).

Falconry. Impact of falconry on wild populations is unknown, but thought to be minimal. Has been trained for falconry for at least 2,000 yr; species was favored among Oriental, Middle Eastern, and North European falconers (Cooper 1981) and especially prized by Japanese falconers. Depicted in a ninth-century Bayeux Tapestry where King Harold hunted with hawk and hounds. During the eighteenth century, falconry declined and Goshawks were viewed as competitors for game as guns became available. Since World

War II, interest in falconry has increased and spread to North America. Modern-day falconers value Goshawks for their willingness to hunt a variety of prey and their aggressive dispositions. Members of the British Falconers' Club report a relatively constant annual mortality rate of 22% for captive birds ($n = 216$; Kenward et al. 1981b); most birds died of infectious disease or in accidents when used for hunting. See Beebe (1976) for description of training.

MANAGEMENT

Conservation status. Prior to 1970s, not afforded special management protections. Not currently listed as Endangered or Threatened. In 1991, was designated a "Category II" species of concern by the U.S. Fish and Wildlife Service (FWS), meaning additional information was needed before final listing status was determined; Category II designations eliminated in 1996. In 1993, a petition to list the Queen Charlotte Goshawk subspecies as Endangered was submitted to the FWS. The FWS subsequently found the petition unwarranted on the basis of available data (50 CFR 17). Goshawk is included on the "Sensitive Species" lists of the U.S. Forest Service (USFS) in the Pacific Southwest (1981), Southwest (1982), Intermountain (1992), Rocky Mtns. (1993), and Alaska (1994) regions; Northern, Eastern, and Pacific Northwest regions do not list the species. Sensitive species designation requires biological evaluations to consider potential impacts of proposed management actions. Goshawks are also considered "management indicator" species on many national forests because they are potentially sensitive to habitat change.

In Canada, *A. g. atricapillus* is considered "not at risk" in all provinces on the basis of a recent evaluation; the subspecies *A. g. laingi* is considered "vulnerable" because it has a small population subject to habitat fragmentation on islands (Duncan and Kirk 1994). Considered threatened in Mexico (Estados Unidos Mexicanos 1994).

Measures proposed and taken. Management agencies usually attempt to

reduce disturbance during nesting period by delineating protected areas around nest trees (Reynolds 1983). Crocker- Bedford (1990) found that, between 1985 and 1987, 66% of control nests were reoccupied at least once compared with only 12% of buffered nests. Occupancy was low in both small (1.2–2.4 ha) and large (16–200 ha) buffered nests, a result suggesting that the sizes of buffer areas were inadequate.

Reynolds et al. (1992) developed management recommendations for nesting birds in the sw. U.S. These recommendations describe desired forest conditions for nesting and foraging habitat; especially emphasized are forest conditions for supporting diverse prey populations. Recommendations prescribe habitat conditions at 3 spatial scales—nest, postfledgling areas and foraging areas.

Timber harvest may be used to improve nesting habitat (Reynolds et al. 1992). In some cases, harvest may be necessary to restore forest structure in damaged ecosystems. In the Rocky Mtns., mature lodgepole pine stands are often not recognized as potentially important nesting habitat in management plans; old-growth scoring procedures used by agencies may need modification so that forest structures associated with nesting habitat (often lacking structural complexity) are identified as important habitat components (Squires and Ruggiero 1996).

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