Trees, Repeat Photography and Pathways to Landscape Transition in Honduras

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Resumen

La comprensión de aumentas vegetación que se encuentra en Honduras con la fotografía repetir se lleva a cabo utilizando una plantilla de las vías de transición de los bosques. Aumenta la vegetación se observaron en un gran número de pares de fotografías de repetición, aunque estos aumentos aparecen en una variedad de formas y configuraciones. Uso de las vías de bosque de transición para clasificar a los cambios evidentes en los conjuntos de fotografías, ilustra que la intensificación de los pequeños árboles basado en la categoría dominante explica los cambios observados. Una variedad de aumentos no forestales en la cubierta forestal en todo el país reflejan la compleja variedad de los procesos que influyen en la transición del paisaje.

Palabras clave: *fotografía repetida, cambio en el paisaje, transición del bosque, Honduras*.

Abstract

Understanding vegetation increases found throughout Honduras using repeat photography is undertaken using a template of forest transition pathways. Vegetation increases were observed in a large number of repeat photograph pairs, though these increases appear in a variety of forms and settings. Using forest transition pathways to classify the changes evident in the sets of photographs illustrates that smallholder tree-based intensification is the dominant category explaining the observed changes. A variety of non-forest increases in tree cover throughout the country reflect the complex variety of processes that influence landscape transitions.

Keywords: *Repeat photography, Landscape change, Forest transition, Honduras*.

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Introduction

Increases in tree cover in places throughout the developing world in recent years have led many scholars to reconsider commonly held assumptions. Forest transition literature seeks to elucidate the processes behind the shaping of such landscapes through the framework of pathways. Pathways to forest transition can be seen as complex sets of processes, generally socio-economic, thought to help shape human impacts on environmental conditions through reshaping behavior, options, and relationships with the environments within which people live.

During previous research, increases in vegetation across much of Honduras were found to have taken place between 1957 and 2001 (Bass, 2004; 2006a). Using repeat photography, these increases were found to be remarkably complex in site, situation, and formation. Settlement forests, public plantings, spontaneous dense growth, random dispersed growth, and forest patches were equally common (see Figure 1). The factors that would explain these increases were likely as numerous and complex as the landscapes they helped shape.

Using newly-collected repeat photographs from the same study area, this article examines the vegetation changes that have taken place in parts of Honduras within a context of forest transition pathways. Rather than focusing on the patterns of change, which can be rather difficult to classify, this focus on pathways offers a processural perspective that seeks to elucidate the sets of processes and events influencing the ways we shape and reshape landscapes.

Trees

A body of literature has emerged in recent years addressing recently observed increases in vegetation in places throughout the world. Particularly in the developing world, such increases appear to be related to a variety of factors, providing conceptual challenges to traditional notions surrounding forest transitions taking place.

For example, a general pattern of vegetation increase was observed between 1957 and 2001 across much of Honduras using repeat photography. This general increase took different forms in different situations across the country. Previous research has described the variety of forms of increases observed: settlement forests, agroforestry, random dispersed growth, and forests. These patterns appear to have persisted and the observed increases appear to have continued through 2010.

Forest transition theory suggests that, as regions become developed, rural populations are drawn to urban centers for economic opportunity in various economic sectors, allowing agriculture to be concentrated and intensified on the most arable lands and leaving marginal rural areas to secondary forest succession (Farley, 2010;

Rudel 2006, 1998; Aide and Grau, 2004; Rudel *et al*., 2002; Mather, 1992). Other processes and pathways also contribute to the shaping of landscapes in complex ways, though focus was long on deforestation (Zimmerer, 2004).

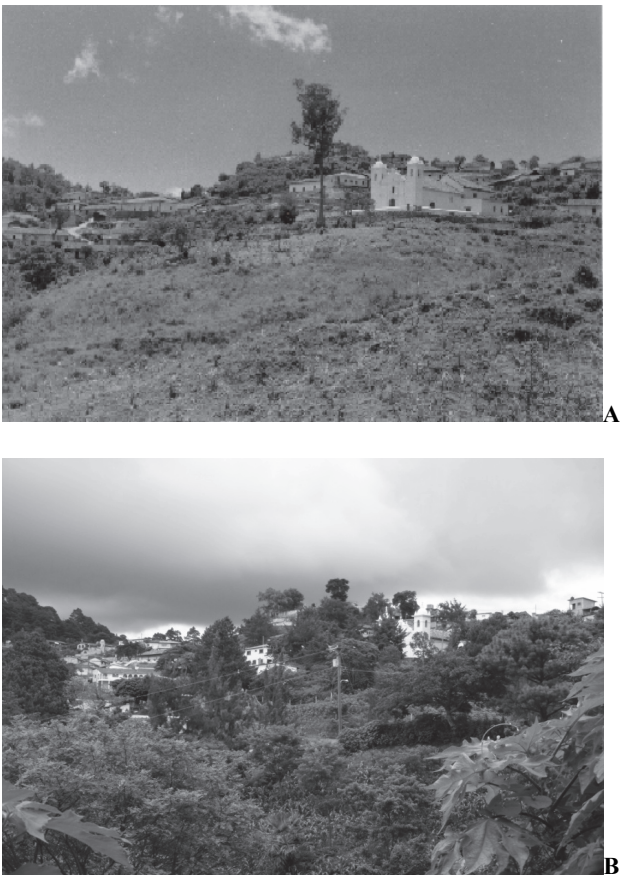


Figure 1. **A** (1957) and **B** (2010). Santa Lucia, Francisco Morazan, former mining center NE of Tegucigalpa. The town has become a weekend getaway and bedroom community for more affluent residents of the capital city. The increases in vegetation are clearly evident but difficult to classify and explain.

Of course, the variables that influence landscapes change over time. The growing influence of globalization on rural economies, and consequently, forest conditions has been well documented (Grau and Aide, 2008; Tucker, 2008; Hecht *et al*., 2006; Rudel, 2006; Klooster, 2000). In Honduras, recent environmental change has been studied with regard to tree cover and general conditions from a number of

perspectives (Bass, 2006b, 2004; Southworth *et al*., 2004, 2002; Tucker, 2008; Pfeffer *et al*., 2005; Jansen, 1998). A variety of social factors can be seen influencing landscapes in the region (Pfeffer *et al*., 2005; Cochran, 2008; Sandoval, 2000; Stonich and DeWalt, 1996). As population density, global and local economies, and conservation policies change, so do land-use and environmental conditions (Pfeffer *et al*., 2005; Zimmerer, 2002).

More recent perspectives on the dynamics of forest cover change recognize woodland resurgence at small scales and the importance of anthropogenic forest types. This new perspective also recognizes an array of forces imposed by globalization on landscape change in places like Latin America, as well as challenges conventional notions of forest transitions as applied to developing nations (Farley, 2010; Lambin and Meyfroidt, 2010; Hecht, 2004).

Scholars have recently begun to pay significant attention to such patterns of vegetation increases, as their occurrence seems to be common in some situations. Among the variety of types of increases observed, distinctions between various types of forested landscapes exist (Farley, 2010). Differences between aforestation and reforestation also elucidate differences in historical antecedents and processes behind contemporary conditions. In short, different motivations and different processes affect various activities that lead to a fascinating complex mosaic of different arrangements of trees and vegetation across landscapes. The many forms of vegetation increase that have been increasingly observed in recent years provide an intriguing pattern of change taking place in many places that compels more investigation. Examining these landscapes through repeat photography offers a holistic perspective on the numerous changes that can occur in the same place, often simultaneously. Understanding such changes within a context of the processes that are helping shape modern landscapes offers insight into these processes and helps characterize observed changes within a template of proximate causes.

Forest transition theory provides a framework for understanding changes such as recently observed shifts from forest decreases to forest increases. Analyses that have historically utilized national scale data have probably obscured variations in forest change that have been taking place at more local scales. In some places, forest increases have actually been observed concurrent with population increases, challenging some traditional assumptions (Tucker, 2008). In many countries, both deforestation and afforestation can be observed simultaneously in different regions (Redo, Bass and Millington, 2009; Perz, 2007; Lambin and Meyfroidt, 2010; Batterbury and Bebbington, 1999).

Conceptual pathways to forest transition seek to elucidate primary affective processes (see Farley, 2010). The *economic development path* offers the notion that, as modern development proceeds, agriculturalists move to cities, abandoning land

to return to forest (Rudel *et al*., 2005). The *forest scarcity path* observes that forest increases may take place as response to a real or perceived current or future scarcity of forest products (*ibid*). The *state forest policy path* links national forest policies with social, economic, and political goals that shape forest transitions (Lambin and Meyfroidt, 2010). The *globalization path* offers the idea that the integration of national economies with international markets and global ideas can shape forest cover in numerous ways (*ibid.*). Finally, the *smallholder tree-based intensification path* observes that increases in tree cover can be related to many other factors and result in a variety of vegetation increases such as some forms of agroforestry, windbreaks, woodlots, etc. (*ibid*.). This also probably best describes many of the increases observed in Honduras, previously described using the categories *spontaneous dense* and *random scattered* stands. Such increases, increasingly described as *tree resources outside forests* (Herrera-Fernández, 2003), are also potentially significant, as they are particularly widespread and are thought to have high conservation value and involve native species more often (*ibid.*; Farley, 2010).

In Honduras, increases in vegetation observed in 2010 through a recently acquired set of repeat photographs indicate that the patterns of change in vegetation observed between 1957 and 2001 appear to persist. An overall increase in vegetation was observed, though explaining the increase was complicated by the variety of patterns it has taken. Increases in agroforestry (shade coffee, wood products, etc.), vegetation along fencerows, in towns, around houses, along roadsides, as well as in forest patches have characterized landscape changes across the past half-century in Honduras. The variety of patterns of increases observed likely mirrors the variety of factors affecting them. Settlement forests have increased as towns and cities have grown. Improvements in prevention of diseases, such as malaria, may be related to this change, as the thick vegetation providing habitat and refuge for mosquitoes may have been kept down to avoid disease. The public discourse on forest and conservation issues appear to also contribute (see Bass, 2006b). Understanding these changes within a context of the 'pathways' that may be linked to them may help overcome some of the difficulties that have been met trying to explain their patterns.

Method

The complex relationships between social, cultural, economic, and political processes and the biophysical landscapes in which they are manifested help reaffirm the value of the holistic qualities of using photographic data to assess changes, particularly those that may be occurring simultaneously, in the same places, and, perhaps, in relationship to the some of the same broader processes of change. An overall complexity in vegetation changes has meant that classifying them has been

met with difficulty. In an effort to provide a general picture of these changes, this article utilizes forest transition theory and proposed pathways to transitions to help explain the observed changes and some of their proximate causes.

Repeat photography is the process of replicating a previously taken photograph, typically for purposes of observing and assessing change. Similar methods using other data sources offer insightful perspectives on change as well as on the collection and recording of various forms of field data (Brady, 2009). In recent years, a considerable amount of research has relied upon repeat photography. A sampling would include Webb, Boyer and Turner, 2010; Michel *et al*., 2009; Nyssen *et al*., 2009; Hendrick and Copenheaver, 2008; Bass, 2004; Clark and Hardegree, 2005; Lewis, 2002; Byers, 2000; Veblen and Lorenz, 1991; Humphrey, 1987; Foote, 1985; Klett and Manchester, 1984; and Vale and Vale, 1983. Perhaps the most comprehensive volume on the method to date is the recent *Repeat Photography; methods and applications in the natural sciences* (Webb, Boyer, and Turmer, 2010). Repeat photography inherently confines the second photographer, removing most opportunity for compositional bias and providing a sort of constrained sampling of the landscape. In landscapes that contain elements of both change and continuity, this constraint can help avoid over-focusing on specific dramatic change at the expense of general landscape characteristics.

This article offers an analysis of landscape change in Honduras using repeat photography assessed within a context of the five forest transition pathways discussed previously (economic development, state policy, forest scarcity, globalization, and small holder intensification). Changes evident in the photographs were classified by way of the pathways believed to explain their occurrence. Classification assigned to each photograph set as many pathways as were thought to be relevant to observed changes. Most photograph sets were assigned more than one pathway, as the complex landscape patterns observed are typically caused by numerous complex sets of processes.

Among several shortcomings with the method, one problem with using oblique photographs to study change, particularly compared to other sources like maps, satellite images and aerial photographs, is that they are simply hard to measure. This is true for many reasons, primarily related to their oblique nature and the dramatic differences in scale between foreground and background this provides. Further, photographs are as much compositions as they are objective reflections of reality and should be understood as such. Both of these are best overcome in repeat photography by utilizing a large number of photographs and comparing general patterns evident across the two sets.

For this study, photographs were selected from a previously assembled collection of 75 repeat photograph pairs from Honduras from the years 1957 and 2001. Using the photographs of Robert C. West from 1957 and the author's own repeat

photographs from 2001, photograph pairs were selected for further repeat study through the combination of an initial selection process in the lab and fieldwork in July 2010, during which some photographs were excluded from the current study due to inaccessibility and similar logistical constraints. In the end, 41 photograph pairs make up the final selection used for analysis.

Analysis

Photograph pairs were classified based on the five pathways to transition proposed by Farley (2010) (Table 1). Pathways were assessed based on a combination of empirical observation and knowledge of shaping forces gathered during ethnographic work and research. That said, many processes at work in many of the landscapes in the photographs have the potential of being unacknowledged due to incomplete information. For example, Catherine Tucker's (2008) detailed knowledge of the constellation of different processes involved in shaping landscape in one small place that appears in one of the photograph pairs illustrates how complexly processes are embedded in a landscape. Not knowing all that is going on in every part of the landscape in every photograph pair is a logistical shortcoming of the method, as it covers many different places across a large region, trading breadth for depth.

Table 1

Pathway	*Percentage of Photographs*
Economic Development	44%
Forest Scarcity	11%
State Policy	11%
Globalization	29%
Smallholder Intensification	82%

Of the five pathways to transition, smallholder intensification appears to have shaped landscapes in more photograph pairs than any other pathway, overwhelmingly so. Smallholder appears to be a relevant category in 82% of the photo pairs. This differs from the other four pathways, which appear far less significant across the photograph set. Economic development, the standard forest transition theory that economic diversification and rural-to-urban migration reshape landscapes appears to be significant in 44% of the photograph pairs. Globalization was identified as significant for 29% of the photo pairs, while state forest policy and forest scarcity each appear significant in 11% of the photo pairs.

One reason for the high occurrence of the smallholder intensification pathway is likely due to the breadth of the category. Though it accounts for changes in most of the photo pairs and accounts for most of all of the changes evident in some of the photograph pairs, the category includes a variety of processes and vegetation types that occur in a variety of contexts, forms, and places. Again, increases in tree cover can be related to many factors and result in a variety of vegetation increases such as some forms of agroforestry, windbreaks, woodlots, etc. (Lambin and Meyfroidt, 2010). This is almost a catchall category for processes that cannot clearly be identified within the other four pathways. In many cases, the processes in this pathway appear to be most significant in affecting change at the local level.

As populations have grown, both in the countryside and town, so have the trees around their homes. In rural areas, this appears in photograph pairs as small clusters of trees —practically all fruit-bearing— in formerly open areas (Figure 2). Occasionally, the houses within the trees are visible. In towns, this appears as the growth of an urban or settlement forest. The increase in settlement forest has been noted elsewhere. As will be discussed, this increase can be associated with different pathways as it probably has taken place due to a variety of factors. Immigration by rural folk, changes in conservation ethics (see Bass, 2006b), and changes in the geography of disease are all likely tied to this. In another way, this can be seen as the other end of the traditional set of forest transition processes, whereby rural folk move to town and change the way they use land, not only in the rural areas but in the spaces to which they move (Figure 3).

By reshaping what people do, the processes of economic diversification and rural-to-urban migration are thought to have potentially significant impacts on landscapes (Aide and Grau, 2004). For this investigation, this economic development pathway has been broadened to include the landscapes at the other end of its processes. Where changes in photograph pairs can clearly be tied to the economic and settlement changes described – for example, where a town has visibly expanded into former rural space as a result of in-migration from surrounding rural areas (Figure 4), the economic development pathway was considered significant. As so much of rural Honduras has been shaped by the extractive strategies of the Honduran and U.S. governments (or potentially so) (United States Agency for International Development 2001) as well as general population increases, seeing any reforestation in rural landscapes as simply a one-way result of the processes of forest transition theory would be difficult.

Figure 2. **A** (1957) and **B** (2010). Llano Yarula, La Paz. Trees on distant slope are primarily agroforestry patches where residents are growing construction materials, domestic kitchen orchards around houses, and fence rows. The junipers in the foreground are growing along a barbed wire fence that did not exist in 1957.

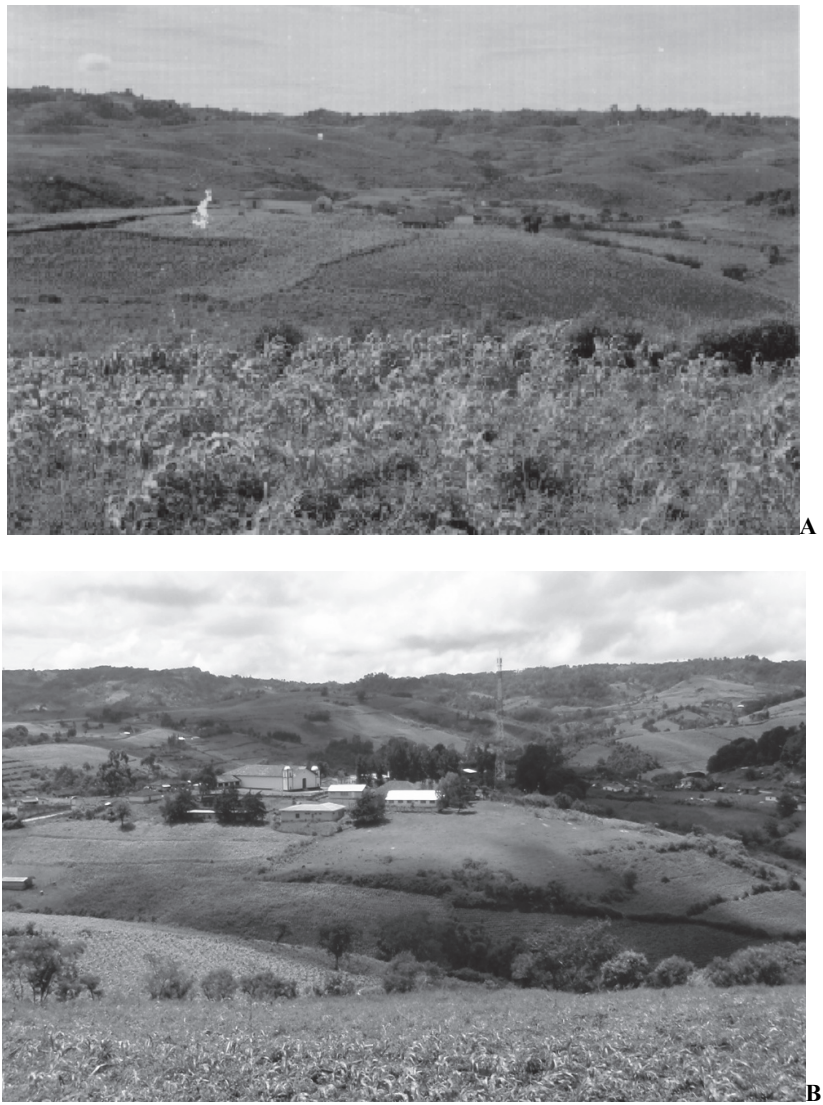


Figure 3. **A** (1957) and **B** (2010). Santa Elena, La Paz. Many of the Lenca residents in the town still engage in corn-based agriculture for a living. However, recent growth of the town has occurred along with the arrival of modern amenities, such as transportation, electricity, household water, and —very recently— cellular communications. Schools have also been built, accommodating increased demand by a larger population. Scattered trees and stands of trees throughout town have accompanied this growth.

Table 2
Population changes for Honduras and selected municipios, 1961-2001

	1961 Population	*Urban*	*2001 Population*	*Urban*	*% Change in Population*	*% change in urban population*
Honduras	1,884,765	433496	6,076,885	2,794,592	322%	645%
Municipio						
Gracias, Lempira	9,538	1,854	31,422	6,716	329%	362%
Santa Elena, La Paz	2,438	72	6,829	360*	280%	500%
Marcala, La Paz	5,517	1,828	20,434	8,797	370%	481%

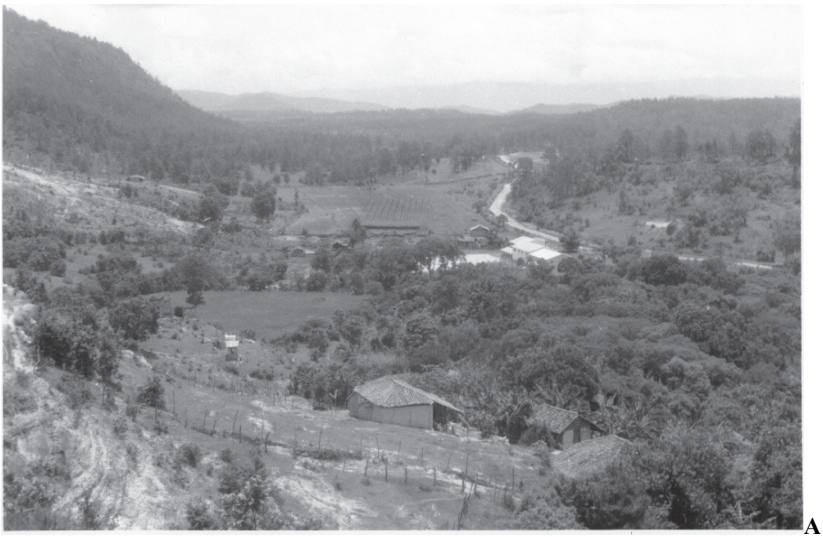
* Author's estimation based on survey of houses and average household size, due to missing data in the 2002 national census (INE, 2002).

Globalization appears significant in over one-quarter of the photograph pairs. This too is a broad category but does have distinct implications regarding the scale of the processes at work. The expansion of global-local linkages means that global processes and information flows increasingly help shape landscapes in some long-isolated places. The expansion of the global coffee market in recent decades is apparent in several photographs, generally in the form of stands of shade trees over coffee farms, as well as a proliferation of concrete patios in coffee-growing regions (Bass, 2006a) (Figure 5).

The forest scarcity pathway was identified as significant in 11% of the photograph pairs. It is likely so in others, as well. Identifying this pathway was conducted through detailed ethnographic investigation (see Bass, 2010) in some of the places across the study area, during which specific stands of trees were identified by owners as specifically for the production of construction materials and firewood (Figure 2). Though a conservation ethic was typically also associated with these stands, owners indicated that they were poor and had to produce many of their own resources if they were able. Such manifestations may be more common across the landscape than thought, as they take place on such a local scale, making ascertaining them a logistical challenge.

Discussion

Examining changes in vegetation cover using repeat photography and classifying changes within a contextual template of forest transition pathways offers a perspective on recent observed vegetation increases in portions of Honduras. This perspective attempts to use patterns of change to assess processes affecting change.


A


B

Figure 4. **A** (1957) and **B** (2010). Marcala, La Paz. A coffee growing center in southwestern Honduras, Marcala has seen remarkable economic and population growth in recent decades surrounding the growth and processing of coffee. First introduced in the mid-1800s by the Draewert family, German immigrants, coffee has become the dominant economic activity for many in the region, considerably reshaping landscapes. The town continues to grow, receiving many immigrants from surrounding rural areas, accommodated by the spatial spread of the settled area.

Figure 5. **A** (1957) and **B** (2010). Chinacla, La Paz. Located about two miles north of Marcala and adjacent to the paved highway, Chinacla also shows considerable influence of the global coffee market, as much of the vegetation in the recent photograph serves as shade for coffee growing beneath it and the concrete patio in the foreground serves as a drying and processing space. Such patios are prolific throughout the region, mirroring the expansion of coffee farms.

In Honduras, increases in vegetation observed in 2010 through a recently acquired set of repeat photographs indicate that the patterns of change in vegetation observed between 1957 and 2001 appear to persist. An overall increase in vegetation was observed, though explaining the increase was complicated by the variety of patterns it has taken. Increases in agroforestry (shade coffee, wood products, etc.), vegetation along fencerows, in towns, around houses, along roadsides, as well as in forest patches have characterized landscape changes across the past half-century in Honduras. The variety of patterns of increases observed likely mirrors the variety of factors affecting them. Settlement forests have increased as towns and cities have grown. Improvements in prevention of diseases, such as malaria, may be related to this change, as the thick vegetation providing habitat and refuge for mosquitoes may have been kept down to avoid disease. The public discourse on forest and conservation issues appear to also contribute (see Bass, 2006b). Understanding these changes within a context of the 'pathways' that may be linked to them may help overcome some of the difficulties that have been met trying to explain their patterns.

The many forms of vegetation increase that have been increasingly observed in recent years provide an intriguing pattern of change taking place in many places that compels more investigation. Examining these landscapes through repeat photography offers a holistic perspective on the numerous changes that can occur in the same place, often simultaneously. Understanding such changes within a context of the processes that are helping shape modern landscapes offers insight into these processes and helps characterize observed changes within a template of proximate causes.

State forest policy is potentially among the most significant of factors in understanding rural Honduran landscapes, at least where there are trees. The formation of modern national forest policies and agencies took place basically across the same time period as this study. In the 1950s, the first concepts of so-called "professional forest management" arrived in Honduras, essentially directly from the U.S. under the auspices of the Food and Agriculture Organization (FAO) and United States Agency for International Development (USAID) (AFE-COHDEFOR 1996, 88-89). The forestry school, *La Escuela Nacional de Ciencias Forestales* (ESNACIFOR) was founded in 1969 to promote and expand a professionalized forestry sub-sector (*Ibid*., 127). In 1971, the *Ley Forestal* introduced ideas of multiple use, sustainability, and conservation (Sandoval, 2000, 277). In 1974, the same year that Hurricane Fifi reeked havoc in the country, Honduras formed the *Corporacion Hondureña de Desarollo Forestal* (COHDEFOR).

COHDEFOR was formed with the economic and professional assistance of Germany, the United States, and the United Nations Program for Development (AFE-COHDEFOR 1996, 39). At first, the organization focused on organizing and

managing timber resources-extraction. Eventually, conservation programs led to 24% of the country being put under a variety of forms of protected status, ranging from national parks to forest reserves to inhabited forest areas with regulations on their use (Sandoval, 2000, 279; AFE-COHDEFOR, 1996, 150-153). However, the twenty years that saw the growth of concerns with forests also saw a net loss of forest cover, practically all of it broadleaf forest (Sandoval, 2000, 279). Pine forest cover remained essentially unchanged.

Table 3
Forest Cover in Honduras, 1962-2001

Year	*Forest Cover (km²)*
1962	71,088
2001	59,896
2010	46,500

Source: AFE-COHDEFOR, 1996; Instituto Nacional de Estadística, 2002; Nationmaster, 2010.

With neoliberal economic restructurings of the 1990s, COHDEFOR received different degrees of influence over a significant portion of Honduras' land, public and private. By the end of the decade, the organization wielded considerable control over state land and maintained a certain authority over private forest use as well. Honduras established the *Secretaría de Estado en el Despacho del Ambiente* in 1993. In the same year, the Congress passed laws that, officially at least, assured the protection of the environment and guaranteed that forests would be protected, managed, and, if need be, replanted, formally 'concretizing' the growing concern with the environment (*Ibid*., 280-284). The extractive enterprise of much Honduran forestry was met with different results, according to residents. Some saw it as appropriation of their resources. Tucker's work in La Campa, Lempira shows the intricate detailed and often dramatic way that the policies unfolded on the ground, and how people responded (2008) (Figure 6).

Conclusion

Though broad-scale pathways do appear to help explain landscape transitions in many places and many cases, the complex mosaics of processes and decisions that help shape landscapes are, again, likely as complicated as the patterns of vegetation increases observed in the photograph sets that inform this study. In fact, nearly all of the processes associated with all five proposed pathways to transition are likely to often be at work together at the same time in many places.

A

B

Figures 6. **A** (1957) and **B** (2010). La Campa, Lempira. South of Gracias, La Campa has been the focus of intense scholarly work by anthropologist Catherine Tucker (2008), who has sought to understand the complex arrays of processes that shape environmental conditions and forest cover in the area.

Conceptual pathways to forest transition seek to elucidate primary affective processes. In this study, the *smallholder tree-based intensification path* explains more increases in tree cover across more of the repeat photograph sets than any other. This, again, can be related to many factors and result in a variety of vegetation increases such as some forms of agroforestry, windbreaks, woodlots, etc. Many of the increases observed in Honduras, previously described using the categories *spontaneous dense* and *random scattered* stands, are perhaps as complex and varied as the processes included in the smallholder intensification category.

As populations grow and gain increasing access to more and more information, communication and transportation opportunities, economic options and activities, conservation ideals, land use, and settlement patterns are all changing, influencing each other as well as landscape conditions across the world. Honduran landscapes contain material manifestations of a remarkably high number of different processes seen to shape environmental conditions. Increases in vegetation that are occurring in such varied arrangements and places are reflections of the many reasons that are behind them. Seeing this at the scale of oblique photography allows a more intimate perspective on an issue typically informed by more distant imagery or maps that use coarse data relative to the types of changes seen in many places. This more humanized scale also perhaps offers more insight into the true complexity of understanding what we are up to and how it shapes our landscapes.

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