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Chapter 14

VIRGINIA RAIL

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Abstract: One subspecies of Virginia rail ***(Rallus limicola limicola)*** is recognized in North America. Populations have declined over the past **10** years and declines are most evident in the central United States, where wetland loss and degradation have been severe. Virginia rails prefer warm, freshwater marshes with dense emergent vegetation interspersed with open water or mud flats. Natural wetlands with heterogeneous topography, **0–15** cm water depths, and high invertebrate abundances are selectively used by Virginia rails. Migration routes, migration chronology, and important staging areas are unknown. Adequate population and harvest surveys are lacking, but vocalization surveys could be used to effectively monitor rail population trends throughout their range. Thirty-seven states and Ontario consider Virginia rails a game species, but few hunters take rails. Hunting pressure is highest in Atlantic and Gulf Coast states. Major management needs include better knowledge of seasonal distributions and population trends, increased wetland acquisition and restoration, active manipulation of man-made wetlands to increase productivity, and establishment of national population and harvest surveys. Research priorities include better estimates of survival, nesting success, and chick mortality; identification of environmental features affecting these population parameters; and effects of existing wetland management programs on rail populations.

DESCRIPTION

Virginia rails are small (23–27 cm) reddish-colored birds with gray cheeks and a long, slightly decurved bill (Peterson 1980). Wings are rich chestnut with a 1-mm long claw on the outer digit (Bent 1926, Mousley 1940). Legs and bill are reddish. and flanks are banded black and white. Sexes are similar in plumage, but females are smaller than males (C. J. Conway, unpubl. data). There is no adequate technique for ascertaining gender of Virginia rails in the Field. Adults weigh 55–124 g. Wing chords range from 95 to 117 mm.

Newly-hatched Virginia rail chicks are covered in black natal down (Gillette 1897, Billard 1948) (Fig. 1) that is replaced by juvenal plumage by mid- to late-summer when young are fully grown (Bent 1926). Juvenile Virginia rails are blackish-brown above and mottled black/gray below. Wing coverts acquire the reddish-brown adult color by 4 weeks of age and full adult plumage is attained at 14 weeks (Billard 1948). Pairs of Virginia rails make antiphonal, duetting calls known as "grunts" (Brewster 1902, Walkinshaw 1937, Irish 1974, Ripley 1977).

Only 1 subspecies of Virginia rail ***(R.*** l. limicola) is recognized in North America (Am. Ornithol. Union 1957; but see Dickey 1928, Dickerman 1966). Lacking better information on seasonal distributions, this species should be managed as 1 continental race.

LIFE HISTORY

Breeding Virginia rails are monogamous and territorial. As pair bonds are formed, pairs engage in allo- and autopreening, precopulatory chases, courtship displays, copulations, exchanges of calls, and vigorous defense of their territory (Audubon 1842; Ehrlich et al. 1988; Kaufmann 1988, 1989). Males perform the majority of territorial defense (Kaufmann 1989). Mated pairs perform courtship feeding (Ehrlich et al. 1988) and may defend their territory for up to 9 weeks before nesting (Kaufmann 1989). The actual courtship period is brief and can be identified by the short duration of the "tick-it" or "kid-ick" calls in spring (Bent 1926, Glahn 1974, Irish 1974). However, territory defense may be rare within several weeks after territory establishment (Johnson and Dinsmore 1985). Copula-

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Fig. 1. Virginia rail chicks are covered in black natal down (Photo by C. J. Conway).

tions have been observed as long as 20 days prior to laying of the first egg.

Females select the nest site and nest-building begins with laying of the first egg (Short 1890, Kaufmann 1989), or shortly prior to egg laying (Shaw 1887), or more than a week prior to egg laying (Mousley 1940). Both sexes construct the nest and nests are completed within a week (Pospichal and Marshall 1954, Kaufmann 1989). In the northeastern United States, nest construction normally begins in early May (Wood 1937, Billard 1948). Both sexes can breed in their first year, and pairs probably have 2 broods (Pospichal and Marshall 1954, Ehrlich et al. 1988).

The peak of egg laying occurs in mid-May in Iowa (Johnson and Dinsmore 1986). Nesting females lay 1 egg/day (Mousley 1940, Pospichal and Marshall 1954), usually early in the day, and clutch size averages 8.5 eggs (range 4–13, $n = 115$) (Walkinshaw 1937, Ripley 1977, Kaufmann 1989). Egg laying has been recorded as early as 17 April in New York (Orman and Swift 1987). Peak incubation is late-May through mid-June (Bent 1926). Incubation usually begins 1 day (range 0–5 days) before laying of the last egg (Bent 1926, Walkinshaw 1937, Mousley 1940) and is shared by both sexes, with changeovers occurring every 1.5–2 hours.

Incubation length for Virginia rails is normally 19 days (range 18–20 days) (Walkinshaw 1937, Wood 1937, Mousley 1940, Billard 1948, Pospichal and Marshall 1954, Ripley 1977). Eggs are pipped about 48 hours before they hatch, and newly hatched young average 6.7 g (Walkinshaw 1937). Both sexes engage in nest defense and continue to defend their young after they leave the nest, but the female is usually more aggressive (Weber 1909, McLean 1916, Burtch 1917, Mousley 1940, Pospichal and Marshall 1954, Wiens 1966, Ripley 1977). Hatching has been described as synchronous, or nearly so (within 48 hr) (McLean 1916; Burtch 1917; Bent 1926; Walkinshaw 1937; Mousley 1940; but see Pospichal and Marshall 1954; Ehrlich et al. 1988). Precocial rail chicks leave the nest within 3 days after hatching (Gillette 1897; McLean 1916; Bent 1926; Kaufmann 1987, 1989), and can feed on their own by day 7 (Kaufmann 1987, 1989). Both male and female parents feed and brood the chicks, often dividing up large broods (Kaufmann 1987, 1989). Young rails grow rapidly during their first 5 weeks: metatarsi and toes reach adult size by their third week (Kaufmann 1987).

Chicks are brooded by their parents as a family group within the breeding territory for 3–4 weeks (Kaufmann 1989), after which adults shift their home range out of their territory as young become independent (Johnson and Dinsmore 1985, Kaufmann 1987). Chicks are preened frequently by brooding parents and are fed for >23 days. The pair bond breaks down before dispersal, shortly after young fledge (Johnson and Dinsmore 1985). Adults may return to a nest site the following year if habitat conditions are stable (Mousley 1931, Pospichal and Marshall 1954).

Estimates of nest success are few: 50% (4/8 nests) in Minnesota (Pospichal and Marshall 1954), 75% (18/24 nests) in Connecticut (Billard 1948), 78% (21/27 nests) in Iowa (Tanner and Hendrickson 1954), and 53% ($n = 81$ nests) throughout North America (Conway et al. 1994). Documented nest predators include snakes, weasels (*Mustela erminea* and *M. frenata*), raccoon (*Procyon lotor*), hawks, blackbirds, and wrens (Gillette 1897, Allen 1934, Walkinshaw 1937, Tanner and Hendrickson 1954). Likely nest predators include muskrat (*Ondatra zibethica*), skunk (*Mephitis* spp.), crows, terns, and yellow-billed cuckoo (*Coccyzus americanus*) (Randall 1946, Billard 1948, Pospichal and Marshall 1954, Tanner and Hendrickson 1954, Andrews 1973, Tacha 1975). Pike (*Esox* spp.), bass (*Micropterus* spp.), sandhill cranes (*Grus*


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canadensis), and frogs prey on young chicks (Forbush **1925,** Cramer **1932,** Ehrlich et al. **1988),**and mink (Mustela vison) (Audubon **1842,** Billard **1948,** Baird **1974,** Tacha **1975),** coyote (Canis latrans), feral house cats (Pospichal and Marshall **1954,** Robbins **1967),** great egret (Egretta alba) (Campbell and Wolf **1977),** northern harrier (Circus cyaneus) (Audubon **1842),** and owls (C. J. Conway, unpubl. data) prey on adult and juvenile rails.

Many nests are lost to flooding in some areas (Walkinshaw **1937,** Tanner and Hendrickson **1954,** Post and Enders **1970).** Changing water levels adversely affect rails by increasing nest loss, disrupting breeding activities, increasing chick mortality, restructuring location of optimal foraging sites, and increasing rail movements (Baird **1974,** Tacha **1975,** Griese et al. **1980).**

Chick mortality is probably high prior to fledging; most broods are small (range **2–5)** relative to published estimates of clutch size (Hunt **1908,** Lowther **1961,** Wiens **1966,** Irish **1974).** The daily survival rate of **36** radio-marked birds was **0.998 ± 0.001** and the annual survival rate was **0.526 ± 0.195** in Arizona for all age/sex classes and seasons combined (Conway et al. **1994).** Mortality was highest in winter.

Virginia rails primarily forage at dawn and dusk (Gillette **1897)** by probing the mud and shallow water with their long bill (Bent **1926).** Diet includes slugs, snails, small fish, insect larvae, aquatic invertebrates, caterpillars, beetles, flies, earthworms, amphipods (Gammarus spp.), crayfish, frogs, and small snakes (Audubon **1842,** Shaw **1887,** Cahn **1915,** Bent **1926,** Richter **1948,** Pospichal and Marshall **1954,** Brocke **1958).** Virginia rails also eat a variety of aquatic plants and seeds of emergent plants (Fassett **1940,** Pospichal and Marshall **1954,** Irish **1974),** but insects comprise nearly **62%** of their diet (Horak **1970).** Plant material is more commonly consumed in fall and winter compared to spring and summer (Martin et al. **1951).** Virginia rails undergo simultaneous wing and tail molt prior to fall migration, usually during July–August (Andrews **1973).**

HABITAT

Virginia rails inhabit stands of robust emergent vegetation within freshwater and brackish marshes and wetlands, and occasionally coastal salt marshes (Horak **1964,** Weller and Spatcher **1965,** Post and Enders **1970,** Johnson **1984,** Sayre and Rundle **1984,** Eddleman et al. **1988,** Manci and Rusch **1988,** Gibbs et al. **1991).** Virginia rails prefer freshwater marshes (Ripley **1977)** and are most common in moist-soil emergent wetlands and along seasonal or semipermanent ponds and lakes (Fredrickson and Reid **1986)** (Fig. 2). Virginia rails may feed in adjacent upland habitats in some areas (Horak **1970).**

Shallow water, emergent cover, and substrate with high invertebrate abundance are the most important features of Virginia rail habitat (Berger **1951,** Andrews **1973,** Baird **1974,** Glahn **1974,** Tacha **1975,** Griese et al. **1980,** Rundle and Fredrickson **1981,** Sayre and Rundle **1984,** Fredrickson and Reid **1986,** Gibbs et al. **1991).** In Maine, wetlands used by Virginia rails have greater abundance of emergent vegetation compared to unused wetlands (Gibbs et al. **1991).** In Iowa and Arizona, Virginia rails use relatively homogeneous stands of emergent vegetation compared to other rails (Johnson **1984,** Conway **1990).** In other areas, Virginia rails seem to prefer heterogeneous stands with more vegetative edge (Allen **1934,** Pospichal and Marshall **1954,** Glahn **1974,** Sayre and Rundle **1984).**

Virginia rails need standing water, moist-soil, or mud flats for foraging and avoid dry stands of emergents (Johnson **1984,** Fredrickson and Reid **1986,** Manci and Rusch **1988,** Gibbs et al. **1991).** Virginia rails will use deep-water habitats, but prefer shallow and intermediate water depths **(0–15** cm) with muddy, unstable substrates for foraging (Billard **1948,** Pospichal and Marshall **1954,** Irish **1974,** Tacha **1975,** Griese et al. **1980,** Rundle and Fredrickson **1981,** Sayre and Rundle **1984,** Johnson and Dinsmore **1986).** Virginia rails in Kansas were most frequently observed in areas with **5–15** cm of standing water (Baird **1974),**and were most frequently heard calling from areas with **0–5** cm of water (Tacha **1975).** If adequate upright emergent cover exists, Virginia rails will occupy deeper water habitats where there is substantial collapsed or floating vegetation that give the birds a substrate upon which to walk and forage (Sayre and Rundle **1984,** Johnson and Dinsmore **1985).**

A moderate cover : water ratio within wetlands is important for Virginia rails; they are often absent from wetlands lacking adequate shallow water pools or mud flats. An equal mixture of emergent vegetation and flooded openings increases macroinvertebrate production (Voigts **1976,** Kaminski **1979,** Nelson and Kadlec **1984),** and some species may use intersper-

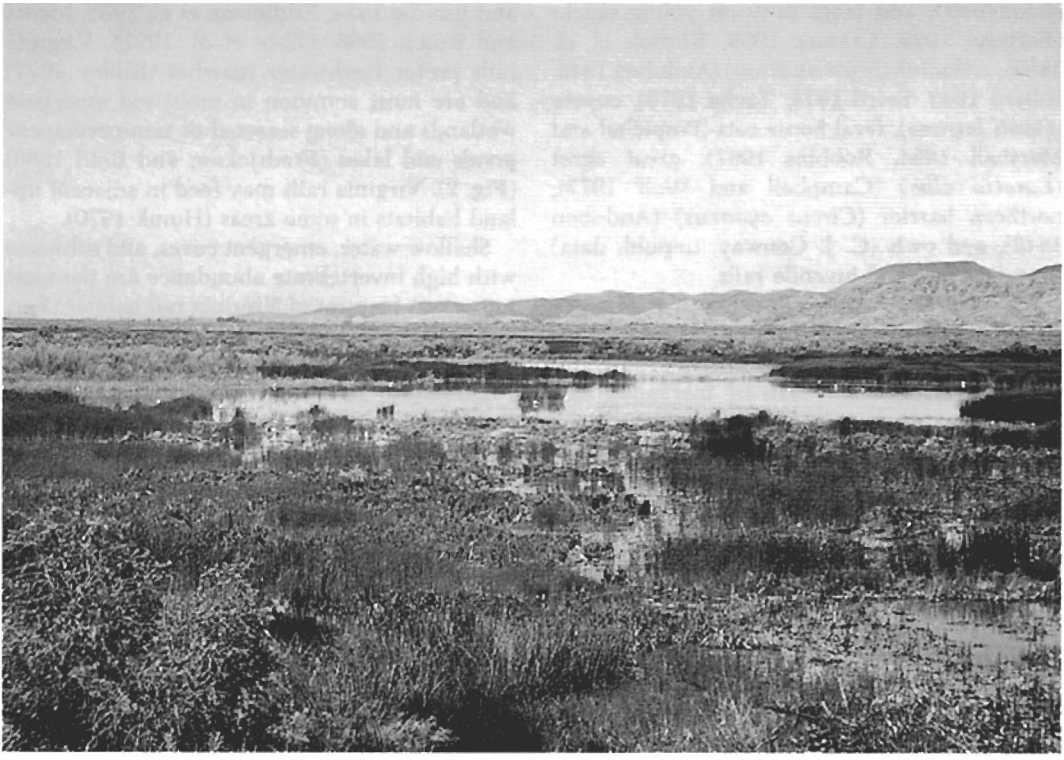

Fig. 2. Virginia rails prefer shallow, freshwater marshes with muddy substrates and 40-70% emergent vegetation interspersed with open water or mudflats (Photo by C. J. Conway).

sion as a proximate cue in selecting habitats rich in macroinvertebrates (Kaminski and Prince 1981, Reid 1985). Management for rails should target **40-70%** (optimally 60%) upright emergent vegetation interspersed with open water, mud flats, and/or matted vegetation (Fredrickson and Reid 1986). Nests of Virginia rails were repeatedly found in semipermanent wetlands with 45–65% emergent cover in North Dakota, but were absent from an otherwise similar wetland with 95% emergent cover (Krapu and Green 1978). Additionally, Virginia rails were abundant in a marsh with 25% open water in Iowa (Horak 1970). Management of wetlands for migrating rails should provide a diversity of plant species with annuals predominating (Fredrickson and Reid 1986).

Virginia rails avoid emergent stands with high stem densities or large amounts of residual vegetation (Johnson 1984, Conway 1990). These features are common in older marshes and impede rail movement. Vegetation height is not considered important for optimal Virginia rail habitat as long as there is adequate overhead cover. Virginia rails will move into regrowing marshes as soon as there is adequate cover.

Wetland size may be an important component of optimal Virginia rail habitat (Gibbs et al. 1991; but see Brown and Dinsmore 1986). Virginia rails in Maine used large wetlands more commonly and wetland use correlated with shoreline length, but area of emergent vegetation within a wetland was more important (Gibbs et al. 1991). Within a wetland complex, Virginia rails prefer littoral sites (Weller and Spatcher 1965, Zimmerman 1977, Johnson and Dinsmore 1986, Swift 1989) and areas of relatively high pH and conductivity (Gibbs et al. 1991).

In Maine, Virginia rails are uncommon in glacial wetlands (Gibbs et al. 1991). preferring beaver- or human-created wetlands with fertile soil, heterogeneous topography, and more understory herbs. Moist-soil management in man-made impoundments can be effective in attracting Virginia rails when it results in diverse habitat conditions with shallow water and a mix of open water and mud flats interspersed within dense vegetation. These conditions support great

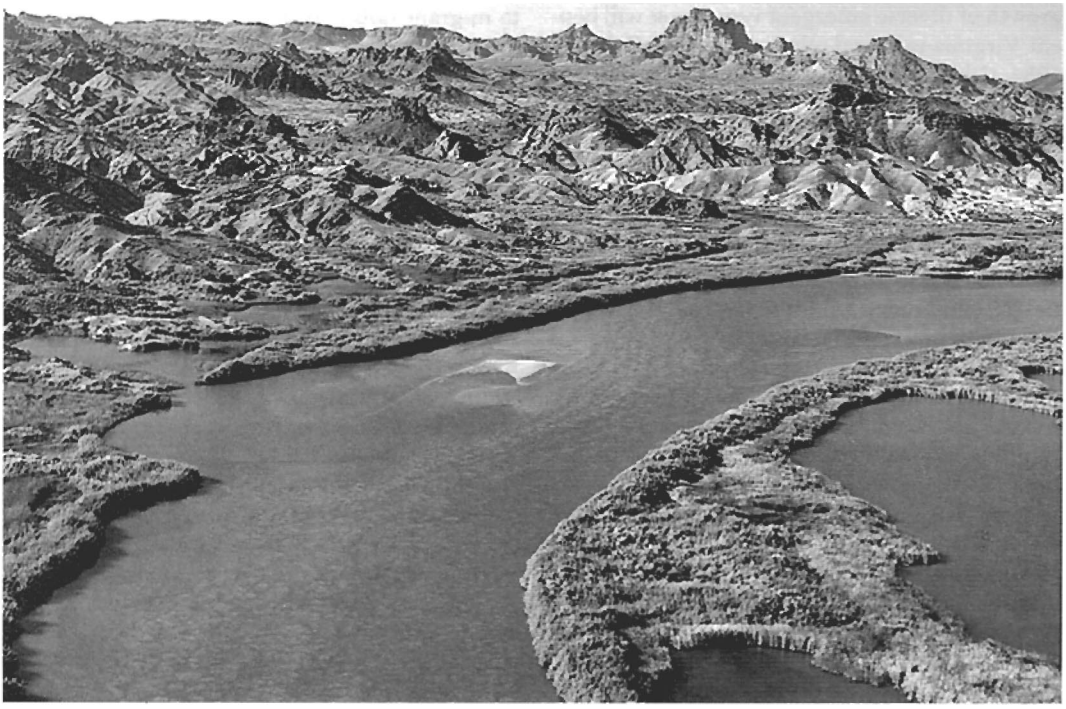

Fig. 3. The highest density of wintering Virginla rails is in the lower Colorado River Valley where **extensive backwaters and oxbows provide cptimal habttat (Photo by J. *C.* Rorabaugh).**

diversity and abundance of invertebrates available for potential prey and provide adequate cover (Rundle and Fredrickson **1981,** Fredrickson and Reid **1986).**

During migration, Virginia rails use flooded annual grasses or forbs with shallow water **(<10** cm) for optimal foraging (Sayre and Rundle **1984,** Fredrickson and Reid **1986).** Migrating rails require a variety of water depths, robust vegetative cover, and short-stemmed seed-producing plants (Andrews **1973,** Rundle and Fredrickson **1981).** Winter habitat includes both freshwater and salt marshes (Zimmerman **1977)** (Fig. **3).**

Nest Site Selection

Virginia rails nest in robust emergent vegetation (eg., Typha, ***Sirpus).*** Rails will nest within a wide variety of emergents (reviewed by Walkinshaw **1937** and Horak **1964),** so the dominant plant species in a marsh is not considered a good indication of habitat suitability for rails. Virginia rails use the most abundant emergent plants at the nest site for nest construction (Walkinshaw **1937,** Billard **1948,** Horak **1964).** Nests are well-concealed and are built touching, slightly submerged, or a short distance **(<15** cm) above the water surface.

Virginia rails nest at sites with a wide variety of water depths ranging from ***0*** to 71 cm (Walkinshaw **1937,** Billard **1948,** Tanner **1953,** Pospichal and Marshall **1954,** Andrews **1973,** Baird **1974,** Griese et al. **1980,** Johnson **1984).** Nests are most often placed near a border between vegetative types (Allen **1934),** but not near open water (Andrews **1973;** but **see** Pospichal and Marshall **1954).** Virginia rails build "dummy" or brood nests near the active nest (Billard **1948,** Pospichal and Marshall **1954,** Kaufmann **1989).** These dummy nests may number as many as 5/active nest and are probably used for feeding, brooding, resting, or as alternates in case of destruction or predation (Billard **1948,** Pospichal and Marshall **1954,** Kaufmann **1989).**

Wetland Management

There have been few, if any, management activities implemented specifically for rails, but rails have responded well to some waterfowl management programs (Rundle and Fredrick-

son 1981). Management activities that promote growth of diverse emergent vegetation will benefit Virginia rails and other waterbirds (Johnson 1984, Gibbs et al. 1991). Activities that increase wetland cover of emergent perennial vegetation, while retaining 30–60% of the wetland in open water or mud flats, will provide both optimal nesting and foraging habitat for Virginia rails.

Manipulation of water levels in man-made wetlands can increase invertebrate productivity for rails and other wildlife. Shallow flooding of areas with heterogeneous topography, or partial drawdowns of more homogeneous man-made wetlands, concentrates invertebrate prey (Fredrickson and Reid 1986, Eddleman et al. 1988), resulting in ideal foraging conditions for breeding rails. Wetland productivity is determined in part by daily, seasonal, and annual hydrologic fluxes (Batema et al. 1985, Reid 1985, Fredrickson and Reid 1986), and manipulations are often essential where hydrology has been modified or habitats degraded (Fredrickson and Reid 1986).

Shallow flooding (<15 cm) of grasses and forbs in spring and again in late summer will provide optimal rail habitat during spring and fall migration (Griese 1977, Rundle and Fredrickson 1981, Johnson 1984, Eddleman et al. 1988). Also, spring flooding in emergent marshes allows increased colonization by macroinvertebrate communities (Nelson and Kadlec 1984). Additionally, shallow flooding of wetland complexes in early fall has been suggested for managing migrant rails in Missouri (Fredrickson and Reid 1986). Fall flooding will stimulate growth and productivity of many invertebrate species (Reid 1985). However, flooding areas too deeply will reduce habitat quality for Virginia rails, as well as other rallids (Fredrickson and Reid 1986, Eddleman et al. 1988).

Drawdowns promote high productivity, diversity, and germination rates in man-made wetlands, but subsequent control of water depth is essential in maintaining plant species diversity (Weller and Fredrickson 1974, Weller 1981, Fredrickson and Reid 1986). Shallow flooding following drawdowns encourages growth of dense emergents and submergents. Partial drawdown of impoundments in early spring will benefit nesting and migrating rails by stimulating emergent growth, while still restricting weed succession (Andrews 1973, Johnson 1984, Fredrickson and Reid 1986). Late summer drawdowns produce seeds and other foods attractive to migrant rails (Rundle and Fredrickson 1981, Weller 1981). Both summer and winter drawdowns can be used to reduce high muskrat populations where excessive damage to marshes has occurred (Weller 1981). Fall or winter drawdowns maintained through August can also provide attractive fall habitat for migrating rails (Johnson 1984). However, overly aggressive drawdown/flooding strategies can increase turbidity and reduce seed stocks, thereby preventing establishment of persistent emergents and increasing open water areas (Weller et al. 1991) which reduce benefits to rails. Whatever the timing of a drawdown, reflooding should be gradual to avoid scouring, turbidity, and plant mortality (Weller 1981).

Achieving stable water levels and reduced turbidity are essential steps in gaining a diversity of emergent plants (Weller et al. 1991) and attracting a variety of rail species. Managers should encourage a diversity of emergent vegetation and seed-producing annuals well interspersed with aquatic bed vegetation (Cowardin et al. 1979) and open water. Management activities that eliminate ground topographic diversity (e.g., grading) reduce vegetation/water interfaces preferred by foraging rails (Sayre and Rundle 1984, Eddleman et al. 1988).

DISTRIBUTION AND ABUNDANCE

The breeding range of Virginia rails extends from southern British Columbia, northern Alberta (Lowther 1961), northern Saskatchewan, central Manitoba, southern Ontario, southern Quebec, Nova Scotia, and New Brunswick south through California, southern Arizona, northern New Mexico, Oklahoma, northern Texas, northern Missouri, Illinois, Indiana, and Ohio, across to southern Virginia, extending south along the coast to North Carolina (Fig. 4), and rather widespread throughout Mexico (Goldman 1908, Bent 1926, Billard 1948, Robbins 1949, Am. Ornithol. Union 1957, Dickerman 1966, Binford 1972, Natl. Geogr. Soc. 1987). Virginia rails have been reported at elevations up to 2,730 m (Goldman 1908, Griese et al. 1980), but generally breed in marshlands where spring air temperatures are warmer when compared to sora (Porzana carolina) breeding marshes (Griese et al. 1980).

The winter range extends from southern British Columbia south through California, across southern Nevada, northern Arizona, New Mex-

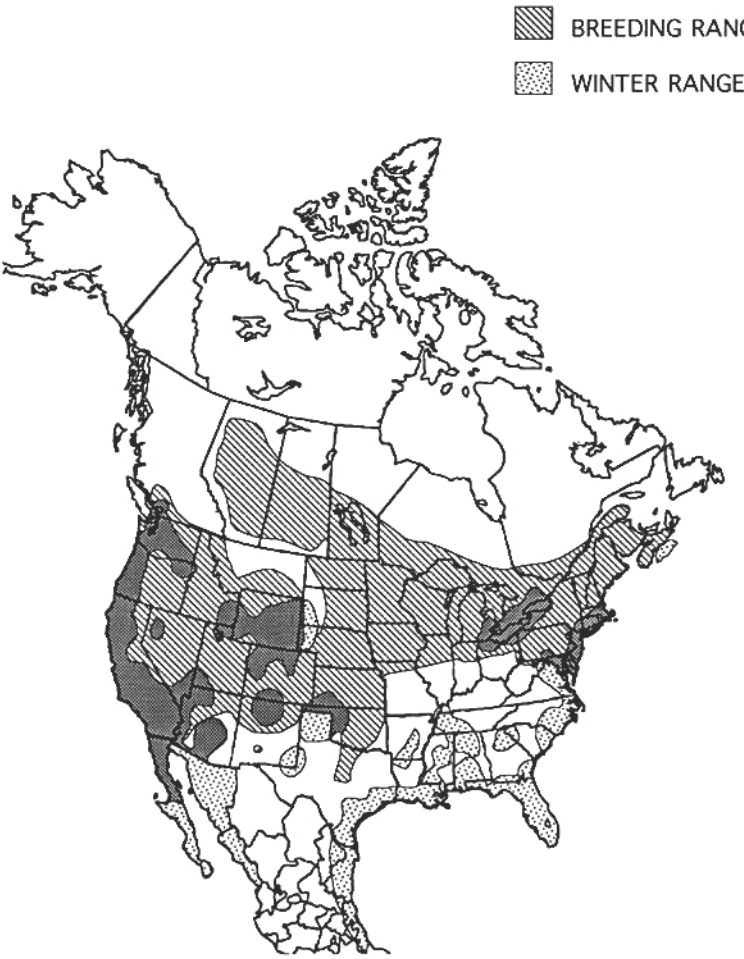

Fig. 4. Breeding and wintering ranges of Virginia rails in North America.

ico, Colorado (Griese et al. 1980), Wyoming, Nebraska, Oklahoma, and northern and southern Texas, and the lower Mississippi Valley states (Fig. 4). The Great Lakes harbor a limited wintering population. On the East Coast, Virginia rails winter from Massachusetts to southern Florida (Billard 1948, Natl. Geogr. Soc. 1987, Root 1988). Most wintering rails occur along the East, West, and Gulf coasts, but the highest density is in the lower Colorado River Valley (Root 1988). The winter range also extends south through Mexico to central Guatemala (Bent 1926, Am. Ornithol. Union 1957, Natl. Geogr. Soc. 1987).

Within their breeding (and probably winter) range, Virginia rails have restricted distributions, but are relatively abundant at sites where habitat conditions are acceptable (Gibbs et al. 1991). Wintering distributions follow major drainage systems, water storage impoundments, irrigation districts, wet meadows, and irrigated hayfields. Environmental factors affecting winter distribution include freshwater marshes and warm (>-7 C) temperatures (Root 1988).

Home range size varies seasonally (Conway 1990) and varies with habitat quality. Estimates of average home range size are limited: 0.18 ha during the breeding season in Iowa (Johnson and Dinsmore 1985), 1.64 ± 1.48 ha during the breeding season in Arizona (Conway 1990), and 2.41 ± 1.84 ha during winter in Arizona (Conway 1990).

Information on migration routes and chronology, and important staging areas is lacking. Birds return to their breeding grounds during early April in Colorado (Glahn 1974, Griese et al. 1980), during the 3rd week of April in Kansas (Baird 1974), and during the 3rd week of April

through the 1st week of May in Connecticut, Iowa, Michigan, Minnesota, Ohio, and Wisconsin (Walkinshaw 1937, Billard 1948, Andrews 1973, Ripley 1977, Manci and Rusch 1988, Kaufmann 1989). Virginia rails have returned to breeding grounds in Kansas, New York, and Ohio as early as 10–17 March (Crandall 1920, Bent 1926, Tacha 1975). Migrating birds fly low during the night and males usually arrive 7–10 days before females (Audubon 1842).

Returning migrants seldom vocalize during the first 1–3 weeks after arrival (Walkinshaw 1937, Pospichal and Marshall 1954, Tanner and Hendrickson 1954, Andrews 1973, Baird 1974, Glahn 1974, Kaufmann 1989; but see Griese et al. 1980). Peaks in vocalization frequency occur during the last week in April through the 2nd week in May in Colorado and Kansas (Glahn 1974, Griese et al. 1980, Zimmerman 1984), the 3rd week of May in Wisconsin and Maine (Manci and Rusch 1988, Gibbs and Melvin 1993), throughout May in Ohio and Iowa (Andrews 1973, Johnson and Dinsmore 1986), late-April to mid-June in Kansas (Tacha 1975), and mid-April in Arizona (C. J. Conway, unpubl. data). A second peak in vocalization frequency has been reported in several studies and may coincide with hatching (Kaufmann 1971, Glahn 1974, Gibbs and Melvin 1993). Vocalization frequency is low after July (Brewster 1902, Glahn 1974, Irish 1974). Peaks in Virginia rail vocalizations vary among years (Tacha 1975).

Density of breeding rails depends on habitat quality, but Virginia rails tend to occur at lower densities compared to soras (Pospichal and Marshall 1954). Densities vary from 0.1–8.9 pairs/ha (Tanner and Hendrickson 1954, Post and Enders 1970, Glahn 1974, Tacha 1975, Griese et al. 1980, Johnson 1984, Manci and Rusch 1988), but the highest density of Virginia rails documented was 25 breeding pairs/ha in Michigan (Berger 1951). Distance between Virginia rail nests averaged 46 m in Minnesota (Pospichal and Marshall 1954). Availability of adequate food and nesting cover probably determines territory size and breeding density.

Fall migration is not obvious and extremely variable (Pospichal and Marshall 1954, Griese et al. 1980), and departure dates vary with latitude and altitude. Birds concentrate on larger marshes prior to fall migration (Pospichal and Marshall 1954). In Kansas, rails are present through October, although vocalizations end in late September (Baird 1974). Virginia rails in Ohio depart by the first week in October, but have been recorded as late as 18 October (Andrews 1973). Birds in Michigan leave in late September or early October and have been recorded as late as 18 October (Walkinshaw 1937). Peak migration in Colorado occurs between the 2nd week in August and the 3rd week in September (Griese et al. 1980). Vocalizations are rare and difficult to evoke in August and September, and cannot be used to assess migration chronology.

Current Survey Techniques

Visual surveys are inadequate because Virginia rails are difficult to flush (Walkinshaw 1937) and visible only in open habitats. Because rails are so secretive, surveys have primarily used broadcast recordings of vocalizations to elicit detections (Johnson et al. 1981) and provide indices of abundance (Baird 1974, Glahn 1974, Tacha 1975, Griese et al. 1980, Marion et al. 1981, Tyser 1982, Zimmerman 1984, Johnson and Dinsmore 1986, Manci and Rusch 1988). Playback recordings increase response rates of Virginia rails (Baird 1974, Glahn 1974, Johnson and Dinsmore 1986, Manci and Rusch 1988, Gibbs and Melvin 1993), but response rate may still vary (22–72%)(Glahn 1974). Response rate is influenced by breeding density (Kaufmann 1971, Glahn 1974), season, and time of day (Gibbs and Melvin 1993), but weekly counts appear adequate to provide crude estimates of rail densities (Baird 1974, Manci and Rusch 1988). Surveys should be conducted between 1 hour before and 3 hours after sunrise and between 3 hours before and 1 hour after sunset (Glahn 1974, Tacha 1975). Evening surveys are equally or more effective than morning surveys (Tacha 1975, Johnson and Dinsmore 1986). Most importantly, surveys should be conducted during the period of peak vocalizations (prior to egg-laying) that varies annually and latitudinally. The peak calling season is usually the 2nd to 4th week of April in southern parts of the breeding range, and the 2nd to 4th week of May near the northern extent of the breeding range. However, several surveys should be conducted throughout the spring and early summer to avoid missing the peak season. Calling activity also is affected by weather (Tacha 1975, Gibbs and Melvin 1993), and surveys should not be conducted with wind >8 km/hour or with temperature/overcast extremes. Useful descriptions of Virginia rail calls have been provided by

Allen (1934), Walkinshaw (1937), and Callin (1968).

A 1992 mail survey of all states and Canadian provinces (W. R. Eddleman, unpubl. data) found that only 4 states (Virginia, New Jersey, Ohio, and California), and no provinces have standardized rail population surveys.

Population Status and Trends

Virginia rail populations have declined 22% ($P < 0.05$, $n = 93$) throughout North America over the past 10 years based on Breeding Bird Surveys (Conway et al. 1994). Trend data are not adequate to address specific states or provinces, but declines were greatest in the central United States. Only 18 states/provinces were able to comment on 15-year Virginia rail population trends within their boundaries (W. R. Eddleman, unpubl. data). Of these, Pennsylvania, Kansas, Connecticut, Kentucky, Alabama, New York, Rhode Island, Georgia, West Virginia, and New Brunswick reported that population size had stayed the same, while Alberta, Ohio, Indiana, Michigan, Washington, Wyoming, and Oregon reported that populations were decreasing, and Iowa reported populations were increasing. Virginia, Indiana, and Ohio classify Virginia rails as a "species of special interest" because of lack of adequate information.

HARVEST

There are no national surveys to estimate numbers of hunters or harvested Virginia rails in North America. Hunting pressure on Virginia rails has probably decreased since the early part of this century (Billard 1948), but surveys of waterfowl hunters buying duck stamps indicate that numbers of hunters and harvest of rails other than soras increased from 1964 through 1975 (Martin 1979, U.S. Fish and Wildl. Serv. 1988) and then decreased from 1975 through 1986 (Table 1). Annual rail harvest varied greatly during 1964–86 (Table 1), averaging 13,374 hunters and 100,983 rails other than soras taken annually (U.S. Fish and Wildl. Serv. 1988). However, most harvested rails were probably clapper rails (Rallus longirostris) in coastal states. Because the U.S. Fish and Wildlife Service survey included only waterfowl hunters, it is incomplete, but the only survey available. Both soras and clapper rails are more popular with hunters than are Virginia rails. Only 0.9% of waterfowl hunters from 3 eastern flyways harvested rails other than soras during 1964-75. The total number of rails harvested increased significantly in the Atlantic Flyway, and the number of waterfowl hunters harvesting rails also increased significantly in the Atlantic and Mississippi flyways during 1964–75 (Martin 1979).

Table 1. Hunting activity and harvest of rails other than soras by waterfowl hunters in the United States, 1964–86.[a]

Year	Hunters (n)	Harvest
1964	8,000	41,300
1965	5,800	24,100
1966	6,700	50,600
1967	10,800	94,300
1968	10,400	67,400
1969	19,900	130,000
1970	21,400	175,200
1971	14,900	118,300
1972	19,900	147,100
1973	18,000	148,100
1974	16,400	108,300
1975	18,900	160,300
1976	19,800	165,600
1977	15,400	95,400
1978	15,800	97,400
1979	13,300	98,800
1980	12,500	99,000
1981	12,200	130,400
1982	10,000	69,600
1983	9,400	63,300
1984	10,900	85,900
1985	9,100	73,100
1986	8,100	79,100
Mean 1964–88	13,374	100,983

[a] From U.S. Fish and Wildlife Service (1988:Table 26)

Thirty-seven states and Ontario consider the Virginia rail a game species (W. R. Eddleman, unpubl. data). Vermont, New Hampshire, South Dakota, North Dakota, Utah, Nevada, Montana, Arizona, California, Idaho, Washington, Oregon, Alaska, Saskatchewan, Alberta, Manitoba, Nova Scotia, Quebec, and New Brunswick do not consider the Virginia rail a game species. Virginia rails are hunted by a limited number of sportsmen. Hunting pressure is highest on their wintering grounds along the south Atlantic and Gulf coasts (Horak 1964, Andrews 1973). Virginia rails are also hunted more intensively in Connecticut, New Jersey, Delaware, and Maryland. Virginia rail hunting in midwestern states is minimal and by only a few individuals (Andrews 1973). Of the 38 states/provinces that allow hunting of rails, only 11 (Virginia, Nebraska, Kentucky, Missouri, Colorado, Minne-

sota, Ohio, Maryland, Wyoming, New Mexico, and Texas) have harvest surveys.

In all but 1 state, the rail hunting season is in the fall, and in most states (22/35), seasons are from 1 or 2 September through 4–9 November. Daily bag and possession limits are set at 25 birds in most (3035) states. Nebraska and Ontario have a daily bag limit of 10 and a possession limit of 20 birds. New Mexico has bag and possession limits of 10 birds, Alabama has bag and possession limits of 15 birds, and Iowa has a bag limit of 12 and a possession limit of 24 birds. Bag limits have stayed the same for the past 15 years in 36/39 state/provinces. Bag limits in New Mexico have decreased, and Vermont and Alberta have closed their rail hunting seasons. Additional harvest opportunities exist in 14 states and provinces, while no additional opportunities are thought to exist in 17 other states and provinces (W. R. Eddleman, unpubl, data).

Effects of harvest on Virginia rail populations are not known, but annual harvest is probably within sustainable levels, at least on a national scale (Eddleman et al. 1988, U.S. Fish and Wildl. Serv. 1988). Of 1,688 Virginia rails banded prior to 1950, none was reported harvested by hunters (U.S.Fish and Wildl. Serv. 1988). Despite liberal bag limits, seasonal hunter success averaged only 7.5 rails (other than soras) per active hunter during 1964–84 (U.S.Fish and Wildl. Serv. 1988). None of 37 agencies responding to a United States and Canadian rail harvest survey was able to estimate the number of rail hunters in their state/province, and only Kentucky was able to provide a minimum number of birds (1,000) harvested annually. Five states and provinces indicated a need for decreased season lengths or bag limits, while 25 states/provinces reported no need for such changes (W. R. Eddleman, unpubl. data).

MANAGEMENT NEEDS

State and provincial managers were asked to rank their needs based on information necessary for more effective management of rails (W. R. Eddleman, unpubl. data). Needs identified were:

1. better data on abundance, distribution, population trends, and other population parameters,
2. better data on habitat needs,
3. data on effects of existing habitat management programs,
4. improved harvest surveys,
5. evaluation of census techniques,
6. basic life history information,
7. public education, and
8. improved sex/age criteria.

Habitat Management

Habitat loss, primarily draining of inland freshwater wetlands for agricultural purposes, is the greatest threat to Virginia rail populations. Habitat management programs should favor acquisition and restoration of natural wetland areas that have been degraded. Management of man-made or severely degraded natural wetlands should strive to maintain or emulate natural water fluctuations of the region.

Marshes should be managed where build-up of residual vegetation is evident. Such marshes should be burned, disked and flooded, mowed, or plowed to remove residual vegetation that impedes rail movement (Rundle and Fredrickson 1981, Johnson 1984, Fredrickson and Reid 1986, Conway et al. 1993). Rail use can be encouraged by maintaining marshes in early successional stages and promoting moderate cover : water interspersions of wetland types 3–4 (Stewart and Kantrud 1971). Moderate cover: water ratios are also preferred by dabbling ducks (Kaminski and Prince 1981, Murkin et al. 1982). In general, avian productivity and species diversity are highest when cover-to-water ratios are 50–70% (Weller and Spatcher 1965, Weller and Fredrickson 1974). Disking followed by shallow flooding in man-made wetlands reduces woody vegetation and stimulates growth of robust annuals used by migrating rails (Rundle and Fredrickson 1981, Fredrickson and Reid 1986). Because rails use a variety of water depths and depth is affected by soils, hydrology, rainfall, and evaporation, there is no single optimal initial flooding depth. Rather, the management goal should be water interspersion and habitat heterogeneity, incorporating a large range (0-40 cm) of water depths (Rundle and Fredrickson 1981).

It is important to maintain or create diverse wetland complexes. Rails have different habitat requirements during different seasons and life stages (Conway 1990, Conway et al. 1993), and effective management must satisfy all habitat needs of a species (Fredrickson and Reid 1986, Conway et al. 1993). Therefore, a mosaic of wetland types, conditions, and compositions is encouraged for management and conservation of a wide-array of species, including rails.

Although 37 states and provinces consider Virginia rails a game species, few (n = 10) have habitat management programs for rails (W. R. Eddleman, unpubl. data). Many states/provinces (n = 31) address rail management in existing management plans for other species, but knowledge of the effects of existing management activities on rails is limited. Managers need to consider rails in wetland management plans, and to examine the effects of existing programs on rail productivity and survival.

Population Management

Survey techniques for all rails need to be standardized, so that relative densities can be compared among studies and annual trends can be discerned. All states should participate in statewide rail surveys of major wetland habitats. These surveys would require relatively little time and results would provide more accurate information on rail distribution, abundance, densities, and annual trends in North America. Surveys should:

1. include samples of all available marsh habitats and estimate total area of marsh including classification of vegetative cover when possible,
2. playback recordings of paired duets should be broadcast for 5 minutes.
3. count stations should be placed 60 m apart, using tapes broadcast at >80 db amplitude, (Virginia rails will respond up to 200 m away, but 90% of responding rails were within 60-75 m of the speaker [Glahn 197.1, Gibbs and Melvin 1993]), and
4. surveys of important wetlands should be repeated 3 times to ensure detection of rails (Glahn 1974, Gibbs and Melvin 1993).

Pollution and pesticide accumulation in wetlands is a great hazard to Virginia rails (Odom 1975, Eddleman et al. 1988). Rails are especially susceptible to bioaccumulation because they feed upon invertebrates within the substrate. Pesticides can also reduce the invertebrate prey base available to rails (Eddleman et al. 1988).

Hunting of migratory game birds is a socioeconomically important activity in the United States (Tautin et al. 1989) and accurate surveys are needed to regulate harvest of sensitive populations. The lack of nationwide data on hunters and harvest pressure on non-waterfowl species places significant limitations on management of rails. The National Migratory Bird Harvest Information Program should provide more accurate estimates of Virginia rail harvest in the United States.

Better information is needed on seasonal distributions of Virginia rails (Odom 1977, Zimmerman 1977, Johnson and Dinsmore 1986). Without adequate knowledge of identifiable Virginia rail populations, effective management will remain limited.

RESEARCH NEEDS

Basic information on biology and habitat needs is limited for Virginia rails, and severely restricts ability to properly manage rail populations (Tacha 1975, Johnson and Dinsmore 1986). Virginia rails have been studied infrequently because of their limited economic importance and the difficulty in observing individuals within the dense vegetation they inhabit (Billard 1948, Horak 1964).

Priorities for research are:

1. estimate adult and brood survival, nesting success, site fidelity, and recruitment,
2. examine environmental factors affecting survival, nest success, site fidelity, and recruitment,
3. examine effects of common wetland management programs on Virginia rails,
4. evaluate effectiveness of vocalization surveys for estimating population density or indexing population trends, and
5. develop effective techniques for ascertaining gender of Virginia rails in the field.

RECOMMENDATIONS

1. Relevant private, state, provincial, and federal agencies should collaborate to acquire and protect important natural wetlands, especially in the central United States. Although large wetland complexes should be given priority, even small wetlands are valuable to Virginia rails.
2. The U.S. Fish and Wildlife Service (USFWS) should establish a national population survey of rails in cooperation with state wildlife agencies. This could be accomplished by an annual spring vocalization survey for rails within major wetland areas.
3. The USFWS should insure the National Migratory Bird Harvest Information Program provides estimates of harvest of Virginia rails, so that managers and research biologists can

make informed decisions when setting harvest policy.

4. The USFWS, Canadian Wildlife Service, and state wildlife agencies should promote funding of, or conduct, the research identified.
5. The National Wildlife Refuge System should incorporate rail management into their wetland management plans, and identify refuges that will make rail management a stated priority. One of the refuges on the lower Colorado River should be managed for rails because of the importance of this wetland complex to Virginia rails, Yuma clapper rails ***(Rallus longirostris yumanensis),*** soras, and black rails ***(Laterallus jamaicensis).***

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