Secondary succession in the buffer zone of Corbett Tiger Reserve, Uttarakhand

The Corbett Tiger Reserve (CTR) established in 1936 is the oldest national park in the Indian subcontinent. Spread over 1318.54 km² in the foothills of Uttarakhand Himalaya, it occupies the Siwalik-Terai biotic zone abutting the Himalaya. The reserve is adorned with a unique assemblage of Himalayan flora and fauna.

With the passage of time and increase in animal population, an urgency to expand the protected area was perceived by the forest authorities. With this aim two villages, namely Dhara and Jhirna, which were situated on the southern boundary of the reserve (Dhara ca. 5 km from Kalarag and Jhira ca. 7 km from Kalarag), were relocated to Firozpur-Manpur area situated on Ramnagar-Kashipur highway (Figure 1) during 1990–93. There were about 25 families in Dhara and 30 in Jhira, which were mostly dependent on the forest products. These inhabitants were rehabilitated on the Ramnagar to Kashipur road in the village Ampokhra. The areas thus vacated were designated as CTR buffer zones.

As time passed, nature began its secondary succession arising from the destruction of previous ecosystems or the abandonment of cultivated land, on the abandoned fields and soon they began to show signs of ecological recovery. During this process a tangle of vines, herbs, grasses and small trees arose initially. Such a situation is the primary stage of secondary succession. These were subsequently supported by herbaceous flora, eventually leading to natural forest type. In the CTR, it was noticed that the vacated agricultural fields were soon taken over by grass and the adjoining forest areas started recuperating.

By 1999–2002 several plant species, namely Abelmoschus crinitus Wall., Acacia pennata (L.) Willd., Alnus excelsa Roxb., Albizia lebbeck (L.) Benth., Alternanthera sessilis (L.) DC., Cyperus nutans Vahl., C. rotundus L., Galium aparine L., Heliotropium striosum Willd., Indigofera glandulosa Willd., Ipomoea nil (L.) Roth., Limonia acidissima L., Melochia corchorifolia L., Mucuna capitata Wt. & Arn., M. nigricans (Lour.) Steud., Perotis hordeiformis Nees ex Hook. & Arn., Saccharum spontaneum L. and Thevetia peruviana (Pers.) Merr., had already emerged in these buffer zones. It was therefore clear that secondary succession was fast progressing and was on way to acquire a climax.

The newly arisen lush green fields started attracting animal population and subsequently colonization began. The grass-eating animals, mainly deer and elephants, slowly migrated towards these areas and even preferred to stay here throughout the monsoon. These animals,

![Figure 1. Map of study area.](image-url)
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which normally migrated to the Sonanadi area during the previous years, showed no signs of movement outside the CTR. The climax of this succession is expected to reach in the coming decades, when a persistent dynamic equilibrium between organisms and their habitat would be achieved. This would be a condition when the buffer zones become floristically rich and provide independent support to the life of animal species dependent on them and in turn, to the carnivores, mainly tigers, in order to enhance tiger management programmes. The Jhira and Dhara regions would then be completely encompassed in the core zone of the CTR. According to the forest authorities, once these fields develop into chaur (grasslands), the forest cover would increase and this would offer good potential for wildlife-viewing and attract more tourists. Such practices, in turn, would help fetch more revenue for wildlife protection, and support future conservation programmes in our country.

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Where do we place the Indian cattle Theileria mutans of yore?

Theileriosis causes immense economic losses in the improved cattle of the tropics and subtropics. As measures to control the pathogenic Theileria have been evolved, attention has now shifted to the benign parasite, Theileria mutans described as ‘rag-bag’, in which were dumped all bovine benign Theileria strains of the world1. Recent researches revealed that T. mutans is a sub-Saharan parasite of African buffalo (Syncerus caffer) affecting cattle and sheep, and is transmitted by Amblyomma ticks2. Another finding that indirect fluorescent antibody test (IFAT) differentiates Theileria species of cattle from one another3, stimulated research on benign Theileria occurring in cattle. It soon became clear that British T. mutans was different from T. mutans of Africa, but was similar to Australian Theileria of buffalo and cattle4. A comparative study showed that benign strains of Theileria isolated from cattle in Britain, Australia, Iran, Japan, USA and a more pathogenic stock of T. sergentii from Korea were closely related in morphology, serology (IFAT) and transmission by Haemaphysalis ticks, except the American stock transmission which is yet to be determined5. The authors described the parasites as T. orientalis. Some subsequent reports from Ethiopia, New Zealand and Burundi in Central Africa designated benign Theileria of cattle as T. orientalis, whereas others from Italy, Greece and Australia assigned them to T. buffeli.

Two Theileria species contending for attention are T. sergentii and T. orientalis6 described from cattle of eastern Siberia; the former as pathogenic and the latter as benign. According to the International Code of Zoological Nomenclature, the name sergentii is invalid as it is propeccupied by a valid species of sheep parasite. This leaves T. orientalis as the only valid species to designate benign Theileria of cattle in Eurasia ‘as long as its identity with T. buffeli has not been established’7. T. buffeli is known to infect buffaloes in South East Asia. It is transmitted by Haemaphysalis ticks and is transmissible to cattle8, therefore, the name T. buffeli takes preference over T. orientalis. Stewart et al.9 support the view that the benign parasite seen in cattle has been correctly named as T. buffeli.

Despite the warning on the invalidity of the nomen T. sergentii, Japanese authors have stuck to this name basing their assertion mainly on molecular studies reviewed by Gubbels et al.10, who suggested to continue using the name T. buffeli for buffalo-derived parasites of cattle. In India, the ‘small pirolasms’ affecting almost all cattle have been described as T. mutans, as they produced no ill-effects in the host even when occurring in large numbers11. A recent publication erroneously mentions T. mutans as occurring in the ‘Middle-East and Far East, Russia, Africa and Australia’12.

Some light on benign Theileria of cattle and buffaloes in India was shed by Shastrin et al.13, who identified the parasite isolated from an ox as T. orientalis on the basis of the characteristic ‘bar’ structure in the host erythrocytes in all the six calves infected by H. bispinosa, and positive reaction of sera of three out of six infected calves to IFAT but not to African T. mutans. Another study14 showed that Theileria isolated from debilitated and anaemic buffaloes was transmitted by H. bispinosa ticks to nine buffalo-calves, but not to cow-calves. Blood smears of the buffalo-calves showed pleomorphic pirolasms and typical ‘bar’ or ‘veil’ or both in the host cell, sera of five of them reacting positive to T. orientalis in IFAT and not to T. mutans or T. annulata. The authors left the parasite unnamed, but Uilenberg, who provided findings on morphology and serology opined that unless the infectivity of the buffalo parasite to cattle was further examined, the name T. orientalis be retained ‘for the moment’15.

There is another Indian report16 on five out of seventeen cattle reacting positive to complement fixation test using T. mutans antigen obtained from Germany. On the basis of this and other observations the occurrence of T. mutans in India was pointed out17. Uilenberg replied that (i)