K. C. DERRICKSON & R. BREITWISCH

Derrickson '92

Mimus
polyglottos
SPANISH:
Centzontle, Jilguero
Ruiseñor
FRENCH:
Moqueur polyglotte

Northern Mockingbird

NORTHERN MOCKINGBIRD

The Northern Mockingbird, a year-round resident throughout most of its range, is renowned for its complex, ebullient, mimicking song and for its pugnacious defense of territory, nest, and young. An omnivore, this species eats a wide variety of fruit and insects, favoring habitats such as park and cultivated lands, second growth at low elevations, and suburbs, where it commonly forages for insects on mowed lawns. Although this mockingbird has recently declined in the southern part of its range, it has expanded northward during the past century, a trend likely to continue as suburbs and areas of second growth spread.

Both male and female mockingbirds sing, unmated males at night. A male's repertoire often contains more than 150 distinct song types which change during its adult life and may increase in number with age. Songs are acquired through imitating the calls and songs of other birds, the vocalizations of non-avian species, mechanical sounds, and the sounds of other mockingbirds.

Northern Mockingbirds typically pair monogamously, but bigamous and polyandrous matings do occur. Some adults may spend the entire year as a pair on a single territory, while others establish distinct breeding and wintering territories.

The Birds of North America

Life Histories for the 21st Century

Figure 1.
Year-round range
of the Northern
Mockingbird.

During their first winter, mockingbirds either set up their own territory or move around together in flocks. The causes of these differences in social organization are unknown. Parental care is shared more or less equally by the sexes, although females perform all incubation and nearly all brooding of young nestlings. Mockingbirds overlap successive nesting attempts, and their temporal division of labor allows them to produce up to four broods each breeding season. Because they are numerous, geographically widespread, conspicuous in their activities, and complex singers, mockingbirds have proven an excellent species for behavioral studies.

DISTINGUISHING CHARACTERISTICS

Medium-sized songbird. Total length: males 220–255 mm (mean = 239), females 208–235 mm (mean = 225; Ridgway 1907). Males generally heavier than females (mean = 51 g vs. 47 g; see Appendix 1), but sexes not safely separated by size or plumage. Legs and tail long, wings rather short and rounded. Bill moderately long and somewhat decurved. Upperparts gray to gray-brown with black posterior border to wing. Two parallel, narrow white wing bars on proximal half of wing connected to broad, white wing patch, conspicuous in flight. Central rectrices black, lateral rectrices partially to entirely white, conspicuous in flight. Underparts white to white-gray. Albinism reported very rarely (Berger 1972).

DISTRIBUTION

AOU CHECK-LIST REGION

Breeding range. Extensive (Fig. 1). Occurs sporadically in southern Manitoba, Saskatchewan, Alberta, and British Columbia. Range includes Bahama Islands and Greater Antilles (east to Anegada in Virgin Islands and Little Cayman in the Cayman Islands). Extends southward through Baja California and Mexico to Oaxaca and Veracruz (Am. Ornithol. Union 1983).

Winter range. Same as breeding range. Northern populations may be partially migratory (Am. Ornithol. Union 1983, David et al. 1990), but not as drastically as depicted by Christmas bird counts (Root 1988).

RANGE OUTSIDE AOU CHECK-LIST REGION

Three records (Aug 1971, 1978, 1982) from Great Britain. One probably an escaped bird, others may be vagrants. Based on abundance along East Coast, proclivity to wander in the fall, and body size and flight speed, Robbins (1980) listed the mockingbird as a possible visitor to Great Britain.

FOSSIL HISTORY

Nothing reported.

HISTORICAL CHANGES IN DISTRIBUTION

Recent northward expansion of range along east coast of U. S. into southern Canada, with occasional sightings farther north (Stiles 1982, Curry 1987). Range also expanding northward along west coast (Arnold 1980). Introduced and established on Hawaiian Islands in 1920s (subsequently colonized French Frigate Shoal; Berger 1972). Introduced unsuccessfully during the late 1800s on Bermuda (lasted approx. 20 yr), Barbados (extirpated), and St. Helena; and in 1930s on Tahiti. Isolated populations in south-central Canada (and Churchill, Man.), Oregon, and San Francisco, CA established in 1890s (Long 1981).

SYSTEMATICS

SUBSPECIES; RELATED SPECIES

Mimus polyglottos and the Tropical Mockingbird (*M. gilvus*) are phylogenetically closely related and hybridize, at least occasionally, in Oaxaca and Veracruz, Mexico (Am. Ornithol. Union 1983). Cladistic analyses based on 97 nonskeletal variables and 57 skeletal measures, have *polyglottos* and *gilvus* as nearest relatives (J. Gulledge pers. comm.). The Bahama Mockingbird (*M. gundlachii*) is not as closely related. DNA-DNA hybridization data indicate starlings and mockingbirds are more closely related to each other than either is to any other living taxon, and Sibley and Ahlquist (1984) suggest grouping them in the family Sturnidae.

MIGRATION

NATURE OF MIGRATION IN THE SPECIES

Not well understood. Reported to be partly migratory in northern portion of range (Am. Ornithol. Union 1983, David et al. 1990), but at least some individuals remain in winter at northern limits of breeding range. Perceptions of status could be affected by reduced visibility of mockingbirds during winter. Complex movements reported in southwestern U.S. (Phillips et al. 1964) and elsewhere. Local movements occur between breeding and wintering territories, when different (Laskey 1935). Banding records indicate some individuals travel considerable distances, up to 500 miles (Cooke 1946).

TIMING AND ROUTES OF MIGRATION

Little known. Seasonal fluctuations in censuses conducted in Illinois suggest early spring migration (Graber et al. 1970; Fig. 2).

MIGRATORY BEHAVIOR

No information.

CONTROL AND PHYSIOLOGY OF MIGRATION

No information.

HABITAT

BREEDING AND WINTERING RANGE

Parkland, cultivated lands, and second growth habitat at low elevations throughout its range. Prefers short, grassy to nearly bare substrate when foraging on the ground (Roth 1979). Common in suburban habitat, especially favoring mowed lawns. Absent from the interior of all forested habitat but frequents forest edge. Found in the same habitat year-round.

FOOD HABITS

FEEDING

Main foods taken. Omnivorous, a wide variety of arthropods and fruits, also earthworms. Occasionally eats small lizards (*Anolis* spp.).

Food capture and consumption. Forages throughout day and sometimes into crepuscular hours. Most arthropods taken by walking, running, or hopping along the ground. Typically, runs a short distance, stops, and lunges at prey on ground (Breitwisch et al. 1987). Also catches insects flying just above ground. Short grass preferred to long grass for such foraging (Roth 1979). From perches, flies down directly onto arthropod at ground surface, killing and dismembering prey there or carrying it back to perch (Roth 1979, Breitwisch et al. 1987). Occasionally hawks insects from air, as flycatchers do (Roth 1979). Can knock large cicadas to ground by hitting them with wings and chest before grabbing with bill (KCD, RB).

Usually picks fruit while perched in tree or shrub, but also while hovering. Large, ripe, fallen fruit are ripped apart. Group foraging in a strangler fig (*Ficus aurea*) observed, most probably first-year birds (Merritt 1980). Individuals known to leave territories at any time of year to forage at large fruiting trees nearby (Merritt 1980, RB, KCD, C. Logan pers. comm.). Flights over neighboring territories at greater distances above the ground with wingbeats more accentuated than in normal flight (KCD).

Occasional short flights into neighboring territories to steal fruit, which is fed to nestlings (C. Logan pers. comm.).

DIET

Adults: about 50% arthropods (especially beetles, ants, bees, wasps, and grasshoppers) and 50% native and cultivated fruits (Beal et al. 1916, Sprunt 1964, Howell 1932, Breitwisch et al. 1984). No extensive study on diet since Beal et al. (1916), but no reason to suspect significant departures from their data. Mockingbirds in southern Florida observed eating adult Zebra Butterflies (Heliconiidae; *Heliconius charitonius*), even though this species has "warning" colors (yellow and black) and as larvae ingests secondary compounds when eating the foliage of passion flowers (Passifloraceae; RB). The proportion of animal prey increases in the breeding season to nearly 85% of volume of food (from stomachs) and decreases in winter to ca. 13% (n = 417 stomachs total; Beal et al. 1916). Because fruit is a critical component of the fall and winter diet, the geographic expansion of the mockingbird's range northward in the northeastern United States may be related to plantings of a particularly favored winter fruit, Multiflora Rose (*Rosa multiflora*; Stiles 1982). Adults have been observed to drink sap from recently pruned deciduous trees (KCD).

NUTRITION AND ENERGETICS

Specific requirements not known. Easily maintained in captivity on a "well-rounded" diet.

DRINKING, PELLET-CASTING, DEFECATION

Drinks from puddles, river and lake edges, also dew and rain droplets that collect on vegetation. Head raised before swallowing.

FOOD SELECTION AND STORAGE

No data.

SOUNDS

VOCALIZATIONS

Development. No detailed study. One-day-old nestlings can produce faint peeps, which rapidly develop into a high frequency, tonal begging call. This call later incorporated in spring song of adult males. Origin of this call in the adult male repertoire unknown; it could be derived from his own begging call, from that of his young, or from neighboring males. Young begin to sing quietly between one and two months of age. Detailed composition and patterning of this early singing behavior not studied. Not known if a hatching-year bird in its first fall sings as much or as loudly as an adult.

Individuals learn new sounds throughout life (Laskey 1944, Derrickson 1985, 1987b, Merritt 1985). Kroodsma and Baylis (1982) listed four types of evidence consistent with song learning in mockingbirds: (1) vocal imitation in the laboratory of conspecific, heterospecific, and nonavian sounds, (2) interspecific vocal imitation in free-living birds, (3) conspecific vocal imitation among free-living birds, and (4) abnormal vocal development under acoustic deprivation in the laboratory. Not known if sensitivity or tendency to learn new vocalizations is seasonal. Typically, adults sing for approximately three fourths of the year (Feb through Aug, and late Sep to early Nov); occasionally sing during winter.

Adults possess extensive vocal repertoires of acoustically distinct sounds called song types (Fig. 2). In a detailed study of the repertoires of two males, Burnett (1978) found that spring and fall song repertoires have only 1% of their song types in common. Thus, mockingbirds effectively may have two vocal repertoires. Also, a minimum of 35%–63% of song types in a given spring repertoire occur again the subsequent spring; the rest are new (Derrickson 1985, unpubl. data). Finally, spring repertoire size (the total number of distinct song types recorded from an individual as determined from analyses of extensive recordings) increases with age (Derrickson 1987b).

Mockingbirds are persistent mimics, which has long intrigued people (Wilson 1828, Dickey 1922). Lists of other birds and sounds imitated by mockingbirds were common early in this century (Bailey 1911, Whittle 1922, Townsend 1924, Visscher 1928, Mayfield 1934, Miller 1938); more recently, the faithfulness of these imitations has received attention (Borror and Reese 1956, Brenowitz 1982). Mockingbirds appear to cluster imitations from the same species more often than expected by chance, but this has not been studied in detail (Merritt 1985, KCD).

Vocal array. Four calls are recognized: *nest relief call, hew call, chat* (or *chatburst*), and *begging call.* The latter two are also used in the adult male's song. Males give a low amplitude, high-pitched *nest relief call* from a shrub or tree near the nest before flying to the nest site (Breitwisch et al. 1989). This occurs during the first half of the nestling period when the female is likely to be brooding.

The *hew call* is a relatively high amplitude, broad spectrum, rasping vocalization given by both sexes toward nest predators while mobbing, and during chases of conspecifics. A low amplitude version is also uttered when a male approaches his mate after having been involved in an agonistic encounter or chase with a neighbor or intruder (RB, KCD). Soft *hews* are exchanged between mates as one approaches the other closely during incubation and

nestling periods, even without any immediately prior aggressive interactions (RB, KCD, C. Logan pers. comm.). In addition, the female often *hew* calls after leaving the nest during incubation (C. Logan pers. comm.).

Chats (see sonagram in Logan et al. 1983) are short, explosive, broad spectrum notes given by both sexes either singly (*chats*) or in series (*chatbursts* = 2–8 *chats* each separated by 50 ms). *Chats* are uttered throughout the year and are also given by nestlings and fledglings (Logan et al. 1983), while *chatbursts* by juveniles and adults occur predominantly during the fall. *Chatbursts* are significantly more likely in response to territorial intrusions by non-neighbors than is song and they are the primary signal in fall territorial defense (Logan et al. 1983). *Chats* are given by either sex if mildly disturbed. They are interspersed in song by males during spring and summer, often being alternated with the high-pitched begging call described above (KCD). Finally, *chats* are typically the first vocalization uttered during morning twilight and seem to be contagious, spreading from territory to territory through the population. They are especially common in mated males (RB, KCD).

Mockingbirds have extraordinarily diverse song repertoires consisting of acoustically distinct song types (= song patterns = syllable patterns). Temporal and frequency characteristics are summarized by Wildenthal (1965). These songs are acquired through imitating the calls, songs, and parts of songs of other avian species, vocalizations of nonavian species, mechanical sounds, and sounds of other mockingbirds. The proportion of songs imitated is not known and would be extremely difficult to estimate because the entire auditory experience of an individual would need to be known to determine whether a vocalization was acquired through imitation. Geographic variation, although not studied, is likely, given that mockingbirds are relatively sedentary, acquire songs from neighbors, and imitate other species characteristic of the local avifauna.

Phenology. Males begin to sing sometime during February (as early as late Jan in southern populations) and continue into August throughout their range. Females rarely sing during the summer, and only when their mates are off the territory (KCD). Males sing during the establishment of fall territories during mid-September through November. Females also sing during this period, but the amplitude is generally lower. Because female song is difficult to sample, no one has estimated the proportion of females that sing during the fall. Females do not sing as much as males during this period. The propensity with which females sing may be greater in northern populations because more birds establish separate winter territories and

Figure 2.

Spectrogram of spring song (3 May 1988) of a male Northern Mockingbird. Twenty-nine songs are organized into nine bouts of nine different song types. The first example of a song type is underlined (note that the sixth song type is consistently sung in an extended form). The nine bouts contain 1, 6, 2, 3, 8, 2, 3, 1, and 3 songs, respectively.
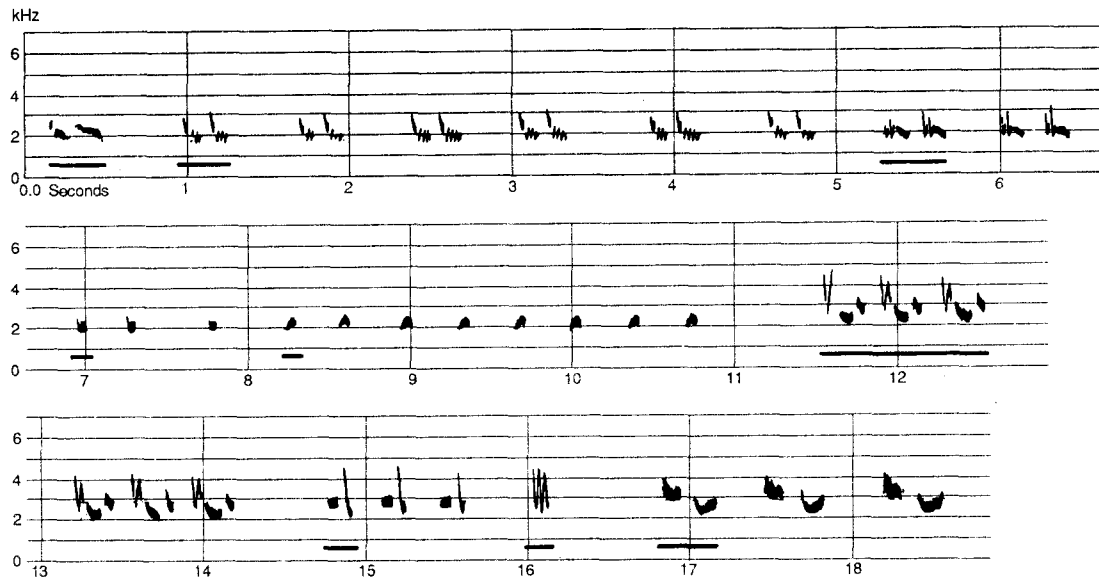
pairs do not remain together as often as they do farther south. Song by females seems less complex but this has not been studied.

Daily pattern of vocalizing. During the breeding season, males typically begin to sing 0.5 to 1 hour before sunrise. Unmated males start earlier than mated males (Merritt 1985). Song is prevalent during the morning, with its incidence declining gradually until dusk (Merritt 1985). Cessation of evening song is associated with sunset (light intensity), not temperature (Shaver and Walker 1930). Throughout the day, unmated males sing more often than mated males (Merritt 1985).

Nocturnal singing generally occurs from sheltered perches (Merritt 1985, KCD), but also from exposed, elevated, man-made structures. Few males are heard to sing between 20:00 and 24:00 (Merritt 1985, RB, KCD). In southern Florida, only unmated males sang for long periods during 00:00 to 04:00 (Merritt 1985). A similar pattern was observed in southeastern Pennsylvania in areas without artificial light, but in well-lit areas unmated, and to a lesser degree mated, males sang at night (KCD). Mated males occasionally sing nocturnally, but such singing is typically brief and discontinuous. Nocturnal singing appears to be more common around the period of a full moon, possibly because of the higher light intensity.

During the fall, song begins around sunrise, is sporadic throughout the day, and is never as continuous as in the spring. Both sexes sing, females

less so. There is no apparent evening song, even of low amplitude. No nocturnal song occurs during the fall.

Chats and *hew calls* are used year-round by both sexes. *Chatbursts* are used predominantly during the fall by both sexes. All three calls appear to be dependent on context (see above).

Places of vocalizing. Males typically sing from the tops of isolated trees during spring and summer, but also while on the ground or from concealed perches in vegetation. Song also occurs in flight and during the "flight display" (see Behavior: sexual). Particular trees are favored, but birds may sing from almost any location on the territory. Successive males on a territory may sing from the same perch site and thus singing sites cannot reliably be used to identify unmarked individuals (S. Halkin pers. comm., KCD). Males, when building the nest foundation, will sing quietly from the nest site after depositing a twig. Males also sing during copulation, while foraging, and even with food in their bills. The majority of song at night is given from concealed perches (except in suburban areas). Although males occasionally enter the nest cup containing eggs when the female is away, and very rarely incubate eggs, they have not been heard to sing from the nest. Females rarely sing during the spring and summer and have not been heard to sing while incubating. Males select different song types from their repertoire when in flight as compared with nonflight

periods, and when associating versus not associating with mates (Derrickson 1987a).

Repertoire and delivery of songs. Mockingbirds typically repeat one song type several times (see Fig. 2) before switching to another. Songs are presented in "bouts," with each bout consisting of repetitions of only one song type. Song types of short duration are repeated more often within a bout than are longer song types (Derrickson 1988). Mockingbirds also vary how often they return to repeat a bout of a particular song type (called "recurrence interval").

Several measures have been developed to describe the presentation of the extensive repertoire: versatility measures (see below), bout length (number of repetitions within a bout), and recurrence interval (number of intervening bouts before a song type is repeated). All measures vary among reproductive stages, behavioral situations, and individuals (Derrickson 1988). The three versatility measures are proportional (allowing for comparisons among species) and range in value from zero to one, with singing in which a particular song type is repeated (highly monotonous) receiving a value of near zero and singing in which each song uttered is a different song type (highly versatile) receiving a value near one (Kroodsma and Verner 1978, d'Agincourt and Falls 1983).

"Song versatility" is the number of different song types that occur in a sample of singing, which encompasses a predetermined, arbitrary number of successive songs ($n = 25$ songs in Derrickson 1988). Thus, if only one song type occurs during the sample of 25 songs, the song versatility is 0.04 (1/25). If five song types occur in the next sequence of 25 songs, the song versatility for this segment is 0.20 (5/25).

"Transition versatility" is the number of switches between different song types (recall, the mockingbird usually repeats a particular song type several times before switching) that occur during the sample of 25 songs. Alternating between two song types can result in a low song versatility, 2/25, but a high transition versatility, 24/24 (in a sample of 25 songs there are only 24 possible switches).

"Total versatility" is the product of song versatility and transition versatility. Singing behavior is most versatile during courtship, declines significantly during incubation, and then slowly increases during subsequent nesting stages (Derrickson 1988). Rare song types occur most commonly during the pre-female and courtship stages, and result in an increase in versatility (Derrickson 1988). Males that sing with the greatest versatility and lowest bout length are the first to attract mates and begin nesting (Derrickson 1988).

The vocal repertoires of individual males have been estimated to be as low as 45 and as high as 203

song types (Wildenthal 1965, Howard 1974, Merritt 1985, Derrickson 1987b). Wildenthal (1965) reported a male in Kansas with an estimated 194 song types and one in Florida with 134. Selander and Hunter (*in* Wildenthal 1965) estimated two repertoires in Texas as 66 and 91. The average repertoire size of 18 males in Texas was 90 song types (range = 14–150; Howard 1974), but several birds were inadequately sampled. The average repertoires of four males (multiple estimates on each male) in southeastern Pennsylvania was 148 (84–203) in 1980 and 167 (111–195) in 1981 (Derrickson 1987b). Merritt (1985) found two males in southern Florida each with approximately 200 song types.

Song types appear to be added continuously to the vocal repertoire, suggesting that an individual bird may not have an upper limit to its repertoire (Derrickson 1985, Merritt 1985). Thus, estimates of song repertoire size are only meaningful in relation to a specified time interval. Further, estimates of repertoires vary, are difficult to obtain, and are unreliable unless long sequences (150 bouts or more) of singing are analyzed (Derrickson 1987b). Kroodsma (1982), Merritt (1985), and Derrickson (1987b) discussed several other criteria not always met when estimating repertoire size, especially in species with extensive repertoires. In mockingbirds, many song types are recorded only once (consistently > 25% of the song types recorded from four well-sampled males, each over two years; Derrickson 1987), even in extraordinarily large samples. These rare songs likely arise from the combining of elements taken from other song types (Merritt 1985, Derrickson 1987b). Finally, repertoire size estimates vary depending on social situation, the largest estimates being derived from singing by a male when associating with a female (Derrickson 1987b). Without controlling all these aspects, any comparison of estimates from different regions or birds is tenuous. A detailed investigation of regional differences in repertoire size has yet to be done.

Presumed functions of song. Mockingbird song has received much attention from a sexual selection perspective. While both intrasexual (i.e., male-male) and intersexual (male-female) functions have shaped mockingbird singing behavior, it appears that song serves mainly to attract and stimulate females.

The following observations and arguments have been advanced to support the notion that singing expresses competition among males (intrasexual function), but most have been or can be discounted for various reasons. (1) Mockingbirds sing during the spring and summer, and again during the fall. Initially, fall song might be thought not to involve any intersexual function and be strictly intrasexual because no breeding occurs at this time. However, Logan and Hyatt (unpubl. ms) suggest that fall song

occasionally can attract a female and may allow for early breeding the following season. (2) Song continues after pairing, suggesting additional functions besides mate attraction such as territory maintenance. However, both the amount of song and the presentation change (see below) in a fashion parsimoniously implicating intersexual functions. (3) Playback of both spring and fall song produced agonistic responses during both the spring and fall, but birds responded significantly more often during playback of spring song regardless of the season (Logan and Fulk 1984). (4) Males respond aggressively to playbacks during all stages of the breeding season, so song does not appear to serve a mate-guarding function (Logan 1988). (5) A partial correlation analysis showed that repertoire size was more strongly correlated with territory quality than with date of nest initiation or female arrival (Howard 1974). Howard's measures of territory quality and repertoire size have been found deficient (Derrickson 1985, 1987b; Merritt 1985), thereby weakening his conclusion of an intrasexual function. Because of its importance, this study needs to be redone with appropriate controls. (6) Males match song types during countersinging; the function of this is unknown and has not been studied.

Evidence for an intersexual function in the evolution of mockingbird singing behavior can be found in the following: (1) directionality of singing is associated with mating status; (2) nocturnal singing is associated with mating status; (3) males sing during copulation; (4) amount of song depends on mating status; (5) cyclicity of song varies with nesting stage; (6) versatility of song varies with nesting stage; (7) singing behavior changes upon removal of mate; (8) song stimulates quicker renesting; (9) repertoire size varies with behavioral context; (10) repertoire size is associated with mating success, the amount of singing, and reproductive success; and (11) the occurrence of rare song types varies with reproductive stage.

Unmated males project their song in many different directions, as if broadcasting widely for females, while mated males, although also broadcasting widely, project their song statistically more often into their territory (Breitwisch and Whitesides 1987). The preponderance of nocturnal song (see above) by unmated males also argues for a mate attraction function as does the observation that unmated males sing more than mated males. That song occurs during copulations seems to imply some intersexual function, as does such song's low amplitude, which restricts its propagation into neighboring territories. The amount of singing by mated males varies cyclicly with breeding stage (maximum song output during nest building and egg laying; Logan 1983, Merritt 1985) and the

versatility of song follows a similar pattern (Derrickson 1988). Also, males dramatically increase song output with the experimental removal of their mates (Merritt 1985, C. Logan pers. comm., KCD). Logan et al. (1990) presented experimental evidence that song may stimulate established pairs to renest in the presence of dependent young and thereby regulate the extent of clutch overlap. Repertoire size estimates are highest during courtship and nest building (Derrickson 1987b) and males with the largest repertoires tend to attract females earlier and nest earlier (Howard 1974, but see above cautions; Derrickson 1987b). This finding, too, was based on a detailed study of only four males, a common problem in studying song in a species with such an extensive repertoire. Rare song types occurred frequently during the pre-female and courtship stages and rarely during subsequent nesting stages (Derrickson 1988).

NONVOCAL SOUNDS
    None noted.

BEHAVIOR

LOCOMOTION
    Walks, runs, and hops on the ground. Hops adroitly, even through dense foliage. Occasionally clings to tree trunks, like a woodpecker, when preying on arthropods on trunks. When walking or running on the ground, frequently raises wings ("wing flashes") half to fully open in a stereotyped manner, in several progressively higher jerky movements, exposing conspicuous white wing patch (Gander 1931a, Sutton 1946, Selander and Hunter 1960, Hailman 1960a, Sprunt 1964; Fig. 3). Function of this behavior unknown; speculations include startling insects or potential predators (especially nest predators) and as a component of territorial display (Selander and Hunter 1960, Mueller and Mueller 1971). Adults, especially females, perform wing flashes upon returning to the nest after a longer than normal absence (KCD). Typically, the adult lands on the outer portions of the tree, faces the nest and wing-flashes before moving onto the nest to incubate eggs, or brood or feed nestlings. Juveniles, including newly fledged young, flash wings even before they can forage for themselves (Sutton 1967). Similar wing movements observed in Chalk-browed (*Mimus saturninus*; Halle 1948) and Tropical (*M. gilvus*; Haverschmidt 1953) mockingbirds, both of which lack white wing patches. Halle (1948) therefore discounted the startling function while Whitaker (1957) thought that the jerky movement of a dark wing against a light gray body would suffice to startle insects.

Flight varies from direct and rapid, with rapid wingbeats, to slow, with shallow wingbeats. Individuals parachute from perches to ground and from buildings to tree perches or ground in suburban habitat (RB, KCD). May drop rapidly, wings folded, from such a perch (Dillard 1974: 8; RB, KCD). Also capable of rapid, acrobatic flight through tree crowns, as during courtship flight.

SELF-MAINTENANCE

Preens frequently, males about 3 min/h and mated males twice as often as unmated (territorial) males (Breitwisch and Whitesides 1987). Females seem to preen more before egg laying than at other stages (KCD), and also immediately after terminating an incubation bout (RB, KCD).

Bathes in shallow pools of water. On early mornings with heavy dew in spring and summer, flies through thick foliage, wetting feathers, then perches and preens.

Suns infrequently; orients perpendicular to sun in open area, leans away from sun with wings slightly extended away from body, drooped, touching the ground (KCD, RB).

During the breeding season in central California both sexes spent 92% of daylight hours perched, 2% in bipedal locomotion, and 5%–6% in flight (Biedenweg 1983).

AGONISTIC BEHAVIOR

Physical Interactions. Chases of conspecific territorial intruders common, especially during the breeding season. In northern portion of the range, where breeding and nonbreeding territories are often different, such chases are more frequent early in territorial establishment during both spring and fall. Intruders most frequently fly back to their own territories, although fights do occur. Supplanting an intruder from perches in trees within the territory may also occur before a rapid chase. Chases are either silent or accompanied by *chats, chatbursts,* or *hew* calls, but seldom song.

The "boundary dance" is a territorial boundary display. It infrequently follows obvious intrusion but rather occurs as two neighboring males fly simultaneously toward their shared boundary. Once thought to be courtship behavior (e.g., Sprunt 1964), now known to be agonistic (Laskey 1933, 1935, 1936, Michener and Michener 1935, Hailman 1960b); almost always between males and much more frequent in the spring than fall (Breitwisch et al. 1986a). However, C. Logan (pers. comm.) observed numerous dances involving females in North Carolina, including females dancing against a neighboring male along a territorial boundary. During the boundary dance, birds face each other while standing on the ground (within a half meter
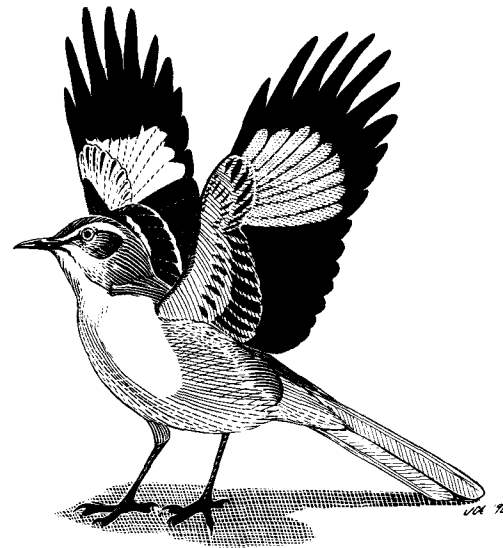
Figure 3.
Wing-flashing
behavior of the
Northern
Mockingbird. By
J. Anderton.

of one another) and hop laterally, first to one side, then the other, while still facing each other. This can continue for minutes, and is usually broken off when one individual retreats, followed for a short distance in flight by its antagonist. Birds sometimes leap at each other from the face-off position, grappling, using wings and claws, and jabbing with bills. Boundary dances can continue in one direction along the territorial boundary, even forcing the two males to dance through or over a shrub or tree and then onto the ground on the other side. In suburban habitat, dances also occur up and over low buildings. Dances are silent, unless one bird retreats and is then chased by the other, who may call when chasing; most frequent in open areas with short vegetation.

When fights occur in any context, these include flying against one another, breast to breast, within a meter of the ground or grappling together on the ground, using wings, bill (jabbing the opponent), and claws (gripping the opponent by the feet or legs). Occasionally, in a severe fight between neighboring males that has escalated to grappling on the ground, mates may also become involved, jabbing with their bills at the neighboring male or chasing one another near the scene of the fight (RB).

Threat and appeasement displays. No distinctive threat or appeasement displays described. However, the flight display may function as a low-intensity threat display insofar as it is more common in years when there has been a marked turnover in the population of territorial males (see below).

SPACING

Individual distance. Fledglings from the same brood may perch together close enough to touch. Fledglings sometimes approach within a half meter of the parental male as they loudly beg for food. Fledglings have been observed to approach within a meter of a parental male as he sang from an

exposed perch, and then orient toward the male, who continued to sing (KCD). Mates commonly perch within a half meter of one another. Neighboring birds are closest (except when fighting) during boundary dances, when they may be within a half meter of each other.

Territoriality. Highly territorial; pairs usually defend territories together, each member defending against intruding mockingbirds of the same sex. Territorial year-round, defending all-purpose territories. In southern Florida, territorial defense in fall is strong but less effective in excluding intruders as density of wandering juveniles is high (Kale and Jennings 1966, Logan et al. 1983, Logan 1985, Breitwisch et al. 1986a). Pairs frequently stay together in winter, co-defending territories (Laskey 1935, 1936, Michener and Michener 1935, Breitwisch et al. 1986a, Logan 1987). Occasionally, a female defends an individual fall-winter territory, sometimes adjacent to the territory of her erstwhile mate (C. Logan pers. comm., KCD). The incidence of females occupying their own territories appears to increase northward along the East Coast, being the predominant situation in Pennsylvania (KCD).

Breeding territories in south-central Florida in May and June averaged 1.27 ha ($n = 6$, range = 0.41–2.00; S. Halkin unpubl. data). Michener and Michener (1935) reported similar estimates in California. They also found that unmated females held the smallest territories, followed by unmated males, and then pairs. The maximum size of breeding territories in Tennessee was 1.01 ha (Laskey 1935). Breeding territories in Texas were estimated to range from 0.66 to 2.53 ha (Howard 1974).

Winter territories are smaller than breeding territories. In the Piedmont of North Carolina, winter territories varied in size through the fall and winter, averaging 0.39 ha ($n = 6$; range = 0.26–0.57) in early fall and 0.24 ha (6; 0.09–0.56) in December. Territory size subsequently increased slightly to 0.39 ha (6; 0.11–0.89) in January (Logan 1987). In south-central Florida, S. Halkin (unpubl. data) found territories averaged 0.31 ha (10; 0.08–0.59) in Nov through Jan, increased slowly to 0.37 ha (5; 0.14–0.55) by mid-March, and by late March, with the onset of breeding, had expanded to 0.74 ha (13; 0.15–2.61). These territories become even larger later in the breeding season (see above). Fall-winter territory size is not simply related to fruit density (Logan 1987, Safina and Utter 1989), and fluctuations in the size of winter territory may reflect changing weather conditions (Logan 1987). All of these estimates are likely influenced by the particular vegetational characteristics of the territories studied.

In southern Florida, birds may wander in winter from territory, moving unknown distances, presumably as a pair, before returning in one to four weeks (RB). Such behavior unknown in southeastern Pennsylvania and Maryland (KCD).

The use of vocalizations in territorial defense is not clear (see Vocalizations: presumed functions). Calls, especially *chat* calls, may be given in response to song from adjacent neighbors or even from males that are one or two territories removed (Logan et al. 1983, RB, KCD). Males may countersing, but this does not necessarily show that song is used as a keep-out signal (Merritt 1985, Breitwisch and Whitesides 1987).

Despite suggestions otherwise, there is little compelling evidence that mockingbirds hold interspecific territories (Howard 1974; but, see Sprunt 1964, Mueller and Mueller 1971, Moore 1978, Baylis 1982). Merritt (1985) found no relationship between intrusion frequency by other species into mockingbird territories, attack frequency by mockingbirds, and dietary overlap. Highly frugivorous Cedar Waxwings (*Bombycilla cedrorum*), however, are repulsed from fruiting trees by mockingbirds (Moore 1978), even killed occasionally (Hedrick and Woody 1983). Vocal imitations by mockingbirds can, at least temporarily, deceive other birds, for example Red-winged Blackbirds (*Agelaius phoeniceus*; Brenowitz 1982).

Dominance hierarchies are not known to occur among Northern Mockingbirds.

SEXUAL BEHAVIOR

Mating system. Monogamous, usually for the length of a breeding season, occasionally for life. Some pairs in southern Florida known to stay together for at least eight years (RB) and a pair in southeastern Pennsylvania remained together for at least six years (KCD). When separation occurs, female moves from territory. Separation sometimes follows nest failure. Polygyny rare (<5% of territorial males), although Ford (1983) classified mockingbirds as opportunistically polygynous. All known cases of polygyny are of bigamous males (Laskey 1941, Logan and Rulli 1981, Breitwisch et al. 1986b, Derrickson 1989, P. G. Merritt unpubl. data). Bigamy appears to arise either when a male disappears and a neighboring male expands his territory to include that of the neighboring female (who becomes the male's second mate), or when a female newly arrives in the population within the breeding season and chooses to settle on the territory of an already mated male. Aggression between females appears to limit the occurrence of the second path to bigamy (Derrickson 1989).

Bigamous males provide parental care to nestlings of both females, if nestling periods do not overlap. If broods overlap, the male feeds only one set of young, although he may defend both broods from predators. Polyandry occurs rarely (Fulk et al.

1987, C. Logan pers. comm.). Females and unmated males occasionally visit active nests of neighboring pairs but are chased immediately from the territory by one or both pair members (RB). Similarly, an intruding female was chased by a resident female after the former deposited an egg in the resident female's active nest (KCD); the resident female subsequently cracked this newly laid egg. In one instance each in southern Florida (RB) and southeastern Pennsylvania (KCD), eggs have been found buried beneath the lining of active nest cups.

Pair bond. Three known courtship displays:

(1). An acrobatic, swift flight through the territory, male chasing female, often accompanied by the exchange of soft *hew* calls (RB, KCD, C. Logan pers. comm.). In North Carolina, this courtship chase occasionally involves three birds along territorial boundaries, apparently a mated pair and a neighboring unmated male (C. Logan pers. comm.). Mate acquisition may also be accompanied by an elaborate, lengthy (> 30 min) tandem flight display in which the male and a newly arrived female fly rapidly together throughout the territory, repeatedly perching next to each other (C. Logan pers. comm.). The male's song production declines, while he gives more *hew* calls (C. Logan pers. comm.). It is difficult to determine which sex leads, but either sex can direct the pair's movements (RB, KCD, C. Logan pers. comm.). Some of these flights take the pair to prospective nest sites and berry-producing trees, both of which may be important in determining if a female remains on the territory (C. Logan pers. comm.). We speculate that the chase begins as mistaken identity (female approached as an intruder), but the female's subsequent behavior identifies her gender to the territorial male. The chase may also allow each potential mate to assess the other's general health, as the rate of energy expenditure must be high during this flight. Prowess in flight could also be assessed. In addition, the female might begin to learn the male's territorial boundaries (C. Logan pers. comm.).

(2). A "flight display" is given from a high singing perch. A singing male jumps upward, flaps his wings once or several times, ascends a meter or two above the perch, and then parachutes down, wings open, onto the same or a nearby perch. White wing patches are conspicuous during the display, and the bird sings continuously (Breitwisch and Whitesides 1987, J. Baylis unpubl. data), generally a limited subset of its repertoire (KCD). Unmated, territorial males give flight displays an order of magnitude more frequently than mated males (Breitwisch and Whitesides 1987). The frequency of the flight display fluctuates yearly (KCD). In one year when all the males in a population returned to their respective

breeding territories, the display was almost nonexistent. In previous and subsequent years, when new males resided on some of the territories, it was common.

(3). When a female has newly arrived on a male's territory, he runs along shrub and tree branches, singing continuously, perhaps showing her potential nest sites (Laskey 1935, Derrickson 1989, RB, C. Logan pers. comm.).

Song is given as a copulatory display. All copulations observed have been on the ground, near a bush, or some other form of cover. Males sing before (from an elevated perch), during, and after copulation (Gander 1931b, Merritt 1985, RB, KCD, C. Logan pers. comm.). The female, while on the ground below the male, may quiver her wings (solicitation display) before the male's descent to the ground. He lands and walks toward her before mounting. In one case, the female sang briefly before the male's descent, possibly matching his songs (KCD). In North Carolina, the female may quiver her wings repeatedly after copulation (C. Logan pers. comm.).

Logan (1988) concluded that song does not serve a mate-guarding function. Pairs may forage together before clutch completion and the beginning of incubation, but there has been no other study of possible mate guarding. If nesting is successful, most pairs seem to remain together for at least the duration of the breeding season (mockingbirds are multibrooded), and over the winter (more common in southern portion of range) and into the succeeding breeding season (re-pairing on original breeding territory in northern populations; RB, KCD). Pairs may separate after nest failure, but this appears less probable as the duration of the pair bond increases, even though long-established pairs lose nests to predators (Breitwisch 1988). A female has been found to switch mates while each male remained on its respective territory (C. Logan unpubl. data), suggesting continuous mate or territory assessment by females. The effect of the length of the pair bond on the occurrence of this switching needs further study.

Extra-pair copulations. No observational evidence. Parentage of offspring has not been verified biochemically.

SOCIAL AND INTERSPECIFIC BEHAVIOR

Degree of sociality. Adults spend most or all of the year in pairs, although male-biased adult sex ratios result in significant numbers of unmated males (Breitwisch et al. 1986c, Breitwisch 1989). Many unmated adult males are also territorial. Females sometimes hold fall-winter territories by themselves (KCD), although apparently not in

southern Florida (RB). Extent of floater subpopulation unknown, but probably few if any floater females. Merritt (1985) and KCD (unpubl. data) removed females from mated pairs in the breeding season and found no replacement females.

Juveniles appear to form short-term aggregations in fall between adjacent territories defended by adults (RB, KCD, C. Logan pers. comm.). In addition, during the fall, loose flocks (composed largely of juveniles) are active in and around fruiting trees in the southern United States (Kale and Jennings 1966, Merritt 1980, Breitwisch et al. 1986a).

Play. Sprunt (1964) noted that mockingbirds "bedevil" dogs and cats, dive-bombing them repeatedly. Whether this qualifies as play or as serious nest defense is debatable.

Interactions with other species. A few suggestions of interspecific territoriality (see above), but probably not likely.

PREDATION

Pugnacity may make mockingbirds less common prey than other passerines of similar size in the diet of hawks and owls. Adults taken by Sharp-shinned Hawks (*Accipiter striatus*) and Screech Owls (*Otus asio*) (G. Powell and O. Owre pers. comm.). Also Scrub Jays (*Aphelocoma coerulescens*) can kill and eat mockingbirds (Curry 1990). Great Horned Owl (*Bubo virginianus*) also a likely predator. Incubating females rarely taken by snakes.

Predation of eggs and nestlings not uncommon. Likely predators include Blue Jays (*Cyanocitta cristata*), Fish Crows (*Corvus ossifragus*), and American Crows (*C. brachyrhynchos*), also snakes and squirrels. Give alarm calls (*hew* calls, *chat* calls, and high-pitched cries) in presence of nest predators, and mob and actively pursue predators, sometimes striking them (Breitwisch 1988, Zaias and Breitwisch 1989, KCD). A soft *chuck-chuck-chuck* call occasionally given by the female when potential predators, particularly squirrels, approach old nestlings or young fledglings (C. Logan pers. comm.). Terrestrial mammals, including humans (Merritt 1984), are also mobbed and sometimes chased from vicinity of nest site. Introduced knight anoles (*Anolis equestris*) are chased from nest trees in southern Florida, where they are possibly occasional predators on eggs and nestlings (RB). No sentinel system noted, but males may be more responsible for vigilance in the vicinity of the nest (Breitwisch et al. 1989; see below).

BREEDING

PHENOLOGY

See Figure 4. Mockingbirds build and use several nests during a breeding season. In Florida and North Carolina, nest building starts as early as late February, although March is more common (Howell 1932, RB). Northern populations begin building nests three to five weeks later, beginning in mid-April and continuing through mid- to late August (Sprunt 1964). In southeastern Pennsylvania and Maryland, nesting can begin late March (mid-Apr is more common), terminating during August (KCD). Many pairs are multi-brooded, with two to three broods per season common, even in northern parts of the range (Sprunt 1964, Logan 1983, Breitwisch 1988, Derrickson 1989). Broods frequently overlap, the male caring for fledglings while the female incubates the next clutch (Zaias and Breitwisch 1989, Logan et al. 1990).

NESTS AND NEST SITES

The nest site is probably selected by the male (Laskey 1935, Derrickson 1989), although this needs study. Acrobatic courtship chase of female by male may pass near various potential nest sites (see Behavior: sexual). The male may construct as many as three nests for the first brood before eggs are laid in any. Some unmated territorial males build partial nests during the breeding season (RB), most commonly when a female has been in the vicinity (KCD).

The nest is an open cup of dead twigs lined with grasses, rootlets, and/or dead leaves (plus human artifacts, e.g., paper, aluminum foil, plastics, and shredded cigarette filters). Male builds most of the twig foundation and may supply some lining, while the female supplies few twigs but most of the lining (Sprunt 1964, Biedenweg 1983, Derrickson 1985, 1989, Zaias and Breitwisch 1989). Nests are built in shrubs and trees (42 species in northern Louisiana), occasionally on buildings (eaves and rafters) and on one occasion in a hole in a tree (Means and Goertz 1983, S. Hopp pers. comm.). Nest heights are generally between 1 and 3 m (Sprunt 1964), ranging as high as 19 m and as low as 0.5 m. In northern Louisiana, but not southern Florida or southeastern Pennsylvania/Maryland, nest height increases with season.

In northern Louisiana, nests in low dense shrubs fledge the most young (Means and Goertz 1983). In southern Florida, successful nests are lower than unsuccessful nests, and nests placed at junctures of branch and trunk are more successful than those placed either along a branch or in twigs or in leaves (Breitwisch and Zaias unpubl. ms.). Nest success is

positively associated with both the degree of isolation of the tree or shrub containing the nest from other vegetation and the homogeneity of foliage around the nest (Joern and Jackson 1983).

Nests are almost never reused (Means and Goertz 1983, RB, KCD). Pairs build up to six nests in a breeding season in southern Florida (although not all of these receive eggs; Breitwisch 1988), and up to eight nests in southeastern Pennsylvania (Derrickson 1989). Rarely, twigs from the foundation of a previous nest are used (KCD, RB). Nests may be abandoned if disturbed during incubation, but rarely once eggs hatch (severe, cold, rainy weather increases the chance of abandonment; Means and Goertz 1983, RB, KCD).

EGGS

Shape. Oval to short oval, occasionally short subelliptical. Runt eggs are rare and likely to be the last laid.

Size. Diameter and length, *M. polyglottos polyglottos*: U.S., 18.3 mm (*n* = 50, range = 17.2–19.8) x 24.3 mm (50, 22.4–27.4; Sprunt 1964); southern Florida, 18.3 mm (77, 16.6–19.6) x 24.6 mm (77, 21.5–28.0; Merritt unpubl. data); northern Louisiana, 18.1 mm (46, 16.0–19.5) x 24.5 mm (46, 21.0–29.0; Means and Goertz 1983); southeastern Pennsylvania/Maryland, 18.5 mm (246, 16.2–20.4) x 24.5 mm (246, 20.1–27.8; KCD unpubl. data). *M. polyglottos leucopterus*: 18.6 mm (50, 17.3–19.8) x 24.6 mm (50, 21.8–27.4; Sprunt 1964).

Mass. Southeastern Pennsylvania and Maryland, 4.2 g (0.4, 71, 3.4–5.1; KCD unpubl. data); southern Florida, 3.5 g (0.4, 31, 2.7–4.5; Oniki and Merritt unpubl. ms.). Each egg, on average, about 9% of adult female's weight. One female laid 27 eggs during a breeding season (Derrickson 1988), about 240% of her weight, an extreme case.

Eggshell thickness. Not determined by direct measurement. Klaas et al. (1974), using an index described by Ratcliff (1970) that is correlated with actual thickness, determined that differences among clutches accounted for 62% of the variance in eggshell thickness, while differences among eggs within a clutch accounted for the remaining 38%.

Color. Ground color, bluish gray or greenish white, through shades of greenish blue and bluish green, to darker shades of blue and green. Most eggs heavily marked with spots, blotches and short scrawls of various shades of brown (hazel, russet, cinnamon) and deep red; more concentrated and occasionally restricted to large end. Rarely, light blue egg with no markings.

Surface texture. Smooth.

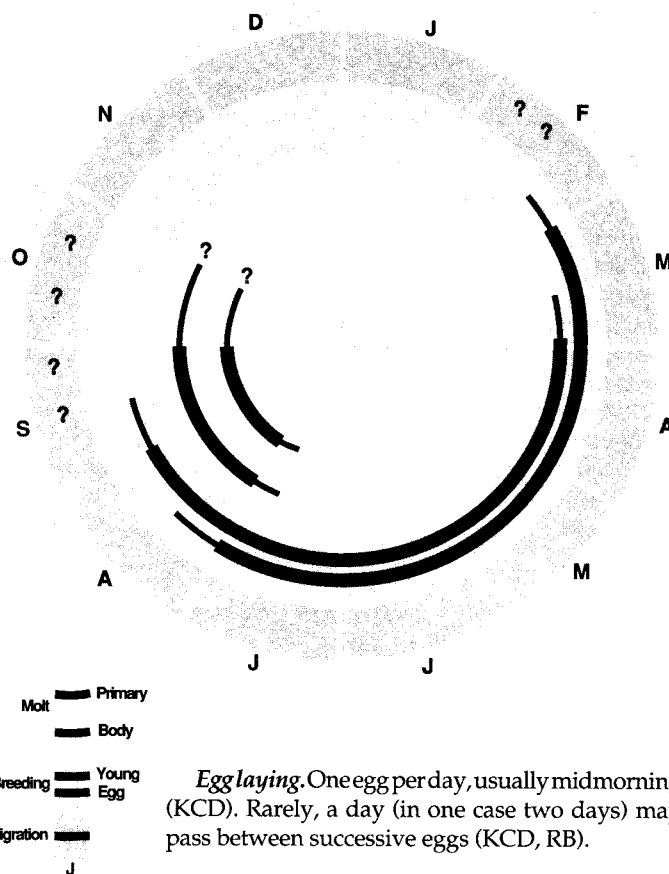Molt ▬ Primary
▬ Body

Breeding ▬ Young
▬ Egg

Migration ▬

Figure 4.
Annual cycle of breeding and molt for a southern population of the Northern Mockingbird. Migration is restricted to the most northern populations.

Egg laying. One egg per day, usually midmorning (KCD). Rarely, a day (in one case two days) may pass between successive eggs (KCD, RB).

INCUBATION

Only the female incubates, generally for 12 to 13 days in southern Florida, North Carolina, and southeastern Pennsylvania, and 13 days in northern Louisiana and Illinois (Graber et al. 1970, RB, KCD, C. Logan pers. comm). Incubation is sporadic until the clutch is complete, becoming much more constant with the penultimate egg. Subsequently, approximately 10 to 15 minutes are spent on the nest, followed by five to ten minutes off. Times vary considerably, probably in relation to ambient temperature (KCD, RB, C. Logan pers. comm.). Male rarely feeds incubating female (RB). Incubation may become sporadic just before the eggs hatch, sometimes associated with the male chasing the female back into the tree or shrub containing the nest (KCD). The female remains on the nest during the night.

Only females develop brood patches. These are completely denuded of feathers and not highly vascularized, with the abdominal skin translucent.

HATCHING

Eggs generally hatch in early to midmorning, although they can hatch at any time of the day.

Eggshells are removed on the day of hatching. Hatching is synchronous or asynchronous, even for successive clutches of the same female, although all eggs generally hatch within 24 hours (Oniki and Merritt unpubl. data, RB, KCD). Egg infertility rate has ranged from 2% in Illinois (Graber et al. 1970), to 6% in northern Louisiana (Means and Goertz 1983), to < 2% in southern Florida (RB).

YOUNG BIRDS

Condition at hatching. Altricial (naked, blind, helpless at hatching) and nidicolous (remain in the nest until they can fly). In southern Florida, chicks weighed 3.5 g (n = 31, range = 2.7–4.5) at hatching, with a tarsus length of 9.2 mm (31, 8.0–10.5; RB unpubl. data). One-day-old nestlings are covered with light gray down; their neossoptile down indicates beginnings of all pterylae; eyes are closed and ear openings visible; gape yellowish; egg tooth present (Horwich 1966). Nestlings gape on day of hatching (once dry) and can also peep faintly.

Growth and development. Asymptote to the growth curve was 37.5 g (n = 20 eventually independent young) in southern Florida (Oniki and Merritt unpubl. ms.), 39.1 g (n = 10) (= 36.8 g when reanalyzed by Oniki and Merritt unpubl. ms.) in Texas (Fischer 1983). Growth constant (k) = 0.492 in southern Florida, with an inflection point at 4.5 days (Oniki and Merritt unpubl. ms.), while k = 0.452 with an inflection point of 4.8 days in Texas (Fischer 1983); (k = 0.544 and inflection point = 3.8 when reanalyzed by Oniki and Merritt unpubl. ms.).

By day three, pinfeathers on all pterylae; quills visible on capital tract, around bill and eyes, spinal and femoral tracts, along with secondaries, primaries, and coverts; much down on middorsal and pelvic areas, humeral, femoral, and ventral tracts; eyes just beginning to open. Feathers of spinal and femoral tracts break from sheaths by day four and nearly unsheathed by next day. Eyes completely opened by day five. Secondaries, rectrices, and primaries begin to break free from sheaths on days six, seven, and eight, respectively. Most feathers, except rectrices and remiges, completely unsheathed by day 12. Breast feathers, with dark brown streaks, completely cover ventral apterium by day nine and femoral tract completed soon thereafter. Down remains on capital and spinal tracts to day 20 (8 days postnest departure). Age of physiological endothermy (able to regulate body temperature) estimated as 7 days (Breitwisch et al. 1984), and effective endothermy slightly earlier. Nestlings produce loud begging call by approximately nestling day 6 and continue through to independence (RB, KCD, C. Logan pers. comm.). The gape response becomes stronger and lasts longer with increasing age in response to a tapping of the nest (KCD). This response is not given as often in response to tapping the nest after day ten if parents are giving alarm calls nearby (KCD).

PARENTAL CARE

Brooding. Females do nearly all the brooding of chicks (97% of brooding bouts), usually 1–3 brooding bouts/hour. They brood after delivering food to nestlings and usually stop brooding when their mate arrives with food for nestlings. Brooding quickly declines about 6 days posthatching, as nestlings develop full endothermy (Breitwisch et al. 1984).

Feeding. Both parents feed nestlings, bringing food items in bill. Nestlings are fed a mixture of arthropods (82% of feeding trips) and fruit (18%). Initially, nestlings are fed almost solely arthropods: spiders and insects (dragonflies, grasshoppers and crickets, beetles, moths and butterflies, ants; Breitwisch et al. 1984). With further growth, nestlings receive more fruit; 25%–30% (by volume) of all food delivered to older nestlings is fruit, enough to power their basal metabolism (Breitwisch et al. 1984). A similar mixture is fed to fledglings (Zaias and Breitwisch 1989). In southern Florida, nestlings also receive small lizards, along with bits of limestone and snail shells.

Usually, a single food item is delivered each trip, with an overall feeding rate of 3–5 deliveries/hour/nestling (Breitwisch et al. 1984). Broods of two and three nestlings receive equal amounts of food, and each parent provisions equally (female brings 52% of the food to the nestlings and makes 53% of the feeding trips; Breitwisch et al. 1986c). Males in southern Florida peak food delivery around the midpoint of the 12–13 day nestling period, when nestlings grow most rapidly. Females show no such peak but rather increase feeding rate monotonically as nestlings age. Males in southern Florida also bring larger loads of animal food as nestlings grow.

Food items are thought to be apportioned equally among healthy, begging nestlings, but brood reduction does occur in some nests, perhaps owing to starvation, usually within the first half of the nestling period.

Nest defense. Both parents defend eggs and nestlings against potential predators, with the male assuming the greater role in defense (Breitwisch 1988). In southern Florida, the strength of male (but not female) attack against potential predators of eggs and nestlings was associated with nesting success (Breitwisch 1988). Furthermore, the strength of defense displayed by mates was correlated. Adults learn to recognize individual humans who repeatedly intrude onto their territory during the nesting season (Merritt 1984) and will selectively

mob those individuals while ignoring other humans that pass through their territory (Merritt 1984, Breitwisch 1988).

Nest sanitation. Both parents carry away fecal sacs and both also eat fecal sacs (Breitwisch et al. 1989).

Parental carrying of young. Not known to occur.

COOPERATIVE BREEDING

Not known to occur, except in the Galápagos Mockingbird (*Nesomimus parvulus*), a close relative of the Northern Mockingbird (Curry and Grant 1989). The young from the last nest of the season in Northern Mockingbirds remain on the natal territory for an additional two to four weeks, a behavior that might have preadapted this lineage to the evolution of cooperative breeding.

BROOD PARASITISM

Brood parasitism by Shiny Cowbirds (*Molothrus bonariensis*) in Puerto Rico low (0% in one site, 8% at another; Wiley 1985). Records of brood parasitism by Brown-headed Cowbirds (*M. ater*) on the mainland of North America infrequent, although the mockingbird is reported as an "accepter species" (Friedmann 1934, Friedmann et al. 1977). The Bronzed Cowbird (*M. aeneus*) has parasitized mockingbirds several times in Texas (Friedmann et al. 1977). One incident of a single active mockingbird nest parasitized by both a Verdin (*Auriparus flaviceps*) and Bronzed Cowbird reported (Carter 1987).

FLEDGLING STAGE

Most nestlings depart the nest (usually in early morning) on the 12th day after hatching (Laskey 1962, Adkisson 1966, Oniki and Merritt unpubl. ms., KCD, RB), although they may leave as early as the 10th day (especially if disturbed) and as late as the 15th day. Young frequently run immediately after leaving the nest, and climb into shrubs a day or two later (Zaias and Breitwisch 1989, KCD). Nearly all fledglings (90%–95%) can fly within 8 days of departure. Mean weight for fledglings was 32.2 g (4.1, 114; 20.4–39.6), ca. 60%–70% of adult weight (Zaias and Breitwisch 1989).

Both parents feed fledglings. Overall feeding rate is similar to that of older nestlings, with similar mixtures of animal prey and fruit. Mates divide labor temporally when they renest while still caring for fledglings from the previous nest (Zaias and Breitwisch 1989, KCD). After nest departure, young are fed by both parents for one to several days, then the male nearly or completely stops providing and begins to construct the foundation for the next nest. After a few days, the male resumes providing, and the female stops feeding the young as she finishes the nest, lays and incubates the eggs. Males alone may feed fledglings up to three weeks after fledging. On average, less than one fledgling dies before independence in southern Florida, almost always within the first four days after fledging (Zaias and Breitwisch 1989).

Both parents defend fledglings against predators, with the male assuming the greater role in defense (Zaias and Breitwisch 1989, KCD). Pairs sometimes launch joint attacks against Fish Crows, American Crows, American Kestrels (*Falco sparverius*), and other potential predators.

No brood division when caring for fledglings and renesting (Zaias and Breitwisch 1989), thus making mockingbirds somewhat exceptional among North American birds. Zaias and Breitwisch (1989) suggested that the temporal division of labor precludes brood division. There are some indications that final broods of the season may be divided (Zaias and Breitwisch 1989). If the brood consists of only one or two fledglings, a single parent may assume sole responsibility, most often the female (KCD). When this occurs the male begins his molt and becomes extremely secretive. If the female disappears or is removed from the territory temporarily, the male rapidly begins to feed the juveniles. Final broods are allowed to remain on the territory longer than previous broods (KCD). Some pairs begin their Prebasic molt while still caring for young (Zaias and Breitwisch 1990, KCD).

IMMATURE STAGE

Newly independent immature birds congregate in areas between adjacent defended territories where they forage for arthropods on the ground, frequently agonistically, flying at and supplanting one another. In early fall, the density of such immatures can be high in southern areas (Breitwisch et al. 1986a, C. Logan pers. comm.), less so in the mid-Atlantic region (KCD). Individuals in such groups commonly produce *chats* and *chatbursts*, less often song (RB, KCD, C. Logan pers. comm.). Compared to adults, immatures forage inefficiently on the ground; as summer progresses, they increase the frequency of aerial attacks on arthropods to a level similar to that of adults (Breitwisch et al. 1987).

DEMOGRAPHY AND POPULATIONS

MEASURES OF BREEDING ACTIVITY
Age at first breeding. Most females likely breed at one year of age. Males can physiologically breed at one year of age, but may not initially attract a mate in male-biased populations. Pairs are multibrooded (see Breeding: phenology).

Clutch. 2–6 eggs (Burleigh 1958, Imhof 1962, Laskey 1962, Sprunt 1964, George 1969, Woolfenden and Rohwer 1969); southern Florida, mean = 3.5 eggs (n = 156, range = 2–5; RB); northern Louisiana, 3.7 eggs (266, 2–6; Means and Goertz 1983); Tennessee, 3.9 eggs (212, 3–5; Laskey 1962); southern Illinois, 3.8 eggs (52, 3–6; Graber et al. 1970); southern Pennsylvania and Maryland, 3.6 eggs (88, 2–5; KCD).

Annual reproductive success. In southeastern Pennsylvania and Maryland, the average number of nesting attempts/female/year was 2.7 (n = 43, range = 1–7; KCD), but *not* all nests received eggs: 36.4% of the nests were successful, but varied from lows of 6.7% and 17.4% in 1981 and 1989, to highs of 80% and 54.2% in 1979 and 1987, respectively. Females on average laid 9.8 eggs per season (42, 2–27; KCD).

In southern Florida, nesting attempts/female averaged 3.2 (68, 2–6) and females, on average, laid 9.7 eggs per season (42, 5–17; RB unpubl. data). Again, not all nests received eggs: 39.4% of the nests were successful. Annual variation in the proportion of successful nests (3 yr; 39.4%, 37.3%, and 41.2%) was much smaller than in the mid-Atlantic populations. While the mean number of eggs per female is similar in southeastern Pennsylvania/Maryland and southern Florida, the variance for the former population is significantly larger. On average, less than one fledgling dies before independence in southern Florida, almost always within four days of fledging (Zaias and Breitwisch 1989).

In Illinois, 61% of the nests were successful overall, but late nests did much better than early ones (32% in Apr–May vs. 85% in Jun–Aug; Graber et al. 1970). Overall, 16.8% of the eggs laid produced fledglings, with later eggs producing more (9% in Apr–May vs. 24% in Jun–Aug; Graber et al. 1970). The average number of young raised to nest departure/female/year in southeastern Pennsylvania/Maryland was 2.5 (2.0, 43, 0–8): 30% of the females failed to rear even one brood, 42% reared one, 26% reared two, and 2% reared three (KCD unpubl. data).

The average number of young raised to nest departure per successful nest (and the variance) was similar for several populations: southern Florida, 2.7 (0.9, 22, 1–4) and 2.4 (1.0, 25, 1–4) in two years (Zaias and Breitwisch 1989); 3.0 (1.0, 101) in northern Louisiana (Means and Goertz 1983), and 2.5 (0.9, 43, 1–4) in southeastern Pennsylvania and Maryland (KCD unpubl. data). The number of young that depart from a nest is an accurate measure of the number of young reaching independence (2 to 3 weeks after departure when the male stops feeding; Zaias and Breitwisch unpubl. data).

Male seasonal reproductive success is extremely variable. In a southern Florida population, 50% of the fledglings were attributed to only 18%, 16.7%, and 12.5% of the territorial males in 1984, 1985, and 1986, respectively (RB unpubl. data). In a southeastern Pennsylvania population, 18.2% of the territorial males accounted for 50% of the fledglings and, similarly, in Washington, DC, 20.3% of the territorial males did so (KCD unpubl. data).

LIFE SPAN AND SURVIVORSHIP

No systematic study. Most individuals likely have a short life span, based on the low survivorship of juveniles. Once established on a territory, individuals have lived as long as eight years (RB, KD). Caged birds can easily live more than six years, formerly making them attractive pets. Holden (1883), in a book with cultural and historical implications, noted that they can live to be 20 years old.

MORTALITY AND DISEASE

Nestlings in southern Florida are commonly infested with blowfly larvae (family Calliphoridae; RB). Although not carefully studied, levels of infestation can be high. Emaciated, heavily infested nestlings are frequently encountered in southern Florida in the latter half of the nestling season (RB). Such nestlings almost always die, probably due to the blowfly larvae. While some nests are free of fleas and mites, others (and nestlings) are occasionally heavily infested (RB, KCD). Infestations of all these parasites seem to increase as the season progresses. Avian pox sores also appear on the feet and legs of nestlings more frequently in the latter half of the breeding season, and only in some years (KCD). The habit of rarely reusing nests may help to limit these infestations.

RANGE

Initial dispersal from natal site. No individual is known to have bred on its natal territory, although two females have done so on adjacent territories (KCD, P. Merritt pers. comm.). Immatures disperse up to 200 miles (Cooke 1946). Neither RB nor KCD found banded nestlings subsequently breeding within their study populations (two exceptions noted above). Young appear to disperse natally at least several territories away, but no detailed study has been conducted.

Fidelity to breeding site and winter home range. Migration, if occurring, is restricted to northern populations; site fidelity of these individuals is unknown. Most adults in southern and western populations stay on territory year-round, and appear to nest there for life (Laskey 1935, 1936, Michener and Michener 1935, Logan 1987, RB). Individuals occasionally change territories, but apparently do not move far. Farther north in Arkansas and

Figure 5.

Range and relative abundance of the Northern Mockingbird. Abundance data are the average number of individuals seen or heard on Breeding Bird Survey routes (1966-1987) in the U.S. and southern Canada (Robbins et al. 1986). No such data are available for south of the U.S.

☐ Sporadic
▨ 0.01-4.9
▩ 5.0-24.9
▨ 25.0-79.9
▧ 80.0-101.0
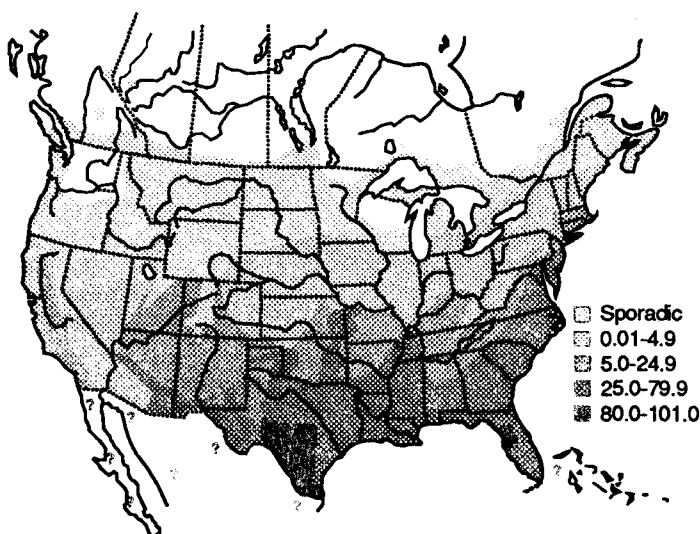
southeastern Pennsylvania, individuals are more likely to establish two territories, a breeding and a fall-winter territory, and appear faithful to both (Thomas 1946, Derrickson 1985).

POPULATION STATUS

Density. Highest in Gulf Coast states, with declines northward and westward (Fig. 5). Densities in Mexico not documented.

A total of 22,914 mockingbirds were seen on 891 of the 1,832 Breeding Bird Survey routes conducted in 1977 (Robbins et al. 1986); only 15 other species were more numerous. Mockingbirds were reported on at least one route in all states and provinces except Prince Edward Island, Newfoundland, North Dakota, Saskatchewan, British Columbia, and Alaska.

Population numbers. The mockingbird reaches its greatest abundance in South Texas brushlands, Edwards Plateau (central Texas), and Florida (Fig. 5). By state, Texas and Florida reported an average of 62.8 and 59.9 mockingbirds per route during 1966–1987, respectively (Robbins et al. 1986). Remaining Gulf Coast states west to New Mexico also reported large numbers. The maximum number of mockingbirds seen on Christmas bird counts was 5.26/hour, recorded in Texas and Florida (Root 1988).

Mockingbird densities declined an average of 1.8% per year (Appendix C in Droege and Sauer

1989; see Geissler and Noon 1981 for statistical treatment) between 1966 and 1987, with significant decreases in all three regions (eastern, central, and western) and across the continent (Fig 6). No reasons have been advanced to explain this large yearly decline. Canada and the far western states were the only areas without significant declines. Local increases occurred in central and southern New England, eastern portions of the Great Lake plains, and the northern portion of the ridge and valley section of the Appalachian Range (Fig. 6). Upper Midwest populations declined after severe winters of 1976–77, 1977–78, and 1981–82, and have not recovered in Michigan (R. Adams pers. comm.). Mockingbirds have disappeared as a breeding species in Minnesota during the past 10 to 20 years (Janssen 1987); along the northern edge of the range, populations are often very local in distribution and densities vary greatly.

Historical trends on East Coast. During the past century, the mockingbird has expanded its range northward from the mid-Atlantic states well into the eastern Canadian provinces. Coues (1903) reported the mockingbird as "not common north of 38°; though known to reach 42°," as occurred in 1852 in Massachusetts (Wright 1921). Ridgway (1907) reported the species as sporadic to Maine (Boardman 1871, Brown 1897a, b) and Hamilton, Ont. Wright (1921) documented a notable increase during the first 20 years of this century extending into Maine,

Figure 6.

Population trends (% annual change) of the Northern Mockingbird, according to Breeding Bird Survey data.
See Robbins et al. (1986) for description of method used to determine significance levels.

significant annual increase > 3%/yr   nonsignificant annual decline
significant annual increase ≤ 3%/yr   significant annual decline ≤ 3%/yr
nonsignificant annual increase   significant annual decline > 3%/yr
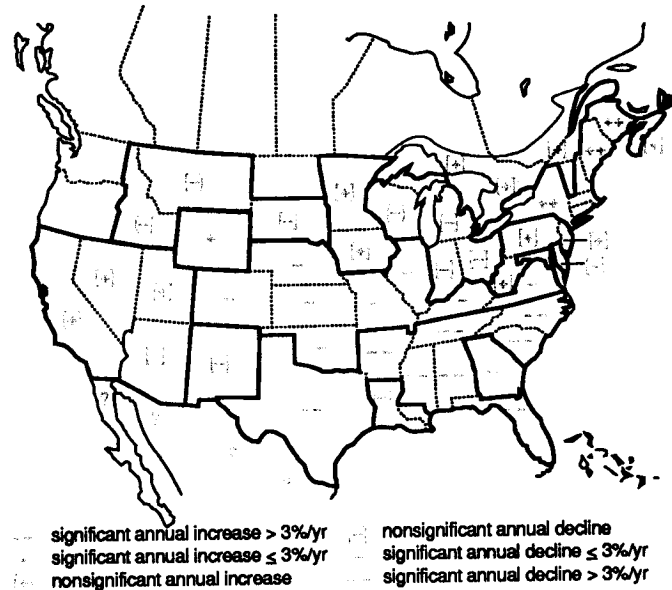
with less noticeable increases in Vermont (earliest record 1883, nesting; Townsend 1884), New Hampshire (1900), Sable Island (1884) and elsewhere in Nova Scotia (1883), and southern Ontario (1860). Some of the early, nonnesting sightings may have been released birds. More recently, Curry (1987) reported a slow, steady northward progression of their breeding range in Ontario since the 1960s, and Stiles (1982) documented with Christmas bird counts a similar increase for the northeastern states and provinces during 1947–80. Further, the increase in winter populations occurred later in the western sections of New England than along coastal regions at similar latitudes (Stiles 1982).

Current status along northern edge of range. Densities should continue to increase in northern populations. Range expansion is also likely, as humans alter habitat in ways favorabe to mockingbirds. The following brief synopses of the current (1990) status along the northern portion of the range should be useful for future comparisons.

MARITIMES: Widespread but local in Nova Scotia and New Brunswick, absent from Prince Edward Island (possibly because of little appropriate overwinter habitat); probably an uncommon resident in N.S. and N.B. B. Dalzell (pers. comm.) reported that 1 out of about every 25 multiflora rose clumps contained a mockingbird during the winter in N.S.; "fair population of birds" in Moncton, N.B. (even though winter temperatures reach minus

30°C). Multiflora rose, apparently more abundant in N.S. than in N.B., where it is restricted to human plantings; further population increases therefore more likely to occur first in N.S. Nests on Magdalen Islands in the middle of the Gulf of St. Lawrence, as far east as Glace Bay, north to Miscou Island, and northwest to Florenceville.

MAINE: Confirmed breeding throughout lower half of state, especially along coast and around Portland; sporadic nesting in northern half (P. Adamus pers. comm.).

QUEBEC: First nested in 1960, isolated occurrences as early as 1902 (David et al. 1990). Simultaneously colonized (in contrast to slow progression found in most other regions of range expansion) sparsely and evenly the entire St. Lawrence Valley during the 1960s. Breeding population remained low and evenly dispersed in the valley until the mid-1970s, when the breeding population in the southern half of the valley began to increase slowly (David et al. 1990). Successful overwintering apparently rare (but does occur), suggesting that birds may migrate (David et al. 1990). A few confirmed breeding records in the Abitibi region in western Quebec (David et al. 1990) and possibly at St. John Lake (J. Gauthier pers. comm.).

ONTARIO: Niagara peninsula is heart of range in Ontario; slow progression northward: Ottawa (nesting 1971), Sudbury (1972), Cochrane, and

northward and westward of Lake Superior (Curry 1987).

NEW HAMPSHIRE: First records for the state during the falls of 1900, 1904, and 1916, all in the southeast (C. Robbins pers. comm.). First summer residents reported from Manchester in 1922. Subsequent spread northward and westward from the southeastern section of the state, becoming sporadic in the upper half of the state (C. Robbins pers. comm.). Breeding Bird Survey (BBS) showed a gradual increase from a single bird recorded in 1967 to a high of 43 in 1987.

VERMONT: Numbers and distribution increased in recent decades (Laughlin and Kibbe 1985, S. Laughlin pers. comm.), especially along Lake Champlain and Connecticut River valleys and along major drainage systems in the center of the state. Birds retreat to densest cover during winter.

NEW YORK: Extensive breeding in southeast, expanded through Finger Lakes and northward up the Hudson Valley into Lake Champlain Valley; sporadic breeding throughout state. In southeast from 1870, reported in the interior by 1910, with a widespread increase between 1951 and 1970 (Meade 1988).

MICHIGAN: Rare prior to 1900; seen casually and nested primarily in southern Michigan until 1950s. Between 1950 and 1970, increased sufficiently to become regular but uncommon resident in scattered locations throughout state, but mainly in southwestern part. Recent decline owing to severe winters (R. Adams pers. comm.)

ILLINOIS: Breeds throughout state, but sparse in north central region; common along Mississippi Valley, and Chicago and south (Graber et al. 1970). Forbes (1880) noted northward range expansion and Graber et al. (1970) documented progression of nesting pairs to Wisconsin border.

MINNESOTA: Rare spring and fall migrant; disappeared as breeding species in past 10–20 years; overwintering attempts are unsuccessful (Janssen 1987).

MANITOBA: Rare throughout the province, but sighted as far north as Churchill.

NORTH DAKOTA: Rare. First record 1916, University of North Dakota campus. "Hypothetical" breeder based on isolated males singing during the summer.

SOUTH DAKOTA: Rare to uncommon summer resident, with a few nesting records (earliest 1934). Possibly breeding at two locations along the border with North Dakota and in the southeast corner of the state. All of the probable and confirmed breeding in southwestern portion of the state (R. Peterson pers. comm.).

SASKATCHEWAN: Confirmed breeding around cities such as Regina and Saskatoon, possibly breeding sporadically across lower third of province (mostly

in cities; Brazier 1964, A. Smith pers. comm.). Winter resident occasionally as far north as Prince Albert.

ALBERTA: Local and irregular. A few nests recorded from lower third of province. First nest found 1928, produced three fledglings. Occasionally seen in fall and spring as far north as Edmonton and Grande Prairie (Salt and Salt 1976).

MONTANA: Occurs sporadically throughout state in low numbers with little or no evidence of breeding (D. Flath pers. comm.).

WYOMING: Breeds currently in southeastern corner of state. Uncommon summer resident, thought to migrate out of state during winter, but some remain in urban areas (Oakleaf et al. 1982).

IDAHO: Only one overwintering record (1987) at Twin Falls near Snake River; wintered in multiflora rose and Russian olive patch. Breeding documented in Pocatello, Holebrook, and Boise; sporadic south of Snake River plain, typically associated with junipers (C. Trost pers. comm.). Earliest record for occurrence was July 1949 at Grays Lake (Burleigh 1972).

BRITISH COLUMBIA: Year-round resident in and around Vancouver and Victoria. Spring and summer observations rare and distributed sporadically along southern edge of province below 52°N. Spring and summer sightings as far north as Prince George (54°N, 123°W). Fall sightings as far north as Fort Saint John (56°N, 121°W). Winter and spring sightings in Kamloops (R. Campbell pers. comm.).

WASHINGTON: Sightings every year during spring, summer, and fall, but breeding not confirmed (P. Mattocks pers. comm.).

OREGON: Appears to be increasing, but not regular; some northward movement in spring (H. Nehls pers. comm.).

CALIFORNIA: Has expanded its range northward. Before European settlers, probably restricted to sagebrush, chaparral, and desert biomes in the Lower Sonoran (Pitelka 1941). Now resident in the San Joaquin and Sacramento valleys from Bakersfield, Kern Co., north to Redding, Shasta Co. (Arnold 1980). Also expanding northward along coast (Arnold 1980), but populations remain isolated. The establishment of permanent residence appears to depend on presence of large shrubs such as *pyracantha*, *crataegus*, and fruit trees, all associated with human settlement (Arnold 1980).

POPULATION REGULATION

Severe winters probably kill many mockingbirds in northern portion of range (Janssen 1987, David et al. 1990), and may ultimately restrict further range expansion. May be developing migratory habits in Quebec because those birds that attempt to overwinter are at a selective disadvantage due to

severe winter conditions and lack of appropriate fruit-bearing plants (David et al. 1990). Juvenile mortality probably high, especially if winter territory not secured, from unknown agents.

CONSERVATION AND MANAGEMENT

EFFECTS OF HUMAN ACTIVITY

From the late 1700s to the early 1900s (reaching a peak in late 1800s), mockingbirds were captured and sold as caged birds throughout the United States and parts of Europe because of their famous singing ability. Nestlings were preferred because they habituated to captivity more readily, but older birds fetched more money because of their more versatile singing.

The intensity of egg collecting and collecting nestlings and adults for sale decimated local populations. Wilson (1828) noted that mockingbirds were almost eliminated from Philadelphia and the surrounding area. He also remarked, as evidence of the intensity of collecting, that mockingbirds were captured in Wilmington and Newcastle, DE, transported to Philadelphia or New York City, and sold for as much as $50 for a good singer ($100 was refused for a "still more extraordinary one"). This local extinction was severe and widespread enough that subsequent repopulation from southern areas was still occurring as late as the 1940s. Local birders mistakenly thought these increases and northern progression represented range expansion, even though the species was well established much farther north by this time. Nehrling (1893) noted similar local extinctions around St. Louis as mockingbirds were captured for sale, as pets, or killed to prevent crop loss.

The prevalence of mockingbirds in the cage bird traffic likely facilitated their introduction to many localities via Acclimatisation Clubs (e.g., Hawaiian Islands, Portland [OR], San Francisco, cities in central Canada, and coastal Maine; see Nehrling 1893). More recently, human alteration of the habitat in the northeast and Maritime Provinces and California likely has facilitated range expansion (Arnold 1980, Stiles 1982). The creation of fields and concomitant edge for farming, and the plantings of ornamental shrubs and trees (especially multiflora rose and *pyracantha*) around dwellings, have provided breeding and wintering habitat.

APPEARANCE

MOLTS AND PLUMAGES

All color references are of a general descriptive nature and do not refer to any standardized color chart. Detailed quantitative description of the plumage has not been done.

Juvenal plumage and Prebasic molt. Juvenal plumage similar to adult plumage (see below), with the addition of the obvious distinguishing characteristic of brownish to black spots and streaks on the brownish gray to whitish breast feathers. The crown, nape, mantle, and back are plain brownish gray, slightly darker than in adults. The Juvenal back plumage contains indistinct brown streaks, lacking in adults; wing and tail a dull blackish slate with pale slate gray to white edges; R1, R2, and R3 plain dark feathers while R4, R5, and R6 patterns with dull white, increasing in extent from R4 to R6; immature rectrices are narrower, irregularly patterned and spotted; immature rectrices contain less white and often show a graded coloration between the white and dark regions; rectrices dissimilar to adults' but overlap in patterns (see below) does occur; outer primary often has no white, but white is present on broad inner web under coverts; leading edge of primaries predominantly dark. The amount of white on both leading and trailing edges increases gradually from P9 through P4 and is maximal on P3–P1. Webs are equally white on P3–P1. Trailing edge of the remiges is more tapered in juveniles than adults (see below). Coverts tipped with dull white to grayish white, forming two narrow bars. Amount of white expressed varies among individuals, remaining fairly constant between juvenal and adult plumages; minimal differences occur among subsequent adult plumages (Michener 1953). Indistinct superciliary stripe of pale gray may be a lighter shade than in adults. Remaining portions of plumage similar to those found in adults but tend to be slightly darker.

First Prebasic molt occurs late summer; pure white breast feathers replace spotted feathers of Juvenal plumage. First Prebasic molt is incomplete; all feathers are molted except the remiges and rectrices (Horwich 1966). Individuals nevertheless differ in the extent of replacement of remiges and rectrices; most birds molt the inner remiges and some molt all (Michener 1953). Also, rectrices more likely to be replaced than remiges (Michener 1953).

Definitive Basic plumage and subsequent Prebasic molts. Adult mockingbirds begin annual prebasic molt in mid-July to early August (California, Michener 1953) or late August (Florida, Zaias and Breitwisch 1990; southeastern Pennsylvania, KCD), and complete it by mid-October.

Molt begins with P1 and progresses sequentially to P10. The trailing edge of the remiges is more rectangular than in juveniles (see above). Amount of white expressed varies among individuals; for an individual it remains relatively constant between immature and adult plumages, and minimal differences occur among subsequent adult plumages (Michener 1953). The appearance of the coverts changes with the First Prebasic molt; immature coverts have more extensive black than adults and gradually grade between white and dark parts; adults are light or entirely white, occasionally with a well-defined small distal black spot or crescent. Adult pattern retained in subsequent molts. Males generally have larger white wing patches than females, but because the sexes differ widely in this respect (Michener 1953), sexing by wing pattern is not recommended.

Rectrices vary from blackish brown to white. R1, R2, and R3 plain dark feathers; R4, R5, and R6 patterned with white, increasing in extent from R4 to R6; R6 often completely white. Immature rectrices are narrower, irregularly patterned and spotted; adult rectrices contain more white with definite border between dark and white regions. Variation in extent of white occurs mostly on broad inner web of R5 and R6. Although this region can vary between subsequent plumages for an individual, adults generally are consistent (Michener 1953). Differences in rectrices are of limited use in aging or sexing birds due to extensive variation among individuals. Growth bars on rectrices can be used to identify juveniles. During the fall, however, they can cause an adult to be misidentified as a juvenile if the adult loses all of its tail feathers at one time (KCD).

Male ground color of upper surfaces (crown, nape, mantle, back) plain brownish gray (deep smoke gray); wing and tail dull blackish slate with pale slate gray to white edges; middle and greater wing coverts tipped with dull white or grayish white, forming two narrow wing bars; primary coverts white, occasionally spotted or streaked with smoke gray; base of all primaries white, extending distally to an increasing extent on interior primaries (see above); outer rectrix (R6) white, occasionally with grayish brown tint on outer web; second rectrix (R5) outer web mostly black and inner web mostly white with occasional smoke gray regions; next inner tail feather (R4) less white (often less than 0.5 its length). Indistinct superciliary stripe of pale gray. Eyelids grayish white. Lores dusky. Auricular region grayish. Suborbital and malar regions dull white flecked with grayish brown. Chin and throat dull white with submalar streaks of gray. Chest and sides of breast smoke gray grading into buffy wash on sides and flank. Abdomen and central portion of breast white. Under tail coverts buffy white (Ridgway 1907).

Female similar to male, with white portions of primaries and lateral rectrices more limited (see above), resulting in less contrast between dark and pale portions of wing patches and tail (KCD).

BARE PARTS

Bill is black with base tending to dark brown; immature iris gray to gray-green; adult iris light green-yellow to dark yellow or occasionally orange. Juveniles can be distinguished from adults by eye color; legs and feet dusky. In North Carolina, the bottoms of birds' feet are sometime golden instead of the usual grayish green (C. Logan pers. comm.); while not yet studied carefully, this apparently is unrelated to sex of the bird.

MEASUREMENTS

Two subspecies of the Northern Mockingbird are recognized, *Mimus polyglottos polyglottos* and *M. p. leucopterus* (Am. Ornithol. Union 1957). Subspecies differ in size (see tables on pp. 226, 228, and 232 in Ridgway 1907). Measurements of mockingbirds are given in Appendix 1, irrespective of subspecific designation. There is no obvious latitudinal pattern in linear dimensions.

Males are slightly larger and heavier than females (Appendix 1). Linear measurements are 2%–8% greater for males than females, and males are 9% heavier than females. The single exception is bill width, which is the same for the sexes. These differences, however, should not be used to sex individuals because of extensive overlap in the measurements of the sexes.

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ABOUT THE AUTHORS (Order of authorship determined by coin toss)

Kim Derrickson, a Smithsonian Research Associate at the National Zoological Park in Washington, DC., has a B.S. in Zoology from the University of Wisconsin, Madison, and a Ph.D. in Biology from the University of Pennsylvania. His interests are in communication and social behavior. The evolution of complex singing behavior has been the focus of most of his recent research. He has also conducted research in the tropics, studying how song can be used to assess distance in tropical species. He currently teaches at Loyola College, Baltimore, and George Washington University, Washington, DC., along with maintaining active involvement in adult education courses offered at the National Zoological Park. Address: Department of Zoological Resources, National Zoo, Smithsonian Institution, Washington, DC. 20008.

Randall Breitwisch, an Associate Professor of Biology at the University of Dayton, Ohio, has an M.S. in Zoology from the University of Michigan and a Ph.D. in Biology from the University of Miami. His dissertation research was on sex roles in the parental care of mockingbirds. He and his graduate students are currently studying parental care and mate choice in a second sexually-selected monogamous passerine, Northern Cardinals. His other research has included study of song, foraging behavior, and ontogeny of behavior in birds. Breitwisch has begun work on a technical book on parental care in birds. He has also published papers on social behavior in spiders and antelope. He has conducted research in Africa the past two summers on communication between oxpeckers and large mammals, and a non-technical article summarizing some of this research appears in the March 1992 issue of *Natural History*. Address: Department of Biology, University of Dayton, Dayton, OH 45469.

Appendix 1. Length and weight measurements of Northern Mockingbirds. Males significantly larger than females for each measurement ($P_s < 0.05$). Mean values shown, with SD, sample size in parentheses below.

Bill Length (mm)	Wing (mm)	Tail (mm)	Tarsus (mm)	Weight (g)	Location (reference)
BOTH SEXES					
17.5[a]	108.1[e]	114.2	32.1[e]	–	USA[1]
(–, 20)	(–, 20)	(–, 20)	(–, 20)		
12.4[b]	108.8[c]	115.1	33.0[f]	49.0	Southern Florida[2]
(0.7, 126)	(5.6, 127)	(6.3, 126)	(1.5, 126)	(3.9, 130)	
10.9[b]	111.5[e]	–	33.5[e]	47.8	Texas[3]
(1.3, 15)	(6.8, 10)		(1.3, 15)	(3.8, 15)	
	107.4[d]	–	29.2[f]	49.9	North Carolina[4]
	(–, 73)		(–, 68)	(–, 70)	
17.7[a]	109.7[d]	119.0	30.5[g]	47.9	Washington, DC[5]
(1.4, 25)	(4.8, 25)	(5.7, 26)	(1.6, 26)	(4.8, 17)	
18.4[a]	107.5[d]	111.8	31.9[g]	48.8	SE Pennsylvania[5]
(1.2, 8)	(5.6, 8)	(5.9, 8)	(1.5, 8)	(4.3, 8)	
FEMALES					
17.0[a]	104.8[e]	108.5	31.6[e]	–	USA[1]
(–, 10)	(–, 10)	(–, 10)	(–, 10)		
12.2[b]	103.7[c]	110.6	32.5[f]	46.4	Southern Florida[2]
(0.7, 44)	(3.7, 44)	(4.5, 44)	(1.5, 44)	(3.9, 44)	
	103.2[d]	–	29.3[f]	47.2	North Carolina[4]
	(3.5, 29)		(2.3, 25)	(3.1, 27)	
17.4[a]	107.7[d]	116.7	30.0[g]	46.5	Washington, DC[5]
(1.3, 13)	(4.6, 13)	(4.7, 14)	(1.4, 14)	(4.5, 11)	
18.0[a]	104.4[d]	109.6	31.6[g]	47.0	SE Pennsylvania[5]
(1.4, 5)	(3.7, 5)	(5.7, 5)	(1.5, 5)	(4.4, 5)	
MALES					
17.9[a]	111.4[e]	119.9	32.5[e]	–	USA[1]
(–, 10)	(–, 10)	(–, 10)	(–, 10)		
12.6[b]	111.5[c]	117.5	33.3[f]	50.5	Southern Florida[2]
(0.6, 82)	(4.4, 83)	(5.8, 82)	(1.4, 82)	(3.0, 83)	
–	110.1[d]	–	29.2[f]	51.5	North Carolina[4]
	(5.0, 44)		(2.5, 43)	(4.0, 43)	
18.1[a]	111.7[d]	121.8	31.0[g]	50.7	Washington, DC[5]
(1.4, 12)	(4.2, 12)	(5.8, 12)	(1.8, 12)	(4.5, 6)	
19.0[a]	112.5[d]	115.5	32.5[g]	51.8	SE Pennsylvania[5]
(0.5, 3)	(4.4, 3)	(5.2, 3)	(1.6, 3)	(2.0, 3)	

[a] exposed culmen
[b] anterior end of nares to tip
[c] flattened (arc)
[d] chord
[e] unknown method
[f] to joint
[g] to last complete scale

[1] Ridgway, 1907
[2] R. Breitwisch and P. Merritt, unpublished data
[3] Fischer, 1983
[4] C. Logan, unpublished data
[5] KCD, unpublished data

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