Expansion of Industrial Logging in Central Africa

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Central Africa's dense humid forests have long been regarded as among the most pristine on Earth, but in recent decades industrial logging has become the most extensive form of land use in the region. Currently more than 600,000 km^2 (30%) of forest are under logging concessions, whereas just 12% is protected. Logging-related disturbance in the region alters ecosystem composition and biodiversity (*1*), opens remote areas to poaching (*2*), and modifies numerous functional attributes of the ecosystem (*3*). Laws and regulations are in place to improve forest management at national and regional scales, but limited resources are available to enforce regulations or to provide technical support (*4*). Here, we report on the use of over 300 Landsat satellite images, covering 4 million km^2, to track the progression of logging roads for three decades preceding 2003 (*5*). We document accelerating rates of logging road construction in much of the region and show that monitoring with satellite remote sensing provides a practical approach to map changes associated with logging activities.

We mapped 51,916 km of logging roads within the forested region (Fig. 1). This is a conservative estimate, because not all areas had recent cloud-free satellite images (*5*) and logging roads are converted to public roads where population density is high. Logging roads accounted for 38% of the length of all roads, ranging from 13% in the Democratic Republic of Congo (DRC) to >60% in Gabon and the Republic of Congo (ROC). The combined road density (public and logging) was 0.07 km km^{-2} and, considering logging roads only, 0.03 km km^{-2}. The highest logging road densities (0.09 km km^{-2}) were in Cameroon and Equatorial Guinea (EG), where most of the forest was cut at least once. Logging in these two countries and in Gabon has extended inland in recent decades after the earlier harvesting of coastal forest.

The most rapidly changing area was in northern ROC, where the rate of road construction increased from 156 km year^{-1} for the period 1976–1990 to over 660 km year^{-1} after 2000. Evidence for a new frontier of logging expansion was documented within the DRC, which currently contains 63% of the total remaining forest of the region and has the lowest measured logging road density (0.01 km km^{-2}) of all Central African nations. Rates of logging road construction increased within DRC, particularly in a 50,000-km^2 region of north-central DRC, where the rate of road development progressed from 336 km year^{-1} (1986–1990) to 456 km year^{-1} (2000–2002). We expect industrial logging concessions to expand, with commensurate increases in the rates of logging and road building associated with foreign investment (*6*).

With the exception of the Okoumé forests of Gabon (*7*), most of the industrial logging is selective and focused on high-value tree species for export (for example, African mahoganies). We estimated 5% (89,715 km^2) of the total forested area as disturbed and 29% (567,782 km^2) as more likely to have increased wildlife hunting pressure because of easier access and local market opportunities offered by new logging towns (*5*). The greatest amount of forest disturbance (15%) occurred in Cameroon and EG, compared with just 1% within the DRC. In addition, we used finer resolution (4-m) satellite imagery to document disturbance created by logging skid trails and tree felling. These locally disturbed areas had canopy gaps that were five to six times larger than those in adjacent unlogged forests. Gaps created by tree fall ranged from 200 to 600 m^2 in size and, together with skid trails, accounted for 9% of the area in which logging occurred.

To date, few reliable data sets have been available to monitor the changes taking place in remote areas of the Congo Basin, but regular monitoring with satellite remote sensing provides a consistent approach to monitor both legal and illegal logging activities. In the context of the rapid frontier expansion, the conservation of forested landscapes and sustainable timber production is crucial for Central African nations and their inhabitants.

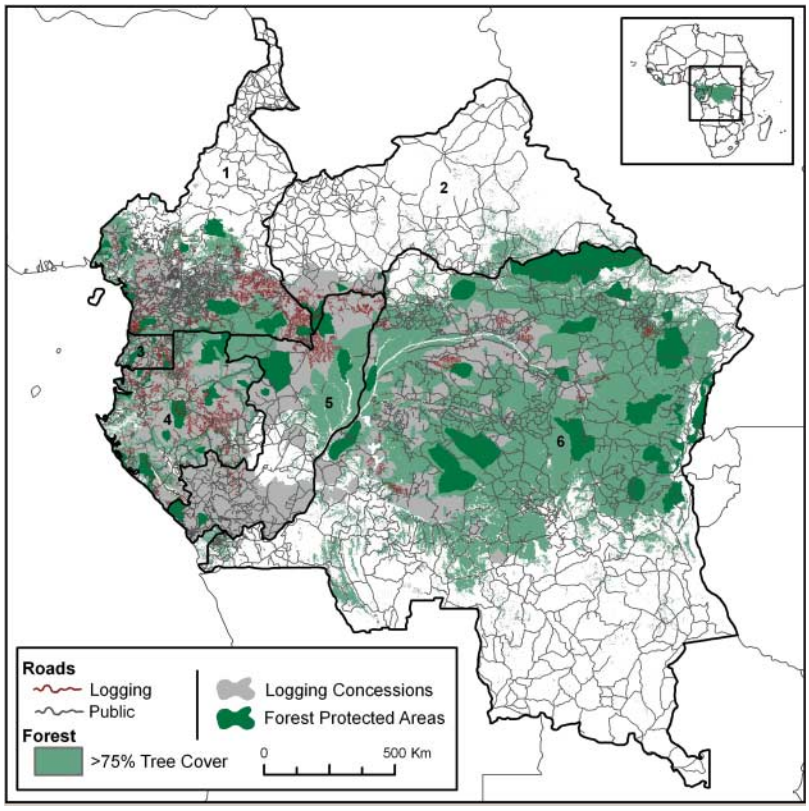

Fig. 1. Logging concessions and road distribution in Central Africa: Cameroon (labeled on the map as 1), Central African Republic (2), Equatorial Guinea (3), Gabon (4), Republic of Congo (5), and Democratic Republic of Congo (6). A more detailed graphic of logging roads for a portion of the region is provided in fig. S1.

References and Notes

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