Chapter 28
Forest Clearing by Slash and Burn

E. Beck(✉), K. Hartig, and K. Roos

28.1 Introduction

Burning is still the common method used by settlers (Colonos; see Chapter 3 in this volume) to clear the primary forest for new farming areas. Every fire, irrespective of being lit inside or at the edge of the forest, kills the trees by burning or by the emerging heat. A fringe of dead, but not charred, trees is always found where forest has been cleared by fire. Later, when these heat-killed trees have completely dried up, they can be used to start a new fire.

28.2 Vegetation Succession After Repeated Burning

The remnants of previous burnings – charred trunks and large branches – are frequently left where they have fallen, because of the enormous efforts to remove them from the steep and often remote areas. Many areas have thus to be burned repeatedly until the spaces between the remaining logs are wide enough to plant beans or maize, or the pasture grasses *Setaria sphacelata* (Schumach.) Stapf & C.E.Hubb. ex Chipp. and *Melinis minutiflora* P. Beauv. At just 3–4 weeks after the fire, bracken fern (*Pteridium arachnoideum* (Kaulf.) Maxon was observed, sprouting vigorously on both the burnt and the heat-killed areas, while it was absent in the intact primary forest. This de novo colonization by bracken may result via its readily germinating spores (Conway 1953, 1957; Mitchell 1973) or from already present leaf-producing lateral branches of elongating main rhizomes (Watt 1940; Daniels 1985) which form a dense network (Fig. 28.1) in the soil. Elongation growth and leaf sprouting is significantly stimulated by heat shock up to 70 °C (Roos and Beck, unpublished data).

Bracken and crops develop simultaneously after burning. Sooner or later the crops are replaced by tillering pasture grasses, in particular *Setaria sphacelata*, and the bracken fronds protrude mainly from spaces between the tussocks. When planted manually, *Setaria* grows faster than bracken and forms homogeneous pastures. However, since only the very young leaf blades and the tips of mature leaves

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Fig. 28.1 In situ "network" of bracken rhizomes in an area of 1×1 m from a depth of 0 cm to about 80 cm on an abandoned pasture within the RBSF

are eaten by cattle, the carrying capacity of these pastures is low. The same is true for another grass, the stoloniferous, curtain-forming *Melinis minutiflora*, which maintains only one to three green leaves on a shoot. Bracken is not eaten by cattle due to its toxicity (Evans 1986; Hannam 1986; Fenwick 1989). Therefore sooner or later the fern overtops the grasses and, by shading, weakens their growth. On flat slopes, its mainly horizontal fronds produce a closed canopy, preventing the establishment of a shade-intolerant vegetation beneath; but on the steep slopes its canopy is more open. Wind-dispersed seeds and light can protrude to the soil surface and a

variety of herbaceous and shrubby plants are found in addition to *Pteridium* in abandoned pasturelands. In particular, Asteraceae (*Baccharis latifolia*, *Ageratina dendroides*) and Melastomataceae (*Monochaetum lineatum*, *Tibouchina laxa*) can successfully compete with the fern (Stuart 1988). For pasture rejuvenation and weed killing, farmers set fire whenever the weather permits. Especially the bushy Asteraceae survive recurrent fires and resprout from their base simultaneously with the emergence of the new fern fronds. A patchy vegetation results in which islands of bracken are separated by the 2–3 m high bushes and in which sporadic tufts of *Setaria* bear witness to the former pasture land. This is a highly stable type of vegetation (Fig. 28.2), due to the high propagation potential of the bushes via seeds and of the fern via rhizomes. It is encountered in many abandoned farming areas and thus may be addressed as a long-lasting serial stage if not a climax. The described successional sequence of stages has been documented phytosociologically by Hartig and Beck (2003).

Many measures have been implemented to control bracken in agricultural areas but, due to the vigor of the rhizome system, none has been sustainable or successful (Lowday 1986; Marrs et al. 2000). Thus bracken is considered one of the world's most powerful weeds (Webster and Steeves 1958) as it destroys arable land that has been managed by fire everywhere from the tropics to the temperate zones.

Tree species characteristic of the former primary forests are very rarely found in the bracken–bush vegetation of abandoned pastures, and therefore a fast regeneration of a forest is very unlikely. The regenerative pressure of bushes, which produce immense amounts of wind-dispersed seeds, by far outstrips that of forest trees.

Fig. 28.2 Pastures (*bright green*) and bracken-dominated former pasture areas (*dark green to brownish*) which have been abandoned. At the crest of the mountain, remnants of the original forest can be detected

Seeds and fruits of the latter are dispersed predominantly by birds and bats (Matt 2001) and a single seed that is dropped by an animal on that kind of bushland has hardly any chance of germination. In addition, a substantial seed input from forest is unlikely as the remnants of the primary forests are usually far away.

28.3 Conclusions

As elsewhere in the tropics, farmers in the Andes of South Ecuador make extensive use of fire to convert primary forest into farming land and to foster their pastures. Repeated burning of the pastureland weakens the competitive strength of the pasture grasses, but increases the competitive strength of the extremely aggressive and fire-tolerant bracken fern. Pastures are finally abandoned when bracken becomes completely dominant. On steep slopes wind-dispersed seeds of several weeds germinate in the shade of the bracken leaves. A long-lasting successional vegetation composed of dense patches of bracken interspersed with individual bushes develops. Since in these areas natural regeneration of the indigenous forest is very unlikely, reforestation may be the only way out of the dilemma caused by the extensive use of fire.