

## Chapter Five

### Ecological Change Along a Gradient of Forest Use

I investigate changes in woody plant and small animal communities that result from forest resource harvest - specifically fuelwood, timber, tree fodder, bamboo, pollarded stems, leaf litter, and pasturage - at an isolated village in the Temperate Sikkim-East Nepal Himalaya (Chitre, Sankhuwasabha District, northeastern Nepal). I estimate the intensity of resource harvest across three progressively disturbed habitat zones, and assess the effects of harvest on wildlife habitats and the abundance, diversity, and composition of woody plant and small animal communities.

Most resource harvests occur in a zone of disturbed forest (DF) 300-600 m from the center of Chitre Village. Only pollarded stems are harvested primarily in village environments  $\leq 300$  m away (VE), and only bamboo is harvest exclusively in closed-canopy forest  $\geq 600$  m away (CF). Past harvest pressure has caused two-thirds of high-value woody plant species to decrease in abundance with proximity to the village, and all but a few low-value, disturbance-tolerant, woody species to increase. Among 51 woody plant species: 1) diversity ( $H'$ ) is highest in CF and no different between DF and VE, 2) basal area declines 17% from CF to DF and 36% from DF to VE, 3) the proportion of canopy volume contributed by large trees drops from 77-79% in CF and DF to 46% in VE, and 4) canopy heterogeneity, shrub cover, and shrub edge increase with proximity whereas bamboo cover decreases.

Among 70 small animal species, uncommon habitat- and dietary-specialists tend to decline with proximity, whereas regionally widespread habit- and dietary-generalists adapted to xeric habitats increase. Fifty-one percent are more abundant in DF than either CF or VE, 31% are

more abundant in CF than in either DF or VE, and habitat specialists are most diverse in DF and least diverse in CF. Bird diversity ( $H'$ ) is highest in DF and no different between CF and VE, whereas small mammal diversity does not differ significantly across zones.

Guild abundance (total detections of member species) varies across habitat zones more than guild richness (number of member species). Guilds that fare worse with increasing disturbance are avian strict frugivores and nectarivores, small mammals that are occasional carnivores, and birds that nest or forage strictly in the mid-canopy, nest strictly in the shrub canopy, or forage occasionally in the high canopy. Guilds that fare better with increasing disturbance are birds with a mixed diet of insects and leaves or buds, that forage strictly in the high canopy or occasionally on the ground, build open cup nests, nest strictly on the ground or occasionally in ground-level cavities, birds that nest occasionally in the high canopy or occasionally build domed nests, and fossorial small mammals.

Fuelwood and timber harvest directly decrease canopy cover, canopy volume, leaf fall, basal area of targeted late-successional tree species, and log abundance, and indirectly increase shrub cover and frequency of woody pioneer species, negatively affecting avian strict frugivores, avian strict shrub canopy foragers, and avian strict dome nesters, and positively affecting avian facultative granivores, avian omnivores, avian high canopy foragers, avian strict open cup nesters, avian strict tree cavity nesters, avian brood parasites, and avian strict ground nesters.

Tree fodder harvest reduces abundance and canopy volume of tree fodder species, negatively affecting avian strict frugivores and positively affecting mammalian facultative structure foragers, avian omnivores, avian ground and high canopy foragers and nesters, avian brood parasites, and birds that use open cup, dome, and tree cavity nests.

Pasturage reduces the frequency and basal area of palatable late-successional tree species and increases shrub cover and frequency of unpalatable pioneer species, negatively affecting avian strict frugivores and nectivores, avian strict dome nesters, avian hanging nest builders, and mammalian facultative insectivores, and positively affecting avian facultative nectarivores, avian facultative shrub canopy foragers, avian facultative mid-canopy foragers, avian facultative depression nesters, mammalian facultative frugivores, mammalian facultative shrub canopy foragers, and mammalian strict fossorial foragers.