30

Sour Orange (*Citrus aurantium* L.) Invades Old-growth Subtropical Montane Forest, But is It Worth Removing? (Argentina)

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The results of a study we carried out in a subtropical montane forest of the Parque Nacional El Rey in northwestern Argentina, indicate that sour orange—an understory tree species native to southeast Asia—is invading old-growth forest sites much more successfully than second-growth forest sites. This suggests to us that the main factor favoring the invasion is the similarity of this old-growth habitat to the species' natural habitat rather than the degree of disturbance of the native vegetation. We found that sour orange generally does not invade sunny sites, but establishes itself readily in shady conditions where there is sufficient soil moisture (Gade, 1976).

The reasons for the extremely low density of sour orange in the second-growth forest are not immediately obvious, however. They may be related to two factors, which could account for both low seed arrival and low recruitment. On the one hand, this type of forest, due to the absence of the upper-canopy vegetation, may lack the microclimatic conditions necessary for germination and establishment. On the other hand, very sparse sour orange recruitment may also be indirectly linked to dispersal. The capuchin monkey (*Cebus apella*) is the main disperser of sour orange in the region (Gade, 1976), and it visits secondary forest much less frequently than old-growth forest (personal observation), probably because secondary forests have a simplified vertical structure.

In the old-growth forest, the distribution of sour orange densities in size classes shows an established and growing population. The high proportion of seedlings suggests that the conditions are good for regeneration (Veblen, 1992). The presence of streams, which carry the buoyant fruits long distances, also seems to influence the population distribution and, thus, the spread of the species across the landscape. The reason for this association may be the high levels of animal activity related to streams. Furthermore, sour orange could benefit from the occurrence of periodic floods that move floating fruits onto sites suitable for germination, but at a distance greater than the disperal range of stream-borne fruits (Gade, 1976).

Conservation policies for protected areas often recommend the eradication of exotics (Houston and Schreiner, 1995; Coblentz, 1990), and the same holds true for sour orange in many situations. However, in the ecosystem we studied we believe that the removal of sour orange may not be the best option for a number of reasons. First, there have been no reports of negative effects on the native forest due to sour orange (Gade, 1976), although we agree that it would be a good idea to conduct a quantitative assessment of the role of sour orange in the plant community and its relation to ecosystem processes. Second, all the consumers of sour orange fruits in the invaded area are vertebrates with high conservation value, including collared peccary (*Tayassu tajacu*), tapir (*Tapirus terrestris*), agouti (*Dasyprocta azarae*), capuchin monkey and several members of the parrot family (*Psitacidae*) (Gade, 1976). They may have incorporated sour orange into their winter diets as a supplement. If so, sour orange may strongly increase the carrying capacity of the reserve area for wildlife (Janzen, 1986; Terborgh, 1986).

The apparent benefit derived from sour orange illustrates the importance of inquiring into the identity of each alien species and its interaction with the invaded community before launching an eradication plan. In this case, even if an eradication plan were justified, carrying out the plan would likely be very expensive and probably unsuccessful. Sour orange is difficult to detect at a landscape scale because it grows below the dense canopy of the old-growth forest and, therefore, cannot be detected using aerial photographs. Once it is detected, eliminating sour orange would require heavy applications of herbicides to prevent resprouting. This hardly seems like a good option within a protected wildlife area.

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