An Ecological Research on Lemurs as Important Seed Dispersers in a Gallery Dry Forest, Southern Madagascar

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● Research background

Tropical forests are areas of highly biodiversified ecosystems, and the seed dispersal of each silvicolous plant plays an indispensable role in preserving its ecosystem and the regeneration of a forest. Many plant species in tropical forests in particular are largely dependent on animals that eat fruits and thus spread the seeds over. These complex interactions between animals and plants have developed the symbiontic seed dispersal systems in tropical forests. Some studies have so far reported that frugivorous birds and mammals are primary seed dispersers in most tropical forests. The insular island of Madagascar, however, has evolved into depauperate frugivore communities, separately from the Continent and over time enough a differentiation of birds and mammals progressed. Many prosimian species from among these depauperate frugivores, whose ancestors probably reached Madagascar in the Eocene, have been gradually differentiated through the adaptive radiation, and today they constitute the largest component of the frugivore biomass in forest communities. My previous study suggested that Malagasy forests have their own uniquely evolved ecosystems of forest functions that are restored largely with seed dispersal of frugivorous lemurs (Sato, 2008). I hope that my study, together with further continuous research and a deepening of the understanding of this unique system of seed dispersal, may substantially contribute to the forest recovery projects or the conservation for Malagasy forest ecosystems.

● Research purpose and aim

Forest ecosystems in Madagascar are indigenous to each region; north, south, east, and west, corresponding to the different climates of each region, and it is a fact that lemurs here range over these areas as the dominant frugivores and seed dispersers. It has been suggested that genera of *Eulemur* and/or *Varecia*, frugivorpus lemurs, are important dispersers in tropical forests of northern, eastern, and western Madagascar, but not in those of the southern area. On the other hand, these two genera are not distributed in the semi desert forest vegetation of southern region, but ringtailed

Figure 1. Ringtailed lemur (*Lemur catta*)

Figure 2. Red-fronted brown lemur (*Eulemur rufus*)

lemurs alone *(Lemur catta*; *L.c* in the following), a frugivorous lemur species, are distributed there and found chiefly in gallery forests. In the study site (Berenty Reserve) we can find two frugivorous lemur species in sympatric, native *L.c* and also artificially introduced red-fronted brown lemurs (*Eulemur rufus*; *E.r* in the following). The original habitats of *E.r* are more humid tropical forests in the east and the west regions. The purpose of this study is to know preliminarily the niche separation of two frugivorous lemur species and their seed dispersal function by comparing the feeding ecology between the two lemur species.

● Results and achievements through fieldwork

The research was carried out at Berenty Reserve in southeastern Madagascar for 20 days in a period of transition from the dry season to the rainy season (15^{th} Oct - 5^{th} Nov). In a gallery forest where *L.c* and *E.r* live in sympatric, I conducted observation for approximately 133 hours on the two species, fecal analysis on 80 samples, and phenological survey on *Tamarindus indica*, a woody plant species considered as a main fruit resource in the dry season. The result of the phenological survey suggested that there might have been low availability of *T. indica* fruits during this dry season, and there were few species to supply ripe fruits in the latter part of October. *L.c* fed on unripe fruits of *Rinorea greveana*, flowers of *Azadirachta indica*, cladodes of cactus, mature leaves of four shrub plant species, and new leaves of *T. indica* during the research time. *E.r* fed on pollen of *Crateva* sp., new leaves and old fruits of *T. indica* in this period. From the beginning of November, small rain fall began, and fruits of *R. greveana* and *Cordia sinensis* became ripe. Both lemurs began to spend a long time eating these ripe fruits in the beginning of November. Intact seeds of these plants were found in the feces of both lemurs.

Figure 3. A unripe fruit (left) and a ripe fruit (right) of *Rinorea greveana*

Figure 4. Ripe fruits of *Cordia sinensis* (left) and the seeds extracted from feces of lemurs (right)

These results indicate that both lemur species prefer to feed on ripe fruits in the available season. Sato (2008) described that brown lemurs (*Eulemur fulvus*) are frugivore and they feed mainly on ripe fruits all year around. *E.r*, a close related species, also seems to feed on ripe fruits through a year in the original habitats. Because the construction of digestive tract of frugivorous lemur species is comparatively simpler (Campbell et al., 2000), they are not adapted to digestive fibrous foods. Therefore, it can be considered that *E.r* at Berenty selected low-fiber diet items such as pollen of flowers and new leaves in the term of scarcity of ripe fruits. In contrast, *L.c* fed on

high-fiber diet items such as unripe fruits, cladodes of cactus, and mature leaves in the scarcity term. As a result of adaptation to dry habitats with a long scarcity term, *L.c* might have evolved into being an opportunist that is able to access diet items other than ripe fruits. Although *Lemur* is the close related genus to *Eulemur* and *Varecia*, it might be essential for *Lemur* "to be an opportunist" in order to expand into the dry habitats of southern Madagascar. Different selection, in my study, of diet resources between two lemur species suggests "the difference of their niche". Furthermore, from the aspect of seed dispersal, *L.c* can also be a seed predator because of feeding on unripe fruits. In contrast, *E.r*, that tends to avoid eating unripe fruits until the ripeness, must be a better seed disperser for plants. These observations reveal that the niche separation of lemurs accordingly brought the difference of the seed dispersal functions.

● Implications and impacts on future research

Although this study consisted of some short and preliminary surveys, the aspect of niche separation between two frugivore lemur species was significantly shown by conducting the research in a transition period of the seasons, which made it possible to estimate their seed dispersal functions qualitatively. It is true, however, that such a short research time was not enough to evaluate the seed dispersal functions quantitatively, and for being able to define seed dispersal functions among dispersers in Madagascar more properly and adequately, there may remain some work to elucidate – to understand the feeding ecology of seed dispersers, to identify plant species dispersed seeds all seasons, to measure the quality of seed dispersal service (e.c. the number of seeds dispersed, the special distribution of seeds), then to compare seed dispersal functions between some dispersers in detail. Moreover, important future research is needed to observe the changes in interaction between plants and dispersal animals more thoroughly and over longer years, because some of the main fruit resources such as *T. indica* show large interannual variability in their fruiting scales.

References

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