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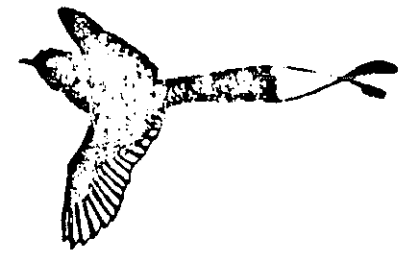

DIVERSITY : CULTURAL AND BIOLOGICAL

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January 1987

Technical Report No. 23

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Diversity: Cultural and Biological

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At the hunter-gatherer stage the human species occupied a broad niche of a large mammalian omnivore inhabiting a diversity of environments. This called for fine behavioural adjustments to a variety of local condiitons through culturally transmitted patterns of behaviour. This favoured conformism resulting in substantial between-group, but much less within-group variation in cultural traits. Group selection for cultural traits promoting sustainable use of biological resources and conservation of biological diversity could prevail under these conditions. Hence, primitive societies of territorial hunter-gatherers possessed high levels of cultural diversity dependent on and supportive of high levels of biological diversity. This pattern changed drastically with technological innovations enabling certain human groups to break down territorial barriers and to usurp resources from other human groups. The dominant groups have gone on to sequentially exhaust a whole range of resources; depleting both biological and cultural diversity. Traditions of resource conservation can however re-emerge with the concerned innovations diffusing to other human groups. Current initiatives such as the World Conservation Strategy may be traced to such a situation. This will change once again as genetically engineered organisms become an economically viable proposition with the accruing advantages concentrated in the hands of a few human groups; this is likely to lead to further drastic

reduction in biological and cultural diversity.

Diversity of life on earth is currently under serious threat; so is the diversity of human cultures. Since the now dominant technological culture displacing all others is often perceived as a major cause of loss of biological diversity, there is serious interest in understanding how the diversity of human cultures relates to the conservation of biological diversity; and whether the attempts to conserve biological and cultural diversity could go hand in hand [1].

Biological diversity has been on the increase through evolutionary times, presumably because much of it arises through diversity of adaptations to environmental heterogeneity, which itself has been continually enhanced by the activities of living organisms [2,3]. Part of the adaptation of organisms to the variety of environmental conditions they encounter is behavioural, with behaviour becoming increasingly flexible in higher animals. Thus birds and mammals take to new sources of food by imitating other members of their social group who may have discovered a new desirable resource [4]. Biologists define culture as such acquisition of behavioural traits from conspecifics through social learning; and man's close relatives like chimpanzees have further progressed in cultural transmission of behaviour by introducing deliberate teaching [5]. The capacity for symbolic communication has however enabled human species to far outstrip all others in the complexity of its culturally transmitted behaviour. This has rendered possible a tremendous variety of cultural behaviours in the different human populations covering the surface of the earth [6].

Human niches

Man's early ancestors occupied a niche similar to that of the savanna baboons. They initially broadened it by adding effective group hunting, as with the hyaenas or lions to their behavioural repertoire. This was followed by an expansion of hominid hunter-gatherer populations into a variety of other environments, ranging from humid forests to hot, arid deserts and coral reef islands to the prairies and tundras. Colonization of these environments called for complex behaviours highly specific for each locality, for instance, as to what to eat and where and when to find different prey species, as well as what not to eat and how to avoid predators and parasites. The most effective way to acquire these behaviours would be to imitate and learn from other members of the social group. This would favour conformism, or tendency to acquire behaviour patterns of the majority of group members as a genetically programmed trait in the human species. Conformism would result in low levels of intra-group variation in culturally transmitted behaviour patterns. The tremendous cultural diversity of the human species might then have arisen through forces favouring fine-tuning of behaviour to local environments; an important component of the environment being the biological diversity of the locality[6].

The primitive hunter-gatherer societies may be thought of as occupying a rather broad niche of a large mammalian omnivore and carnivore in a whole range of environments. On the savannas this may have encompassed the niches of the baboon and the lion; in the humid forests those of the chimpanzee and the panther, and on the coral

Figure 1:

Historical changes in patterns of resource utilization by human societies. (a) The earliest hominids were genetically and culturally adapted to utilize biological resources of tropical savannas. (b) Cultural adaptation then enabled hunter-gatherer societies to occupy a wide range of environments, with each local society fine-tuned to utilize biological resources of its own environment. (c) Technological advances enabled a few societies to usurp the bulk of resources from the more primitive and culturally more diversified societies. Technologicallay advanced societies initially maintained rather high levels of resource utilization, while the availability of resources to more primitive societies was markedly depressed. (d) With diffusion of technologies and depletion of the resource base, the advantage enjoyed by the technologically advanced societies is reduced, so that the less advanced indegenous societies can begin to reassert some control over resources.

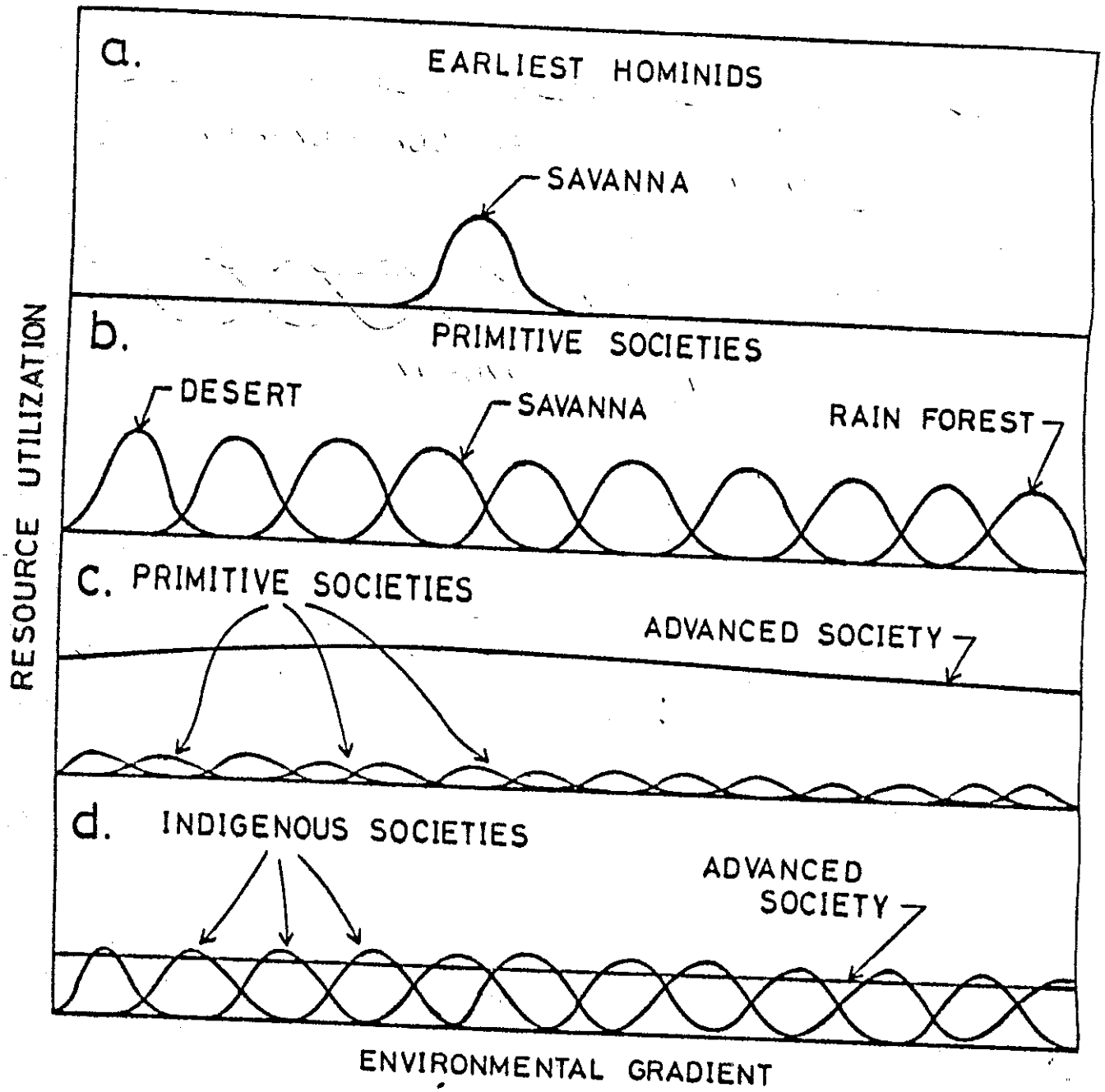

a.
EARLIEST HOMINIDS
SAVANNA
b.
PRIMITIVE SOCIETIES
DESERT
SAVANNA
RAIN FOREST
C. PRIMITIVE SOCIETIES
ADVANCED SOCIETY
d. INDIGENOUS SOCIETIES
ADVANCED SOCIETY
RESOURCE UTILIZATION
ENVIRONMENTAL GRADIENT

Fig. 1

reef islands those of the macaque and the dolphin. There would have been tremendous inter-group variation in the niche occupied, rendered possible by a diversity of behaviours acquired through a combination of individual and social learning, over generations of occupancy of a given niche (Figure 1).

Cultural group selection

With bulk of the variation being partitioned between, rather than within groups, cultural traits are much more likely to have been subject to group level selection[6]. Many primitive hunter-gatherer societies are known to have been highly territorial, with each endogamous group constantly in struggle with neighbouring groups[7]. Humans being a K-selected species with a long generation time, cannot quickly convert resources into increased population size, unlike r-selected species such as many rodents . Well being of a human group therefore requires the availability of resources at a minimal level over periods of several years. For territorial groups, this implies the need to sustain resource levels on a long term basis within their own territory. Any group that fails to achieve this would find itself weakened and subject to the territorial aggression of neighbouring endogamous groups. Such a group may be culturally, even if not genetically, exterminated. Cultural group selection is then expected to favour behavioural traits that would ensure sustainable use of the biological resources of the territory. In addition to cultural group selection, within group co-operative behaviour promoting prudent resource use is also expected to prevail in endogamous groups where a relatively small number of individuals repeatedly interact with each

other over long time intervals[8,9].

Ecological prudence

The primitive hunter-gatherers would utilize a diversity of biological resources for purposes ranging from food, bait, structural material to drugs and are therefore likely to possess cultural practices promoting prudent use and conservation of a wide spectrum of biological diversity. Such practices should be particularly common for groups inhabiting stable, productive habitats where territoriality is likely to be strong. Indeed, as expected, the best documented examples of conservative use and protection of a wide spectrum of biological diversity come from human groups of small Pacific islands and of New Guinea rain forests[10,11,12,13].

Such groups possess a variety of practices leading to sustainable use of a wide range of biological resources and conservation of biological diversity as a whole. These include :

(a) Total protection to certain biological communities which serve as refugia

(b) Total protection to certain species

(c) Protection to certain life history stages, or during certain seasons

(d) Restrictions on methods of harvest

(e) Quantitative restrictions on amounts of harvest

(f) Restrictions on certain social, age or sex groups from harvesting certain species

(g) Restriction of access to certain localities to certain groups or individuals.

Notably enough many such practices are known to be flexible and imposed as and when the need arises. Thus New Guinea tribal chiefs order a moratorium on hunting certain species of birds when their populations appear to have declined, or Pacific islanders ban certain methods of fishing when the fish populations appear to be on the decline. Such flexible and purposeful behaviour suggests that this range of practices has not arisen merely through a process of cultural drift with conservation an accidental consequence. It must, however, be noted that some features of traditional hunting behaviour, for instance, the preference for the meat of pregnant female Dugongs goes against sustainable resource use [13,14].

Sequential exploitation

Cultural traditions of conservation would cease to be of advantage to a group under the following conditions [8,15]:

(a) When the resource level fluctuates independently of the extent to which resources are harvested, for instance in highly unstable environments such as deserts.

(b) When the user group is not dependent on a given resource in a particular locality for any length of time. This could be the case with a nomadic population in an unstable environment; with a conquering human group that can move into new areas displacing the earlier territory holders as the resources of a locality are exhausted; or for a human group with rapidly changing technologies.

(c) When a group is unable to prevent other groups from usurping its resources and therefore fails to reap the benefits of any practices of sustainable resource use. This would be the case for a subordinate

group in a society dominated by other groups with higher levels of coercive abilities.

(d) When a group is unable to ensure co-operative behaviour on part of its members.

This suggests that technological innovations conferring marked advantage in coercive abilities to certain human groups would radically transform the patterns of resource use. Such a development would enable the groups in possession of the advantageous innovations to usurp the resources to which other groups had earlier maintained exclusive access (Figure 1). Since the dominant group would have open to it possibilities of moving on to fresh pastures as resources of any locality are exhausted, it would derive no advantage from traditions of sustainable, conservative use. At the same time groups now subordinated would also lose any advantage from traditions of conservative use that might have been favoured in times when they could exclude other groups from their territory. The result would be a relatively rapid and exhaustive use of resources, with the wave of resource exhaustion spreading outward from localities first coming in contact with the dominant group. Such a pattern of resource use has been termed as the fishing-up sequence in the context of fisheries and sequential exploitation in a broader context[16].

This process would tend to deplete biological diversity. At the same time it would diminish cultural diversity for two reasons. Firstly, a significant component of cultural diversity relating to fine-tuning of cultural behaviour to the local biological environment would lose its functionality. Furthermore, like conformity we expect

imitation of the behaviour patterns of successful individuals or groups to be a part of the genetically programmed tendency underlying human cultural behaviour[6]. Hence, many subordinated groups may begin to imitate the culture of one or few dominant groups, thereby losing part of their cultural diversity.

There is abundant historical evidence of such a process accompanying two major technological revolutions in the human history; the neolithic revolution leading to cultivation of plants and domestication of animals originating in the middle east some ten thousand years ago and the industrial revolution with its roots in the scientific renaissance of sixteenth century Europe. Thus colonisation of the Gangetic plains by the dominant agricultural-pastoral people of the so-called Aryan culture from about 1200 to 600 B.C. was accompanied by systematic destruction of natural biological communities and breakdown of cultures of indigenous populations as they were subjugated[17]. We have better documentation of the conquests by the industrial nations, for instance of the wave of overfishing and overhunting that swept from east to west over North America accompanied by substantial depletion of cultures of indigenous people[16].

Reassertion of conservation ethic

This process could however cease once the technological innovation giving an edge to a particular group have been absorbed by other human groups. It is then likely that local groups may once again assert restricted access to certain localities and/or resources (Figure 1). Practices of sustainable resource use may then again

confer advantage on the local group involved, and may become reestablished [8,16]. With groups tuning in to the use of local resources, cultural diversity relating to biological diversity may partially reappear. However, because they open up possibilities of interconversion of resources, most technological advances would result in a dimunition in the value placed on biological diversity. Technological innovations also enhance the facility of communication amongst different human groups, and would thereby favour imitation of a smaller and smaller number of cultures of successful dominant groups by other less successful groups. These processes would tend to lower the levels of biological and cultural diversity even after the innovations have diffused to other groups.

The caste society that emerged at the conclusion of the wave of agricultural colonization of the Indian subcontinent around 500 A.D. is a fascinating example of the reassertion of cultural diversity based in substantial part on biological diversity. This society was made up of tens of thousands of endogamous groups, each with its own, often highly specialized, mode of subsistence. In this society sympatric endogamous groups had so partitioned the use of specialized biological resources that a particular resource tended to be monopolised by a particular endogamous group in a given region [18]. Thus three major groups of nomads indulging in extensive hunting in semi-arid tracts of Maharashtra had so specialized their hunting techniques that one of them had virtual monopoly over antelopes and deer, another over small carnivores and a third over porcupine and wild pig (Figure 2) [19]. Phasepardhis, who traditionally had a monopoly over the antelopes report that they used to let loose any pregnant doe

Figure 2

Proportion of different groups of prey hunted by three sympatric endogamous nomadic communities of semi-arid tracts of Maharashtra state in India (19° N lat and 75° E long). Nandivallas who hunt with the help of dogs take much more of wild pig and porcupines, Vaidus who use baited traps concentrate on small carnivores, while Phasepardhis who lay snares with the help of a trained cow have a near monopoly over antelopes, deer and game birds (Ref. 19)

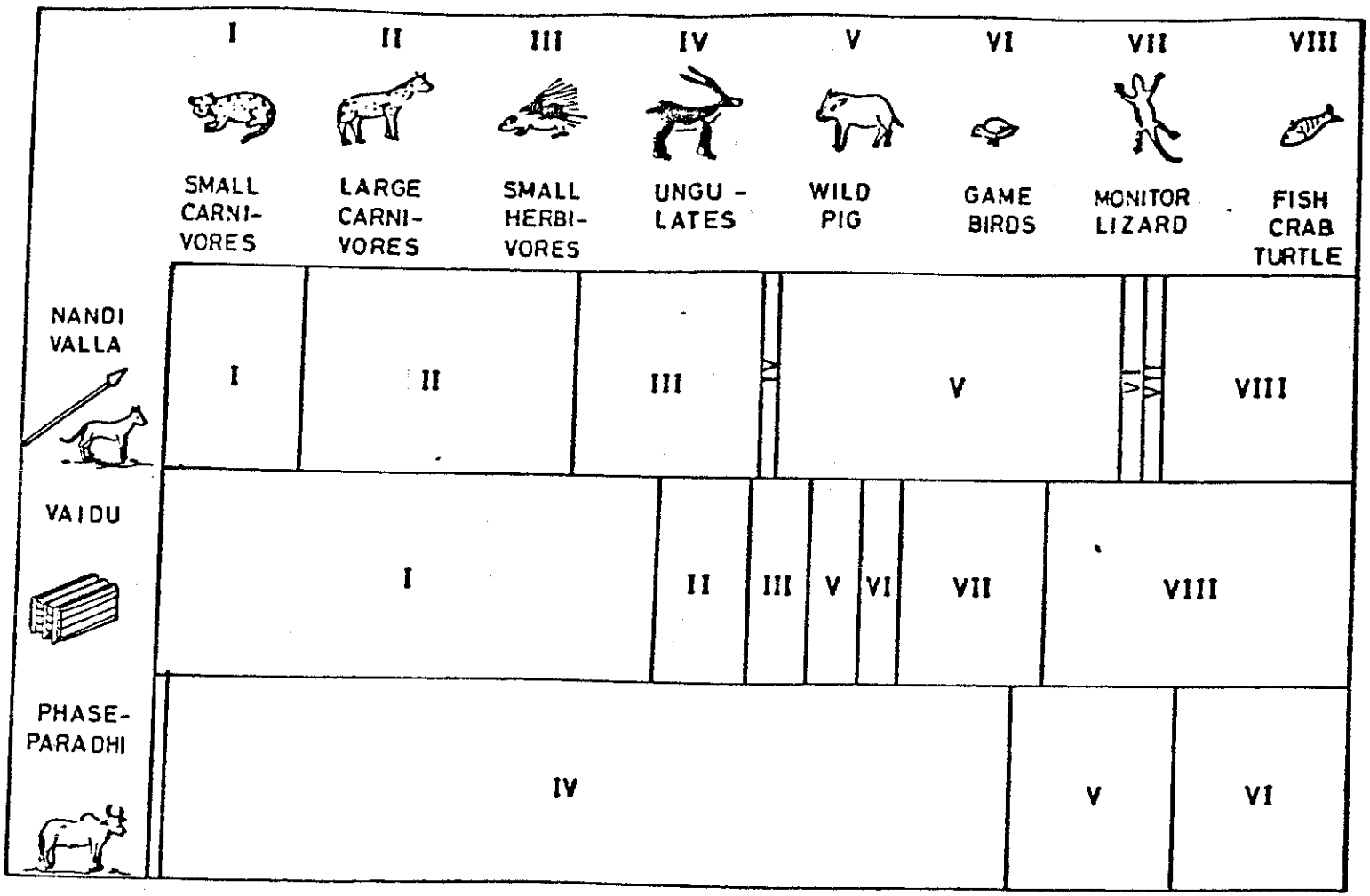

I
II
III
IV
V
VI
VII
VIII
SMALL CARNI-VORES
LARGE CARNI-VORES
SMALL HERBI-VORES
UNGU - LATES
WILD PIG
GAME BIRDS
MONITOR LIZARD
FISH CRAB TURTLE
NANDI VALLA
VAIDU
PHASE-PARADHI

Fig. 2

Figure 3:

Utilization of different plant materials by eight different endogamous groups practicing basket and mat-weaving on the west coast of Karnataka state in India (14^{o} lat and 75^{o} E long). The more abundant and easily workable bamboo and cane resources are used widely by many groups. However, groups heavily dependent on mat and basket weaving namely, Holeya, Chamagar, Halakki and Patgar tend to monopolise the use of some more specialized resource in a given locality (Ref. 20).

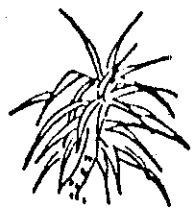
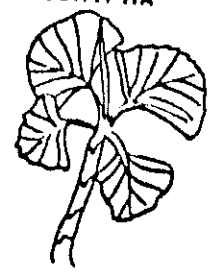
	CYPERUS	PANDANUS	CANE	BAMBOO	PHOENIX	CORYPHA
						
HOLEYA			+	+		
CHAMAGAR		+				+
HALAKKI		+	+	+	+	
MARATHI			+			
PATGAR	+					
HARIKANTRA			+	+		
AMBIGA			+	+		
AGER			+	+		

Fig. 3

or fawn caught in their snare; but have given up this practice since other groups have started hunting these animals with guns. Basketweavers of coastal Karnataka similarly divide up their raw material resources, so that those heavily dependent on this occupation have monopoly over certain species e.g. Patgars over Cyperus and Holeyas over Corypha (Figure 3)[20]. Apart from such partition of specialized resources, others more commonly in demand such as fuelwood and bamboos were controlled by multi-caste village communities on village common lands. The result was the persistence of cultural practices of sustainable resource use and conservation of diversity on the Indian subcontinent right down to the present day. Thus today a turtle, Trionyx nigricans survives only because it is protected in a single pond sacred to a moslem saint in Bangladesh, and a new species of a leguminous climber, Kunstleria keralensis was described a few years ago from a sacred grove on the otherwise thickly settled west coast of India[15,21].

World conservation strategy

There are signs that the colonization of the world by the dominant technological culture pouring out of Europe is now nearing completion, and with this, traditions of sustainable use of biological resources and conservation of diversity are reappearing. They have reemerged most readily in regions where the technological revolution was first completed. Thus Japanese have successfully established highly sustainable use of their inshore fisheries, basing it on earlier communal controls by artisanal fishermen. However, Japanese fishermen behave very aggressively and practice exploitative fishing in the open access ocean areas[22]. Nevertheless, even outside of these

Figure: 4

The cycle of utilization of a potentially common property resource (CPR), namely fur bearing mammals of northern Canada. At high levels, while not limiting, the resource was used by indigenous populations with open access to all. On its becoming a limiting resource, it was used in a conservative fashion with restricted access based on communal territories. White settlers broke down this system resulting in resource depletion. Currently there are trends towards reestablishment of conservation measures along with communal territories (redrawn from Ref. 8).

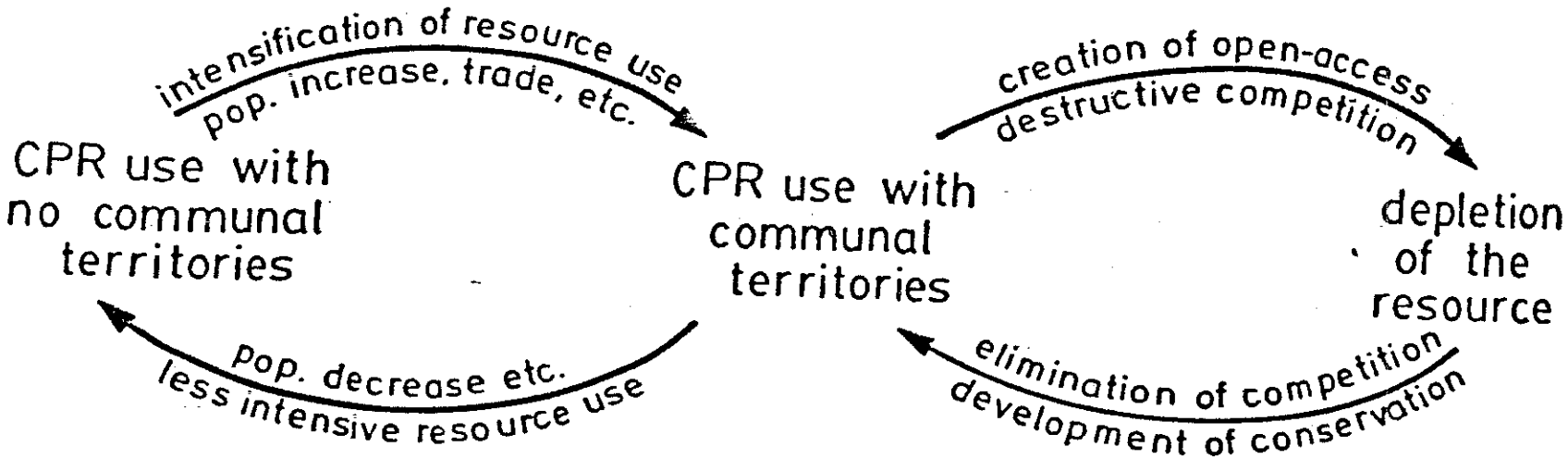

intensification of resource use
pop. increase, trade, etc.
CPR use with no communal territories
CPR use with communal territories
creation of open-access
destructive competition
depletion of the resource
pop. decrease etc.
less intensive resource use
elimination of competition
development of conservation

Fig. 4

regions where technological revolution has fully established itself, the control over local resources is being reverted to local people as resources are reduced to levels too low for profitable exploitation by those employing more sophisticated and hence more expensive technologies (Figure 1). Thus in the Canadian Arctics the Amerindians are reasserting territoriality in areas depleted of fur bearing mammals (figure 4) and in the Torres Straits of Pacifics the indigenous islanders are reestablishing control over islands now depleted of pearl bearing oysters [8,14]. In these cases the indigenous people are asserting both their practices of conservative use of biological resources and their right to maintain their own cultural traditions. The same forces are driving the newly emerging concepts and practices of conservation of biological diversity, such as the World Conservation Strategy and the Biosphere Reserve Programme.

Prospects

The situation is likely to change once again as new genetically engineered organisms become an economically viable proposition and when apparently degraded lands and waters again become highly profitable bases of resource production. At that time the world is likely to be dominated once again by cultural traditions of aggressive, exhaustive resource use that prevailed during the nineteenth century era of conquest of so-called new worlds by the technological civilization originating in Europe. This could be expected to lead to further drastic erosion of natural biological diversity as profit making enterprises attempt to establish monopoly over genetic diversity maintained by them under their control in the so-called gene banks. As the concerned technological advances provide

a competitive edge to the technologically sophisticated societi there is likely to be further erosion of cultural diversity as well.

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