Characterizing the Impacts of Coal Mining on Forest and Protected Areas in Sumatra, Indonesia (2000-2014)

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INTRODUCTION

Southeast Asia's biodiverse forests have become increasingly vulnerable due to rising demand for agricultural products and natural resources. Indonesia contains roughly half of Southeast Asia's forest cover, and the country experiences a deforestation rate second only to Brazil. Over the past two decades, Indonesia's coal industry has rapidly expanded, and it is now the second largest coal producer in the world. The growth of the coal industry can be attributed to particular changes in the government. Suharto's New Order Government (1966 to 1998) gave rights for biodiverse forests to powerful conglomerates. The next president passed vague decentralization legislation in 2001 that gave lower levels of governments more autonomy in terms of forest management and distribution of industrial concessions, which caused an immediate decline in the health of Indonesia's forests. A comparative study of the relative contributions of different industries to recent deforestation in Indonesia is needed. Examination of overlapping concessions has potential to encourage better regulation of concessions and a reorganization of the system that maintains concession records. This research will inform policy recommendations for conservation efforts to maintain forest cover and improve the landscape for natural and human benefit.

Research Questions:

1) What is the direct impact of coal mining on forest cover in Sumatra, Indonesia from 2000-2014?
2) How do the direct impacts of coal mining compare to the impacts of other industries (logging, oil palm, wood fiber, and tree plantations) from 2000-2014?
3) Are protected areas effective in preventing forest loss?
4) What impact do overlapping concessions have on forest loss?
5) What are the indirect impacts of coal mining on biomass surrounding the concessions?

STUDY AREA

The study area consists of Sumatra, Indonesia, which is an island of roughly 45 million hectares, equivalent to the state of California in the United States (Figure 1). It is made up of ten provinces and has a population of about 50 million people. It is bordered by the Indian Ocean and the Java Sea.

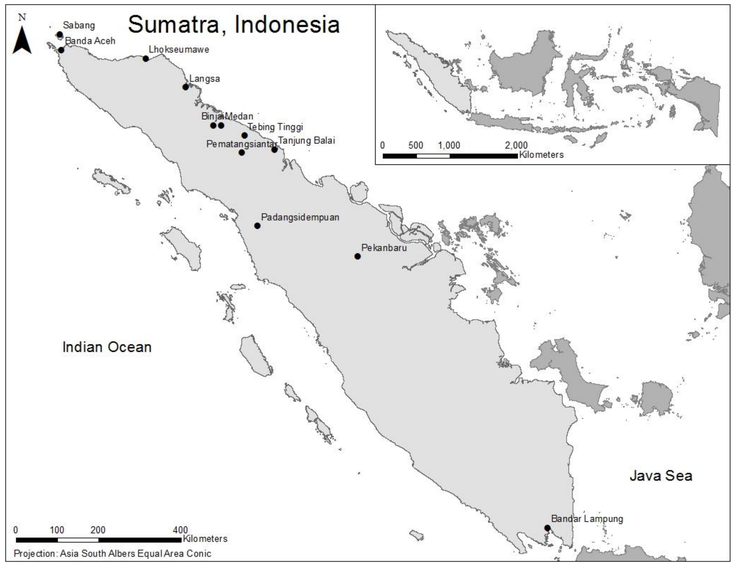
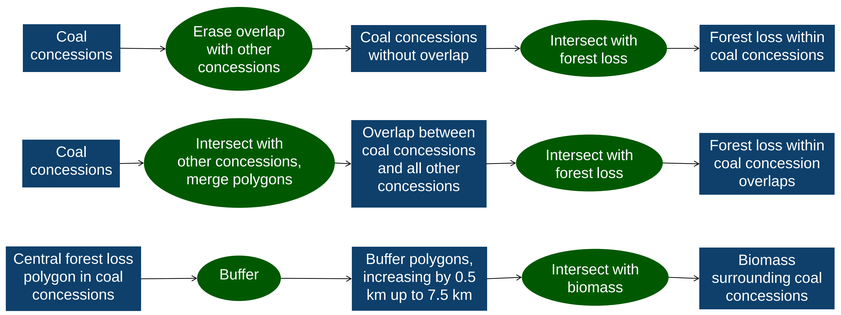


Figure 1. Study area map of Sumatra, Indonesia.

DATA & METHODS

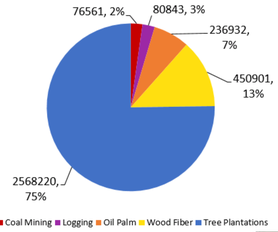
Polygon data representing logging concessions, oil palm concessions, wood fiber concessions, tree plantations, forest moratorium (forests and peatlands protected from future concessions), and protected areas were collected online from freely available data sources, including the Global Forest Watch, World Resources Institute, and the World Database on Protected Areas. Coal mining concession data were provided by Fern and JATAM (Mining Advocacy Network). The 30 meter forest cover data were produced by Hansen *et al.,* (2013) using Landsat-7 and -8 satellites from 2000 to 2014.



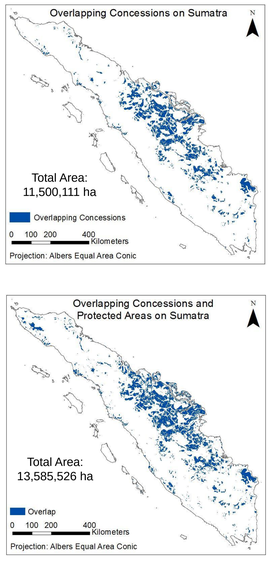
RESULTS – DIRECT IMPACTS

	Forest Loss Without Intersections (ha)	Forest Loss Within Intersections (ha)
Coal Mining	76,561	240,980
Logging	80,843	124,751
Oil Palm	236,932	928,132
Wood Fiber	450,901	1,801,213
Tree Plantations	2,568,220	2,780,084
Protected Areas	1,430,238	773,664

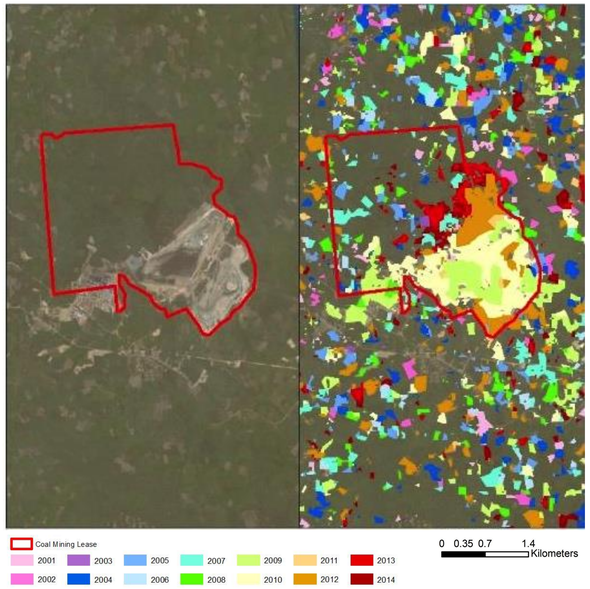
	Percent Forest Loss Without Intersections	Percent Forest Loss Within Intersections
Coal Mining	22%	40%
Logging	6%	56%
Oil Palm	29%	34%
Wood Fiber	24%	70%
Tree Plantations	28%	52%
Protected Areas	8%	37%



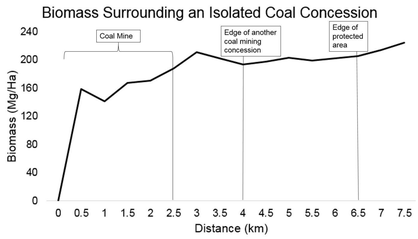
	Forest Loss (ha)
Island of Sumatra	8,533,198
Within Concessions	3,413,457
Within Concession Intersections	2,712,872
Outside Concession Boundaries	2,406,869

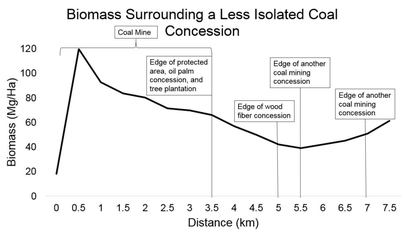


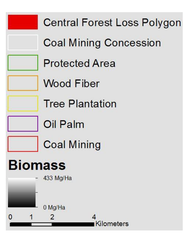
Forest Loss Within a Coal Mining Concession Example in Sumatra, Indonesia: 2000-2014

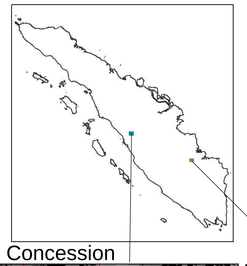


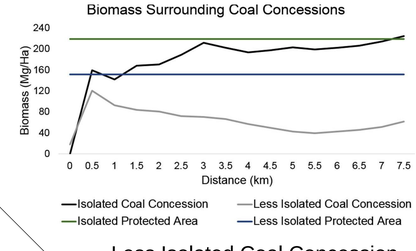
RESULTS – INDIRECT IMPACTS



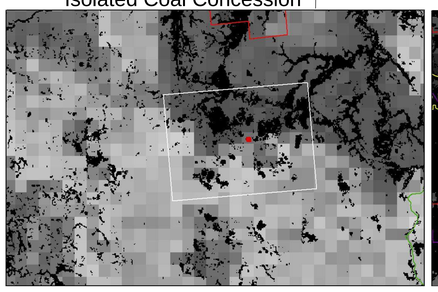




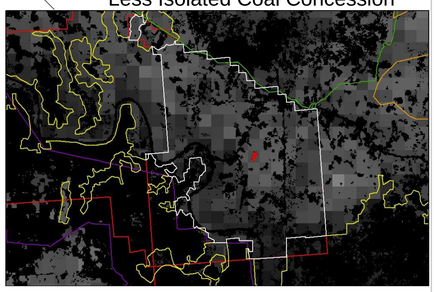




Isolated Coal Concession



Less Isolated Coal Concession



DISCUSSION

Sumatra experienced 8.5 million hectares of forest loss between 2000 and 2014, of which 3.4 million hectares (40%) occurred within concessions. Coal mining caused the least amount of absolute forest loss within concessions (2%) compared with other industries, while tree plantations caused the most loss (75%). However, the relative loss showed that coal mining is just as impactful as other industries.

Because coal mining has expanded rapidly over the past two decades and has a similar rate of forest loss as other detrimental extractive industries, such as wood fiber, coal mining leases and associated forest loss should be monitored closely to prevent the coal industry from growing. Protected areas have a relatively low rate of forest loss (8%) compared to most concessions (>20%), indicating that these areas are effective in preventing forest loss. However, it is alarming that there is such a high degree of overlap between protected areas and concessions, because these overlaps have a 37% rate of forest loss.

Overlapping concessions dramatically increase the relative amount of forest loss. Isolated coal mining concessions have a lower biomass within the concession, and an increase in biomass as the distance from the center of the concession increases up to roughly 7.5 km. Sumatra's high degree of overlapping concessions means few concessions are isolated. Less isolated concessions have a lower biomass compared with isolated concessions, with an average of biomass of 171 Mg/Ha in an isolated concession and an average of 75 Mg/Ha in a less isolated concession, compared with the 151 Mg/Ha and 218 Mg/Ha average biomasses of the two control sites. The biomass surrounding the edge of a less isolated concession is less predictable because other concessions are impacting the landscape.

The issue of overlapping concessions is a problem that the Indonesian government needs to prioritize resolving, because efforts to organize concession records and prevent future overlapping claims on an area could be impactful in decreasing forest loss. Forest loss for all concession types has increased during the study period, indicating that Indonesia should expect continued increases in forest loss unless changes in the system of granting concessions occur.