

GROWTH AND DEVELOPMENT OF SORA AND VIRGINIA RAIL CHICKS

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ABSTRACT.—Sora (*Porzana carolina*) and Virginia Rail (*Rallus limicola*) chicks were observed in the wild and in captivity. In both species the chicks are precocial in ground and aquatic locomotion, semiprecocial in feeding themselves, and altricial in feather development, flight, and possibly thermoregulation. Sora chicks had more conspicuous head coloration and begging display than did Virginia Rail chicks, and they were slightly slower in attaining feeding self-sufficiency. Received 7 Oct. 1986, accepted 23 Jan. 1987.

The newly hatched young of most Rallidae are covered with black down and are precocial (Ripley 1977). There are, however, considerable morphological differences in the head coloration among species of rails, and even within some subspecies. Boyd and Alley (1948) made the first extensive comparison of the coloring of young rails in their attempt to evaluate the function of bright coloration. Their search was hampered both by lack of species descriptions and by descriptions of chicks of unknown age. The latest coverage by Ripley (1977) still lacks descriptions of many species of rail chicks and their degree of parental dependence. Until more species are described, the function and adaptive value of these differences remain unknown.

Here, I describe the morphological and behavioral development of the chicks of the Sora (*Porzana carolina*) and the Virginia Rail (*Rallus limicola limicola*) of known age.

METHODS

Newly hatched Sora and Virginia Rail chicks were observed in the field and in captivity in Iowa and Minnesota during the 1963-1969 nesting seasons (Kaufmann 1977, 1983). Causal observations of newly hatched young were made during the inspection of 21 Sora nests and 14 Virginia Rail nests in the field. More intensive observations were made from blinds near one Sora and 4 Virginia Rail nests in the field. Four broods of Soras (17 chicks total) and one brood of 2 Virginia Rail chicks that were raised by their parents in a large flight pen with marsh conditions were also observed. Three Sora and one Virginia Rail pipped eggs were taken, and the chicks were raised by hand in 1966, and 2 Sora chicks were taken from nests and raised by hand in 1969. Chicks were kept in a box along with a saucer of water and a light bulb, and were hand-fed every 2 h from 04:00 until midnight for about one week after hatching at which time they began feeding for themselves.

I mixed 2 hard boiled egg yolks, 1 can of horsemeat dog food, 1 can of nearly all vegetable dog food, and several vitamin drops for rail food. Two Sora and a Virginia Rail chick were

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weighed, and the lengths of their right tarsometatarsi were measured every several days for 5 weeks.

RESULTS

Physical Development

Body growth.—The young of both species gained weight rapidly during their first 5 weeks (Fig. 1A). Their metatarsi and toes grew rapidly and reached adult size by the 3rd week (Fig. 1B). Tarsal lengths (mm) of autumn juvenile and adult Soras were $\bar{x} = 3.13$ (range = 2.65–3.54, N = 58) and of Virginia Rails were $\bar{x} = 3.42$ (range = 3.14–3.60, N = 34).

Eye pigmentation.—The iris of both species is black at hatching and changes to a dark olive during the 3rd week. By the 4th week, it is olive brown, and it is brown by the 8th week. The iris of the adults of both species is reddish brown, but those of Soras change to black during the breeding season (Kaufmann 1983).

Bill color.—The bill of the newly hatched Sora chick is dirty white, with a pure white egg tooth at the tip of the upper mandible and a large blood red cere. The cere, which is soft, is filled with blood, and its color fades within a few minutes of a chick's death. By 2 weeks, the distal half of the bill darkens, the cere becomes dull and deflated, and the base of the lower mandible becomes a pale orange-yellow, while the base of the upper mandible remains a dirty white. The egg tooth is gradually incorporated into the tip of the upper mandible during the 2nd week. At 3 weeks, the cere is nearly gone, and the base of the upper mandible is a soft rose. At 5 weeks, the entire bill is dull greenish-black, with a ring of soft rose at the base. During the 2nd month the bill becomes green and then increasingly yellow; at 3 months, the bill is yellow with a wash of green. During the breeding season, the bill is spectrum yellow, frequently with a patch of rose or orange near the nares. During the nonbreeding seasons, the bill decreases slightly in size and reverts to yellow with a wash of green.

The bill of the newly hatched Virginia Rail is pale pink, with a narrow band of black just distal to the nares. The white egg tooth at the tip of the upper mandible is less conspicuous than is that of the Sora. The bill color remains constant, but the pigment of the center black band expands, so that by the 2nd week the central third of both mandibles is black. In addition, black pigment expands from the base of the lower mandible, and the egg tooth is nearly absorbed into the tip of the upper mandible. At 3 weeks, the lower mandible is black except for the tip. At 1 month, the entire bill is black; at 3 months, the center of the lower mandible is brownish red. In the adult, the lower mandible is nearly all brownish red, as is the lower portion of the upper mandible.

Legs.—The tarsometatarsi and toes of the Sora are a light pink during

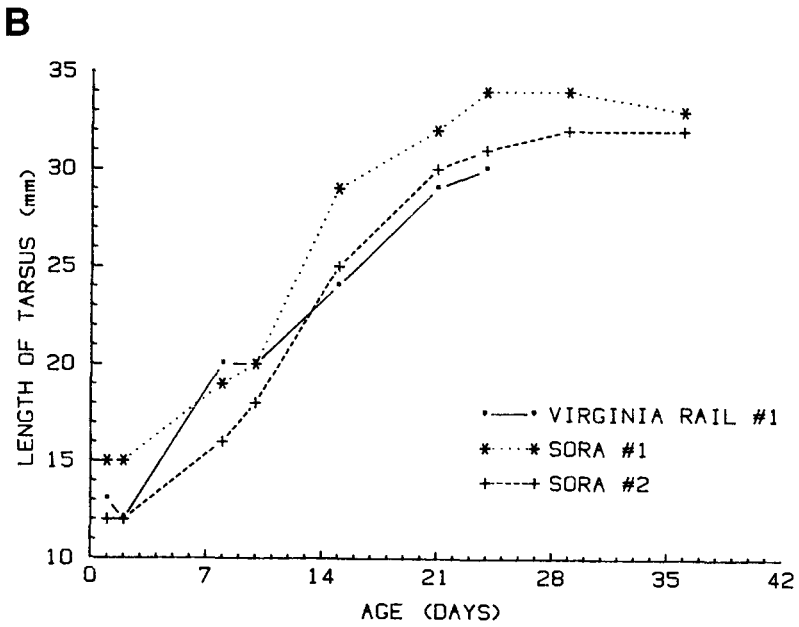
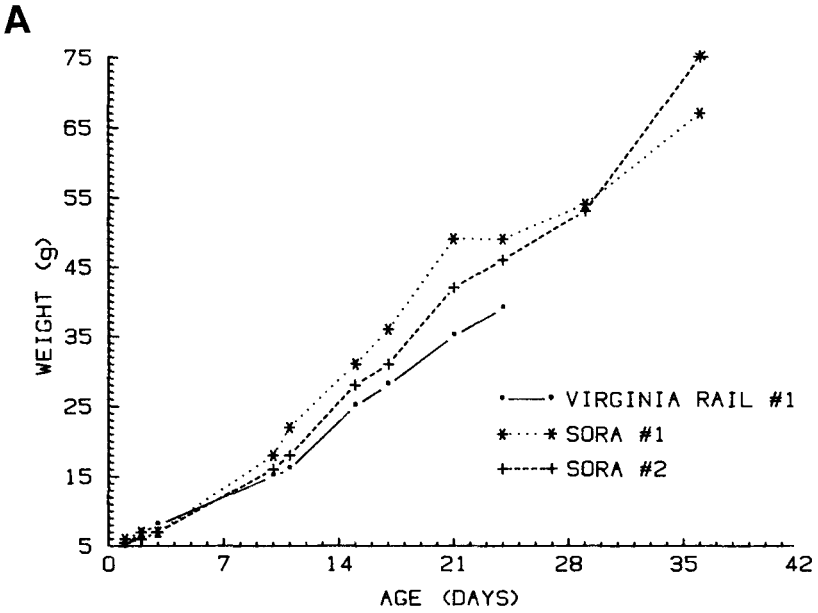


FIG. 1. A. Weight gain of 2 hand-raised Sora chicks and 1 Virginia Rail chick. B. Growth of tarsometatarsi of 2 hand-raised Sora chicks and 1 Virginia Rail chick.

the 1st week, changing to a dull gray at 2 weeks, to gray-green at 3 weeks, to dark yellowish-green at 3½ weeks, and to yellow-green at 4 weeks. The tarsi and toes of the Virginia Rail change color more gradually. Initially they are dark brownish black and remain so far a month; they become dusky-brown during the 2nd to 3rd month.

Plumage and skin.—The chicks of both species are almost entirely covered with black down that has a greenish gloss in sunlight. The Sora chick has a long tuft of chrome orange down at the base of its lower mandible, which is conspicuous during its first week but disappears almost entirely by the 2nd week. Both species have bare areas on the crown of their heads and around their eyes, but these areas are more conspicuous in the Sora. The entire crown of the Sora chick is nearly devoid of down, and it remains bare until the 3rd week. The down on the posterior of the crown of Virginia Rail chicks is less dense than elsewhere, and appears most bald during the 2nd and 3rd weeks. Both species have dark bluish-black pigmented skin around their eyes, covering nearly the entire side of their heads. This is more conspicuous in Sora chicks because there is more bare area around the eyes.

Juvenal plumage begins to emerge at 2½ weeks on the breast area of the ventral tract of both species, expanding anteriorly and posteriorly, until the ventral tract is fully emerged by 3½ weeks. Ventral feather tracts are tan in the Sora and sooty black in the Virginia Rail, grading to a cream in the center of the breast in the Sora and to a dirty white in the Virginia Rail. The crural tract emerges several days after the ventral tract; then the femoral, spinal, and capital tracts emerge during the 3rd week. The alar and caudal tracts are the last to develop, emerging during the 3rd to 4th weeks. The 1st winter plumage emerges during the 3rd and 4th months.

Behavioral Development

Hatching, locomotion, and maintenance behavior were similar for Sora and Virginia Rail chicks, and the following descriptions apply to both species. I will point out the differences between the species in begging, feeding, and social behavior. All descriptions apply to observations of both wild and captive chicks unless specifically mentioned.

Hatching.—The first signs of hatching were the appearance of a small area where the eggshells were broken outward, forming a projection on the surface, and the soft, peeping cries of the chicks inside. After 36–48 h chicks broke entirely through the eggshells, and they emerged within 1–1½ h.

Locomotion.—The newly emerged chicks were weak, and could hold their heads up for only a few seconds. After about 6 h, they could remain upright by sitting on their metatarsi and feet, while propping themselves

up with their wings. They moved on both the feet and metatarsi while balancing and pulling with outstretched wings. The claw on the first digit of each wing was used in grasping vegetation to pull themselves forward. By the end of the 1st day, they could scamper down the nest ramp to drink and defecate, and could swim. When I disturbed the nest, the chicks ran off and swam in all directions, and sometimes dived. Chicks over 3 days of age would swim over 5 m, but 1-day-old chicks usually swam for 30–60 cm. Newly hatched chicks, still wet and less than 2-h-old, occasionally swam when I visited a nest. Chicks would swim into the base of a clump of marsh vegetation with their head in the clump and their body floating outside. Wet chicks had difficulty floating. Unless disturbed, the chicks never left the nest the first 3 or 4 days.

At 3 weeks of age chicks were able to jump 30–40 cm high. Chicks were able to fly at 4 weeks, when their flight feathers were nearly developed.

Maintenance behavior.—For about the 1st week, chicks drank by dipping the bill in water, then pointing the bill up. Older chicks and adult rails did not tip the bill up during drinking. Defecation usually followed drinking. Chicks touched their cloacas to the water for several seconds, defecating while performing a two-wing stretch. For the 1st week, hand-reared chicks continued to defecate in the water. During the 2nd week, defecation in the water gradually diminished. I believe my first attempts to raise rail chicks failed because I did not provide them with water pans sufficiently shallow for them to enter for such defecation.

When they were 1-day-old, chicks performed several comfort movements including yawning, wing-and-leg stretch, body shake, bill scratching, bill shake, and preening of the belly. Bill scratching was unsuccessful until the end of the 1st week when the chicks could balance on one leg.

Although they preened themselves on the 1st day, chicks were preened much more by the adults at this time. Siblings frequently preened each other in the nest. Oiling was not observed until day 18. Bathing by alternately dipping the head and tail up and down into the water occurred at the end of the 1st week. Three or 4 days later bathing was performed more vigorously, with the addition of pronounced flicking up and down of the tail. Several chicks did not bob their heads or thrash their wings until 3–4 days later. At 8 days the two-wing stretch was performed without defecation.

Feeding and begging behavior.—One-day-old Sora chicks begged with loud, plaintive peeping calls and gaping. Gaping first consisted of raising the head and neck upward with the mouth open. By day 2, the chicks pecked at the tip of the parent's bill. The frequency of pecking appeared to increase as the time increased since the young were last fed. Pecking

appeared to stimulate the brooding parent to call "Tug," which probably enticed the other parent to bring food to the nest.

Hand-raised Soras plaintively peeped when they had not been fed for more than an hour. When I approached, they begged to me. Begging consisted of crouching down on the metatarsi, waving the wings vertically, and alternately gaping toward my hand and bowing the head so that the bald forehead faced my hand. The down on the head was depressed, but there were no striking color changes of the bare skin of the head. Soras continued to crouch on their metatarsi while begging long after they were able to stand on their toes. When begging, Sora chicks drew attention to the facial coloration of red cere, ivory bill, orange down beneath the bill, and bald head against the glossy black down by waving their wings.

In the wild, I could not see whether young Soras begged while being fed during the first two days, as their bodies were beneath the parent. I did, however, see begging at age 3 days, as soon as the young were able to run to the parent, which was bringing food to the nest. Adults continued to feed their young for 3 weeks.

Young Virginia Rails did not show elaborate begging behavior. After a period of not being fed, they peeped loudly and pecked at the parent's bill. The brownish red coloration of the lower mandible of the adult's bill appeared to aid in the orientation of this pecking response. Occasionally, the young Virginia Rails waved both wings while begging or being fed, but this was not nearly so marked as in the Sora.

Chicks of the Water Rail (*R. aquaticus*) have a special display, which apparently has an appeasement function (Lorenz 1952). The chick bows its head, flattens the down on the top of its head, and reddens the exposed skin on the head. I never saw the chicks of the Virginia Rail bowing their heads to adults. Although they may have flattened the down feathers of the head and flushed the exposed skin, this was never as conspicuous as that described for the Water Rail, nor did it occur very frequently. Occasionally, captive chicks sleeked their down, and then the skin appeared to be more pinkish than usual. The only time I observed definite sleeking and possible flushing was when a wild female picked up its youngest chick by the head and carried it back to the nest in her bill.

Hand-raised Soras began to feed themselves at the same time as did the Virginia Rails, but they appeared to be slower in obtaining full self-sufficiency. Chicks of both species pecked at the food on day 2, but were unable to pick up food until day 3. Between days 4 and 7, chicks became adept at feeding, and by day 7 they could feed themselves. Virginia Rail chicks ate a larger portion of food by themselves than did the Sora chicks during days 4 to 7.

Although the Virginia Rail chicks appeared to be able to pick up food

within a week, adults continued to feed them for some time. Free ranging juveniles over a week old were seen being fed by adults, and captive juveniles in the flight pen were fed by their parents for over a month after hatching.

Probing for food and washing food by Virginia Rail chicks began later than did self feeding. When Nice (1962) first provided mud to her 22-day-old juvenile rails, they probed immediately. The juveniles in the breeding pen were not observed probing until they were older than this. The hand-reared chick first washed its food at the age of 16 days.

The food items brought by the adults are presumably important in influencing the juvenile's ability to recognize food. The hand-reared rails of both species readily ate canned dog food from hatching. Wild juveniles over one month old I caught would not eat dog food unless I continued to mix in live invertebrates (crayfish and dragonfly nymphs) for over a week.

Social behavior.—The following response of rail chicks was unlike the classical response of young Anatidae. Chicks of both species usually left the nest by following a parent, but frequently lagged behind. As each parent approached and then left the nest, it was followed by some of the chicks. Typically, one to 4 chicks continued to follow within a meter of each adult. Other chicks stopped to preen, feed, or rest and were soon left alone or in small groups. Chicks without an adult appeared to be contented and frequently returned to the nest before a parent did. Hand-raised rails ran toward me for feeding and, when I released them outside, they remained within a meter of me. At 3 weeks they began to withdraw at my approach. At 25 days they crouched at my approach, and defecated when I picked them up. At 30 days, they flicked their tails at the sight of me, and at 37 days the Soras pecked me when I handled them.

The appearance of aggressive behavior varied greatly in the captive birds. One hand-reared Sora, 12 h older, vigorously pulled the downy chrome orange beard of its sibling on the 1st day. Sora chicks in the flight pen actively chased the much larger juvenile Virginia Rails at 18 days. Nice (1962) observed her hand-reared Soras pecking strange chicks at the age of 14 days, allopreening at 17 days, and play-fighting at 18 days.

Overt aggression was not observed among juvenile Virginia Rails. At 3 days of age, however, hand-reared Virginia Rails pecked the beards of the 3-day-old Soras when the Virginia Rail was hungry and appeared to dominate them. Nice (1962) noticed that her Virginia Rails pecked strange birds introduced to the group at 16 days. Nice also observed allopreening at the age of 15 days in her Virginia Rails and "play-fighting" at the age of 31 days.

Rail chicks appear to depend upon their parents for warmth and dryness

for an extended period of time. Young chicks quickly became waterlogged when they swam from the nest, presumably because they had not received oiling from their parents. Older chicks were brooded by their parents for about a month. The hand-raised Virginia Rail died at 25 days when I placed it outside overnight. The night was cool (for an Iowa July) and a rain shower fell.

DISCUSSION

The morphological and behavioral development of Sora and Virginia Rail chicks closely parallel each other. Nice (1962) classified the maturity at hatching in rails as the fourth category of precocial, i.e., birds which follow their parents and are fed by them. I would describe rail chicks as precocial in that they are down covered and capable of running and swimming the 1st day; semi-precocial in that they begin feeding themselves by the 3rd day and reach self-sufficiency in picking up food by the 7th day; and altricial in their development of wing limbs, flight feathers, and in achieving thermoregulation.

The head coloration of young Soras is strikingly more conspicuous than that of Virginia Rail chicks. Boyd and Alley (1948) remark that bright head coloration is more common in *Fulica*, *Porphyrio*, and *Gallinula* and that it is rare in *Rallus* and *Porzana*. They suggest that the function of such coloration is to stimulate the adults to feed the young. The presence or absence of such coloration in the various species of rails, however, should be viewed as being but one aspect of the entire repertoire of ecological adaptations of the species. The function of head coloration in rails remains unknown, and further comparative work on food habits, clutch size, and asynchrony of hatching is needed. A comparison of *R. l. limicola* with *R. l. aequatorialis* might prove useful, as the young of the latter subspecies have orange and scarlet bill markings, which are absent in the former.

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