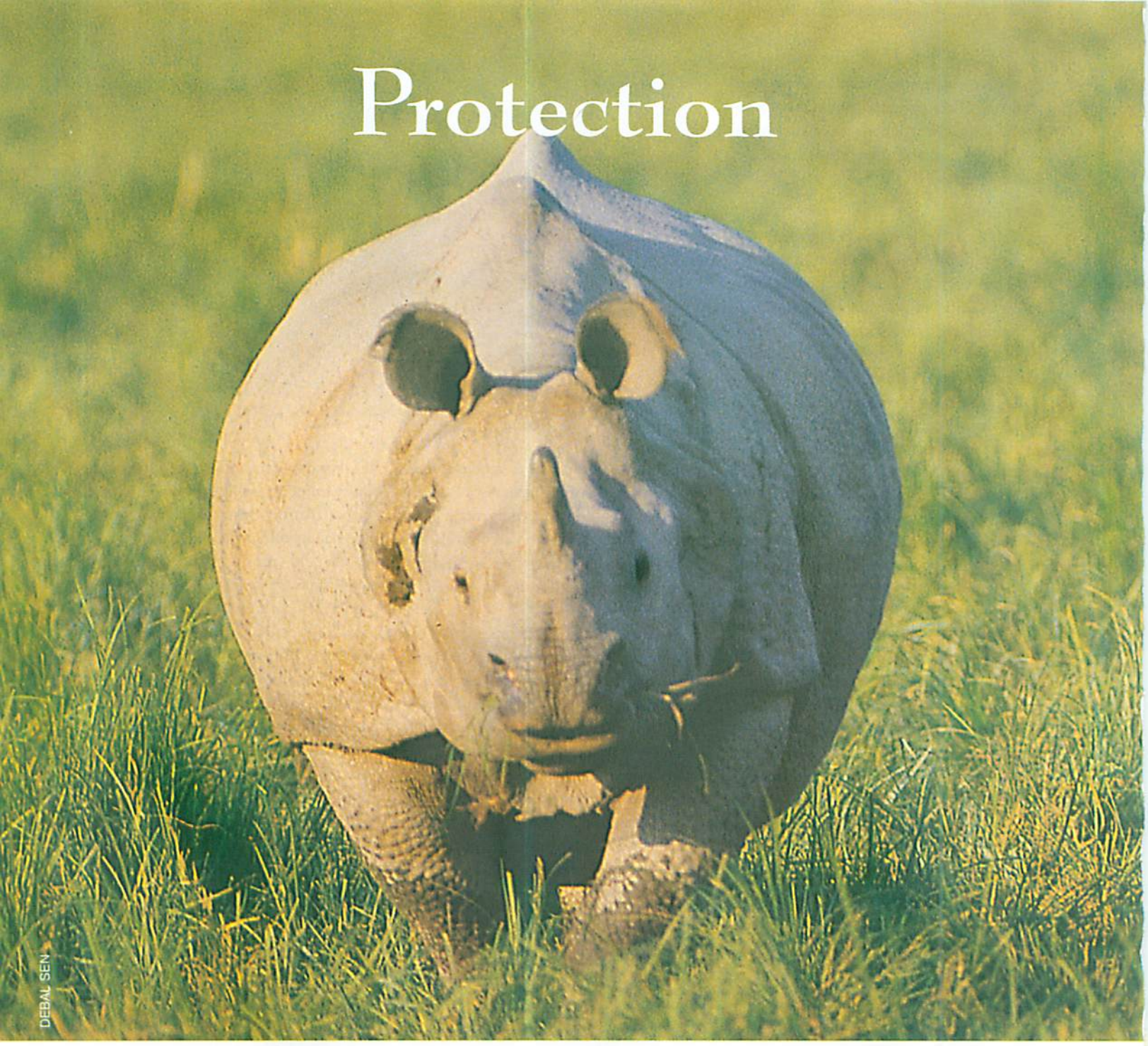

Kaziranga celebrates 100 years of conservation success in February 2005. It is now a haven for its star-resident, the endangered one-horned rhino.

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Kaziranga

The most densely populated tiger habitat in the world, says, Dr. K. Ullas Karanth, of the Wildlife Conservation Society, New York.

In 1995, I began field surveys of tigers and their prey in a number of nature reserves across India. My goal was to estimate tiger population densities in a variety of ecologically representative sites. The floodplain grasslands of Chitwan in the Nepalese *terai* region were already recognised as among the most productive habitats for prey species such as deer, pigs and wild cattle and consequently for tigers. Only a few remnant patches of the once extensive floodplain grasslands of northern India and southeast Asia now survive in a few reserves like Kaziranga and Chitwan. Moreover, in comparison to Kaziranga, even Chitwan's fauna is impoverished: human impacts have extirpated the elephant, wild buffalo and barasingha from Chitwan in recent times. It was critical for me to estimate tiger densities in Kaziranga to assess the conservation potential of floodplain grasslands.

I began field-work in Kaziranga in February 1996, assisted ably by Samba Kumar and other researchers in my team. How should I go about estimating tiger densities in this vast sea of grass was the key question. In my view the traditional 'Indian pugmark census' did not stand up to acceptable scientific scrutiny. A more reliable method, based on modern science was needed. At that time, I had just developed such a method – camera-trap sampling – at my long-term research site of Nagarahole in Karnataka. I had also employed this method successfully in the Pench and Kanha Tiger Reserves of Madhya Pradesh. The camera-trap sampling worked because it addressed two key problems in sampling tiger populations, namely the inability to reach every last corner of the forest and the impossibility of counting every secretive tiger, even where we have reached.

Apart from being secretive, tigers also live at low population densities: we simply cannot go out and 'census' wild tigers to get a total count as conservationists sometimes assume. When we try to count tigers – or even their photographs or paw-prints – we must squarely confront these two problems. In technical language we refer to them as the problems of 'spatial sampling' and 'observability'. Any reliable tiger-counting method must have a statistical basis that allows us to estimate both the fraction of the area surveyed, and, within that area, the proportion of tigers that are actually counted.

Over the past couple of centuries, beginning with the work of the famous French mathematician P. S. Laplace, scientists have developed methods that allow us to

The camera-trapping technique takes advantage of the fact that tiger stripes are unique to each individual. By photographing tigers that walk past the camera trap the number of tigers in the area can be estimated. Science is being used to boost conservation efforts in Kaziranga.

DR ULLAS KARANTH/WCS

June

The Black-necked Stork shares its habitat in Kaziranga with the Lesser Adjutant, a globally threatened stork whose breeding habitat and nesting trees have largely been usurped by humans, for one reason or another. This prehistoric looking bird is a characteristic feature of the wetland landscape of Kaziranga. Virtually every large *beel* or inundated paddy field has a Lesser Adjutant scouring its waters for food.

Large, heavy birds, when they take to the air it is with an almost laboured flight, and seeing them alight heavily onto a *Bombax* tree each evening to roost remains the dominant image of Kaziranga in my mind.

The *Bombax*, or silk cotton, is an important nesting tree for several waterbirds in Assam. Large numbers of egrets, herons, cormorants and the Oriental Darter nest in Kaziranga's protected heronries made up of groves of *Bombax* trees. What advantage does colony nesting offer birds like herons and egrets? Ornithologists are not totally agreed, but there is probably something to gain for young birds that choose to nest alongside more experienced and established birds.

But years of personal observation suggests to me that colony nesting has distinct advantages when it comes to the smaller passerines. From atop the watch tower at Bahu *beel*, I watch a Black Drongo frantically mobbing a Large-billed Crow till it succeeds in driving it away. This done, the drongo perches on top of the *Bombax* where it had built its nest. The *Bombax* is crammed to capacity with sparrow-sized birds of a brilliant yellow hue. These are Finn's Weavers – colony nesters that weave large nests from materials sourced from the extensive wet alluvial grasslands in which they thrive.

Finn's weavers are also globally threatened, having lost most of their grassland habitat to agriculture over the years and they too owe the rhino a debt of gratitude for the protection it inspires for Kaziranga.

I watch as some Finn's Weavers plucking leaves from the tree in which they are nesting. Why do they do that I wonder? Surely this makes them easier to spot by birds of prey? Even as I search for answers to such apparently inane questions, the aggressive nature of the Black Drongo clearly benefits the weaver colonies. But then, another question arises: how do the weavers return the favour? How do they benefit the drongo?

Most of the lands along the banks of the Brahmaputra must once have been as productive as Kaziranga is today. Nature has always been in a state of flux, but we have radically altered the landscape and things are difficult for wild species now.

BERNARD CASTELEIN

This Oriental Pied Hornbill has landed itself a treat as it feeds on its favourite food – fruit. When fruits are unavailable, the hornbill eats young birds and large insects.

There are four species of weaverbirds in the Indian sub-continent, the other three being the Dark-throated, Streaked and Baya Weavers. The Dark-throated and Streaked nest on reeds, while the Baya displays a penchant for betel-nut palms and other suitable trees. The Baya Weavers of Assam and northeastern India are distinct from those found elsewhere in India and are of the race *burmanicus*, a reminder of the fact that we are closer to Rangoon than New Delhi.

July

The monsoon has well and truly broken. The weather is humid and the moisture-laden clouds will probably drop their burden of rain later in the morning, or the afternoon perhaps.

Most fledglings have left their nests and juvenile White-vented Mynas can be seen at Dunga with the adults as they forage on the backs of wild water buffalo grazing peacefully in their grassland haven. The young ones can be told apart because the tell-tale tufts on the forehead have not yet formed and their plumage is yet to moult into the deep-grey of adulthood. The White-vented shares its habitat with the Jungle Myna, while the Common Myna has either been kept at bay, or finds richer pickings in and around the increasing human settlements along the southern boundary of the park.

In the distance, I could hear the magical bugling call of a swamp deer. The rut has begun.

Hours pass. I sit watching the rain come down in sheets. Birds are largely inactive now and I watch as a Long-tailed Shrike clambers into the tall grass to escape the downpour. A resident bird, this shrike breeds in the wet alluvial grasslands, while the Grey-backed and Brown are winter migrants. Could the Long-tailed, known as *tricolor*, have perhaps diverged from the wintering population through this isolating mechanism?

The rain has gone. A Lesser Coucal call wafts over the rain-drenched grassland. Juveniles would be about in the grass somewhere. They look so different from the adults that all too often novice birdwatchers mistake the two for different species altogether.

This is also the time when flocks of near-threatened Spot-winged Starlings start arriving in droves to Kaziranga. Comprising 50-60 birds, each flock is characterised by a large number of juveniles, learning the tricks of survival from more experienced adults. The starlings stay till early October, after which they disappear, only to resurface in thousands when the *Bombax* is in flower and food is aplenty. I wish I knew where they went and what kind of homes they went back to away from Kaziranga. Despite years of questioning, I for one have still not properly understood their migratory patterns.

... How many times must a man look up, before he can see the sky? Kaziranga's megafauna is seriously impressive and this often caused people to overlook the larger umbrella of life that habitat protection has led to. The 'larger' picture lies hidden in leafy glades, on the forest floor and also high overhead where magnificent sights such as soaring raptors and storks using thermals easily present themselves.

'sample' animal populations and estimate the fraction of area sampled and the proportion of animals counted. Whether we are counting tigers, tortoises or any other creature, the underlying statistical issues are the same.

Fortunately, tigers have stripes that are unique to each individual. By deploying camera traps that automatically photograph tigers that walk past them, we can obtain 'capture histories' from 'photographic captures'. We can then estimate tiger numbers in that area from sample counts of tigers obtained in the field, using a method called 'capture-recapture sampling', which permits the estimation of probabilities of capturing tigers present in the area.

My camera traps consisted of two automatic cameras hooked to an infra-red tripping device. In Kaziranga, I deployed such traps at 63 carefully chosen locations that maximised the probabilities of capturing tigers. These traps effectively sampled a prime habitat of 167 sq. km. during 544 'trap-nights' of effort. This effort resulted in the 'photographic capture' of 22 individual tigers. However, analysis of the capture histories of tigers caught showed that the average probability of our traps capturing a tiger during each of the nine sampling periods was only about 19 per cent. In other words, on an average, tigers present in the sampled area had a 19 per cent chance of being caught in our traps in a given sampling period. From these data, I could estimate that although I caught only 22 individuals, the total number of adult tigers in the sampled area present during the survey was about 28. Overall, I had 'caught' 79 per cent of the tigers present in the area I sampled within Kaziranga.

The estimated average tiger density was 16.8 tigers per 100 sq. km. in the surveyed area. However, because I sampled one of the best-protected parts of the Kaziranga reserve, tiger density over the entire park may not be as high. In the eight years since that survey, I have been fortunate to conduct similar studies at a dozen tiger habitats in India. Other biologists have followed my methods in Russia, Thailand, Malaysia, Indonesia and Nepal. The tiger densities estimated from these studies have ranged from one to 12-tigers per 100 sq. km., depending on local conditions. To this day, the high density of tigers recorded in Kaziranga remains unmatched elsewhere. Kaziranga should make India proud, not only as a stronghold for rhinos but also for its world-beating tiger densities. I hope it remains that way forever.

DR. ULLAS KARANTH/WCS

Camera traps also wind up capturing lesser-known creatures such as this nocturnal porcupine. But the traps must be carefully laid and the data very meticulously analysed if it is to be of use to manage wild habitats.

Biologists have followed Dr. K. Ullas Karanth's camera trap methods in Russia, Thailand, Malaysia, Indonesia and Nepal.

DR. ULLAS KARANTH/WCS