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THE IMPACT OF LATE WOODLAND LAND USE ON THE FOREST LANDSCAPE OF SOUTHERN ONTARIO

The Iroquoian peoples of Southern Ontario started cultivating maize and other plants ca. A.D. 900; this paper assesses the impact they may have had on the landscape of Southern Ontario. It is determined that the maximum area disturbed up to A.D. 1600 would have been less than 3.2 percent of Ontario south of the Canadian Shield. Due to the small horticultural population, non-intensive cultivation technology, and the lack of domesticated grazing animals, prehistoric populations likely had no significant lasting effect on the regional landscape.

INTRODUCTION

The Late Woodland period in Southern Ontario started ca. A.D. 900, and continued until European contact, ca. A.D. 1600. During these 700 years, the cultivation of tobacco, maize, beans, and squash advanced northwards (Fecteau 1985) and became an integral part of Southern Ontario's economy. In some areas of the world, most notably Mediterranean Europe, agricultural practices are believed to have had a lasting deteriorating effect on the landscape. In the northeastern United States, the impact of prehistoric land use on the landscape was at first ignored, then exaggerated (e.g. Maxwell 1910), then considered to be minimal (e.g. Martin 1973; Russell 1983). This paper assesses potential prehistoric horticultural populations and the impact they may have had on the regional forest landscape and forest succession of Southern Ontario.

The Woodland period, which started ca. 2800 B.P., was preceded by the Paleo-Indian period and the Archaic period. Paleo-Indian and Archaic peoples were hunter-fisher-gatherers, living in small mobile bands. During the Early and Middle Woodland periods, population remained fairly low, with bands of 35 to 50 hunter-fisher-gatherers occupying seasonal villages and camps (Spence et al. 1990). Southern Ontario's total population was probably still only a few thousand at the end of the Middle Woodland period (Warrick 1990).

The transition from Middle to Late Woodland was marked by a simplification of burial rituals, various stylistic ceramic and lithic changes, and the adoption of maize horticulture (Fox 1990). One cultural complex, the Princess Point culture, was intermediate between the Middle Woodland and the Late Woodland period in all these features, and is a transitional period (Fox 1990); while they were incipient horticulturalists, their horticulture likely had no significant impact on the landscape.

The Late Woodland period, starting around A.D. 900 in Southern Ontario, was characterized by sedentary horticultural peoples, mainly the Ontario Iroquois (Fox 1990). It is not necessary here to examine the cultural divisions within the horticulturalists, since they all had similar swidden technology. Central Southern Ontario's population (from

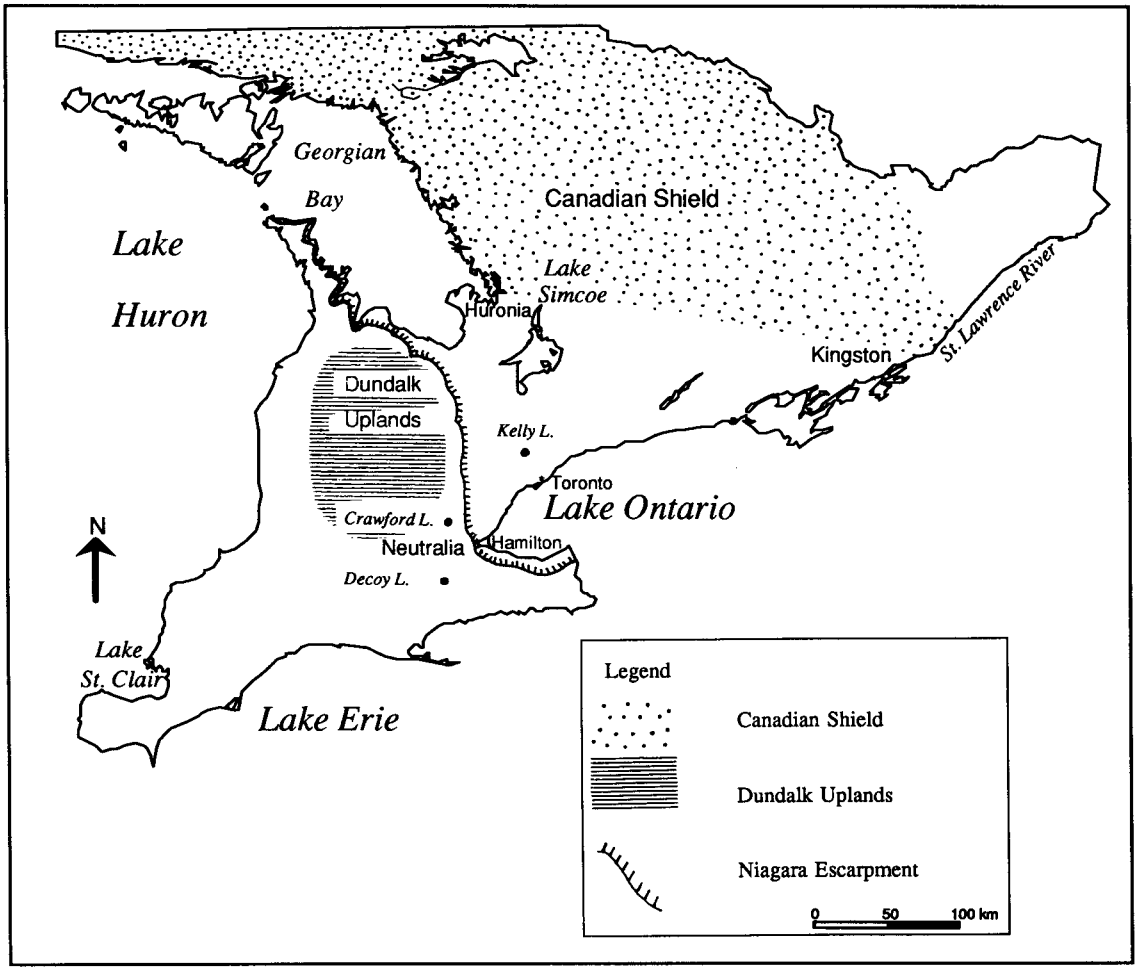


Figure 1a. Important Study Locations in Southern Ontario

the Niagara Escarpment to the Canadian Shield, see Figure 1a) ca. A.D. 900 has been estimated at a maximum of 2000 (Warrick 1990). Warrick obtained this estimate through an analysis of the archaeological record, and believed this area's population to have been a little less than one third that of all Southern Ontario throughout the Late Woodland period (Warrick personal communication). A 2.5:1 ratio of total southern Ontario horticultural population to central southern Ontario horticultural population agrees well with both the density of archaeological sites and with the contact-period population estimates (Warrick 1990). Thus the Late Woodland period in Southern Ontario probably started with no more than 2.5 times the 2000 people in central Southern Ontario alone, or 5000 people.

LATE WOODLAND USE OF FOREST AND LAND

Pre-horticultural land-use was confined to small, impermanent camp sites, with little lasting impact on the landscape, and none

beyond the immediate area of occupation. The development of a horticultural economy based primarily on maize, beans, squash, and tobacco dramatically increased the potential for human impact on the landscape. For the first time, large areas of Southern Ontario were anthropogenically cleared of forest. Indian horticulture was based on a swidden system, which involved clearing fields, cultivating and expanding them for 10 to 30 years, then abandoning them (Sagard 1939:92-93; Champlain 1922-1936(3):124-125, 4:303; Heidenreich 1971; Sykes 1980). Various reasons have been proposed for site abandonment, but the most frequent appears to have been soil exhaustion and lack of suitable firewood (Champlain 1922-1936(4)-:303; Sagard 1939:92-93; Heidenreich 1971).

Activities which may be expected to have an impact on the landscape include the use of wood, the setting (deliberately or accidentally) of forest fires, and field clearance for horticulture.

Wood use

It is reasonable to suppose that the majority of the firewood collected was in fact the trees felled from clearing new fields (Heidenreich 1971). This supposition is supported by the observation that firewood collection and new field clearance were both conducted in the

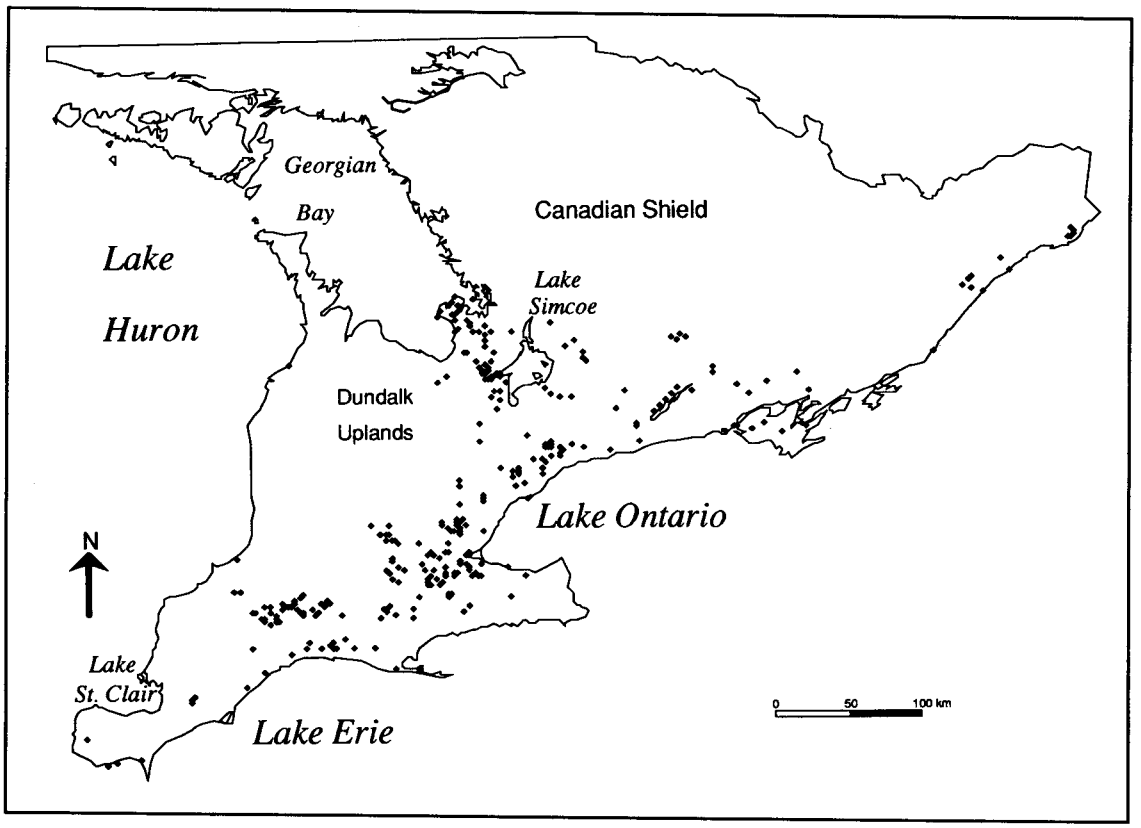


Figure 1b. 333 prehistoric horticultural village sites ca. A.D. 900-1600 (Campbell, 1991).

spring (Sagard 1939:94). If indeed the felled trees from field clearance were the major source of firewood, it can be suggested that firewood availability declined as a result of soil exhaustion: when all arable land near the village had been cleared and exhausted, the only land remaining for new fields and hence firewood would be too remote from the village for comfortable haulage of wood or corn. Thus soil exhaustion and firewood exhaustion were really two facets of the same problem.

Construction materials for the village likely also came from field-clearing activities. The village longhouses were pole frames covered with bark. Although a great many saplings would have been required for village construction, a large amount of wood was moved from the old site to the new site when village movement occurred (Warrick 1990). This would minimize the need for new construction wood. The bark coverings could easily have come from the trees cleared from the new fields.

Anthropogenic forest fire

Russell (1983) reviewed the 15th and 16th century ethnographic literature, and concluded that there is no strong evidence for a significant regional impact of Indian-set forest fires in the northeastern United States. Similarly, there is no ethnographic evidence for Indian-set forest fires in Ontario (Heidenreich 1971). An analysis of the sedimentary charcoal record of Crawford Lake shows only two possible local fire events in the last 2000 years, neither one giving as strong a signal as is common in Minnesota (Clark personal communication); these could have been slash fires and need not have been forest fires. The Indians would have avoided uncontrolled fires, since their villages were constructed of seasoned wood and would have burned easily (Heidenreich 1971). In clearing their fields, they girdled the trees in the fall, then cut them the following spring. Fire was used only to burn the slash which was too small to be worth carrying back as firewood, to burn the trunks which were too large to be moved, and to burn the stubble and weeds off the fields (Heidenreich 1971). Indian-set fires are therefore not likely to have been a significant contributor to forest succession in Southern Ontario.

Szeicz and MacDonald (1991) investigated the possibility that Indian-set fires were responsible for the development and maintenance of patches of oak savannah in Southern Ontario. In Decoy Lake, a small kettle depression in an area which was oak savannah before EuroCanadian clearance, they found clear palynological evidence that the oak savannah preceded the Woodland period by several thousand years. This makes it quite unlikely that the oak savannah was related to native activities; they proposed instead that the oak savannah was the result of excessively well-drained soils combined with a relatively warm dry climate.

Field clearance

Heidenreich (1971) estimated the land needs of an early historic village in Huronia at 0.17 ha/person/decade. Heidenreich based his estimate on ethnohistoric accounts; Sykes's (1980) estimate is higher (0.33 ha/person-/decade), but is based on unpublished data about one archaeological cornfield. Another more recent estimate is provided by Monckton (1992), who reduced Heidenreich's estimate of the importance of maize in the Huron diet and thus arrived at 0.12 ha/person/decade. Monckton's estimate of the importance of maize in the diet is based on the analysis of carbonized food remains from historic Huron sites. Using Heidenreich's intermediate estimate, a village with a population of 1000 would have cleared roughly 170 ha over a ten-year

period. The fields around a particular village would have expanded both with population growth and declining soil fertility (Sykes 1980; Heidenreich 1971); this expansion is included in the 0.17 ha/person/decade estimate.

The fields were kept clear of weeds (Sagard 1939:104), but it is unlikely that the fields were regular in outline. In all likelihood, a few large trees were left in the fields, and the fields were irregular in outline, with only the best, well-drained areas cleared. The proportion of cleared land near the village may have increased with time, as the increasing distance to the fringe of the cleared area made the expansion of fields close to the village more attractive.

PREHISTORIC POPULATION DISTRIBUTION

Figure 1b shows the distribution of 333 Late Woodland and protohistoric village sites in Southern Ontario (Campbell 1991). The map shows a definite patchiness, which is attributed to the distribution of soil texture, relief, drainage, and the length of the reliably frost-free season (Campbell 1991; Campbell and Campbell 1992). Although the list of sites included in this map is not exhaustive, the overall pattern probably represents the major Late Woodland settlement areas in Southern Ontario.

The most notable lacunae on this map are the Dundalk Upland, far southwestern Ontario near Lake St. Clair, and the Canadian Shield area. The densely occupied areas are in Huronia between Lake Simcoe and Georgian Bay, and Neutralia west of Hamilton. These are the areas where the potential for Indian forest disturbance was greatest.

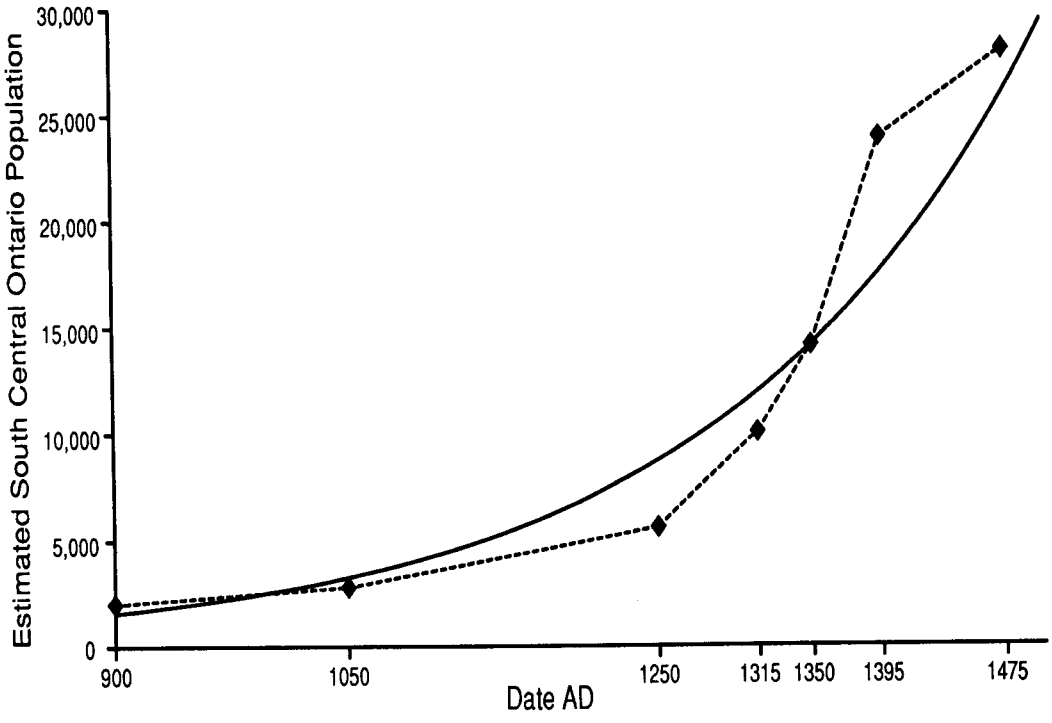
As noted above, the Late Woodland period started with a population in Southern Ontario of about 5000 in A.D. 900. The population estimates for Southern Ontario obtained by multiplying Warrick's South Central Ontario estimates by 2.5 can be partially validated by comparison with the ethnohistoric population estimates at the time of contact.

Warrick's (1990) estimated population through time shows an exponential population increase (r^2=0.94) up to A.D. 1500, as would be expected for essentially unconstrained population growth (Figure 2). Applying the 2.5:1 ratio to the exponential curve and extrapolating to A.D. 1600, we obtain a contact-period estimate of about 116,000 people for all of Southern Ontario. This is high compared to other estimates of the population of that time, many of which place the population of Huronia and Petunia around 35,000 and that of Neutralia at 40,000 for a total of 75,000 (estimates summarized in Warrick 1990). This may be in part due to the extrapolation, which would not be warranted under Warrick's (1990) suggestion that population nearly stabilized in the late 1400's. We will use this overestimate to provide an upper bound on Indian disturbance.

LANDSCAPE DISTURBANCE

Using Heidenreich's (1971) estimate of 0.17 ha/person/decade and the population estimates of the previous section, the amount of land cleared at any time in Southern Ontario can be estimated. This will probably increase the overestimate, because the earlier horticulturalists were probably not as dependent on maize as their historic counterparts, and thus likely required less field area per person.

Since most villages lasted from 10 to 30 years (Warrick 1990), the average village duration can be taken as roughly 20 years. This means that the average age of villages at any given time would have been about 10 years. Thus the 0.17 ha/person/decade estimate can be applied to the population of



Black diamonds are Warrick's estimates for the period A.D. 900-1500; the solid line is a fitted exponential curve with formula ln(pop) = 2.968 + 0.004863 Y; pop = population, Y = year A.D.; r^2 = 0.94.

Figure 2. Estimated population through time (after Warrick, 1990).

any given time to obtain an estimate of the land cleared at that time.

Estimates of land-use through time (calcu lated from the exponential population growth equation in Figure 2 and 0.17 ha/person-/decade) show that only about 19,800 ha were ever cultivated at any one time prior to A.D. 1600. With some 7,700,000 ha of land area south of the Canadian Shield (Chapman and Putnam 1984), this represents approximately 0.26 percent of the available land area. However, any old-field succession would be operating on fields several decades old, so that we need to consider not only the field area of the immediate time of occupation, but also the field-area of various ages of abandonment.

Using A.D. 900 as the starting point and A.D. 1600 as the end point for these calculations, we find a maximum value of 403,000 ha of old fields in all Southern Ontario. This represents about 3.2 percent of the land area of Southern Ontario (taken as 12,600,000 ha), or 5.2 percent of the land area south of the Canadian Shield. This is assuming no reuse of old fields decades or centuries after

abandonment; such reuse may have been quite common, as it has been suggested that old fields would have been preferred sites due to the abundant relatively small trees which would both be easily cleared and provide construction material (Heidenreich 1971; Warrick 1990). Given these indications that these land-use estimates are likely to be significantly inflated, 5.2 percent of the land area south of the Shield can be used as an upper limit. With variation in occupation density, it seems likely that some densely occupied areas such as the heart of Huronia may have been much more densely inhabited and therefore cleared at some time prior to A.D. 1600. Much of this area would have been in an advanced state of forest succession, having had up to 700 years of regrowth. Most of it, however, would have been fairly recently abandoned, since population was rising rapidly.

Studies in southwestern Quebec suggest that old-field succession in the Great Lakes - St. Lawrence forest is very rapid, with maple-dominated forest regenerating in a few decades (Brisson et al. 1988). Taking a generous 250 years as the life-span of the old-field succession on the abandoned fields, a maximum of 293,000 ha of land could have been under old-field succession in A.D. 1600. This represents 3.8 percent of the land area of Ontario south of the Canadian Shield.

Old-field succession

Although the cleared land area is a small fraction of the undisturbed forest, there may have been some local effect on the forest composition in densely occupied areas. The succession which would be expected on old fields would depend in part on the local climate and the soil conditions. The surrounding forest would be the seed source, and so may also be expected to play a role.

Heidenreich (1971) suggested the following succession for old Huron fields: after a few years or decades of herb and shrub cover, the first trees to colonize the fields would have been hawthorn, pin cherry, and elm; later would come poplar, birch, and white pine; because of its tolerance for dry sites, oak would come next; maple, beech, basswood, and hemlock are last to arrive. This succession was based on casual observations in that area. The modern succession, however, may be quite different from that of Huron times. Today, old fields are often turned to pasture for several years prior to being completely abandoned. This would promote the less palatable hawthorn and pine (Shelford 1963:30), by inhibiting more palatable species. Since the Iroquoians had no domesticated grazing animals, hawthorn and pine may be overrepresented in Heidenreich's observations.

In Quebec southwest of Montreal, one old-field was colonized first by white ash and grey birch, but became dominated by sugar maple within 41 years of abandonment (Brisson et al. 1988). In the same study, another abandoned field was immediately dominated by sugar maple, and has remained so for 55 years. Areas which were clear-cut but not cultivated were initially dominated by the prolific stump-sprouter basswood, but rapidly showed clear trends towards maple dominance. Stands from which all but a few large sugar maples had been selectively cut rapidly regenerated a pure maple forest. A single undisturbed maple-dominated stand in the study shows a current trend towards beech.

While there is a major beech to white pine forest succession in Southern Ontario during Late Woodland time which is often attributed to Indian disturbance (for example McAndrews and Boyko-Diakonow 1989; Burden et al. 1978; 1986a,b), recent study has demonstrated that this was due to Little Ice Age cooling rather than human disturbance (Campbell and McAndrews 1991; Campbell and Campbell 1993; Campbell and

McAndrews 1993). It is therefore unlikely that Indian disturbance had more than a minor, highly localized impact.

Soil erosion

Soil erosion due to stripping of vegetation by agriculture and grazing animals is believed to have caused the severe degradation of many circum-Mediterranean landscapes. In Southern Ontario, soil erosion is recognizable today in the form of high sedimentation rates in various lakes. An exceptional example of this is Kelly Lake, north of Toronto. This small lake shows a sedimentation rate of about 2 cm/century prior to EuroCanadian field clearance; after ca. A.D. 1850, the sedimentation rate rises to 100 cm/century (Campbell 1992). Similarly, at Crawford Lake north of Hamilton, a distinct thickening of annual sediment layers and pronounced greenish coloration marks the EuroCanadian period, while prehistoric horticulture, recorded in the lake sediment by maize pollen, leaves only a slight thickening of the carbonate laminae (McAndrews personal communication). At Second and Gignac Lakes, in Huronia, Burden et al. (1986a; 1986b) found much weaker geochemical and palynological evidence of prehistoric field clearance than of EuroCanadian field clearance.

It is reasonable to suppose that the small land areas cleared, the lack of deep ploughing, the lack of domestic grazing animals, and the short life-span of most fields would have minimized soil erosion in Late Woodland Southern Ontario.

CONCLUSION

Any impact the prehistoric inhabitants of Southern Ontario may have had on their environment was likely of short duration. The forest succession on their old fields would likely have reverted to an essentially natural forest in a few decades in most areas. The maximum area disturbed would have been less than 3.2 percent of Ontario south of the Canadian Shield. Although they may have had a local impact where their populations were most concentrated, due to the small horticultural population, non-intensive cultivation technology, and the lack of domesticated grazing animals, prehistoric populations had no significant lasting effect on the landscape.

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