ANTIPREDATOR STRATEGIES IN BREEDING BRISTLE-THIGHED CURLEWS

by Brian J. McCaffery and Robert E. Gill, Jr.

This enimatic curlew has evolved a suite of antipredator strategies to see it through the breeding season and back to its tropical Pacific wintering grounds. USFWS photo by Brian J. McCaffery.

EACH FALL THE WORLD'S BREEDING population of Bristle-thighed Curlews (*Numenius tahitiensis*) arrives on the central Pacific wintering grounds following a migration that entails a nonstop flight of over 5000 kilometers. Sun-drenched, palm-shrouded atolls will be their home for the ensuing eight months. Even in the avian world, however, such apparant luxury is not without costs. For the Bristle-thighed Curlew these costs are incurred on the breeding grounds. From the time they arrive there in early May until they depart again for the wintering grounds in August and September, curlews are exposed to a host of predators. Gyrfalcons (*Falco rusticolus*), Golden Eagles (*Aquila chrysaetos*), Rough-legged Hawks (*Buteo lagopus*), Northern Harriers (*Circus cyaneus*), Parasitic Jaegers

The Red Fox is only one of many predators which threaten Bristle-thighed Curlews on the breeding grounds. USFWS photo by Brian J. McCaffery.

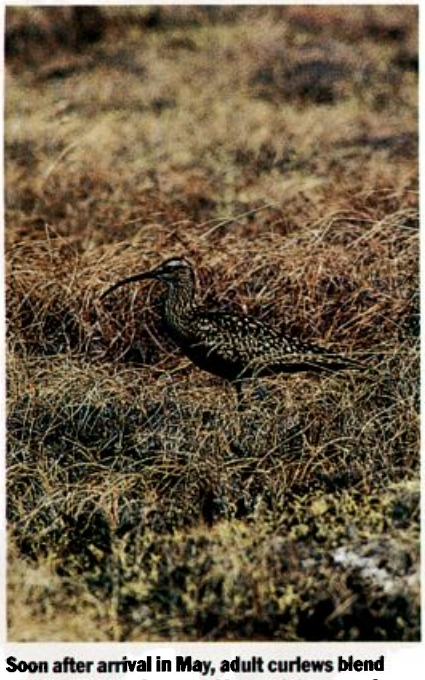
(*Stercorarius parasiticus*), Short-eared Owls (*Asio flammeus*), Common Ravens (*Corvus corax*) and Red Foxes (*Vulpes vulpes*) are potential predators of curlews and their offspring. To combat these threats, the Bristle-thighed Curlew has evolved an elaborate suite of antipredator defenses. Depending on the threat and the phase of the breeding cycle, Bristle-thighed Curlews may respond to potential predators by fleeing or flocking, by camouflage or combat. Given the variety of predators on the tundra, a variety of options is critical.

Until recently, the Bristle-thighed Curlew was among the most mysterious and least-known of the world's sandpipers. Its first nest was not discovered until 1948, and for the next 40 years, only small parties of intrepid birders had an opportunity to glimpse the species on its wilderness breeding grounds in western Alaska. Since 1985, however, we and our colleagues have studied the breeding ecology of the Bristle-thighed Curlew in detail. Working at two sites, one on the Yukon Delta National Wildlife Refuge (Nulato Hills) and the other on the Seward Peninsula north of Nome (Neva Creek), we have witnessed the myriad challenges faced by the species in its annual struggle to bring new curlews into the world. The constant threat of predation tops the list of obstacles.

When curlews first return to their upland breeding grounds in spring, the complex brown patterns of their plumage match the somber tones of the early spring tundra. Soon after

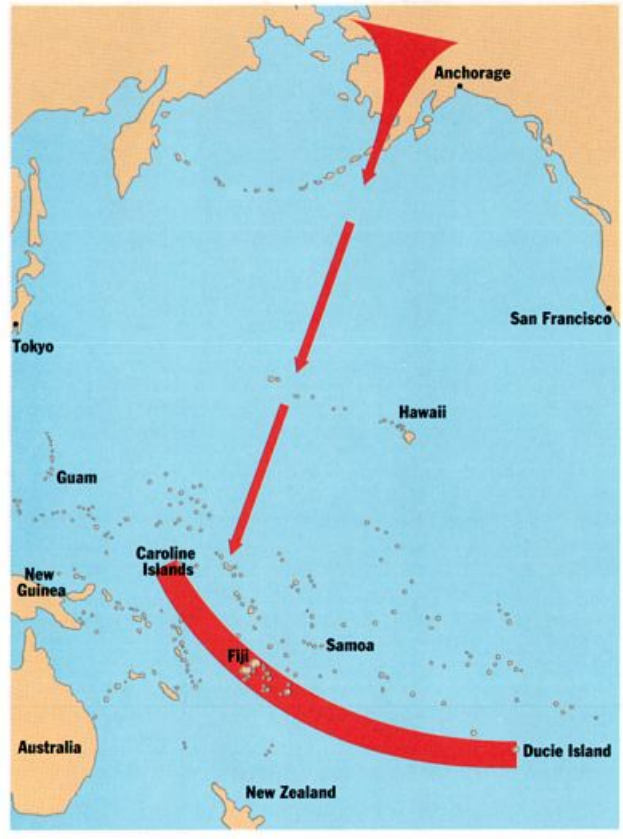
mating, pairs forage together constantly, usually within sight of one another. In the long, quiet intervals between territorial and courtship displays, curlews can be nearly invisible to the human eye as they move through the low vegetation. Both curlews and their predators have keener eyesight than we do, however. While foraging, curlews regularly scan overhead. When several consecutive glances focus on the same sector of sky, a raptor has been spotted.

Bristle-thighed Curlews exhibit an impressive ability to discriminate among potential predators. Species that normally pose little threat to adult curlews, such as harriers and owls, may be virtually ignored early in the season. Golden Eagles and Gyrfalcons, on the other hand, are treated with greater respect. When their dark silhouettes soar above the undulating terrain, adult curlews often freeze, then slowly crouch in silence, eliminating the incriminating shadows that could betray them. Once a raptor spots a potential victim and begins an attack glide, concealment is forfeited as the curlew's ringing "chiu-eet!" call splits the air to warn its mate.



Soon after arrival in May, adult curlews blend cryptically into the muted hues of the snow-free tundra. USFWS photo by Brian J. McCaffery.

Gyrfalcons are probably the most serious threat to adult curlews on the breeding grounds. If actually attacked, a curlew sees its alternatives dwindle rapidly as the falcon approaches. The best option is to separate the attacking raptor from its strongest ally, gravity. By spooking upward past the diving falcon just before the moment of impact, the curlew forces the falcon to brake, reverse direction, and climb in pursuit. In those fleeting moments, the curlew opens up a short lead over its pursuer, which can usually be maintained in level or rising flight. If the falcon is unable to regain ascendancy quickly, the chase is normally terminated. On occasion, however, we have seen curlews lead falcons in spiraling ascents of several hundred meters before the falcon succumbs to its aerodynamic limitations and breaks off the pursuit.



Bristle-thighed Curlews breed in Alaska. From there, they begin the exceedingly long flight across the Pacific Ocean, past Hawaii and onto the Polynesian Islands where they remain for the winter.

The demands of reproduction itself require breeding curlews to evaluate a somewhat different suite of contingencies *vis-a-vis* predators. Foremost among these decisions is nest site placement. To date, we have found 35 nests (23 in the Nulato Hills and 12 at Neva Creek). Like those of most other species of tundra-nesting shorebirds, a curlew's nest is a simple open bowl, lined with lichens, mosses, and the dried leaves of dwarf shrubs. At both study sites dwarf to moderately tall (0.2–1.5 m) shrubs characterized preferred nesting habitats. We believe curlews prefer to nest in shrubby habitat because of the concealment afforded from avian predators. For example, in the southern Nulato Hills, where nest predation is particularly high, one-third of all nests were beneath the shelter of willows, and of these 80% hatched. Among those nests not beneath the shelter of tundra willows, even those within areas dominated by shrubs, only about one-third hatched.

Similarly, curlews, as well as other large shorebirds, frequently nest near other species, such as Long-tailed Jaegers (*Stercorarius longicaudus*),

Shrub thickets, like those in the middle and far distance, frequently conceal nesting curlews on the Seward Peninsula. USFWS photo by Robert E. Gill, Jr.

Most curlews lay 4-egg clutches in simple bowls lined with lichens, mosses, and the dried leaves of dwarf shrubs. USFWS photo by David Ward.

Many curlews eschew the shelter of dwarf shrubs, nesting instead in exposed sites on the open tundra. USFWS photo by Brian J. McCaffery.

that aggressively defend their own nests from potential predators. Such defense is so effective that Long-tailed Jaegers experience the highest nest success (92%; n=13 nests) of any species in our study areas, particularly in the Nulato Hills. Not unexpectedly, large shorebirds nesting close to Long-tailed Jaegers tend to have higher nest success than do those nesting in more isolated sites. The adaptive significance of nesting under willows or near jaegers seems obvious, but not the reason more curlews do not do so. Clearly, we have much more to learn about the factors contributing to nest-site selection.

Once egg-laying has been completed, curlews (and biologists) face 3½ weeks of tension. Like most monogamous shorebirds, both curlew parents share in the duties of incubation. However, the off-duty parent seldom (in < 25% of all encounters) remains in the vicinity of the nest, instead flying several kilometers away to forage. Often they join flocks composed mostly of failed breeders and non-incubating members of other curlew pairs. Thus, if a predator approaches the nest, the incubating parent faces it alone 75% of the time. The first line of defense is to remain motionless, trusting that the cryptic mosaic of the dorsal plumage will prevent detection. So dramatic is the curlew's reliance on camouflage that it normally stays on the nest until any ground or aerial intruder approaches within a meter. If forced from the nest, the incubating parent runs several meters in silence with its wings extended and its flared rusty tail dragging over the tundra. The adult rarely whirls, growls, and approaches the intruder with its wings spread threateningly, at times even fluttering off the ground in its face. More frequently, however, the adult moves 10–100 meters from the nest, giving sporadic "chiu-eet!" calls. If followed by the intruder, the adult curlew continues to move from the nest, leading it away in a series of short flights and sprints.

If the predator is not dissuaded and fooled but actually discovers the nest, the curlew's response escalates. Ravens, Parasitic Jaegers, and even

The shadows of dwarf willow branches enhance the camouflage of nesting Bristle-thighed Curlews. USFWS photo by Brian J. McCaffery.

Through their aggressive attacks on predators, Long-tailed Jaegers provide a protective umbrella for curlews and other species nesting within their defended area. USFWS photo by Brian J. McCaffery.

humans near a curlew nest are frequently subjected to attack-mobbing. Whether diving or approaching at eye level, the parent curlew flies directly at the potential predator, sometimes closing to within one meter before breaking away. A particularly aggressive curlew may actually strike its antagonist. These strafing runs are accompanied by a harsh, shrill "krreee" call. Such behavior becomes even more pronounced just before the eggs hatch, especially toward humans.

Flocks of failed breeders and off-duty nesters may include as many as 90 curlews. USFWS photo by Jeff Mason.

The tan and cinnamon edges on the dark brown dorsal feathers correspond closely to the variegated patterns of tundra vegetation. USFWS photo by Brian J. McCaffery.

Although curlew chicks are precocial and able to leave the nest within hours of hatching, ravens, jaegers, and foxes continue to threaten them. In addition, the same harriers and owls that were ignored just a few weeks earlier are now vehemently attacked as *bona fide* threats to the curlew chicks. Adult curlews even confront and physically attack species that could capture and kill them, such as Golden Eagles and Rough-legged Hawks. More often than not, the male curlew is the first to initiate familial defense, attacking predators up to 400 meters from the brood. If his efforts alone do not adequately discourage the intruder, the female leaves the brood to join the attack as well. Indeed, this behavior is so strong that we were able to elicit mob-attacks to capture most individuals we wished to color-mark.

During distraction displays in the immediate vicinity of the nest, the diagnostic rusty tail is displayed conspicuously. USFWS photo by Christopher M. Harwood.

For the first several days after hatching, the curlew family usually remains within a few hundred meters of the nest site. Over the next two weeks, as the chicks grow and become increasingly mobile, parents begin to lead their young on long treks. Broods may move more than two kilometers in a single day and cross running streams, dense alder thickets, and vast fields of knee-high hummocks. Eventually, numerous broods of just volant young, and occasionally some older, still-flightless young, coalesce into aggregations near the tops of mountains. Among shorebirds, such social groupings have previously been known for only a few species. We believe that forming aggregations may have evolved among Bristle-thighed Curlews primarily as an antipredator strategy, as has been found for most other species that

When defending their young, attack-mobbing curlews may actually strike threatening predators. USFWS photo by Robert E. Gill, Jr.

Soon after drying, downy curlew chicks are ready to leave the nest. USFWS photo by Christine V. McCaffery.

form communal groups of young. We cannot yet discount other possible explanations, however. For example, curlews may form aggregations simply to congregate around limited food resources.

We first observed brood aggregations at Neva Creek in 1989, and to date have followed a total of 11 different groups. Curlews in the Nulato Hills also seem to form aggregations. Broods have been seen moving closer together, but multiple broods have never survived long enough to form an aggregation at that site. At Neva Creek, aggregations begin to form the last week before fledging and usually remain intact until juveniles depart in early August. Aggregations normally consist of fewer than 20 young, but up to 30 young have been seen in a single group. Young in a newly-formed aggregation usually forage close together over a few hectares. Once the young have mastered flight, the distances between young become much more variable, but the overall area used by a créche remains about the same.

This adult curlew was captured while mobbing the investigators. Note the silky, bristled thigh feathers. USFWS photo by David Ward.

When aggregations are first formed, both curlew parents, but primarily the male, aggressively defend their broods and those of neighboring pairs from potential predators. A Northern Harrier, Parasitic Jaeger, or Common Raven bold enough to approach within several hundred meters of an aggregation is immediately set upon by a host of adults that do not hesitate to physically attack the intruder. Most of these adults have offspring in the aggregations but some have young in a different, often distant, aggregations. Adult curlews with and without young in the aggregations defend it, but those with young tend to do so more aggressively. Curlews are often joined in these attacks by Bar-tailed Godwits and Whimbrels, and occasionally by Lesser Golden-Plovers, who have integrated their own young into the aggregation.

About a week before the chicks fledge a marked change begins in parental care of the young. Adult females become much less aggressive and most (> 80%) depart from the area, leaving the adult males to tend the broods. A week or two later, most adult males also leave. The few remaining adult males must see the young through their last couple of weeks on the breeding grounds, but even they depart several days before the young. The antipredator behavior of the adult males charged with tending the aggregations also changes during this period. Alarm calls and attack-mobbing change to silence, crouching, and apparent indifference toward the young as the males prepare to depart.

Between the time of hatching and the departure of young, the antipredator strategy of curlews changes from intense biparental care to flocking. During this transition, the number of adults defending young, the ratio of females to males, and the intensity of their responses to predators greatly diminish. This shift in behavior may be related to a corresponding change in the composition and number of

predators on the breeding grounds and to the energetic demands the adults will be facing during migration.

Immediately after hatching, young curlews probably need the attention of both parents for thermoregulation and or vigilance against predators that are still abundant on the breeding grounds. At about the same time that females begin to depart, however, a marked decrease occurs in the number of harriers, Parasitic Jaegers, and ravens, predators likely to take small curlews. The need for biparental care may be reduced enough to allow the energy-depleted adult females, and subsequently most males, to leave the breeding grounds. The shift to an antipredator system involving aggregations tended by only a few adults may be a response to the threat from dangerous falcons, eagles and foxes that remain.

Such a system assures the continued defense of offspring while allowing most adults to depart and prepare for migration. Why certain adults remain while others depart is unknown. For example, we have recorded two cases in which a marked male has tended an aggregation in the same area for at least two consecutive years. Processes related to kinship selection seem the most logical explanation for this, but we will not unravel this secret without several more years of study.

After leaving the breeding grounds, both adult and juvenile curlews head for the staging grounds on the central Yukon Delta. Once there, they gorge themselves on berries and insects for several weeks, accumulating body fat for their transoceanic migration. Originally, the atolls and tropical islands where they spend the winter were free from predators. In fact, Bristle-thighed Curlews were so secure in their environment that they evolved a flightless wing molt, the only migratory shorebird in the world known to do so. However, their evolutionary vacation seems to be coming to an end. Over the last few centuries, humans have released hordes of exotic predators on these islands. As a result, today's curlews find no halcyon sanctuary during their sojourn in the tropics. Instead they must now detect and evade predators during the winter as well, even when they are flightless and most vulnerable. Such added risks do not bode well for the future of this rare and intriguing shorebird.

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