

*Sphyrapicus  
varius*FRENCH:  
*Pic maculé*SPANISH:  
*Carpintero de paso,*  
*Chupasavia*  
*maculado,*  
*Chupasavia vientre-*  
*amarillo*

# Yellow- bellied Sapsucker

**W**idely known in North American folklore for its amusing name, this woodpecker creates shallow holes (sap wells) in the bark of trees and feeds on sap that flows into them. Like other sapsuckers, the Yellow-bellied Sapsucker creates elaborate systems of such sap wells and maintains them daily to ensure sap production, defending the wells from other birds, including other sapsuckers. When feeding young, sapsuckers usually forage for arthropods, especially ants, but some of these prey items are dipped in sap wells, perhaps for added nutritional value.

Sapsuckers appear to play an important ecological role in the communities they inhabit. Many animals make use of sapsucker sap wells to supplement their own food intake with sap itself or with insects attracted to the sap. The Ruby-throated Hummingbird (*Archilochus colubris*) appears to be closely allied with sapsuckers. This hummingbird places its nest near sap wells, follows sapsuckers in their daily movements, and may even time its migration to coincide with that of sapsuckers (Miller and

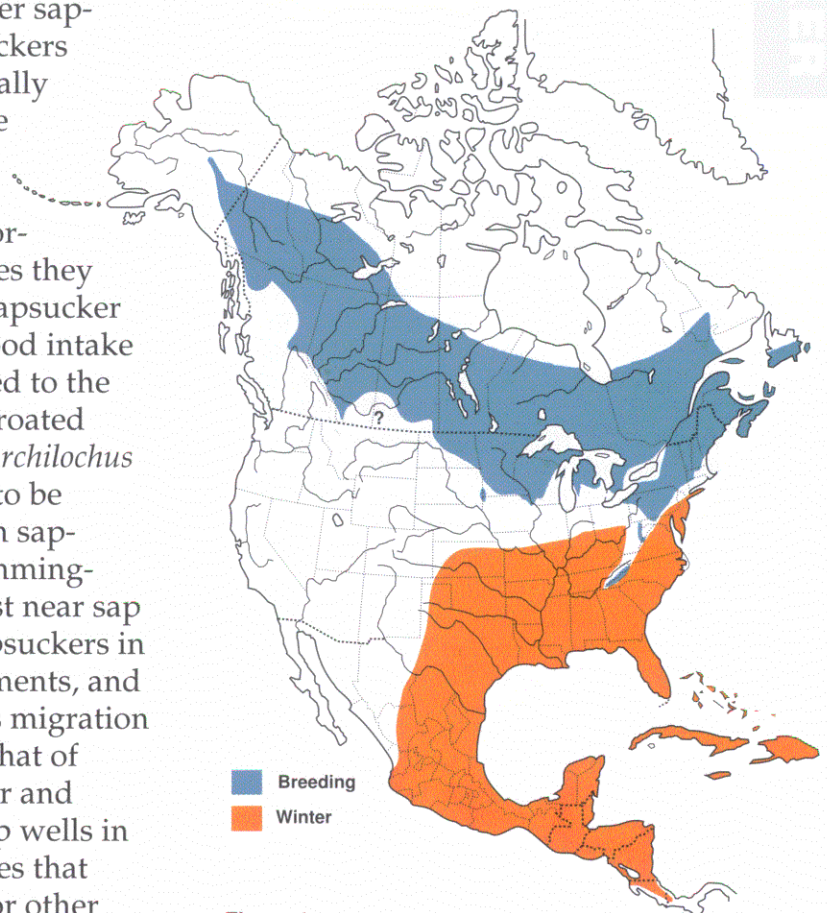
## The Birds of North America

Life Histories for  
the 21st Century

Nero 1983). In addition to drilling sap wells in trees, sapsuckers excavate nest cavities that often provide nesting or roost sites for other species of birds and even some mammals (e.g., northern flying squirrel [*Glaucomys sabrinus*]) that cannot excavate their own.



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**Figure 1.** Distribution of the Yellow-bellied Sapsucker in North and Middle America and the western West Indies. This species also winters in the eastern West Indies. See text for details.

The taxonomic complex comprising the Yellow-bellied, Red-naped (*Sphyrapicus nuchalis*), and Red-breasted (*S. ruber*) sapsuckers has often been treated as a single species with an east-west pattern of increasing amounts of red plumage. The Yellow-bellied Sapsucker, least red, breeds east of the Rocky Mountains; Red-naped Sapsucker breeds in the Rocky Mountain–Great Basin region; and Red-breasted Sapsucker, with its head entirely red, is found along the Pacific Coast. Within this species complex, research has focused on Yellow-bellied Sapsuckers, but the biology of all 3 species is undoubtedly similar (see Walters et al. 2002). Major studies of Yellow-bellied Sapsucker include that of Louise de Kiriline Lawrence, working in Ontario (Lawrence 1967), and Lawrence Kilham, working in New Hampshire (Kilham 1962a, 1971, 1977b, 1983).

### DISTINGUISHING CHARACTERISTICS

Small-medium woodpecker; length about 21–22 cm; mass 43–55 g. Black bib on upper breast, prominent red forehead and crown with black border and band at rear, black stripe alongside of head bordered by 2 white stripes that join at nape, crown red, large white wing-patch formed by median and greater-coverts, back blackish (with yellowish barring), rump white, and underparts buffy or yellow-tinged. Chin and throat mostly red in male, white in female. Some females with reduced or no red on forehead, but otherwise similar to male in plumage and size. Juveniles similar to adults but with black on head and breast replaced by brownish and subdued red-and-white head markings. Juveniles retain brownish plumage until first Prebasic (Postjuvinal) molt (which may not be completed until Mar), during which brown of Juvenal plumage replaced by black coloration of adult.

Most similar to Red-naped Sapsucker, which differs in having red nape; nape of Yellow-bellied Sapsucker white. Additionally, red throat of male Yellow-bellied Sapsucker bordered on sides by broad, black bar; male Red-naped Sapsucker with little or no black border. Female Red-naped Sapsucker with red throat and white chin and may appear very similar to male Yellow-bellied Sapsucker, but distinguished by red nape. Juvenal plumage of both species very similar and identified with caution; Juvenal plumage of Yellow-bellied Sapsucker retained longer and overall coloration paler than Juvenal plumage of Red-naped Sapsucker and with crown brown with yellow scalloping (as compared with crown dark brown to slate with little or no yellow scalloping). Red-breasted

Sapsucker in all plumages has red on face and breast. See Kaufman 1990.

### DISTRIBUTION

#### THE AMERICAS

**Breeding range.** Figure 1. Breeds from se. Alaska (extending northwestward as far as 29 km west of Fairbanks; B. Kessel pers. comm.), sw. Yukon, sw. Northwest Territories (north to Fort Norman, Great Slave Lake; Godfrey 1986), n. Saskatchewan (Uranium City, Milliken Lake, Wollaston Lake; Godfrey 1986, Smith 1996), central Manitoba (Thicket Portage; Bezener and De Smet 2000), n. Ontario (Ney Lake, Attawapiskat, but not Hudson Bay lowland region; Godfrey 1986, Biro 1987), s.-central Quebec (as far north as Eastmain River [52°N] and including Anticosti I.; Paradis 1996), s. Labrador, and central Newfoundland south to ne. British Columbia (Telegraph Creek, Dease Lake, Peace River parklands; Godfrey 1986, Campbell et al. 1990), s. Alberta (in Rocky Mtns. but absent from southeastern plains; Semenchuk 1992), central and se. Saskatchewan (Wingard, Good Spirit Lake, Moose Mtn.; Godfrey 1986, Smith 1996) and breeding status uncertain in Cypress Hills of the southwest where species rare (A. Smith pers. comm.), n.-central and e. North Dakota (east of line joining Ward, Stutsman, and Sargent Cos.; Stewart 1975, R. Martin pers. comm.), extreme e. South Dakota (along Big Sioux River; Peterson 1995), ne. Iowa (confirmed breeding in Allamakee, Clayton, and Winneshiek Cos. and possibly additional areas in n. and e. Iowa; Fleckenstein 1997), sw. and ne. Wisconsin (south to Grant and Door Cos.; Wisconsin Breeding Bird Atlas unpubl.), the central Lower Peninsula of Michigan (Eastman 1991), s. Ontario (south to s. Lake Huron and e. Lake Erie; Biro 1987), ne. Ohio (Ashtabula, Trumbull, Cuyahoga, Geauga, and Lake Cos.; Peterjohn and Rice 1991, T. Leiden pers. comm.), n. Pennsylvania (mostly north of line joining Crawford, Elk, Sullivan, and Pike Cos., but some records south to Westmoreland and Perry Cos.; Gross 1992), w. Maryland (Garrett and Alleghany Cos.; Hilton 1996), extreme nw. New Jersey (breeding confirmed in Sussex Co.; Walsh et al. 1999), se. New York (breeding confirmed south to Sullivan Co.; Levine 1988), nw. Connecticut (Litchfield and Hartford Cos.; Devine and Smith 1994, G. Hanisek pers. comm., M. Szantyr pers. comm.), w. Massachusetts (east to Worcester Co.; Veit and Petersen 1993), New Hampshire (except coastal plain and lower Merrimack River valley; Kilham and Foss 1994), and extreme s. Maine (Adamus 1988). Also locally in Appalachians south to e. West Virginia (probable and possible breeding recently in Pocahontas,

Randolph, and Barbour Cos.; Buckelew and Hall 1994), w. Virginia (Highland and Giles Cos., possibly Rockingham and Augusta Cos.; R. Clapp pers. comm.), e. Tennessee (Great Smoky Mtns. Natl. Park [Sevier and Blount Cos.] and Monroe and Johnson Cos.; Nicholson 1997, C. Nicholson pers. comm.), and w. North Carolina (Alleghany to Swain and Macon Cos.; J. Bulluck pers. comm., M. Johns pers. comm., J. A. Gerwin pers. comm., C. Nicholson pers. comm.). See also Am. Ornithol. Union 1998. Occasionally breeds south to central Illinois (Henderson, Platt, Peoria, and Vermillion Cos.; Bohlen 1989), n. Indiana (3 nesting records since 1900 in Porter, Elkhart, and DeKalb Cos.; Pitcher 1998), and elsewhere just outside main range.

**Hybrid zones.** This species' distribution overlaps with Red-naped Sapsucker in sw. Alberta (from Clearwater River west of Caroline to Porcupine Hills west of Claresholm; J. Hudon pers. comm.), and some hybridization occurs in this area. Yellow-bellied Sapsucker distribution overlaps with Red-breasted Sapsucker in n. British Columbia (near Telegraph Creek and Tupper, near Dawson Creek, southwest to Vanderhoof and Stoner; Campbell et al. 1990).

**Winter range.** Figure 1. From n. Kansas, n. Missouri, central Illinois, central Indiana, central Ohio, se. Pennsylvania, n. New Jersey, and Long I., NY, south (except absent from Appalachian Mtns. south to n. Georgia) through the s. U.S. (west to w. Oklahoma and w.-central Texas), Mexico (except absent from nw. Mexico west of e. Coahuila and e. Jalisco), and Central America to the highlands of Costa Rica (Stiles and Skutch 1989). Rare and irregular in w. and central Panama, where east to e. Panama Province (Ridgely and Gwynne 1989). Rarely winters farther north of these limits (Christmas Bird Count data). Also winters in West Indies, mainly in Bahamas, Cuba, Jamaica, Hispaniola, Cayman Is., and San Andrés; rare on Puerto Rico and Virgin Is. and "vagrant" on St. Martin, St.-Barthélemy, and Dominica (Raffaele et al. 1998). Also rare in California (Small 1994), Bermuda (Amos 1991), and Netherlands Antilles (Am. Ornithol. Union 1998).

Casual or accidental in w. North America from s.-coastal Alaska, Montana, and Colorado south to Arizona and New Mexico, and in the Revillagigedo Is. (Socorro), Mexico. Sight reports for n. Baja California, Mexico (Am. Ornithol. Union 1998).

#### OUTSIDE THE AMERICAS

Three records: Isles of Scilly, England, 26 Sep 1975; County Cork, Ireland, 16 Oct 1988; and Iceland, 5 Jun 1961 (Alström and Colston 1991); accidental in Greenland (4 records, 1845–1934; Boertmann 1994).

#### HISTORICAL CHANGES

Formerly breeding, rarely, as far south as ne. Missouri, with localized breeders occurring in Mississippi River floodplains as far south as St. Louis (Robbins and Easterla 1992, Am. Ornithol. Union 1998). In central Alaska, extensive tree scarring and cross-sections of old trees show feeding scars attributed to sapsuckers (Kessel 1986), but they may actually have been made by Three-toed Woodpeckers (*Picoides tridactylus*; B. Scher pers. comm.).

#### FOSSIL HISTORY

Proximal end of a right humerus from Vero Beach, FL, dated <3,500 yr before present identified as *Sphyrapicus* (Weigel 1962).

### SYSTEMATICS

#### GEOGRAPHIC VARIATION; SUBSPECIES

Generally considered monotypic and treated so here. Individuals from s. Appalachians tend to be smaller and darker than individuals farther north (sometimes identified as *S. v. appalachiensis* Ganier 1954); the name *S. v. atrothorax* (Lesson 1831) has been applied to more northern populations (see Oberholser 1938, Ganier 1954, Rand 1956, Short 1982), but almost complete overlap exists in size and coloration among these populations.

#### RELATED SPECIES

Yellow-bellied, Red-naped, and Red-breasted sapsuckers form closely related complex. Plumage differences among these species consist primarily in amount of red on head. Taxonomic history of this group varied as opinions changed on whether some or all of these forms should be considered specifically distinct. Evidence from distribution, ecology, plumage, assortative mating, and genetics support treating this complex as 3 separate species making up the superspecies *Sphyrapicus varius* (Short 1982; Am. Ornithol. Union 1983, 1985, 1998; Johnson and Zink 1983; Johnson and Johnson 1985; Cicero and Johnson 1995).

Genus *Sphyrapicus* endemic to North America and sister group to *Melanerpes* (Short 1982, Cicero and Johnson 1995). Williamson's Sapsucker (*S. thyroideus*) is sister group to superspecies *S. varius*, but considered fairly distantly related and perhaps not included in *Sphyrapicus* (Johnson and Zink 1983). Yellow-bellied Sapsucker possesses unique anatomical arrangement of hind limb muscle within Piciformes (all 3 parts of *M. iliotibialis lateralis* reduced; Swierczewski and Raikow 1981); condition of this muscle in other sapsucker species unknown. Superspecies *varius* split from common ancestor



with Williamson's Sapsucker during Pliocene, followed by divergence of Yellow-bellied Sapsucker from Red-breasted Sapsucker plus Red-naped Sapsucker in Pleistocene and divergence between Red-breasted and Red-naped sapsuckers subsequent to that (Cicero and Johnson 1995).

## MIGRATION

### NATURE OF MIGRATION IN THE SPECIES

Complete, short- to medium-distance migrant. Annual movement between wintering areas in s. U.S., Mexico, Central America, and West Indies and breeding areas east of Rockies in U.S. and Canada. Females migrate farther south on average than males do (Howell 1953).

### TIMING AND ROUTES OF MIGRATION

*Spring.* Florida, departs Apr (Stevenson and Anderson 1994). Mississippi, about 1 Apr (Wilkins 2001). Missouri, Mar–Apr, peak late Mar–early Apr (Robbins and Easterla 1992). Iowa, late Mar–May, peaks mid-Apr (Kent and Dinsmore 1996). Illinois, Sagamon Co., mean arrival 28 Mar ( $n = 17$  yr), mean departure 28 Apr ( $n = 18$  yr); Cook Co., mean arrival 1 Apr ( $n = 15$  yr), mean departure 11 May ( $n = 20$  yr), latest record 7 Jun (Bohlen 1989). Wisconsin, late Mar to mid-May, peaks 10–25 Apr (Robbins 1991). Massachusetts, mid-Apr to early May (Veit and Petersen 1993). New Hampshire, males early Apr, females late Apr (Kilham 1983). Ontario, mean arrival of males 17 Apr (range 8–24 Apr), females arrive last week of Apr and first week of May (Lawrence 1967). New Brunswick, males arrive mid-Apr to late Apr, females by early May (Gibbon 1970). Alberta, arrives late Apr–early May (Semenchuk 1992). Alaska, arrives 6–10 May (Kessel 1986).

*Fall.* Alberta, departs by early Sep (Semenchuk 1992). Ontario, females depart second to third week of Sep, males last week of Sep and beginning of Oct; peak departure dates from 2 to 25 Sep and last individuals observed 17 Sep–4 Oct (mean 26 Sep; Lawrence 1967). New Hampshire, departs by end of Sep (Kilham 1964). Wisconsin, early Sep–late Oct, most between 20 Sep and 5 Oct (Robbins 1991). Illinois, Cook Co., mean arrival 15 Sep, mean departure 18 Oct ( $n = 16$  yr); Sagamon Co., mean arrival 24 Sep ( $n = 18$  yr; Bohlen 1989). Iowa, most during late Sep to mid-Oct (Kent and Dinsmore 1996). Missouri, peak numbers mid-Oct (Robbins and Easterla 1992). Mississippi, arrives about 1 Oct (Wilkins 2001). Florida, arrives Oct (Stevenson and Anderson 1994).

In California, rare but regular between early Oct and late Mar (Small 1994). South of U.S., occurs late Sep to mid-Apr in Mexico (Howell and Webb 1995), late Oct–late Mar in Costa Rica (Stiles and Skutch

1989), mainly Oct–Apr in West Indies (Raffaele et al. 1998), and mainly early Oct to early to mid-Apr in Bermuda, with extremes 25 Sep and 17 May (Amos 1991).

### MIGRATORY BEHAVIOR

Migrates at night (as indicated by presence in collision mortality at towers and buildings; see Conservation and management: effects of human activity, below). At Kingston, Ontario, 17 Apr 1909, at least 5,000 individuals descended in city, presumably at night, during strong northerly gale after crossing Lake Ontario (Klugh 1909). Migratory flocks of late Oct break up as winter descends (Kilham 1962a). In Florida, well distributed during winter; usually solitary, with no apparent migration peak (Dennis 1951). Generally quiet during migration; often rests motionless on bark of trees; may briefly Drum during fall (Kilham 1962a). In Florida, no Drumming observed during winter (Dennis 1951, ELW), even when playbacks introduced (L. S. Eberhardt pers. comm.).

In spring, previous breeders return before first-time breeders; in fall, juvenile and adult females depart before males, juvenile males usually depart before adult males (Lawrence 1967). Juvenile banded in Sudbury, Ontario, recovered in Don Mills, Ontario, 8 d later; traveled an average 40 km/d (Brewer et al. 2000).

Females more numerous in southern part of wintering range; ratio 3.5 female:1 male in Mexico, Central America, and West Indies (Howell 1953). Males more numerous in northern part of winter range; e.g., of 41 Yellow-bellied Sapsuckers in Nacogdoches, TX, 30 were male, 3 female, and 8 unsexed immature (Beach 1974); of 132 in e.-central Mississippi, 84 were male, 8 female, and 40 unsexed immature (Wilkins 2001); almost all male in Maryland (Kilham 1962a). Immature birds outnumber adults 10:1 in winter in Arkansas (Smith 1915).

### CONTROL AND PHYSIOLOGY

No information.

## HABITAT

### BREEDING RANGE

Favors early-successional tree species for both nesting and feeding (quaking aspen [*Populus tremuloides*], birch [*Betula* sp.], maple [*Acer* sp.]), and mixed-conifer forest, usually along riparian zones up to 2,000 m, especially in quaking aspen and birch (Short 1982, Eberhardt 1994, Winkler et al. 1995). In New Brunswick, found in scattered open stands of red maple (*A. rubrum*), yellow birch (*B. lutea*), and paper birch (*B. papyrifera*) that remain

after harvest of dominant red spruce and balsam fir; common in this extensively cut habitat but absent from dense conifer stands and scarce along hardwood slopes (Gibbon 1970). In n. Michigan, abundant in relatively young forests which grew up after extensive timber harvest; unlike most woodpeckers that are influenced by availability of dead snags for nesting or feeding, Yellow-bellied Sapsucker has very specific habitat requirements for young forests (Eberhardt 1994).

#### SPRING AND FALL MIGRATION

Found in diverse woodlands, orchards, lowlands, coastal palm groves, and scrublands (Short 1982, Winkler et al. 1995).

#### WINTER RANGE

Usually not in pure-conifer stands but in forest edge and various semiopen habitats, mainly in montane areas from 900 to 3,000 m (Winkler et al. 1995). Bottomland hardwood forests in e. Texas important during fall and winter (Beach 1974, Shackelford and Conner 1997). In Mississippi, densities highest in bottomland hardwood stands, especially in areas with hickories (*Carya* sp.; Wilkins 2001). In Florida, found in diverse array of habitats including developed areas, turkey oaks (*Quercus laevis*), longleaf pine (*Pinus palustris*) flatwoods, swamp areas, xeric hammock, mesic hammock, and sand pine (*P. clausa*); most likely found in areas with sweetgum (*Liquidambar styraciflua*), live oak (*Q. virginiana*), and laurel oak (*Q. laurifolia*) trees (Dennis 1951). In Oaxaca, Mexico, found primarily in humid pine-oak forest but also tropical semi-deciduous forest (Binford 1989). In Cuba, more frequently found in human-modified habitat than in natural vegetation from sea level to 1,000 m (Kreisel 1974).

### FOOD HABITS

#### FEEDING

**Main foods taken.** Sap, fruit, and arthropods (Beal 1911).

**Microhabitat for foraging.** Usually in trees. Sap wells recorded in about 1,000 species of perennial woody plants (McAtee 1911, Tate 1969). In early spring, sap wells made into xylem tissues to feed on sap moving upward; after deciduous species leaf out, sap wells tap phloem tissues (Foster and Tate 1966; see below). Most sap wells placed on trunk near base of crown (Erdmann and Oberg 1974), or on trunk above lowest living branches (Wilkins 2001), 85% constructed above scars from old wounds (Eberhardt 1994). Most insects gleaned from bark of trees (Gibbon 1970). When foraging for insects in

colder climates, individuals pry insects from under bark scales in manner of *Picoidea* woodpeckers (Tate 1973). Frequently captures insects in the air; generally flies out from a large branch to do so (Williams 1980). As buds leaf out of quaking aspen, sapsucker will move to outermost branches and feed on buds; hangs on branch tips in a manner resembling chickadees (*Poecile* sp.) and removes buds one at a time (Tate 1973). In winter, found almost exclusively on live trees (Wilkins 2001).

**Food capture and consumption.** Gleans, probes, scales bark, pounds, pecks, and drills during feeding. Most foraging time associated with sap well construction and maintenance (28% drilling for sap and 14% probing for sap; Williams 1975). Individual observed working wells on 1 tree for 1.5–2 h at a time (McGuire 1932). Time devoted to sapsucking tends to increase during time of molt (Lawrence 1967). Wintering birds in e. Texas spent 71.4% of their foraging time ( $n = 357$  min) making sap wells (Beach 1974).

Sap is obtained from both xylem and phloem tissues of a plant. In winter, angiosperm phloem storage cell contents 1–5% sugar; during summer, phloem sap of deciduous trees may be 20–25% sugar (Tate 1973). Sugar concentration of sap of paper birch  $16\% \pm 4.6$  SD (range 9–28,  $n = 94$ ; Southwick and Southwick 1980), yellow birch 17.0–20.0% (Kilham 1964), and hickory 6.4–11.1% ( $n = 28$ ; Williams 1980). In Michigan, sugar concentration in late Apr for sap of elm (*Ulmus* sp.), maple, and oak averaged 3.1% ( $n = 12$ ; Tate 1973); in early May sap of sugar maple (*A. saccharum*) 2.1% (Ohman and Kessler 1964); and in early spring for maple and birch, 1.9% ( $n = 10$ ; Eberhardt 1994).

Xylem well made by creating round hole (about  $4.0 \times 4.8$  mm;  $n = 6$ ) that penetrates through phloem to xylem layer; these wells are not enlarged but remain as circular well into which sapsucker inserts bill to probe plant's sapwood and xylem conducting tissues; xylem wells arranged in short horizontal rows of 3–15 small holes (Eberhardt 1994).

Phloem wells begin as lateral slits penetrating into the phloem; these expanded up tree to form a rectangle (mean size  $7.2 \times 10.6$  mm [range  $2 \times 4$  to  $17 \times 23$ ;  $n = 491$ ; Eberhardt 1994]; new slits made above previously used wells, and this process continues up the tree (Southwick and Southwick 1980); active well may be expanded as far as 20 cm vertically in 3 wk (Bolles 1891). Phloem wells must be continually maintained for sap to flow; individual licks sap with tongue, also eats cambium and phloem. Most sap wells placed on trunk near level of first branching (Erdmann and Oberg 1974), but some on large branches (mean height  $7.1 \text{ m} \pm 3.5$  SD [ $n = 19$ ]; Eberhardt 2000). In winter in e.-central Mississippi, foraged at mean height of  $11.2 \text{ m} \pm 6.3$  SD (range 0.5–

31,  $n = 986$  observations) on trees with mean height of  $28.5 \text{ m} \pm 8.5 \text{ SD}$  (range 11–48,  $n = 67$  trees) and mean dbh of  $42.4 \text{ cm} \pm 18.8 \text{ SD}$  (range 13.0–95.7,  $n = 73$  trees); sucrose concentrations higher above wounds on girdled trees than below (Wilkins 2001, H. D. Wilkins pers. comm.). Most (85%) sap wells constructed above scars left in phloem as result of old wounds (Eberhardt 1994). Sap well usually created 0.5 cm above previous well, enlarged for several consecutive days, and sap collected for average of  $3.1 \text{ d} \pm 1.8 \text{ SD}$  ( $n = 51$  holes) before sap flow stops; individual creates 2–20 new holes/d (Eberhardt 2000). In Michigan, 1 male drilled 129 holes in Scotch pine (*Pinus sylvestris*) during 335 min; female drilled 286 holes in 567 min; average for single pair was 3,060 holes/yr drilled in birches for 3 yr (Tate 1973). During winter, moves constantly and rarely uses same tree for >1 wk (H. D. Wilkins pers. comm.).

Twice observed to feed from resin wells of Red-cockaded Woodpecker (*Picoides borealis*) in longleaf and loblolly pine (*P. taeda*; Rudolph et al. 1991).

When foraging for insects, foraging technique varies with prey type. Most insects captured in crowns and boles close to sap wells (Foster and Tate 1966). Insects taken by scaling (removing bark by lateral blows to reveal prey) or hawking (fly-catching; catching prey in flight) from large limbs (Lawrence 1967, Williams 1975).

#### DIET

**Major food items.** Sap (from variety of perennial plant species), insects, also bast (inner bark [cork cambium, phloem] and cambium layers), fruit, and seeds (Beal 1911).

**Quantitative analysis.** Based on analysis of 313 stomach contents (including some Red-naped Sapsuckers; Beal 1911), 50.7% plant matter and 49.3% animal matter; of plant material, 28.1% of total food matter fruit (71.3% of diet in Nov), 16.5% cambium, and 6.1% miscellaneous plant parts; of animal matter, 34.3% of total food matter ants (Formicidae; 68% for May–Aug), 6.0% beetles (Coleoptera), 5.4% spiders (Araneida) and miscellaneous insects (mayflies [Ephemeroptera]; stoneflies [Plecoptera]; grasshoppers, crickets and tree hoppers [Orthoptera]; caterpillars and moths [Lepidoptera]; and flies [Diptera]), 2.6% wasps (Hymenoptera), and <1% true bugs (Hemiptera). Diet appears to shift according to time of year (see Food selection and storage, below). Cambium ingestion peaked in Apr, representing 48% of diet at that time, but analyses conservative since much fluid passes almost immediately out of stomach prior to stomach-content analysis (Beal 1911). Sap probably makes up 20% of diet annually (Short 1982), but at times may be 100% of diet (L. S. Eberhardt pers. comm.).

#### FOOD SELECTION AND STORAGE

For wells, selects wounded or weakened trees; may choose trees that are oozing sap due to damage from disease, wind, lightning, human activity, or insects (Lawrence 1967) or may choose older trees with fungal infection (Ohman and Kessler 1964). Deciduous trees used for sap wells throughout most of summer (red maple from May to mid-Jun; birch from Apr to Oct; Rushmore 1969) and in early fall switches to red oaks (*Quercus rubra*), apple trees (*Malus* sp.), maples, and other rough-barked species, and also forages on fruit (Kilham 1964, Tate 1973). Insect prey taken as available: Geometridae larvae in Apr; carpenter ants (*Camponotus* sp.) in May and Jun; followed by mayflies, beetles, and spruce budworm larvae (*Choristoneura fumiferana*); and then moths and dragonflies (Odonata) into Jul (Lawrence 1967, Gibbon 1970). Sap wells made during migration; northernmost wintering individuals forage mainly on arthropods found in bark on trees, frozen fruit, and sap; farther south, individuals drill xylem wells and attend them for hours (Tate 1973, Williams 1980); often on hickory, oaks, and elms (Wilkins 2001).

Wintering sapsuckers in Texas observed storing pecans (*Carya illinoensis*) in crevice on branch stub and utility pole, magnolia (*Magnolia* sp.) fruit in crevice of elm, and acorns in elm (Conner and Kroll 1979). Captive sapsucker tried to store a chip of wood in different holes (Kilham 1963).

#### NUTRITION AND ENERGETICS

Xylem sap usually 2–3% sucrose; phloem sap >10% sucrose (L. S. Eberhardt pers. comm.). Sapsuckers prefer trees that yield higher sucrose concentrations versus trees that have higher sap flow rates (Eberhardt 1994). During migration in central Illinois, preferred hickory trees that were both higher in sugar content and sap flow than other available trees (Williams 1980).

#### METABOLISM AND TEMPERATURE REGULATION

Based on standard metabolic equations, a 47.6-g sapsucker requires 85.2 kJ/d, which can be obtained by consuming 299.4 ml of xylem sap that contains 1.9% sucrose; if sap flow is 1.29 ml/min, this individual needs to consume 1 h sap production from each of 4 sap wells (Eberhardt 1994; see also Wilkins 2001).

#### DRINKING, PELLET-CASTING, AND DEFECATION

Probably obtains most of its water by feeding at sap wells. No information on pellet-casting. Individual observed mid-Apr defecating at rate of 1.13 times/min, producing clear, faintly brown liquid containing 0.28% sugar; sap from wells in vicinity contained 3.04–3.86% sugar (Tate 1973); another

individual defecated at rate 0.43 times/min ( $n = 4$ ) producing fecal material containing 0.25% sugar (sap from wells contained 3.25% sugar; Eberhardt 1994); a female excreted 7.32 ml of fecal material in 30 min (Eberhardt 1994). In winter, defecated at rate of 0.1 times/min ( $n = 194$  min; Wilkins 2001). When ingesting excavated material while making sap wells, excrement consists of dry, splintery feces (Tate 1973).

## SOUNDS

### VOCALIZATIONS

Most intensive study of vocalizations (though without spectrographic analysis) for this species by Lawrence (1967). All call types likely homologous to those described in greater detail for Red-breasted and Red-naped sapsuckers (Walters et al. 2002).

**Development.** All information from Lawrence 1967. Soft calls given early in life, audible to humans by pressing ear against trunk of nesting tree. Calls become louder and nearly incessant as chicks mature, so can be heard over long distance by humans. Young chicks' *we-we-we-we* calls change to *ju-ju-ju-ju* over development; resemble soft Interaction Calls (see below) by time of fledging. These Nestling Calls (Chatter Notes) given almost continuously by nestlings when awake during daylight hours, so humans often can easily locate nests with loudly calling older nestlings. Calls vary greatly in structure and tempo at any point in development; several distinctive vocal forms likely exist. Generally only 1 nestling calls at a time (Gibbon 1970). Juvenile version of *Waa* Call (see below) uttered on day of emergence; functions to communicate location of dependent juveniles and as food call. Juveniles give this call type until they are independent of parents.

**Vocal array.** Most behavioral information from Lawrence 1967. Terminology here follows that for Red-breasted and Red-naped sapsuckers (Walters et al. 2002) with equivalent nomenclature from Lawrence (1967), Kilham (1962a, 1983), and Short (1982) also listed. Physical and quantitative descriptions based on Short (1982) and spectrograms included here.

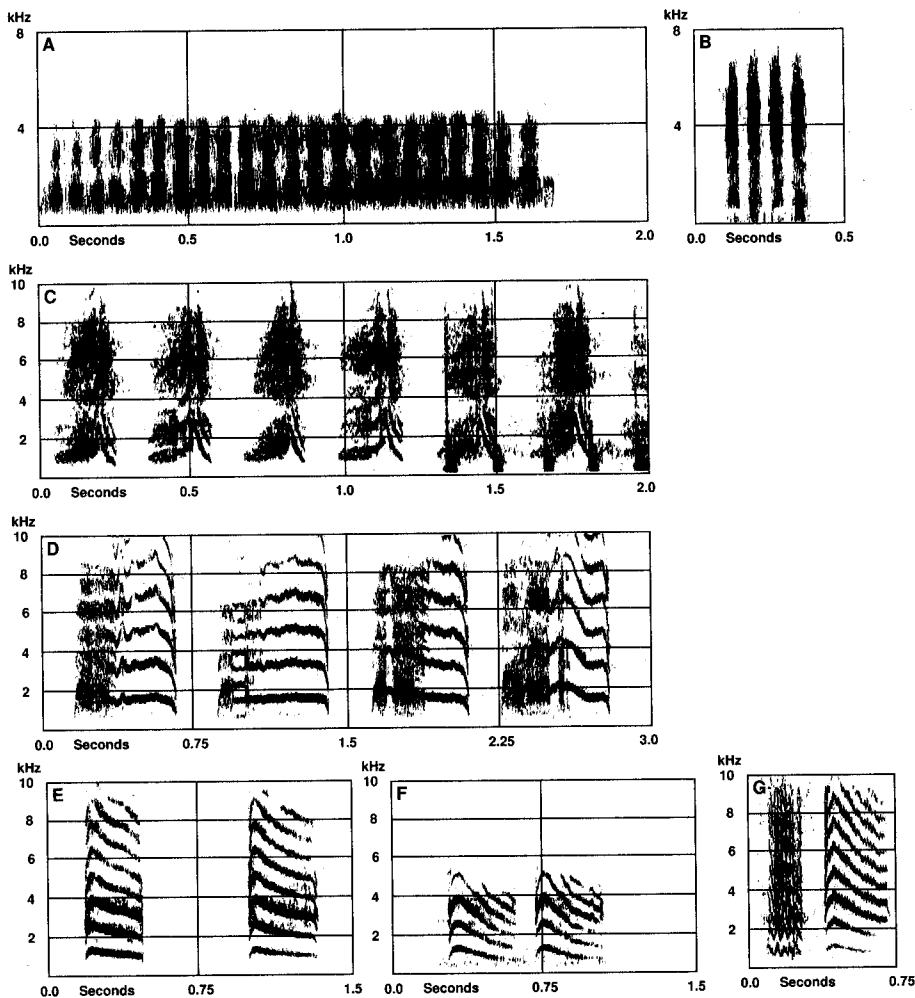
**DRY CHATTER CALL** (Loud Flight Notes ["like the whine of a toy jet plane;" Lawrence 1967: 42]). See Figures 2A–B. Comprises series of rapidly repeated broadband elements (repetition rate 12–14/s), each 40–50 ms long, with fundamental frequency at 1.3–1.6 kHz, and intervals between elements of about 30 ms. Dry Chatter noted during moth-flight display (see Behavior: agonistic behavior, below) in interactions between territorial bird and intruder or between paired birds early in breeding period;

reported to be given by both sexes (Lawrence 1967) or only males (Gibbon 1970).

**INTERACTION-CALL COMPLEX.** Figure 2C. Complex of intergrading vocalizations used by interacting birds, ranging from loud calls used in agonistic interactions to soft short-distance calls. Includes Self-Announcing Location Note (*weetick-weetick*) and Aggressive-Social Notes (*juk-juk-juk*) of Lawrence (1967: 19; Fig. 2C). Uttered in rhythmic sequence at rate of 2 or 3 calls/s. Each call begins and usually ends with broadband noisy section; fundamental frequency rises rapidly to and declines rapidly after peak of 2.5–2.8 kHz; duration 200–230 ms; intervals between calls about 100 ms. Substantial energy in noise and harmonics to about 9 kHz. Self-Announcing Location Note given only in flight by territorial bird when supplanting or chasing conspecific intruder. Aggressive-Social Notes invariable part of aggressive-social displays between sapsuckers not in same family, sometimes also toward other woodpecker species. Variable soft Interaction Calls (Mutual Recognition [Contact] Notes, Lawrence 1967: 20) extremely common, invariably given by mates or family members (after fledging) whenever birds meet or approach one another; especially common between mates near nest; e.g., during approach or changeover during incubation. Nestlings learn to associate this call type with presence of adults and being fed, and adults delivering food to old nestlings commonly stop near nest tree and utter this call, so after fledging, the call functions to attract fledglings to parents with food (Lawrence 1967, Gibbon 1970). Mutual Recognition (Contact) Notes equivalent to *week week*, *wurp wurp* Intimate Notes of Kilham (1962a: 31), "loud, scratchy *quirk, quirk*" Intimate Notes of Kilham in early part of breeding season (1962a: 31) and *week-week* call of Short (1982: 174).

**SCREAM CALL** (1 of 2 High-Intensity Alarm Notes [Lawrence 1967: 23]). Figure 2D. Variable but generally characterized by harmonic richness (to >10 kHz), broadband noise, and varied frequency modulations. Fundamental frequency range 1.0–2.3 kHz; duration 450–550 ms; intervals in continuous call series 190–220 ms. Scream Call uttered repeatedly when adult breeding bird handled, as during banding; often punctuated by struggling or pecking at hand.

**SQUEAL CALL** (Location Call [*owee-owee, weeyaah*, or *wee-wee-wee-wee*; "recalls the sound of air slipping from pumping bellows"; Lawrence 1967: 19]; Breeding Call ["high-pitched *kwee-urk, kwee-urk*"; Kilham 1962a: 31]; Squalling Weep Call [*weep, wee-urp*, or *kwee-urk*; Short 1982: 174]). Call comprises 6–10 rhythmically repeated elements delivered at rate of 1.5–2.0 elements/s. Each element approximately of constant frequency (at about 2.3 kHz) in middle,



**Figure 2.** Vocalizations of Yellow-bellied Sapsucker. **A.** Dry Chatter (Macaulay Library of Natural Sounds [LNS], Cornell University, no. 6959; recorded 27 Apr 1964 in Tompkins Co., NY). **B.** Dry Chatter (4 elements from middle of call; LNS no. 6955; 27 May 1959 in Tompkins Co., NY). **C.** Interaction Call sequence (Aggressive-Social Notes of Lawrence 1967); note soft Drumming by other interacting bird (female?) at start of fifth element (LNS no. 6955). **D.** Scream Call sequence (Borror Laboratory of Bioacoustics [BLB] no. 17603; 21 Oct 1990 in Franklin Co., OH). **E.** Waa Call (2-call sequence with natural interval shown; LNS no. 23876; 3 Jan 1981 in W. Feliciana Parish, LA). **F.** Waa Call (successive calls from longer series; interval between calls arbitrary; LNS no. 26776; 25 Jun 1979 in Avery Co., NC). **G.** Harsh Waa and Waa calls (successive calls from longer series; interval between calls arbitrary; BLB no. 5051; 30 Apr 1961 in Franklin Co., OH). Prepared by EHM using a Kay Elemetrics Computerized Speech Lab 4100 with 162 Hz effective frequency resolution and 200-point FFT transform size for A and B, 126 Hz effective frequency resolution and 256-point FFT transform size for C-G.

with no harmonics (Short 1982). Squeal Call most common early in nesting cycle with brief recrudescence when young about to fledge; mainly uttered by males; frequently elicits Squeal Call, Drumming, or flight approach toward caller by conspecific bird (e.g., approach by female to male calling on copulation branch; Lawrence 1967, Gibbon 1970). Given by both sexes and commonly alternates with or "used interchangeably" with Drumming (Lawrence 1967: 50, Gibbon 1970). Squeal Calls may also be given by unpaired males attempting to attract female over short distance (such as to previous year's cavity; Kilham 1983).

**WAA CALL** (Low-Intensity Alert Call [view; Lawrence 1967: 19]; Disturbed Note [c-waan; Kilham 1962a: 31]; Call Note [chee-aa or c-waan; Short 1982: 174]). Figures 2E-G. Call commonly repeated; declines progressively in frequency. Peak fundamental frequency of 1.2–1.3 kHz; duration 290–325 ms or 400–600 ms (Short 1982); intervals between successive calls 325–525 ms. Brief variant of Waa Call (Harsh Waa) commonly recognized as distinct

call type but intergradation links the forms (see first call in Fig. 2G); this Harsh Waa variant same as 1 of 2 High-Intensity Alarm Notes ("loud hoarse view"; Lawrence 1967: 19); High-Intensity Disturbed Note ("shrill quarr"; Kilham 1962a: 31); Chur Call (chur or quarr; Short 1982: 174). Harsh Waa Call declines progressively in carrier frequency; duration 0.2–0.3s, with strong rhythmic modulation of carrier frequency. Waa Call with broad contextual use but always seems to signal "alertness to danger, to the unexpected, unusual, or strange," such as sudden detection of another animal (not just predators) or of changes to familiar (human-provided) feeding stations (Lawrence 1967: 19). Harsh Waa Call contextually similar to Waa Call but given most often around time when young emerge from nest, especially in taking flight or in making short flights (e.g., in presence of human observer), hence seems to be high-intensity extreme form of Waa Call.

**Geographic variation.** No variation described.

**Phenology.** Most sounds used only in breeding season, but some (at least Drums, Squeals) also



given by individuals migrating north (Lawrence 1967). *Waa* Calls given year-round though less frequently in migration and on wintering grounds than during breeding season (Bent 1939, Dennis 1951). Increases in Drums, Squeal Calls, and Harsh *Waa* Calls occur around hatching, and males that lose mates early in breeding season exhibit resurgence of Drums and Squeals (Lawrence 1967). Unpaired males presumably responsible for most Drums and Squeal Calls after incubation begins. No Drumming in winter (L. S. Eberhardt pers. comm.).

**Daily pattern.** No information.

**Places of vocalizing.** Most sounds produced when sapsuckers on trees but Harsh *Waa* Calls and some *Waa* Calls given aerially. Interaction Calls often occur during flight (e.g., when one bird follows another) and Dry Chatter Calls given only in flight (Lawrence 1967, Gibbon 1970). During breeding season, *Waa* Calls given most often near nest. Dry Chatter Calls given by birds leaving presence of mate or of other individual following interaction (Lawrence 1967, Gibbon 1970). Squeal Calls often occur with Drums, so are uttered at Drumming posts. Short-Range Interaction Calls given on nest tree (e.g., by hole during many exchanges), on nearby trees, or wherever family members meet. In one study, Drumming did not occur on feeding or nesting sites ( $n = 142$  Drumming bouts) but on selected surfaces that produced loudest sounds when struck; these sites mainly (81% of bouts) dead branches on living quaking aspen and also big old pine stumps (8%), dead wood of other tree species (7%), or human-made structures (e.g., metal boat, telephone pole; 4%; Eberhardt 1997).

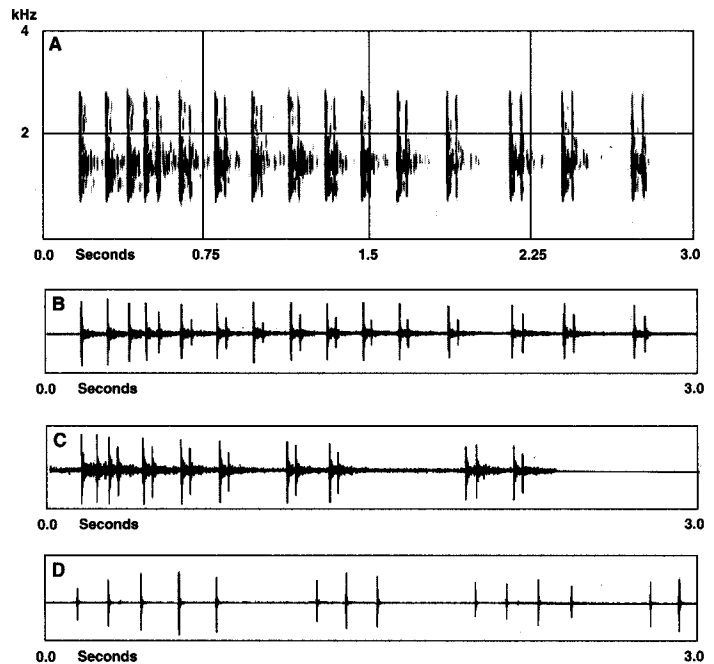
**Repertoire and delivery of songs.** Notion of "song repertoire" does not apply to woodpeckers, unless several different Drumming modes occur (an unstudied possibility). Squeal Calls and Drumming usually occur in bouts and often occur in mixed bouts (Lawrence 1967).

**Social context and presumed functions.** See above.

#### NONVOCAL SOUNDS

Nonvocal sounds include sounds produced by bill striking various substrates and by wings during display flights. Even incidental sounds of feeding and locomotion that are not specialized for communication can be communicatively significant because they are informative to conspecific birds (e.g. wing-beat sounds in takeoff).

**DRUMMING.** (Fig. 3A–C). Produced by striking substrate rapidly and forcefully with tip of bill. Drums usually begin with several rapidly repeated strikes in an "introductory roll" (often increasing in rate of striking within the roll), followed by a



**Figure 3.** Nonvocal acoustic signals of Yellow-bellied Sapsucker. A. Drum (spectrogram; LNS no. 6957; 3 Jun 1962 in Essex Co., NY). B. Drum (waveform; same recording as A). C. Drum (waveform; LNS no. 26158; 26 Jun 1980 in Hancock Co., ME). D. Feeding sounds (waveform; LNS no. 6954; 26 May 1959 in Tompkins Co., NY). Prepared by EHM with Kay Elemetrics Computerized Speech Lab 4100. For A, effective frequency resolution 126 Hz, 256-point FFT transform size.

pause, then more strikes in irregular cadence (Short 1982, Kaiser 1990). Among woodpeckers, drum of all sapsucker species notable for "slowness and irregularity" (Short 1982: 174). In Yellow-bellied Sapsucker, Drums highly variable in duration and temporal patterning, even successive Drums by undisturbed birds. Amplitude and frequency characteristics strongly influenced by local habitat (e.g., many echoes in forest; Fig. 3A) and nature of surface being struck (often highly resonant; Dennis 1964). For example, Drums are of higher amplitude, lower frequency, and greater resonance on favored Drumming sites than on neighboring trees (Eberhardt 1994, 1997). Drums characteristically exhibit couplets following the introductory roll (Short 1982; Fig. 3A–3C), possibly because bill held close to Drumming surface after each strike so that elastic surface of substrate strikes bill tip; brief uniform interval (<10 ms) within couplets makes it unlikely that Drumming birds strike surface twice in rapid succession (compare with feeding sounds, Fig. 3D). Short (1982) reported rate of striking of 4–6/s. Discrepancies on number of strikes and rate of striking across studies may be due to differences in recognizing couplets as 1 or 2 strikes.

Most Drumming by males; females also Drum but less frequently, more softly, more briefly (Law-

rence 1967, Gibbon 1970). Influences of habitat and substrate on Drum structure, coupled with individual differences, make it likely that Drums provide important information to prospecting females and to competing males about both local environment and individual identity.

Drum has some things in common with Squeal: both are long-distance signals given mainly by males, occur mainly early in breeding season, and recur if male loses its mate. Thus, like Squeal, Drumming likely serves to simultaneously attract mates and communicate presence in and occupancy of an area to competing males. Some important functions of Drumming for males seem to be related to obtaining mate and to sexual activity. Males do not Drum on nesting or feeding trees and heavily favor only 1 or 2 Drumming sites (Eberhardt 1994, 1997). Drumming occurs in many other social interactions, too: counter-drumming between males or between an interacting male and female, for example. Full understanding of functions of Drums must consider these dynamic social interactions and the different roles males and females have within them.

**RITUALIZED TAPPING.** Given by both sexes in rhythmically repeated bouts. Ritualized Tapping occurs during excavation, when bird present at nest hole begins to tap (generally at hole's lower rim) in stilted and exaggerated manner upon arrival of relieving bird; also occurs within nest cavity if excavating bird is there when mate arrives. Ritualized Tapping declines over excavation period but also common later in encounters between mates, such as during changeover for incubation.

**DISPLACEMENT TAPPING.** Given by both sexes. Tempo resembles pattern of feeding birds (Lawrence 1967). Resembles Ritualized Tapping during changeover at nest in being executed stiffly and taking place at single location. During incubation or brooding, relieving bird often taps 1 to several times at 1 to several places on nest tree before or as approaching nest hole. During incubation or brooding, attending adult occasionally taps inside nest cavity (apparently unrelated to presence of nearby mate) which may just reflect maintenance or enlargement of nest cavity. Displacement Tapping also occurs in other diverse circumstances: agonistic interactions with conspecific birds; interactions between sexes early in pair formation; after arrival at feeding station occupied by other birds; or when interrupted in an activity (e.g., when returning to nest with food) by arrival of human.

**FEEDING AND EXCAVATION SOUNDS** (Fig. 3D). Tapping in context of feeding or excavation variable in amplitude and temporal pattern, depending on activity (e.g., boring for food, drilling new sap wells, maintaining or enlarging existing sap wells) and

nature of substrate. However, all such tapping includes some bouts of rhythmically repeated strikes. Excavating sapsuckers can sometimes be detected by humans over distances of tens of meters by sounds of excavation. Exploratory tapping also occurs frequently, in testing surfaces for Drumming, drilling, and excavation; exploratory tapping tends to be soft and of irregular cadence, with occasional brief bouts of rhythmically repeated strikes.

**WING SOUNDS.** Three kinds of communicative wing sounds produced. Wing-clapping occurs when ordinary flight occasionally punctuated by loud clapping of wings (Lawrence 1967), Winnow is snipe-like winnow produced only when bird is in flight (Kilham 1962a) and may be produced in conjunction with Moth Flight (see Behavior: agonistic behavior, below; Gibbon 1970), and Ruffle occurs when wings produce noise as they beat rapidly and with shallow amplitude (Kilham 1962a).

## BEHAVIOR

### LOCOMOTION

**Walking, hopping, climbing, etc.** Hops ("hitches") vertically up and down tree trunks as well as when moving laterally (e.g., when approaching a nest hole from the side); also hops on horizontal limbs, rail fences, or when feeding on ants on ground (Lawrence 1967).

**Flight.** Intermittent flight widespread in woodpeckers; sapsuckers share this mode of flap-bounding flight (ELW; see also Walters et al. 2002): flight characterized by vertical undulations in flight path caused by alternating flapping and nonflapping phases, with wings held fully flexed during nonflapping phase (Tobalske 1996). This manner of flight elaborated in ritualized "exaggerated bouncing flight" display (Lawrence 1967). Sapsuckers are skilled flyers, as evident from conspecific high-speed chases through vegetation; also spend much time fly-catching in spring and summer (Bent 1939, Foster and Tate 1966, Lawrence 1967, Williams 1975).

**Swimming and diving.** Not known to swim.

### SELF-MAINTENANCE

**Preening, head-scratching, stretching, bathing, anting, etc.** Maintenance behavior based on aviary observations (Kilham 1983) and wild birds (Lawrence 1967). Scratches head directly (i.e., without lowering the wing; Kilham 1983: Fig. 54). Performs unilateral "leg-wing stretch" with only wing extended its full length down and back and ipsilateral foot remains on substrate or moves only short distance to secure better grip. One or both wings

stretched dorsally partly (Kilham 1983: Fig. 52) or fully. Legs stretched posteriorly singly or (rarely) both if individual rests on belly on horizontal branch. Sapsucker picks with bill deep within contour feathers of breast, shoulders, wing-coverts, and base of tail; rectrices and remiges drawn through bill. Occasionally bird rubs bill against preen gland then rubs foot, which may function to transfer oil to head via scratching. Preening bouts typically punctuated by shaking and fluffing plumage. Female preens more than male during nest excavation. Bathing rarely observed; individual in bird bath splashed vigorously with both wings and then sat deeply immersed for about 30 s before flying off without shaking (Lawrence 1967). Young male observed panting and possibly anting on rock on hot day, then resting on lower belly, braced by tail, with feet and spread wings extended forward; this posture held for about 30 s; male then preened and flew away (Lawrence 1967).

**Sleeping, roosting, sunbathing.** As in other woodpeckers, male sleeps in nest cavity during excavation, incubation, and when nestlings are young (Kilham 1962a, Lawrence 1967, Short 1982). Female roosts outside of cavities (Lawrence 1967). Roosting habits during migration unknown. Old cavities sometimes used by males during inclement weather while excavating nest cavity; females usually feed or cling quietly to trunk of tree during these periods (Gibbon 1970). Does not use cavities during nonbreeding season (ELW). During sunbathing, fully fluffs nape-, dorsal-, and scapular-feathers, orients back toward sun, and partly spreads wings and sometimes tail; if on horizontal surface may extend both legs posteriorly; this posture held for at least several minutes.

**Daily time budget.** Few data available. In central Illinois, 144 min of foraging behavior between Feb and Jun partitioned as 41.5% perching, 27.9% drilling for sap, 14.0% probing in bark, 9.9% scaling, and 0.4% hawking insects (Williams 1975). In e-central Mississippi, 1,067 of 1,965 observations (gathered during 132 sessions recording behavior at 30-s intervals, each session up to 15 min) were of individuals attending sap wells followed by vigilance ( $n = 242$ ), hitching ( $n = 212$ ), and flying ( $n = 77$ ; Wilkins 2001, H. D. Wilkins pers. comm.).

#### AGONISTIC BEHAVIOR

**Physical interactions.** Both sexes engage in agonistic behavior in vicinity of nest, near mate, and at sap wells; greatest intensity and frequency of engagements occur early in nesting cycle.

**Communicative interactions.** Striking ritualized postures and movements used in agonistic (and sexual) behavior, and involve complex vocalizations and both static and dynamic optical signals from

plumage. Descriptions of displays and postures based on behavioral inventory compiled in Short 1982 and descriptions from Lawrence 1967 and Short 1982.

**BILL-DIRECTING POSTURE.** At greatest intensity, bill points horizontally at other bird, head stretches forward, with body and tail aligned with head and bill. Considered threatening.

**BILL-RAISED POSTURE.** Individual raises bill upward, sometimes beyond 90° vertical; posture displays throat-patch, orients bill away from opponent; considered submissive.

**BOWING DISPLAY.** Involves both raising (Bill-Raised Posture) and lowering (Bill-Directing Posture) head, with emphasis on lowering movements; more often between sexes than to another individual of same sex.

**HEAD-SWINGING.** Ritualized and repetitive side-to-side motion of head, involving Bill-Directing and Bill-Raised postures; used in aggressive same-sex encounters.

**WING-FLICKING.** Rapid flick out and in of one or both wings; used in agonistic encounters.

**WING-DROOP POSTURE.** Modification of Wing-Flicking; wings held away from body and wrists dropped with wing tips lifted and crossing over rump.

**CREST-RAISING.** Posterior crown-feathers erected; used in aggressive encounters.

**THROAT-FLUFFING.** Feathers of throat (red in male; white in female) spread and displayed to opponent or prospective mate; incorporated as part of Bill-Raised Posture. Both Crest-Raising and Throat-Fluffing occur also when mates meet during incubation exchanges or when feeding young and when Drumming (Lawrence 1967: Fig. 6).

**AGGRESSIVE-SOCIAL DISPLAY** (Lawrence 1967: Fig. 2). Aggregate of movements and postures. Individuals face each other with head and bill pointed upward and swing stiffly from side to side in an arc (Bill-Raised Posture). Wings held slightly out from body with bend of wing slightly lowered and flicked (Wing-Flicking), throat erected (Throat-Fluffing) and crest-feathers raised and lowered (Crest-Raising), and tail spread and held against substrate; from side, dorsal outline of body deeply concave. Vertical bobbing movements of body often occur (Bowing Display), as in Northern Flicker (*Colaptes auratus*), but less common than in that species (Lawrence 1967, Moore 1995). High-intensity Interaction Calls accompany these displays (see Sounds: vocalizations, above).

Several kinds of display flights occur during breeding season (Lawrence 1967): "exaggerated bouncing flight," "swooping flight" (as when individual approaches familiar and frequently used place such as Drumming post), and "moth flight"

(characterized by head lowered and shoulders hunched and wings beaten rapidly but with shallow amplitude). Moth flight associated with agonistic and sexual interactions, but also occurs in other contexts, such as when male carries feces from nest cavity to disposal site (see Breeding: parental care, below). Dry Chatter Call (see Sounds: vocalizations, above) typically occurs in moth flight early in breeding (see also Flight, above).

#### SPACING

**Territoriality.** Early in breeding cycle, advertises presence and defends more or less exclusively occupied space that includes nest tree; also defends sap wells. Later in cycle, will chase conspecific individuals from immediate vicinity of nest or sap wells, but does not advertise occupancy of space around them (Lawrence 1967, Kilham 1983). Areas close to nest (within 9–12 m) strongly defended and intruders usually driven away; farther from nest, social displays suffice (Gibbon 1970). In Maine, territory size 3.1 ha ( $n = 27$ ; Rushmore 1969); in Ontario, about 2 ha ( $n = 2$ ; Lawrence 1967) and  $0.65 \text{ ha} \pm 0.81 \text{ SD}$  (range 0.06–2.73,  $n = 15$ ; Martin 1960); in New Brunswick, about 0.8–1.2 ha ( $n = 3$ ; Gibbon 1970). Males return to vicinity of their previous nest site, Drum, interact with other males, and show cavity excavations to females (Kilham 1983). Adults dominant over juveniles, male juveniles dominant over females in breeding season (Lawrence 1967). On wintering grounds, individuals solitary and highly sedentary (Dennis 1951).

**Individual distance.** Before fledging takes place, adults rarely in close proximity to one another, except sometimes during excavation, agonistic interactions, courtship or sexual behavior, change-over during incubation or brooding, or coincidental meeting at nest during food delivery to nestlings. Adult males aggressive towards any juvenile <1 m while on wintering grounds in e-central Mississippi (Wilkins 2001, H. D. Wilkins pers. comm.).

#### SEXUAL BEHAVIOR

**Mating system and sex ratio.** Socially monogamous. Rarely adult other than parent looks into nest with nestlings and may even feed them (Lawrence 1967, Kilham 1983). In n. Michigan, female seen at 2 nests, each with different male (L. S. Eberhardt pers. comm.). Sex ratio not known.

**Pair bond.** Except for copulation, displays used for courtship and in agonistic encounters essentially indistinguishable (Lawrence 1967, Short 1982). Agonistic components apparent even during change-overs at nest during incubation and during feeding of fledglings (see Behavior: agonistic behavior, above).

Copulatory activity begins in late excavation, peaks during egg-laying period, and may continue even after start of full incubation, but usually not past day 10 of incubation (Lawrence 1967). Male hovers down upon female's back from above or hops toward her with crown-feathers fully erect, bib ruffled, wings drooping and sometimes flapping weakly, back deeply depressed, and fanned tail scraping the branch. "He bobs and throws out his chest . . . mounts . . . may tramp a few times on the female's back before he acquires a secure hold, then slides down her side and with a few . . . flaps of the wings achieves contact" (Lawrence 1967: 82). Male grasps female with his feet before sliding down her left side, and swings posterior part of his body beneath female's uplifted tail to achieve cloacal contact while his tail presses against her right flank; many variations in this general form and sequence, but male's movement from female's dorsum down her left side seems invariant (Lawrence 1967). Copulation lasts up to 10 s, sometimes followed by Displacement Tapping (see Sounds: nonvocal sounds, above).

Pair bond maintained throughout breeding season, including period of fledgling care; usually re-established between years if mate survives. Fidelity to mate may be partly attributable to general site fidelity or perhaps even fidelity to particular trees that are commonly reused for nesting (Lawrence 1967). Remating pairs less conspicuous, presumably because their courtship is less intense and protracted. Neither sex appears to dominate other at nest (Kilham 1983).

**Extra-pair copulations.** No information.

#### SOCIAL AND INTERSPECIFIC BEHAVIOR

**Degree of sociality.** Not very social. Loose aggregations sometimes occur in migration (see Migration: migratory behavior, above).

**Play.** Juveniles described as "very playful, sporting about the tree-trunks and chasing one another continually" (Brewster 1876: 69). In aviary observations, 2 birds observed "dodging"—each making rapid moves in and out of sight of each another on tree trunk; also erratic flight in which birds "loop in, out, and around, usually among trees" (Kilham 1974: 37), might also be considered play; this flight behavior associated with "dodging."

**Nonpredatory interspecific interactions.** Generally involve defense of nest or sap wells. Most aggressive interactions with other woodpeckers occur if they approach or land on nest tree (Gibbon 1970). Pair with young attacked Pileated Woodpecker (*Dryocopus pileatus*) that alighted 3 m from nest (Lawrence 1967). Sap wells attract species that feed on sap, creating potential for defense of well from birds or mammals or for predation on insects

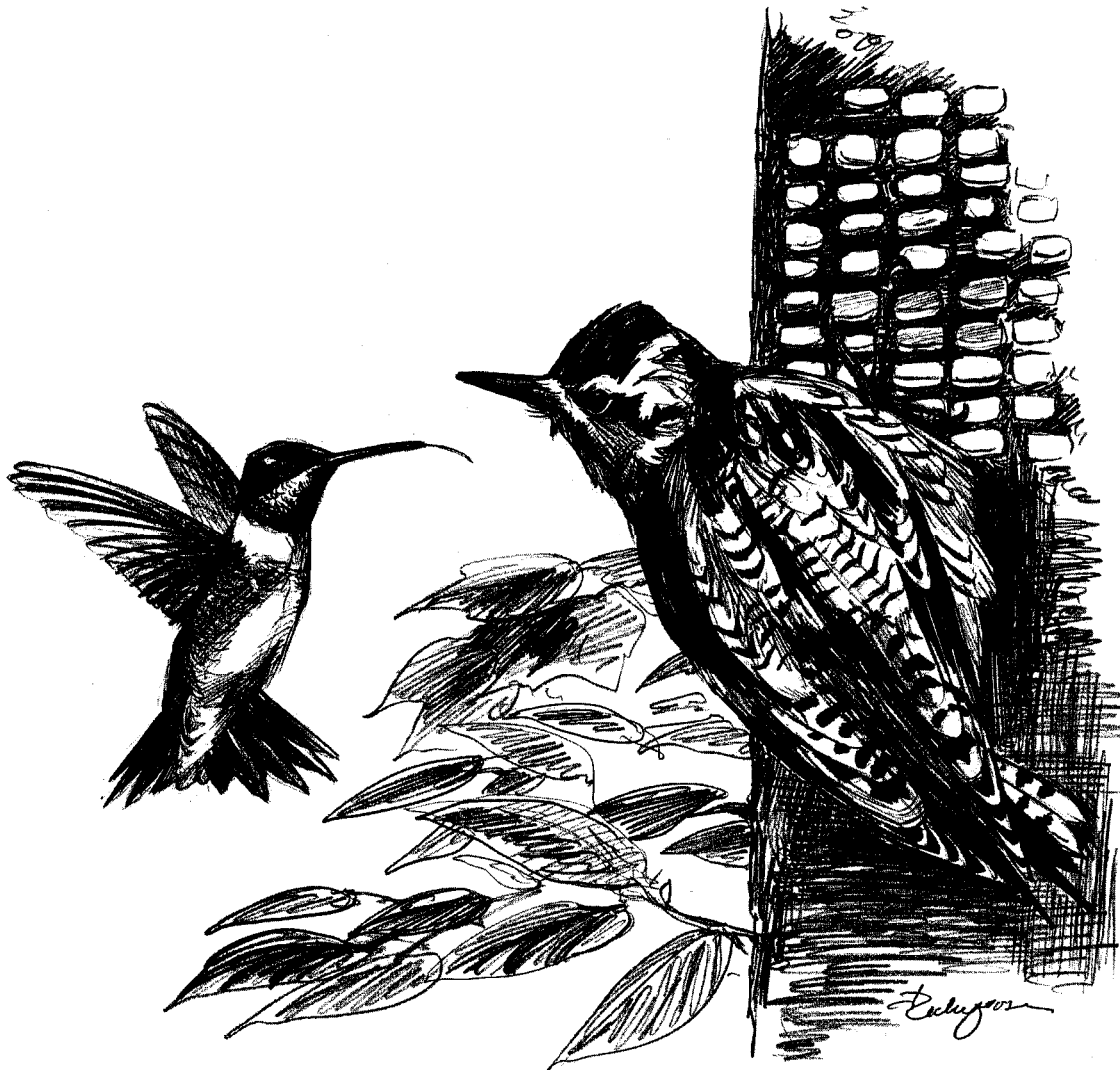


Figure 4. Yellow-bellied Sapsucker repelling a Ruby-throated Hummingbird from its sap well. Drawing by J. Zickefoose.

feeding on sap (Nickell 1956, 1965; Foster and Tate 1966; Rissler et al. 1995); however, few vertebrates or insects observed at sap wells in Mississippi during winter (Wilkins 2001). Insects at sap wells more likely to be treated as competitors and chased away than as potential prey items (L. S. Eberhardt pers. comm.). In n. Ontario, Ruby-throated Hummingbirds chased from vicinity of fecal-sac depository (Lawrence 1967; Fig. 4; see Breeding: parental care, below). Carpenter ants sometimes tunnel into sapsucker nests and cause nest abandonment (Kilham 1971). Female fed begging young Hairy Woodpecker (*Picoides villosus*) and offered food to young Red-breasted Nuthatch (*Sitta canadensis*; Lawrence 1967).

#### PREDATION

**Kinds of predators; manner of predation.** Little information. Predators include hawks (*Accipiter*

sp., L. S. Eberhardt pers. comm.), red squirrels (*Tamiasciurus hudsonicus*; Lawrence 1967, Erskine and McLaren 1972), weasels (*Mustela* sp.; Pettingill 1976), raccoons (*Procyon lotor*; Kilham 1971, 1977a), and black bears (*Ursus americanus*; Erskine and McLaren 1972). Most mammalian predators identified after taking adult or young from nest cavity.

**Response to predators.** In response to threats (i.e., potential predators), sapsuckers emit "alarm calls" and call excitedly (*Waa* or *Harsh Waa* calls; see Sounds: vocalizations, above), but this reaction appears graded according to nesting stage: adults gave mild alarm calls in response to Barred Owl (*Strix varia*) close to nest with very young chicks; male gave *Waa* Calls for 30 min at calling rates up to 36 calls/min in response to owl when young near fledging (Kilham 1983). Adults swoop down and sometimes strike potential predator (Johnson 1947, Pettingill 1976). If 1 parent disappears during



nestling stage, male more likely than female to succeed in raising young (Kilham 1977b).

## BREEDING

### PHENOLOGY

**Pair formation.** Males arrive in breeding areas before females and seek out Drumming posts to establish territories (Kilham 1962a, Lawrence 1967). About 1 wk later, females arrive and seek nest site and territory of previous year (Lawrence 1967).

**Nest-building.** In Ontario, mean date for start of excavation 4 May (range 21 Apr–18 May,  $n = 28$ ; Lawrence 1967). In Maine, one male began excavation on 15 Apr (Kilham 1977b). Excavation can be delayed due to cold or other inclement weather: in New Brunswick, nests completed 15–28 May in a warm spring, 25 May–1 Jun in a cold spring (Gibbon 1970).

**First/only brood per season.** Figure 5. Eggs laid average 8 d (range 3–15) after completion of cavity (Gibbon 1970). Dates for laying range from third week of May until early Jun (Brewster 1876, Lawrence 1967, Kilham 1977b). Egg dates in Ontario 15 May–12 Jul ( $n = 47$ ; Peck and James 1983).

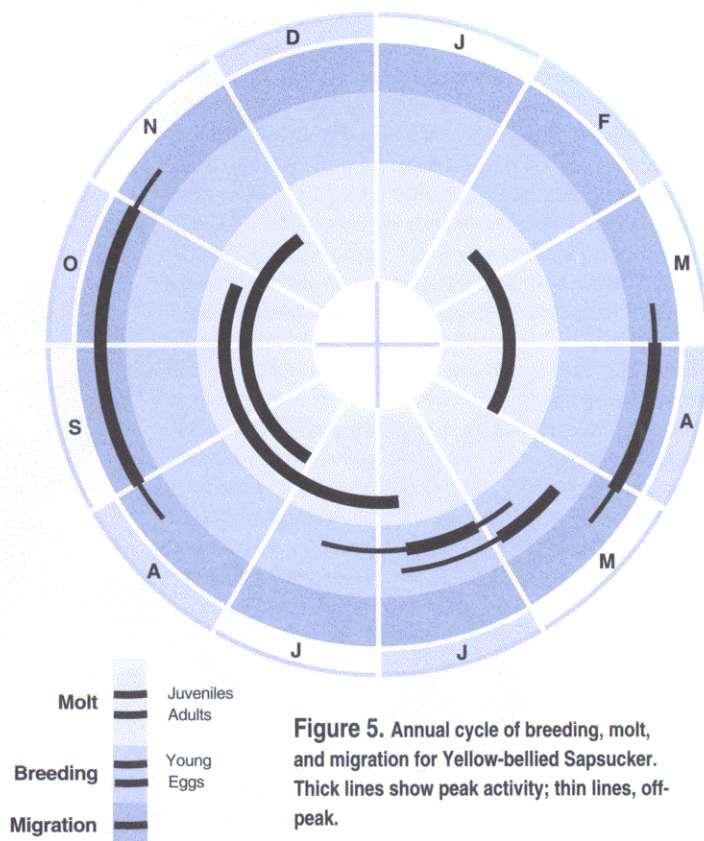
In Michigan, mean hatch date 8–9 Jun ( $n = 8$ ; Eberhardt 1994). Most young fledge from nests in Jul (Kilham 1962a, Lawrence 1967). In n. Michigan, mean fledge date 4 Jul ( $n = 31$ ; no difference between 2 yr; Eberhardt 1994).

**Second brood per season.** No records of second broods. Presumably will renest if fails early in breeding season.

### NEST SITE

**Selection.** Adults often return to breeding site of previous year, often same tree and sometimes same cavity. In Ontario, nest tree chosen by male 71% of time ( $n = 28$ ; Lawrence 1967), often prior to arrival of female (Gibbon 1970). Nest-seeking pair hitches along tree, tapping until selecting site for nest cavity (Gibbon 1970). Initial site may be abandoned during excavation and another selected; female more reluctant than male to leave initial site (Lawrence 1967).

**Microhabitat.** In Ontario, 293 nests in 11 species of deciduous trees and 6 nests in 4 species of conifers; most of these in quaking aspen ( $n = 178$ ), birch ( $n = 39$ ), maple ( $n = 38$ ), beech (*Fagus* sp.;  $n = 12$ ), and elm ( $n = 11$ ; Peck and James 1983). In Vermont, nests in quaking aspen ( $n = 26$ ), maple ( $n = 8$ ), beech ( $n = 2$ ), and other ( $n = 2$ ); 33 of these in live trees (Runde and Capen 1987). Typically prefer quaking aspen infected with the heartwood decay fungus *Phellinus tremulae* [= *Fomes ignarius* var. *populinus*] (Kilham 1971); in Vermont, nest trees most commonly infected with



**Figure 5.** Annual cycle of breeding, molt, and migration for Yellow-bellied Sapsucker. Thick lines show peak activity; thin lines, off-peak.

this same fungus, but infections by *Fomes fomentarius* and sapwood decay fungi (*Trichaptum biformis* and *Traemetes versicolor*) also recorded; most nest trees (35 of 38) contained decayed wood when increment cored (Runde and Capen 1987). In New Brunswick, generally chose dead stubs for nesting and usually did not nest in coniferous or healthy deciduous trees (Gibbon 1970).

**Site characteristics.** In Vermont, nest trees taller and of greater diameter than trees not used; of 38 nests, mean nest height 8.6 m  $\pm$  3.1 SD, mean tree height 19.4 m  $\pm$  4.9 SD, mean diameter at breast height 33.6 cm  $\pm$  14.8 SD, and mean diameter at cavity height 22.8 cm  $\pm$  4.3 SD (Runde and Capen 1987). In Ontario, mean nest height 9.0 m (range 3.0–13.7,  $n = 42$ ), mean diameter at breast height 29.7 cm (range 21.6–42.7,  $n = 25$ ; Lawrence 1967). Of 50 nests in New Hampshire, minimum diameter of nest tree 12 cm, lowest cavity 2 m (Kilham 1971). Nest height co-varies with tree height (Lawrence 1967).

### NEST

**Construction process.** Male does nearly all excavation of nest; female spends much of time preening and resting and removes very little wood from cavity, but will become more involved in excavation if first cavity not successful (Kilham

1977b). In Ontario, during 3,514 min of observation, males excavated 1,317 min, females 476 min; male excavation periods averaged 17.8 min (range 1–96,  $n = 71$ ), female periods 11.5 min (range 1–41,  $n = 40$ ; Lawrence 1967). Cavity usually started on smooth area of trunk with no camouflage (Lawrence 1967). Bill used to chisel out cavity, striking wood at rate of 100–300 strikes/min, periodically stopping to remove chips (Kilham 1962a, Gibbon 1970). Time to complete cavity varies: 9 d (Kilham 1977b), 7+ d (Brewster 1876), 7–10 d (Gibbon 1970), and mean of 19.7 d (range 15–28,  $n = 9$ ; Lawrence 1967).

**Structure and composition matter.** Other than cavity, no nest built; no lining. Lays eggs on bed of wood chips left over from cavity excavation (Gibbon 1970).

**Dimensions.** For 6 nests in Maine, entrance diameter 3.2–4.1 cm (Brewster 1876); for 2 nests in Quebec, cavity depth 27 cm, inside diameter 7.3 cm (Mousley 1916). Entrance hole so small that adults often lose feathers when entering and leaving (Lawrence 1967, Kilham 1977b).

**Microclimate.** Little information. In Ontario, 15 of 42 nests faced southerly direction, more than any other (Lawrence 1967).

**Maintenance or reuse of nests, alternate nests.** Nest trees may be reused for up to 6 or 7 yr (Kilham 1971); cavity reuse varies: none (sample size uncertain; Kilham 1983), 2 of 38 (Gibbon 1970), and 7 of 29 (Eberhardt 1994). Clutch size in reused cavities significantly larger (5.7 eggs,  $n = 5$ ) than those in new cavities (4.4 eggs,  $n = 21$ ), but fledging success in reused cavities less (1.6 young,  $n = 7$ ) than in new cavities (3.0 young,  $n = 22$ ; Eberhardt 1994). No information on alternate nests.

**Nonbreeding nests.** Not all cavities begun are completed; pairs may produce as many as 4 partially completed cavities (Kilham 1962a, Eberhardt 1994). In Vermont, 24 of 38 nest trees contained older sap-sucker holes (Runde and Capen 1987).

#### EGGS

**Shape.** Ovate to elliptical-ovate or rounded-ovate (Bent 1939).

**Size.** Mean size for 92 eggs of 20 clutches: 22.8 mm (range 20.6–26.0) × 17.3 mm (range 16.0–18.3; Western Foundation of Vertebrate Zoology [WVZ] data). Mean size for 52 eggs: 22.4 mm (range 20.6–24.9) × 16.9 mm (range 15.5–18.0; Bent 1939).

**Mass.** Mass of fresh egg 3.4 g ( $n = 70$ ; Schönwetter 1967); total mass of clutch about 33% of female body mass.

**Color.** Pure white.

**Surface texture.** Smooth; dull to moderately glossy.

**Eggshell thickness.** Data unavailable. Mass of empty shell 0.25 g (range 0.20–0.34,  $n = 92$ ; WVZ).

**Clutch size.** In Ontario, mean clutch 4.23 eggs ± 1.28 SD (range 2–7,  $n = 43$ ; Peck and James 1983). In n. Michigan, mean clutch 5.44 eggs ( $n = 27$  nests); no difference in mean size among 3 yr (Eberhardt 1994). For variety of locations, mean clutch size 4.93 ± 1.02 SD ( $n = 46$ ); clutch size showed correlation with latitude (Koenig 1986).

**Egg-laying.** Eggs laid 1/d (Gibbon 1970). Eggs laid within 1 wk of nest completion but laying may be delayed by cold and wet weather (Kilham 1977b); mean interval between completion of nest and first egg 8 d (range 3–15; Gibbon 1970). Once laying begins, pair at nest tree or within sight of tree 66% of time; when in cavity, adults either look out entrance or work bottom of cavity; wood chips created by pecking sides and bottom of cavity remain as nest-lining (Lawrence 1967). No evidence of intra-specific egg-dumping.

#### INCUBATION

**Onset of broodiness and incubation in relation to laying.** Incubation begins after laying of egg 3 or 4 (Gibbon 1970).

**Incubation patch.** Brood patch present in both sexes (Pyle 1997).

**Incubation period.** Ten to 11 d (Gibbon 1970) to 12–13 d (Lawrence 1967).

**Parental behavior.** Reports of role of each sex vary: female incubates more than male (Lawrence 1967), same amount (Brewster 1876, Gibbon 1970), or less than male (Kilham 1977b). Male stays in cavity from dusk to dawn. Eggs rarely unattended for >1–2 min (Lawrence 1967) or up to 16% of time (Kilham 1977b). Incubation bouts up to 20 min (Eberhardt 1994), 20–30 min (Gibbon 1970), 30 min (Brewster 1876), or 60 min (Lawrence 1967, Kilham 1977b). Incubation rhythm varies with temperature; shorter sessions during high temperatures (Lawrence 1967).

Usually no vocalization emitted during change-over except first approach of female in morning; prior to female approach, male goes to ritualized location and calls, female flies directly to nest; relieving individual flies to entrance, taps, and emits quiet Interaction Call, and moves sideways to allow mate to leave; crest- and throat-feathers raised and lowered several times during change-over (Lawrence 1967, Gibbon 1970; see Behavior: agonistic behavior, above). When male relieved, female loiters at entrance before entering cavity during first 5 d of incubation, but becomes more attentive than male for last 6–7 d of incubation (Kilham 1977b).

**Hardiness of eggs against temperature stress; effect of egg neglect.** Prolonged period of cold weather increases egg mortality; during hot weather, adults reduce their time incubating (Kilham 1977b). Loss of

1 adult reduces nest success since incubation duties normally shared (Lawrence 1967).

#### HATCHING

**Preliminary events and vocalizations.** No information.

**Shell-breaking and emergence.** Clutch hatches within 24-h period (Gibbon 1970).

**Parental assistance and disposal of eggshells.** Adults remove eggshells and unhatched eggs within 1 d of hatching (Kilham 1977b, Eberhardt 1994).

#### YOUNG BIRDS

**Condition at hatching.** Altricial and nidicolous. Bill light gray (Lawrence 1967); mass at hatch 2.5 g ( $n = 1$ ; Gibbon 1970).

**Growth and development.** Eyes fully open at 8 d (Gibbon 1970). Mass at 9 d, 24.9 g ( $n = 8$  nests; Eberhardt 1994).

#### PARENTAL CARE

**Brooding.** Both sexes brood equally (Lawrence 1967). Nestlings brooded 1,012 min of 1,325 min observation of 3 pairs during nestling period (Kilham 1977b); duration of brooding periods 5–10 min (Gibbon 1970) or 13–19 min (based on about 61 brooding periods by 3 pairs; Kilham 1977b). Young always brooded first few days (Gibbon 1970); at 4 d after hatch, brooding protracted and irregular, by 8–10 d and later, adults spent only 2–4 min in cavity; but brooding occurs after 10 d if temperature exceptionally cool (Kilham 1977b). Daytime brooding stops after 21–23 d (Lawrence 1967), but may stop at 14 d (Gibbon 1970).

**Feeding.** Both sexes feed young; identity of prey items fed to young not well known. Parents bring small insects when young first hatch (Kilham 1962a). In New Brunswick, 58 of 113 feedings by female (Gibbon 1970); but in New Hampshire, males fed 6–10% more than females (out of 891 feeding observations of 3 pairs; Kilham 1977b). Adult may visit sap trees to coat insects in sap before taking to young (Kilham 1962a, L. S. Eberhardt pers. comm.). Prey fed to young vary in size but most large (as large as luna moth [*Actias luna*] size) and soft-bodied; wings detached from large prey and prey compacted or reduced in size (especially beetles) to facilitate feeding; for nestlings aged 5–8 d, 19 of 59 items brought by male and 25 of 73 brought by female with legs or wings projecting >1 cm from adult's bill (Kilham 1977b). Ants (e.g., *Camponotus pennsylvanicus*) identified in feces, but ants may be overrepresented since exoskeletons often pass relatively easily through digestive tract (Kilham 1977b); fruit of serviceberry (*Amelanchier* sp.) fed to young (L. S. Eberhardt pers. comm.). Not observed feeding sap directly to young (Lawrence 1967).

In New Hampshire, feeding rate 10.5 visits/h when young brooded, 24 visits/h in midnesting period, and 16 visits/h within 4 d of fledging (Kilham 1977b, 1983). In Michigan, feeding rate 15.1 visits/h (1 h observation at each of 8 nests) when chicks 7 d old and 22.9 visits/h (1 h observation at each of 8 nests) when chicks 21 d old (Eberhardt 1994). In New Brunswick, maximum feeding rate 16 visits/h when chicks 11 d old; rate decreased to 8 visits/h when chicks 21 d old (Gibbon 1970). In Ontario, adults fed at 8.8 visits/h ( $n = 4,245$  min observation; Lawrence 1967). At 1 nest in New York, male fed half-grown young 17 times and female fed 11 times during 92 min observation; 2 d later, male fed 17 times and female fed 6 times during 120 min (Johnson 1947). Male that had lost mate successfully fledged young, though taking 29 d to do so (Lawrence 1967).

Observations through "window" in cavity indicate only 1 nestling vocal at a time when adults not present; this vocal chick positions itself near cavity entrance; all chicks vocalize when adult present, but chick near entrance is loudest and thus usually fed; after several feedings, this chick replaced by sibling (Gibbon 1970).

**Nest sanitation.** Some disagreement as to whether nestlings actually produce fecal sacs; other sapsuckers do (e.g., Red-naped Sapsucker [Wible 1960, Walters et al. 2002], Williamson's Sapsucker [Dobbs et al. 1997]), and as reported by Bancroft (1986) for Yellow-bellied Sapsucker (*contra* Kilham 1962b). Defecation takes place in nest cavity after adult prods nestling in anal region (Gibbon 1970). Male removes all (Johnson 1947, Gibbon 1970) or most (Kilham 1977b, L. S. Eberhardt pers. comm.) fecal material, usually along with wood chips to specific site, where it is dropped and adult wipes bill (Johnson 1947); occasionally fecal sac eaten by adult (Lawrence 1967). Same tree used as disposal site 2 yr by same male (Kilham 1977b). Excrement removal usually stops 4–8 d prior to fledging (Kilham 1977b); but 1 individual observed making 7 removals in 30 min just 1 d before fledging (Kilham 1977b) and 1 male seen removing feces even after 1 nestling had fledged (Lawrence 1967).

**Carrying of young.** Not known to occur.

#### COOPERATIVE BREEDING

Not known to occur. One female with chicks remated, and her new mate fed chicks and roosted in her cavity at night (Kilham 1977a).

#### BROOD PARASITISM

Not known to occur.

## FLEDGLING STAGE

**Departure from nest.** Leaves nest at 26.9 d ( $n = 24$  nests) in n. Michigan (Eberhardt 1994); 25–29 d in Ontario (Lawrence 1967); 26–28 d in Maine (Kilham 1977b); and 23–26 d in New Brunswick (Gibbon 1970). Brood leaves nest over 2- to 3-d period (Foster and Tate 1966). Nestling mass at fledging about 40 g ( $n = 4$ ; Gibbon 1970). Young enticed from nest cavity by adults withholding food; adults call from near cavity and young stretch out from cavity entrance and eventually fall from nest and flutter toward nearby branch or tree (Foster and Tate 1966, Lawrence 1967, Gibbon 1970). Young usually leave vicinity of nest within 1 h (Kilham 1971) and do not return (Foster and Tate 1966).

**Growth.** No information once young leave nest.

**Association with parents or other young; ability to get around, feed, and care for self.** Families stay together after fledging but this period of breeding cycle poorly documented (Lawrence 1967). Young fed for 2–3 d after leaving nest then feed themselves on sap and capture insects attracted to sap wells (Gibbon 1970). Young fed insects for 1–2 wk after fledging (Kilham 1962a). Female stops feeding young 4–5 d after fledging and male increasingly avoids young as time passes (Foster and Tate 1966); an unusually precocious fledgling first attempted self-feeding 7 d after emergence and was fully independent 2 d later (when 36 d old); 2 other fledglings became independent when 37 and 38 d old, respectively (Lawrence 1967). Social contact between fledglings and young maintained partly through family movements being centered on sap wells, and partly through active behavior by both fledglings and parents: fledglings utter frequent "location" vocalizations (juvenile version of *Waa* Call; see Sounds: vocalizations, above), and parents call when gathering food even when out of sight of fledglings. When laden parents see fledgling they fly toward it, which elicits calling by the latter. Both parents may simultaneously feed a fledgling; young seem to actively associate with one another (Kilham 1983). Late records of juveniles interacting with adults (20 Sep in New Hampshire, and 22–23 Oct in Maryland) may represent intact or partial family groups in migration (Kilham 1983). Within few weeks out of nest, fledglings attempt to drill wells, but often do so in inappropriate substrates (e.g., dead trees or limbs, tree species not usually used for wells); by about 6 wk out of the nest, young drill wells in suitable trees (Kilham 1964). Young remain on territory for 6–8 wk and feed mainly at sap wells (Gibbon 1970).

## IMMATURE STAGE

No information.

## DEMOGRAPHY AND POPULATIONS

## MEASURES OF BREEDING ACTIVITY

**Age at first breeding; intervals between breeding.** Age at first breeding 1 yr; breeds annually thereafter (Eberhardt 1994).

**Clutch.** Usually 4–6 eggs. See Breeding: eggs, above.

**Annual and lifetime reproductive success.** Little information. In n. Michigan, average of 2.72 young fledged/nest ( $n = 32$  nests; Eberhardt 1994).

**Number of broods normally reared per season.** One; re-nesting in event of early nest failure seems likely but not documented.

**Proportion of total females that rear at least one brood to nest-leaving or independence.** No information.

## LIFE SPAN AND SURVIVORSHIP

No information on annual adult survival rate. Maximum reported longevity 6 yr 9 mo (Clapp et al. 1983).

## DISEASE AND BODY PARASITES

**Diseases.** No information.

**Body parasites.** Recorded ectoparasites include mite *Pteronyssoides speciosus* (Acari; Banks 1905), biting lice *Penenirmus auritus*, *Brueelia straminea*, and *Menacanthus pici* (Phthiraptera; Peters 1936, Stirrett 1952, Whitehead 1954, Emerson 1972, D. C. Arnold pers. comm.), and louse flies *Ornithomyia erythrocephala*, *O. fringillina*, and *O. vicina* (Diptera: Hippoboscidae; Bennett 1961, Bequaert 1954). Of 16 juveniles and 4 adults examined from Algonquin Park, Ontario, 2 juveniles found with *O. fringillina* and 1 with *O. vicina*; presence of louse flies first noted in early Jul, and no adult flies after late Sep (Bennett 1961).

Blood-inhabiting parasites reported include *Haemoproteus velans*, *Haemoproteus* sp., *Leucocytozoon* sp., *Plasmodium* sp., and *Trypanosoma* sp. (Bennett and Fallis 1960, Bennett et al. 1989).

## CAUSES OF MORTALITY

**Exposure.** No information.

**Predation.** See Behavior: predation, above. In n. Michigan, 8 of 39 nests attacked by predators (Eberhardt 1994).

**Competition with other species.** Many competitive interactions with other species documented (see Behavior: nonpredatory interactions, above), but none that led to mortality.

## RANGE

**Initial dispersal from natal site.** Little information; in Ontario, 1 male and 1 female (of 4 juveniles banded) returned to near natal site (Lawrence 1967).

**Fidelity to breeding site and winter home range.** Little information; in Ontario, 5 banded adults returned to same breeding territory (1 male 6 times, 2 males twice each, 2 females once each; Lawrence 1967).

**Dispersal from breeding sites.** No information.

**Home range.** See Behavior: spacing, above.

#### POPULATION STATUS

**Numbers.** Breeding Bird Survey (BBS) census data for routes with highest counts were 25.1 birds/route in Franklin Co., NY; 20.7 in Piscataquis Co., ME; and 20.3 in Nepisiquit, New Brunswick (Price et al. 1995). Atlas data of Maritime Provinces (New Brunswick, Nova Scotia, Prince Edward I.) generate estimate of 62,000 ± 18,000 individuals for that area (Erskine 1992). Wintering Yellow-bellied Sapsuckers near Gainesville, FL, represented 6% of all woodpeckers in that area, with density of 9 individuals/40 ha (Dennis 1951).

**Trends.** Trends measured by BBS data suggest no changes in population from surveywide data for the *varius* superspecies for 1966–2000; Michigan, New York, Pennsylvania, and Wisconsin showed statistically significant positive trends over this period, New Brunswick statistically significant negative trend; for period 1966–1979, data from all BBS routes indicated general decline in numbers:  $-2.8\%/yr$ ,  $n = 426$  routes,  $p = 0.03$ ; for period 1980–2000, trend was positive:  $2.4\%/yr$ ,  $n = 940$  routes,  $p < 0.01$  (Sauer et al. 2001).

Sapsucker populations may be higher now than in presettlement times when vegetation of ne. North America comprised old-growth forests. European settlement created forest gaps and edge, favoring early-successional habitats preferred by sapsuckers and able to support higher densities of sapsuckers than climax forests (Eberhardt 1994). Because of loss of suitable habitat, s. Blue Ridge Mtns. populations of Appalachian region have declined dramatically from mid-1900s (C. Hunter pers. comm.).

#### POPULATION REGULATION

No information.

### CONSERVATION AND MANAGEMENT

#### EFFECTS OF HUMAN ACTIVITY

**Shooting and trapping.** Historically considered pest in orchards and shot as a result; no longer the case. Some concern about destruction of trees in forests; some researchers suggest sapsuckers cause reduction in growth of trees (e.g., birch), and each pair kills 1 or 2 trees/yr because of girdling by sap wells (Lawrence 1967, Rushmore 1969) but little

evidence to support these assertions (L. S. Eberhardt pers. comm.).

**Pesticides and other contaminants/toxins.** Large-scale spraying (85,000 ha) of Accothion for spruce budworm during late 1970 in Maine did not appear to have any effect on sapsucker populations (Rushmore 1971, 1973).

**Ingestion of plastics, lead, etc.** Not reported.

**Collisions with stationary/moving structures or objects.** Over 29-yr period, 104 sapsuckers killed in collisions with television tower located near Tall Timbers Research Station, n. Florida (R. T. Engstrom pers. comm.); for 20-yr period, 41 killed at large lakefront building in Chicago, IL (D. E. Willard pers. comm.). One individual killed when it struck 122-m tower on Grand Bahama I. (Kale et al. 1969). Cumulative effect of towers and other large structures (e.g., tall buildings) encountered during migration unknown.

**Degradation of habitat.** See Population status: trends, above.

**Disturbance at nest and roost sites.** See below.

**Direct human/research impacts.** More likely affected by researchers at beginning of nesting cycle, but no data; usually no effect of observing nest from 7 to 8 m during incubation or nestling stages; usually ignores human presence later in nesting cycle; feeds nestlings with observer <3 m away (Kilham 1977b).

#### MANAGEMENT

**Conservation status.** Protected under Migratory Bird Treaty Act in U.S. and Canada. Southern Appalachian Yellow-bellied Sapsucker (sometimes recognized *S. v. appalachiensis*) listed as Federal Species of Concern. Yellow-bellied Sapsucker listed as "species of conservation concern" in s. Ontario, "species of concern" in Pennsylvania, "in need of management" in Tennessee, and "significantly rare" in N. Carolina.

**Measures proposed and taken.** None known for this species.

### APPEARANCE

#### MOLTS AND PLUMAGES

Plumage and molt descriptions based primarily on Ridgway 1914, Short 1982, Pyle and Howell 1995, and Pyle 1997.

**Hatchlings.** Naked at hatching.

**Juvenal plumage.** Acquired by complete Prejuvenal (postnatal) molt. No information on timing and sequence of Prejuvenal molt except occurs before fledging.

Outer primaries (P6–P9) more tapered than in Definitive Basic (adult) plumage, except Juvenal outermost primary (P10) longer and broader. Wings



and tail similar to those of adults, except rectrices more pointed in juveniles and tail with more barring. Body plumage differs greatly from that of adults: overall appearance dark or olive-brown; back more black, often with black-and-white mottling; rump with more barring on white areas; and sides and flanks with more extensive markings. Belly unmarked, yellowish white in midline; flanks dull brownish with indistinct markings. Lower throat, neck, and breast pale brown with scallop-shaped dusky bars. Head brown with buffy-white scalloping on crown, ear-coverts, and throat; narrow buffy-white lines above and below eye usually present; throat paler than in adults. Sexes similar, although some juvenile males distinguished by slight red tint on crown and throat.

**Basic I plumage.** Acquired by incomplete Prebasic I (Postjuvinal) molt Jun–May; molt includes no to a few inner lesser and median upper wing-coverts but all rectrices and remiges replaced. Molt of body-feathers and wing-coverts suspended during migration and completed on winter grounds. All primaries and rectrices usually replaced by Aug.

Basic I plumage similar to Definitive Basic plumage, except some Juvenal lesser and median upper wing-coverts retained.

**Basic II plumage.** Acquired by incomplete Prebasic II molt Jun–Oct. Includes all upper wing-coverts and primaries, all or most rectrices, but often no primary-coverts or only outermost 1 or 2 feathers (in approx. 42% of birds); 1–6 secondaries retained, usually in a block among S1–S6.

Basic II plumage similar to Definitive Basic plumage, except feathers retained from Juvenal and Basic I plumage.

**Definitive Basic plumage.** Acquired by incomplete Definitive Prebasic molt Jun–Oct. Adult Prebasic molts rarely (if ever) complete; often (in approx. 68% of birds) 1–5 secondaries retained among S1–S8 (but seldom in a block and less often symmetrically on both wings), and a variable number of primary-coverts also retained. Some individuals in third year with 3 generations of secondaries and primary-coverts, including some much-abraded Juvenal feathers.

**MALE.** Forehead and crown bright poppy red or crimson, bordered by occipital crescent of glossy blue-black, extending laterally to above middle of eye. Band of white from nasal tufts and lores extending below eye to side of neck; narrower band of white from behind eye to nape; malar-stripe black. Chin and throat bright poppy red (feathers white basally); red extends to black breast-patch and black malar areas. Nape white or brownish white, rarely tinged with red; back and scapulars black faintly glossed with greenish blue, broken by heavy spotting of white or brownish white, white

prevailing on sides of back, black more prevalent in center of back; rump and upper tail-coverts mostly black on sides and mostly white in center; tail black, inner web of central pair of rectrices (R1) white with several oblique black spots or bars, terminal margins of outer rectrices white; wings black, exposed portion of median wing-coverts and outer web of all but innermost and outermost greater wing-coverts white, forming conspicuous white patch on wing; remiges barred or notched with white. Broad breast-band (not extending to sides of breast) black, remaining underparts to posterior of breast-band pale yellow; sides and flanks dull white or brownish white with black V-shaped marks, markings on flank more regular. Under tail-coverts white with black wedge-shaped markings.

**FEMALE.** Similar to male, but chin and throat white (occasionally with some red mottling). Crown sometimes all black (12 of 69 individuals; Kilham 1977b), mixed red and black, black with red spots on forehead, or black with buffy markings. Outer rectrices black with pale tips and usually some pale mottling.

#### BARE PARTS

**Bill and gape.** Dull black to slaty black (Short 1982).

**Iris.** Brown (Short 1982).

**Legs and feet.** Bluish gray (Short 1982).

## MEASUREMENTS

### LINEAR

**Bill length (exposed culmen).** Male mean 23.4 mm (range 21.5–25.5,  $n = 10$ ); female 22.7 mm (range 22–24,  $n = 10$ ; Ridgway 1914). Male range 19.6–25.2 ( $n = 26$ ), female 19.3–23.9 ( $n = 26$ ; Pyle 1997).

**Wing length.** Male mean 124.1 mm (range 120–130,  $n = 10$ ), female 124.3 mm (range 121–128,  $n = 10$ ; Ridgway 1914). Male range 111–130 ( $n = 73$ ), female 110–129 ( $n = 77$ ; Pyle 1997).

**Tail length.** Male mean 72.5 mm (range 67–76,  $n = 10$ ), female 71.7 mm (range 68–75,  $n = 10$ ; Ridgway 1914). Male range 64–77 ( $n = 54$ ), female 62–76 ( $n = 57$ ; Pyle 1997).

**Tarsus length.** Male mean 20.3 mm (range 19–22,  $n = 10$ ); female mean 19.4 mm (range 18.5–20,  $n = 10$ ; Ridgway 1914).

### MASS

Mean body mass (both sexes)  $50.3 \text{ g} \pm 4.29 \text{ SD}$  (range 40.7–62.2,  $n = 52$ ; Dunning 1993). Mass of migrants at Cook Co., IL: male mean  $49.2 \text{ g} \pm 3.32 \text{ SD}$  (range 44.0–56.8,  $n = 14$ ); female mean  $47.0 \text{ g} \pm 4.71 \text{ SD}$  (range 37.9–55.0,  $n = 13$ ; Field Museum specimens).

## PRIORITIES FOR FUTURE RESEARCH

Nothing is known of sapsucker physiology. At times, sapsucker diet comprises 100% sap. The criteria by which trees are chosen for sap wells is not known; trees may be selected because they are entering senescence and sapsuckers can take advantage of additional amino acid content of their sap (L. S. Eberhardt pers. comm.). Interaction between tree and sapsucker is understood in only a very general sense. Most studies of sapsuckers have been made during the breeding season but only limited observations have been made of behavior within nest cavities. Further work needs to be done to understand the role and importance of sapsuckers in forest communities, as a species that provides cavities for secondary cavity nesters, and gives access to sap for other species. Much remains to be learned about behavior and ecology of this species during the remainder of the year. Little is known about dispersal of young from their natal area (and researchers' study sites). Likewise, migratory routes are not well known. Studies using color-banded individuals would help gain better insight into dispersal and survivorship. More studies that examine population trends, especially on regional scales, are needed.

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