ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Conservation Guidance for

King Rail

Rallus elegans Aud., 1834

IL status:
Endangered

US status:
Not listed, USFWS focal species

Global rank:
Apparently Secure[1]

Trend:
Declining (BBS)[2]

Family:
Rallidae

Habitat:
Shallow semi-permanent marsh, hemi-marsh

Similar species:
Virginia rail

Seasonal cycle:

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

In Illinois
Calling/Time for surveys

Species information

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Characteristics

The King Rail is a medium-sized, marsh bird with a bright **reddish-brown chest and neck** with **black and white stripes** on its flanks[3]. It has a short often up-turned tail, strong legs, and long, slightly **down-curved, brown-tipped, yellow bill.** The King Rail has a compact, chicken-like body and is sometimes called the marsh hen. It is the largest of the North American rails at 15-19 inches in length[4]. Males and females look alike but males are slightly (about 25%) larger[3,4]. Juveniles are similar to adults, but with indistinct markings and a variable amount of black on their sides. Chicks are downy black.

The secretive King Rail is most often detected by its call, a long, slow series of evenly spaced clacks, a short series of deep grunting notes, or a click and trill[3]: https://www.allaboutbirds.org/guide/King_Rail/sounds. The King Rail mostly walks or runs, and is seldom flushed[3]. When it does flush, flights are usually short and low with legs dangling at the beginning of flight and skimming the top of emergent vegetation[5]. In Illinois, King Rails can be confused with Virginia Rail (*Rallus limicola*), which is smaller with a gray face and brighter- colored bill. The King Rail call is not as deep as Virginia Rail, nor does it descend[6].

Habitat

King Rail habitat with interspersed dense emergent vegetation and shallow water. Photo by Abby Darrah[24]

King Rails are typically found in shallow, semi-permanent marshes, but can also be found in wet meadows, river floodplains, temporary ponds, creeks, ditches, mudflats, lakes, flooded vegetation/ agricultural fields, and created or restored wetlands[3,7]. Although the King Rail does not seem to have a minimum habitat size, it may be edge-intolerant and is impacted by the surrounding landscape as much as 0.6 miles away[8–11]. Wetlands more than 50 ac. in size are thought to provide adequate area for King Rails[12].

King Rails are associated with dense vegetation interspersed with open water[9,11]. Optimal habitat contains around 25% open water, but King Rails use marshes with 0-50% open water[13,14]. These hemi-marshes provide a mosaic of open water and emergent herbaceous vegetation, with many open water-vegetation edges, where aquatic invertebrate abundance is highest [11,15,16]. Micro-topographic heterogeneity, meaning small variability in ground level, creates a mosaic of moisture levels and cover types, such as shallow water, moist soil, hummocks, swales, and dry patches, and is ideal for meeting the needs of King Rails at different life stages[15,17]. Nesting typically occurs in a clump of grass or tussock in less than 1 foot of water, while brood-rearing habitat consists of more shallow water (less than half an inch) or uplands[3,9,15].

Seasonal flooding and slow-drying are important characteristics of King Rail habitat and play a role in maintaining the mosaic of open water and emergent vegetation[18,19]. Impoundments with stabilized water levels lack vegetation-type diversity and have a lower abundance of King Rails compared to unmanaged wetlands or managed sites that are drawn-down later in the summer. [10]. Muskrats (*Ondatra zibethicus*), which create vegetation openings and networks of pathways, also create suitable habitat structure[3].

Vegetation composition varies widely across the King Rail's range, but cattails (*Typha* spp.), grasses (Poaceae), and sedges (Cyperaceae) are common throughout[3]. Short emergent vegetation (less than 3 feet) is suitable for nesting and brood-rearing[9,15]. Woody vegetation cover decreases habitat quality, likely due to the increased risk of predation[14,15]. Marshes with as little as 15% tree cover around the margins had lower habitat suitability[20].

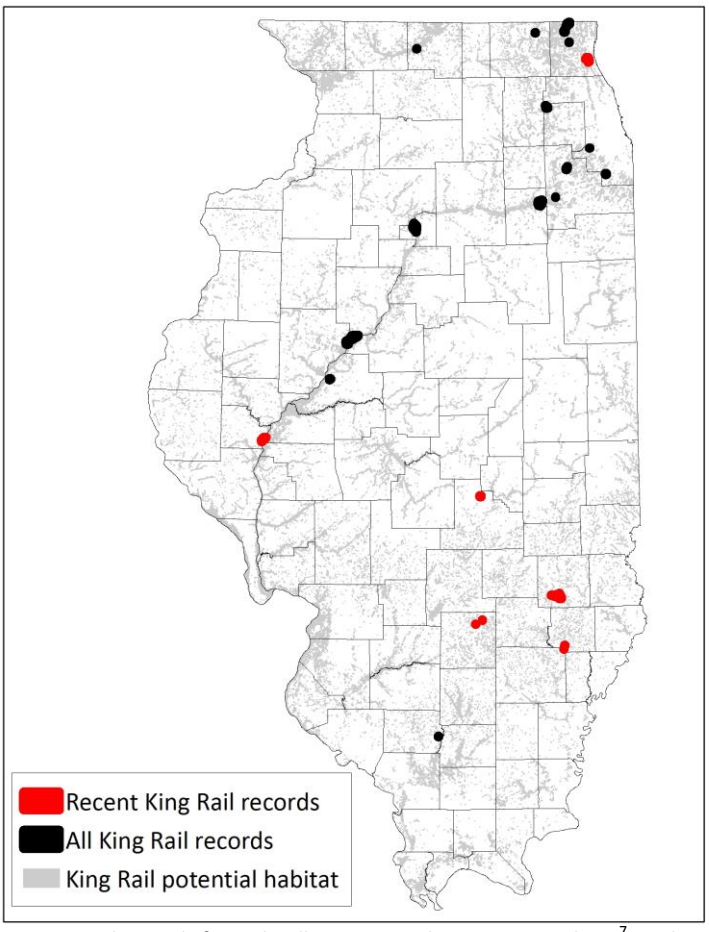
Taxonomy

There are two subspecies of King Rail (*Rallus elegans)*: *R. e. elegans* found in the eastern North America including Illinois and *R. e. ramsdeni* found in Cuba[21]. The King Rail is most closely related to the Clapper Rail (*R. crepitans*), which is found in overlapping coastal areas of eastern North America and Mexico[21]. The King Rail and Clapper Rail are similar in appearance, and there is a narrow zone of brackish marsh where they hybridize[22]. However, they are ecologically distinct because the Clapper Rail prefers saltwater while the King Rail prefers freshwater.

Distribution

King Rails can be found in eastern North America from North Dakota to New York and south to the Gulf of Mexico and Cuba. King Rails in the Midwest are migratory whereas, coastal birds are resident all year. Some birds may reside in the southern tip of Illinois year-round[23].The wintering location of migratory Midwestern birds is not well understood, but it is thought to overlap with resident birds in coastal regions[3,23,24]. Two King Rails from northern Ohio were tracked migrating to Louisiana[25]. However, only around 1% of the overwintering population in Louisiana and Texas were from regions further north[4]. It is thought that some birds likely move south of the U.S. to overwinter[3].

King Rail observations in Illinois are scattered in wetlands across the state[26]. There are records of breeding King Rails in 20 locations, 7 of those observed in the last 10 years[7]. However, due to the



King Rail records from the Illinois Natural Heritage Database[7]. Red records are from the last 10 years, black records are older, and light gray indicates potential suitable habitat modeled by USGS[85]

secretive nature of King Rails and limited targeted surveys, this could indicate true scarcity or inadequate survey effort.

Status

King Rails are most abundant in coastal regions, especially the gulf coast of Louisiana and Texas, where it is a game species. The inland population is quite sparse. King Rail is listed as a state threatened or endangered species in 12 states, identified as a "Species in Greatest Conservation Need" in 30 State Wildlife Action Plans, and federally listed as endangered in Canada[24]. King Rail was listed as Endangered in Illinois due to its decline and limited breeding records[27]. In 2003, the Illinois population was estimated at around 60 birds[12].

Anecdotal records suggest the King Rails were once common in the Midwest, but there have been significant declines over the last 30 years[24]. Breeding Bird Survey (BBS) data from across the U.S. suggest that the King Rail population has been declining by 4.6% per year from 1966 to 2013[2]. However, BBS methods are poor at detecting King Rails and are not necessarily representative of Illinois populations. Indeed, there have been no King Rail observations in Illinois during the BBS.

Natural History

King Rails arrive in Illinois from April to May[9,12]. Males arrive first and establish breeding territories. King Rails defend their territory by chasing and fighting other birds, so that there is minimal overlap in home ranges[13,28]. Home range size varies greatly from 2 – 80 acres[13,17]. Those with higher quality habitat (20-29% open water) have smaller home ranges (<12 ac) and make shorter movements[13]. Typical daily movements are short (300-650 ft), but longer movements (>0.6 mi) have been observed[3,17]. During the breeding season, home range and movement is similar between sexes[13,17].

Most King Rail foraging activity occurs around dusk and dawn, perhaps to reduce risk of predation or heat stress[9]. King Rails are omnivorous but animal matter comprises the larger portion of the diet, especially in the breeding season[3]. Aquatic insects and crustaceans, especially crayfish, are the preferred prey items, but fish, frogs, grasshoppers, crickets, and seeds of aquatic plants are also eaten[3,9]. King Rails feed in shallow water less than 3 inches deep, under or near concealment of plants, or less often, out in the open of mudflats or deeper water[3]. The foraging abilities of young King Rail are likely limited to shallower areas in the first month due to their short legs and beak[9]. King Rails regurgitate pellets of indigestible exoskeleton, often crayfish[9].

King Rail breeding is initiated by calling males. Most records for calling King Rails in Illinois are from mid-May to mid-June but occur as late as August[7]. While concealed in vegetation, males will give the courtship call (a harsh kik-kik-kikkik-kik) to attract a female[28]. The male will then walk around with his tail uplifted revealing his white under-tail coverts, occasionally flicking his tail[28]. Females do not give the mating call or courtship display[3]. Both sexes use the contact call (jupe-jupe-jupe-) to locate and reassure one another. King Rails are known to return to the same nesting site in consecutive years, but it is not known if the pair bond is maintained[3].

In Illinois, King Rail nesting begins in May and June[12]. The male does most of the nest construction. The nest consists of a round, elevated platform with a depression, usually with a canopy that is formed by stalks of the adjacent plants. Nest densities of 0.03 - 0.2 / acres have been recorded[12,17,20,28,29]. One egg is deposited in the nest per day[3]. The smooth and slightly glossy eggs are pale buff in color with sparse irregular brown spots[3]. Eggs are incubated for 21days on average[9,30]. The male and female take turns incubating the eggs[28]. They are reluctant to flush from the nest and occasionally feign injury to

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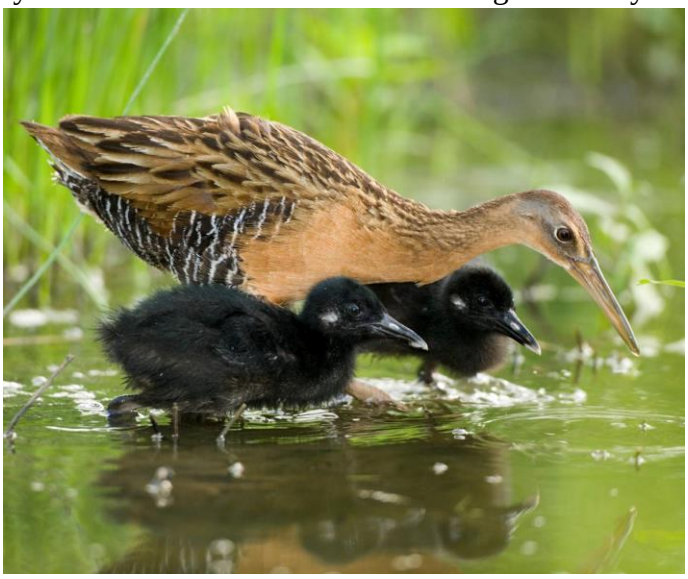
distract an intruder[3]. Nest failure is higher in wetlands that are manually drawn down and at nest sites that are closer to habitat edges, ditches, and woody vegetation, likely due to the increased access for predators, such as raccoons, skunks, and snakes[9,14,15,20]. King Rails may make a second nest attempt if their first nest fails[31].

In the Midwest, King Rail eggs typically hatch from mid-June to early August[15]. There are records of King Rail chicks in Illinois from mid-May to late-July[7]. King Rail young are semi-precocial, meaning they can leave the nest soon after hatching, but remain dependent on parents for feeding. The flightless chicks may follow their parents around or hide and wait to be fed[3]. Adults stay with their young for more than a month after hatching[3]. Parents have been observed moving broods to different habitat more than half of a mile away from the nest within days of hatching, but other broods stay close (within 100 feet) to their nest site for three weeks after hatching[17,28]. After two months, young have assumed eating, walking, and sleeping like adults and have grown full body plumage[3]. After 9-10 weeks, they begin making short flights and are independent of their parents[3,12].

Adults molt between July and October, during which time they are flightless for up to a month[28]. King Rails leave Illinois in September or October on nocturnal migratory flights to overwintering grounds[3,28].

Population dynamics

Due to their secretive nature, King Rails' population dynamics are not well understood. King Rails may



Foraging King Rail adult and chicks. Photo by USFWS[24]

King Rail nest. Photo by Sergio Pierluissi[24]

attempt to breed in their first year, as a female with immature plumage has been observed nesting[28]. Average clutch sizes are around 9-11 eggs, but clutches as large as 14 eggs have been reported[3,9,32]. Success of hatching at least 1 egg in a nest varies widely between studies with averages from 48-81%[9,20,32]. Daily chick survival from week two to six has been estimated at 92-96%, which translates into a 0.03 to 0.18 probability of surviving to week six[15]. However, survival during the first week after hatching is likely lower[15]. First year survival rates have not been measured. Adult survival estimates during the breeding season have been recorded at 89% and 61% with significant uncertainty[13]. Adult survival rates in the non-breeding season and life span are unknown. The large clutch sizes and high nest success rates suggest that population growth is likely limited by chick, juvenile, or adult survival. Based on anecdotal evidence, biologists have suggested that chick survival is likely the limiting factor [3,24].

Community Associations

Muskrat are often associated with King Rail habitat and play a role in creating ideal hemi-marsh conditions[3]. Illinois Species in Greatest Conservation Need (SGCN) that are likely to be found in similar habitat as the King Rail include Least Bittern (*Ixobrychus exilis)*, Yellow Rail (*Coturnicops noveboracensis)*, Marsh Wren (*Cistothorus palustris)*, Sandhill Crane (*Grus canadensis)*, and Whooping Crane (*Grus americana)* [33]. Other SGCN that are found in marshes include: American Bittern (*Botaurus lentiginosus)*, Black Rail (*Laterallus jamaicensis)*, Black Tern (*Chlidonias niger)*, Forster's Tern (*Sterna forsteri)*, Buff-Breasted Sandpiper *(Tryngites subruficollis)*, Common Gallinule

(*Gallinula chloropus)*, Pied-Billed Grebe (*Podilymbus podiceps)*, Wilson's Phalarope (*Phalaropus tricolor)*, Wilson's Snipe (*Gallinago delicatata)*, Yellow-Headed Blackbird (*Xanthocephalus xanthocephalus)*, Blanding's Turtle (*Emydoidea blandingii)*, Spotted Turtle (*Clemmys guttata)*, and Marsh Rice Rat (*Oryzomys palustris)*[33]. Predators of adult King Rails include raptors, such as the Northern Harrier (*Circus cyaneus)*, while nest predators include snakes, such as the Black Rat Snake (*Pantherophis obsoletus*), and mammals, such as the Raccoon (*Procyon lotor*), the American Mink (*Mustela vison*), the Red Fox (*Vulpes vulpes*), and the Striped Skunk (*Mephitis mephitis*)[3,13,23,32].

Conservation and Management

Threats

The greatest threat to King Rail populations is habitat loss and degradation. Additional threats, such as fragmentation, roadways, climate change, and pollution are lesser concerns. The State of Illinois has authorized the "taking" of King Rails twice, for the construction and maintenance of a pipeline through a wetland.

Habitat loss

Habitat loss is likely the greatest threat to the King Rail. Between 1780 and 1980, it is estimated that nearly 7 million acres of the wetlands in Illinois (85% of wetland area) were lost, largely due to drainage for agricultural production[34]. The seasonally flooded wetlands preferred by King Rails are easily drained and converted to agriculture[23]. However, habitat loss has slowed, and there may have been a small increase in wetland area in Illinois since the mid-1980s[35]. Most of the increase is due to the reestablishment of wetlands on agricultural lands, despite the continued installation of subsurface drainage tiles[36]. Presently, there is approximately 37,000 acres of deep-water emergent wetlands in Illinois[35].

Habitat degradation

Even when wetland area is retained, habitat degradation can be a threat to marsh birds[37,38]. Wetland characteristics are dynamic and readily change due to siltation, altered water fluctuations, and invasive plant species[39]. In many cases the semi-permanent hydrology preferred by King Rails has been altered by on-site activities, such as dredging, damming, or stream channelization. Periodic disturbance, such as seasonal flooding and drying, are necessary to maintain suitable habitat[23].

The larger landscape can also impact wetlands[11]. Land use as far as 1.9 miles away from a wetland influences wetland bird community composition, with urban development, agriculture, road density, and railway density decreasing the biotic integrity of the community[40]. Sedimentation, excess nutrient loading, and contaminant runoff from the surrounding landscape can degrade wetlands, potentially impacting King Rails directly or indirectly[41]. One study found that even when wetland area was not reduced, urban development of the surrounding area resulted in altered wetland structure consisting of open water or dense monocultures of vegetation that were not suitable for marsh birds[38].

Invasive species have been rated a "severe" threat to King Rail habitat in the Illinois Wildlife Action Plan[33]. Invasive species, such as Reed Canary Grass *(Phalaris arundinacea)*, Narrowleaf Cattail (*Typha angustifolia)*, Hybrid Cattail (*Typha x glauca)*, Common Reed *(Phragmites australis*), Purple Loosestrife (*Lythrum salicaria)* and others, can form dense monotypic stands, altering habitat structure by eliminating mudflats and reducing microtopographic heterogeneity[42]. Such significant alterations are likely a threat to habitat suitability for the King Rail; yet when appropriate habitat structure is maintained, the presence of invasive species does not preclude King Rails[13].

Many wetlands suffer from woody encroachment by shrubs or trees due to the lack of disturbance or stabilization of water levels. Predation by mesopredators, such as raccoons and skunks,

Raccoons are common predators of King Rail nests.
Photo by Bob Huebner

increases with woody vegetation cover[9,14,15,20]. Mesopredator populations are also higher in proximity to developed areas, which provide food and shelter and lack natural predators[43–46]. There is also concern that predation by domestic cats and dogs may increase with urban development[23].

Wetland areas managed exclusively to provide food for waterfowl in the fall using early-summer drawdowns do not meet the habitat needs of King Rails, which require wetland complexes with water lasting later into the summer to provide suitable conditions for reproduction[41]. Complete drawdowns during the nesting and brood-rearing periods result in higher rates of reproductive failure[9].

Roadways and fragmentation

Habitat fragmentation, such as construction of roads, levees, or utility right of ways, reduces habitat quantity and quality. Smaller wetlands have less interior area, which leads to increases in nest failure as it provides easier nest access for predators[9]. In addition, adults and young have been observed crossing roadways surrounding wetlands, which increases their risk of mortality[7,28]. Low flying birds, such as King Rails, are also at risk of car collision.

Climate change

Climate change will likely result in large loss of wintering habitat due to sea level rise[10]. Climate change projections predict that 83-88 % of the current winter range will be unsuitable by 2080[47].

Pollution

Chemical pollution may be a threat to the King Rail. Since the early 2000s, the use of systemic insecticides, such as neonicotinoids, has become pervasive across the agricultural and residential landscape[48,49]. Indirect impacts to King Rails may be a concern as neonicotinoids are persistent in the environment and efficiently target and devastate prey insect populations at very low doses[48,50,51]. Models attribute recent insectivorous bird declines to agricultural insecticide use[52,53]. In addition, remnant lead, such as from shotgun ammunition, can directly impact bird development and survival[54].

In general, there is concern about the impacts of light and noise pollution on birds. Light pollution can interfere with the navigation of nocturnal migratory birds and result in increased mortality[55,56]. Noise pollution, such as from roadways, can interfere with bird communication and therefore breeding[57,58].

Other threats

Additional threats to the King Rail include collisions with lights, buildings, towers, wires, and wind turbines during nocturnal migration, but rails are at lower risk than many other bird species[59]. King Rails are also at risk of unintentional killing by muskrat trappers[3,28,60].

Regulations

In Illinois, it is illegal to "take" any threatened or endangered animal, such as the King Rail. "Take" of listed species, defined as "to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect, or attempt to engage in such conduct," is prohibited by the Illinois Endangered Species Protection Act: http://ilga.gov/legislation/ilcs/ilcs3.asp?ActID=1730&ChapterID=43

The IDNR Impact Assessment Section reviews proposed actions to assess potential impacts to listed species, using their online tool EcoCAT: http://dnr.illinois.gov/ecopublic/

IDNR can authorize the taking of listed species that is incidental to otherwise lawful activities. To receive Incidental Take Authorization, one must prepare a conservation plan and notify the public of the impact. See: http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/ApplyingforanIncidentalTakeAuthorization.aspx

Research, handling, and possession of listed species requires IDNR permits, including a Scientific Collector Permit and an Endangered and Threatened Species Possession Permit, and additional site permits if research takes place on IDNR land or a dedicated Nature Preserve: http://www.dnr.illinois.gov/conservation/NaturalHeritage/Pages/ResearchPermits.aspx . Risks and impacts of research methods on the species survival must be weighed against the benefits to justify the activity.

Wetland impacts, including management and restoration, to federally jurisdictional wetlands are regulated under the Clean Water Act. The U.S. Army Corps of Engineers is responsible for

enforcing the Clean Water Act and issuing Section 404 permits: https://www.epa.gov/cwa-404/section-404-permit-program

Species Conservation Goals

Upper Mississippi River and Great Lakes Region Joint Venture set a goal of doubling the King Rail population[12]. The Illinois Wildlife Action Plan has set a goal of increasing marsh habitat by 20% through restoration, enhancement, and management[33].

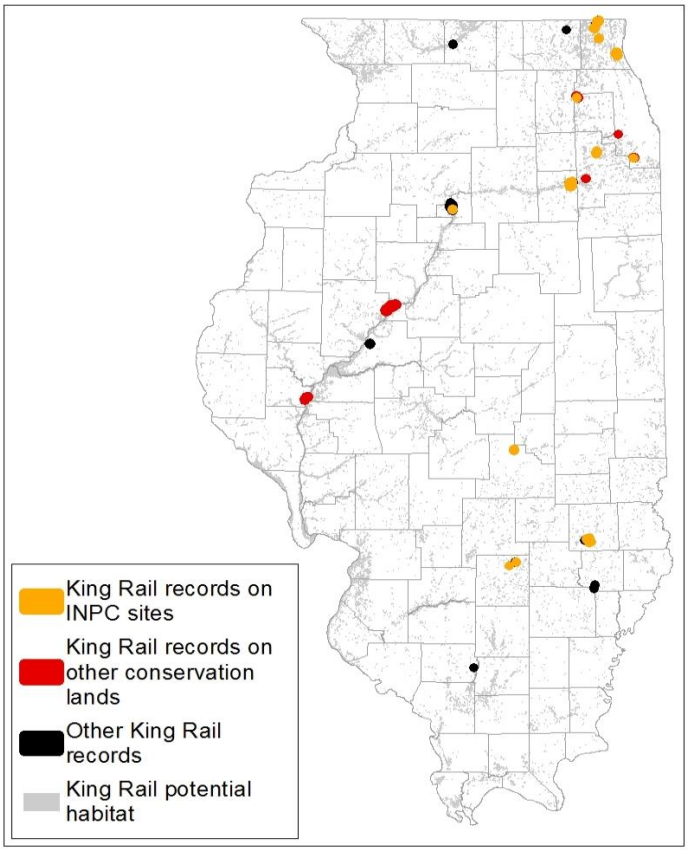
Conservation Efforts

The King Rail was selected as a Focal Species for the USFWS's Migratory Bird Division, which developed a King Rail Conservation Plan describing needed conservation actions[24]. An Upper Mississippi River and Great Lakes Region Waterbird Conservation Plan was developed with population status, trends, and threats[61], along with a Joint Venture Waterbird Habitat Conservation Strategy identifying population and habitat objectives with decision support maps to target conservation[12]. Wetlands across the state were mapped and digitized using 2005 aerial imagery to facilitate the assessment of habitat availability; however, regular updates are needed[62].

The National Marsh Bird Monitoring Program is a framework for coordinating survey design, sampling methods, and data collection and promotes use of the Standardized North American Marsh Bird Monitoring Protocol[63]. USFWS and INHS are monitoring marsh birds across the state[64]. A data repository, Avian Knowledge Network, has been created for holding survey data and facilitating its use: http://www.avianknowledge.net

The Illinois Nature Preserve Commission has designated 18 Nature Preserves or Land and Water Reserves that protect King Rail breeding locations. Three areas in Illinois have been designated Important Bird Areas by the Audubon Society for providing essential King Rail habitat.

In 2007, the Upper Mississippi River and Great Lakes Region Joint Venture set a habitat restoration goal of an additional 2,265 acres of shallow, semi-permanent marsh in Illinois, and as of 2013 had achieved 92% of their goal[65]. In 2016, there were nearly 26,000 acres of wetland restoration in the USDA's Conservation Reserve Program in



King Rail records from the Illinois Natural Heritage Database[7]. Gold records occur on INPC sites (Nature Preserves and Land and Water Reserves), red records occur on other conservation lands[81], and black records occur on non-conservation lands. Light gray indicates potential suitable habitat modeled by USGS[85]

Illinois[66]. In addition, nearly 23,000 acres in Illinois were enrolled in the Conservation Reserve Enhancement Program for wetland restoration, and breeding King Rails have been observed using the resulting wetlands[67].

IDNR's "Statewide Public Lands Native Wetland Wildlife Habitat Restoration Project" has carried out hydrology restoration, prescribed fire, woody plant control, invasive species control, erosion and sedimentation control, and planting of native plants on 17,000 acres of wetlands across the state. The Forest Preserve District of Cook County's "Restoration of King Rail Habitat Project" is removing invasive woody plants to provide 35 acres of habitat specifically for King Rail.

Survey Guidelines

Monitoring for trends

Detecting large-scale trends in the abundance of birds, such as King Rail, is the goal of the Breeding Bird Survey (BBS)[2]. The BBS uses annual roadside

surveys across the US, Canada, and Mexico to track the bird abundance. However, the survey does not adequately sample wetlands to detect King Rail trends[2]. In the future, large-scale surveys should incorporate additional wetlands not covered by the existing BBS routes to improve King Rail estimates[63,68]. The Standardized North American Marsh Bird Monitoring Protocol was developed to provide guidelines for such large-scale surveys of secretive marsh birds[63]. The protocol includes broadcasting recorded bird calls into the marsh to elicit response calls from territorial resident to increase detection [69]. Monitoring data should be submitted to the Midwest Avian Data Center: http://data.pointblue.org/partners/mwadc/

Surveys for presence

Surveys to determine presence or absence of King Rails at a location of interest should also use the Standardized North American Marsh Bird Monitoring Protocol[63]. Survey points should be located on either the upland-emergent vegetation interface or the open water-emergent vegetation interface[63]. There should be at least one survey points per 4 ha (10 ac) of emergent marsh and each should be located 200m (650ft) apart to ensure that all habitat is covered. The amount of survey effort necessary to conclude absence to any degree of certainty is dependent on detection rates, which vary between surveys[70] (see table).

Table indicating the number of surveys necessary to determine presence or absence to various degrees of certainty[70].

	Low detection rate	Median detection rate	High detection rate
Number of surveys	*0.17*	*0.28*	*0.39*
4	53%	**73%**	86%
7	73%	**90%**	97%
13	91%	**99%**	100%

It is recommended that visits are divided across the following time periods depending on the location[71]:

North of Interstate 80

1 May - 14 May 15 May- 31 May 1 June - 15 June

South of Interstate 80

15 April - 30 April 1 May - 14 May 15 May - 31 May

Visits should occur at dawn (30 minutes before sunrise to 2 hours after) or dusk (2 hours before sunset to 30 minutes after), when there is no precipitation and wind speed is <20 km/hour (12 mph)[63,69]. At least 10 minutes should be spent at each point. Survey reports should include habitat characteristics and maps showing survey points. For more details see Conway 2011[63]. Surveys for King Rail should also cover other endangered or threatened marsh birds that may be in the area, such as Black Rail, Least Bittern, American Bittern, Common Gallinule, Yellow-headed Blackbird, Black Tern, and Forster's Tern.

Monitoring for impacts

Surveys to monitor long term impacts of conservation or development action should assess occupancy, nest success, and survival. Ideally, a before-after-control-impact design would be used. Surveys should be initiated as above to locate breeding birds and then track their progress to ascertain nesting attempts, nest success, fledging, and survival rates. Repeated observational visits or installation of nest cameras may be used[15,20,32]. Habitat and environmental variables should be evaluated and installation of a water level gauge may be necessary for monitoring changes in hydrology.

Stewardship recommendations

Areas known or suspected of supporting King Rails should be managed to maintain suitable habitat. Marsh ecology is dynamic and management will depend on understanding the current state of the marsh[72]. Management should include restoring and maintaining semi-permanent hydrology, such that water increases in distribution and depth in the spring, and is followed by occasional drying in summer and fall[67,73]. Dynamic water levels and micro-topographic variation prevent monotypic stands of vegetation and maintain plant diversity[19]. To produce suitable King Rail habitat in wetland impoundments, drawdowns should provide shallow water depths (less than 10 inches) in spring, followed by slow drawdowns through late summer[10,18,73]. Existing micro-topographic variation, such as ridges, swales, and depressions, should be maintained or enhanced to encourage heterogeneity[41]. Management should target the hemi-marsh condition with 25% shallow open water interspersed with herbaceous vegetation.

Emergent vegetation, such as smartweeds (*Polygonum* spp.), sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), rushes (*Juncus* spp.), bur-reeds (*Sparganium* spp.),

and Broadleaf Cattail (*Typha latifolia*) should be encouraged. Although dynamic water levels may prevent monotypic stands of invasive species and woody encroachment, other management methods, such as mowing, disking, burning, manual cutting, and herbicides, may also be necessary[19,73]. Mechanical and chemical removal of vegetation should follow INPC stewardship guidelines (http://www.dnr.illinois.gov/INPC/Pages/INPCManagementGuidelines.aspx). Fire has been shown to increase King Rail nesting use in coastal marshes[32]. These management activities should not take place while King Rails are present (April through October). Mowing ditches and upland areas adjacent to marshes should also be avoided during this period. Invasive carp can reduce emergent vegetation cover and may require active management[74]. In addition if chick mortality is high, predator control projects may increase survival rates[75]. Water quality should be monitored to ensure that pollution, such as from road, lawn, or agriculture run-off, does not impose a direct or indirect threat.

Adjacent land owners and local residents should be informed of the presence and sensitivity of King Rails and of practices that they can perform to support King Rail survival, such as natural landscaping, reducing the use of insecticides, reducing runoff, eliminating mesopredator resources, preventing cats from roaming freely, and conscientious driving[76]. Agricultural best management practices, such as cover crops, buffer strips, conservation tillage, constructed wetlands and integrated pest management, should be encouraged in the surrounding watersheds to prevent runoff and altered hydrology[77].

Avoidance, Minimization, Mitigation

Avoidance measures

To avoid impacts to wetlands occupied by King Rails, development should not occur within 0.6 miles[11]. The hydrology of King Rail habitat should not be altered by damming, draining, dredging, or channelizing flowing water.

Minimization measures

Spatial and temporal efforts

Impacts can be minimized by reducing the habitat area impacted and increasing the distance between habitat and development[40]. Development siting should avoid bisecting wetland complexes. Activities that may impact King Rail should be completed between October 1 and March 31.

Compatible design

Development designs should be compatible with continued King Rail occupation and survival by incorporating natural water fluctuations, interspersed water and emergent vegetation, and no woody vegetation cover. Occupied wetlands should not be dredged, deepened, filled, unseasonably flooded, or drained. Hydrologic and soil surveys may be necessary to understand potential impacts on the existing hydrologic conditions. Impermeable surfaces in the watershed should be kept to a minimum. Chemical use should be minimized and all chemicals should be safe for wildlife and aquatic use. Wetlands and adjacent areas should remain unmowed during the breeding season.

Traffic volume and speeds should be minimized near King Rail habitat. If roads are adjacent to King Rail habitat, diversion poles can be used to prevent collision with cars during typical low flight[78,79]. Diversion poles are verticals poles erected alongside a roadway to divert low flying birds to fly at a higher elevation. The poles should be taller than passing traffic and be placed along both sides of the highway with <10 ft spacing. However, poles should not provide suitable perches for raptors.

Artificial lighting should be used sparingly, at low intensity, and directed towards the ground, especially during migration (March-May and September-October). Lighting on towers should flash to reduce collisions[80]. Noise and vibrations, such as from traffic or construction activities, should be minimized, especially from April to July.

Construction practices

Construction and maintenance practices should be sensitive to impacts to King Rails and their habitat. Clearing of native vegetation should be limited. Staging areas should be located far from sensitive areas. The area impacted should be reduced as much as possible, and areas that are not to be disturbed should be flagged or fenced to alert construction personnel. Debris and excess materials should be removed and properly disposed. Erosion and sediment controls should be strictly implemented, monitored, and maintained for the

duration of the project. Sediment controls should be monitored regularly and after rainfall. All disturbed areas should be immediately revegetated with native vegetation. All project personnel should be informed of the sensitive nature of the project.

Mitigation and Conservation Opportunities
Mitigation opportunities include protection, stewardship, and restoration of King Rail habitat and coordination of conservation actions.

Protection
Unprotected King Rail breeding locations should be the first priority for habitat protection. Seven out of twenty known breeding locations are not under conservation ownership[81], and nine out of twenty are not protected in the Illinois Nature Preserve Commission system providing the highest level of protection[7]. Additional suitable habitat has been identified for protection, largely along the Mississippi River, Illinois River, and Lake Michigan shoreline[82].

Land protection may consist of acquisition or conservation easements. Acquired land may be donated to a conservation agency or local conservation organization. Conservation organizations that may be interested in partnering on conservation efforts can be located through the Prairie State Conservation Coalition: http://www.prairiestateconservation.org . Conservation easements may provide a level of protection without acquisition. The Illinois Nature Preserves Commission permanently protects high quality areas and habitat for listed species on both private and public lands in the Illinois Nature Preserve System. Conservation easements on agricultural land can also protect habitat through retirement of farmed and previously converted wetlands. Various government programs are available to support such work: https://www.fsa.usda.gov/programs-and-services/conservation-programs/index.

Stewardship
Beyond protection of King Rail habitat there is considerable stewardship work that may be required to maintain habitat that is already protected. King Rail habitat stewardship opportunities exist on state-owned property, various forest preserve/ conservation districts, and private properties. One project which used cutting, herbicide treatment, and follow-up treatment to control woody vegetation on King Rail habitat in Cook County was estimated to cost $3,500 per acre[83], but costs will vary depending on the complexity and location of the project.

Restoration
King Rail habitat restoration opportunities exist in large areas across Illinois, largely in agricultural areas with historic wetlands or hydric soils[12,62]. The Illinois Wildlife Action Plan has prioritized restoration of basin marshes in the Northeastern Morainal natural division and stream-side marshes in floodplain areas[33]. County-level and site-specific planning can be targeted by using the National Wetland Inventory mapper: https://www.fws.gov/wetlands/Data/Mapper.html. It is expected that King Rails will be able to locate and use newly restored or created wetlands, even if they are isolated[24,70].

Constructed wetlands should aim to mimic suitable habitat conditions (see Habitat section). Restoration of shallow, native-plant wetlands and wetland complexes should be >50 ac. in size[12]. The most important step in restoration is restoring semi-permanent hydrology. This may be as simple as breaking existing drainage tiles in agricultural areas to allow altered shallow wetlands to hold water for greater time periods and dewater naturally, but it may require intensive management in other areas. If habitat destruction will be followed by restoration, sediment and vegetation can be saved from the original wetland to produce comparable conditions. The "Illinois Wetland Restoration and Creation Guide" may provide guidance for restoring King Rail habitat[84].

The Natural Resource Conservation Service (NRCS) provides standards and estimated costs on various wetland restoration practices that may be of benefit to King Rails. Restoration of wetlands by removing or disabling drainage tiles (NRCS practice 657 and 649) costs an estimated $600/ac. Creating wetlands (NRCS practice 643 and 658) costs an estimated $1800-4500/ac. Mitigation sites should be monitored using the Standardized North American Marsh Bird Monitoring Protocol (See Survey Guidelines section).

Coordination
There is potential to partner with unconventional partners for King Rail conservation. Groups that influence river systems, such as hypoxia task forces,

water treatment facilities, or watershed/drainage districts, may be able to cooperate to benefit the King Rail while also meeting their objectives[33]. Cooperation from multiple groups will be necessary to alter large river hydrology in a way that mimics historic flows that provide suitable floodplain habitats[33].

Research needs

What is the current distribution and abundance of emergent wetland habitat in Illinois?

- Regularly inventory emergent wetland area across Illinois using GIS and aerial imaging to identify trends. Use historical aerial imagery and hydric soil data to identify drained wetlands.

What is the current status and distribution of the King Rail in Illinois?

- Design and implement a statewide marsh bird monitoring program[63].

Where are the wintering grounds of Illinois breeding King Rails? And what is the relative importance of wintering vs breeding grounds for survival and recruitment?

- Use telemetry to track King Rail movements and survival rates throughout their life cycle.

What are the impacts of various management practices, development activities, and recreational activities within and adjacent to wetlands on survival and reproduction of King Rails?

- Monitor King Rail reproduction before and after management activities.

What habitat protection or restoration actions across the state would be most cost effective at increasing King Rail populations?

- Conduct a cost-benefit analysis of habitat restoration and protection options.

What are the predators and predation rates of King Rails in Illinois? How is this impacted by adjacent land use?

- Monitor breeding King Rails using video surveillance to identify predators.

What is the relationship between invasive wetland plants and King Rail survival and reproduction?

- Assess differences in reproduction and survival in habitats with more or less invasive species.

Additional information

Species profiles

- https://www.allaboutbirds.org/guide/King_Rail/id
- http://wwx.inhs.illinois.edu/collections/birds/ilbirds/35/

Conservation planning

- http://www.fws.gov/midwest/midwestbird/documents/kingrailconservationplan.pdf
- http://www.uppermissgreatlakesjv.org/index.htm
- https://www.fws.gov/wetlands/Data/Mapper.html

Monitoring

- http://data.pointblue.org/partners/mwadc/index.php?page=home
- http://midwestbirdmonitoring.ning.com/group/midwest_secretive_marshbirds

Habitat restoration

- Illinois Wetland Restoration And Creation Guide[84]

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Citation

Illinois Natural History Survey. 2016. Conservation guidance for King Rail (*Rallus elegans*). Prepared for the Illinois Department of Natural Resources, Division of Natural Heritage.

Acknowledgements

Review and helpful comments were provided by Mark Phipps, Tara Kieninger, and Randy Smith (IDNR); Tom Lerczak (INPC); Gary Glowacki (Lake County Forest Preserves); and Mike Budd and Greg Souliere (USFWS). Funding for this project was provided by the Illinois Department of Natural Resources and the US Fish and Wildlife Service's State Wildlife Grant Federal Assistance Program. The author is solely responsible for the content of this document.