REVIEW

Deforestation, Swidden Agriculture and Philippine Biodiversity

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t once if projected decade. is the thought forested. current that Forest that no rate This forest destruction about of has deforestation cover 90% now of has shall been Philippine occurred remain reduced is land area was to <20% and, maintained, it is within the next in two steps,

et al. 2004). Unfortunately, a common feature of biodiversity- related research conducted in the Philippines is that most of it goes unpublished. Alcala (2004), for example, states that of 131 funded studies conducted from 1998 to 2003, 17% yielded publications and only 7% resulted in submissions to peer- beginning with logging, followed by various forms of swidden

reviewed journals. Because scientific findings announced in the cultivation. We examined the literature in search of data with

popular press often never make it into refereed scientific which to test the hypothesis that swidden cultivation is “not bad”

journals, the absence of expert peer-review and the lack of for biodiversity in the Philippines. The great biodiversity and

access to research methodology and results raise the issue of endemism of forest flora and fauna are such that, in most cases,

credibility. A recent article in a prominent, national newspaper number and kinds of species in the swidden do not adequately

entitled “Who says kaingin is bad?” (Fernandez 2009) asserts, substitute for what is lost in the course of forest destruction.

based on a study sponsored by the Philippine Council for However, studies comparing forest and swidden biodiversity

Agriculture, Forestry and Natural Resources Research and have been inadequate and have failed to consider ecosystem

Development (PCARRD), that swidden farming (also known as function and services. Because many indigenous and endemic

“shifting agriculture”, “slash and burn farming” or “kaingin”) is species evolved as forest specialists, the continued deforestation

“not really that destructive” and “promotes plant diversity, of the Philippines shall likely lead to their extinction. The

preserves indigenous plant varieties, and provides organic valuation of ecosystem services provided by Philippine forests

fertilizer and food for some biotic components of the may yet reveal that the benefits derived from their conservation

ecosystem”. Such announcements and generalizations by the would greatly exceed those currently derived from their

news media have the potential to influence public perception and destruction.

behavior as well as to change government policy. Given how little forest cover remains in the Philippines, widespread INTRODUCTION

acceptance of claims concerning the benign nature of kaingin can have potentially catastrophic consequences. The Philippines is considered to be a biodiversity “hotspot” of high species richness and endemism (Myers et al. 2000, Sodhi

Here, we examine the process of deforestation and the context in which kaingin has been practiced in the Philippines.

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We then consider their impacts on biodiversity. Our intention is to determine whether there is empirical support for the ecological hypothesis that kaingin is “not bad” for biodiversity, while taking into account both the context in which biodiversity is defined as well as its importance. Although some may question the need to document what may seem obvious, we argue that a scientific, evidence-based approach to this issue is

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Deforestation both timely and necessary, as well as of heuristic value.

and Kaingin in Context The decline in Philippine forest cover is associated with an History of Philippine Deforestation

increase in the area devoted to agriculture, indicating that much According to a recent review (Bankoff 2007), about 90% of

of the deforested areas were converted to agricultural production land area was covered with forest at the commencement of

(Dobson et al. 1997, Sajise et al. 1992). A landmark in studies Spanish colonization of the Philippines in the 16th century.

of Philippine deforestation and kaingin is the work of Kummer Logging during 3 centuries of Spanish rule reduced this to 70%,

(1992a) that documents how, during the postwar period, while half a century of American and Japanese occupation led to

majority of Filipinos remained poor and did not benefit from further reduction that left the newly independent Republic with

economic growth. Wealth, political power and control of about 50% forest cover by 1950. The decline in forest cover

resources became increasingly concentrated in the hands of the occurred while the human population increased from less than a

minority elite. During this period, substantial areas of primary million in the 1500s to about 20 million in 1950. Since then, the

forests were rich in dipterocarp species that were highly valued population has increased almost 5-fold and now exceeds 90

and in great demand overseas. The Philippine government - the million (National Statistics Office, Republic of the Philippines,

largest landowner in the country - granted legal permission to 2010). Recent journal articles quote estimates of remaining

harvest logs to a limited number of wealthy concessionaires. forest cover as low as 17-18% of total land area (Briones 2007;

However, there was so much corruption and inefficiency in the Moya and Malayang 2004, Posa and Sodhi 2006). Of the

regulation of logging that this became a virtually unregulated approximately 6 million hectares of forest remaining, less than 1

activity. After concessionaires harvested dipterocarp trees from million consists of primary forest (Lasco et al. 2001). According

primary forest areas, they left logging roads and secondary to the FAO, the country has one of the highest rates of

forests behind. The poor, who lacked employment opportunities deforestation in the world and, if the current rate is maintained,

in the lowlands, migrated into the upland areas where they cut no significant primary forest cover can be expected to remain

down secondary forests and practiced kaingin. There were within the next decade (Remollino 2004) (Figure 1).

periods during which such migration was encouraged by the

Figure 1. Philippine forest cover in hectares (ha) over time, redrawn from Moya and Malayang (2004) with permission from the publisher. The rate of forest loss greatly accelerated from about the late 1960s to the late 1980s, consistent with the hypothesis that political and socioeconomic factors account for much of postwar deforestation (Cuevas 1991; Kummer 1992a). A useful exercise is to determine which colonial power ruled and which president was in office as the deforestation rate varied.

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critical government, allowing kaingin to serve as a “safety valve” that

population density, it becomes necessary to increase the relieved pressure to undertake much-needed socioeconomic

period of cultivation and to decrease the period of fallow. This reform. There is evidence of deliberate manipulation of forestry

initiates a vicious cycle because of the resulting progressive data concerning the extent and rate of deforestation (Kummer

declines in soil quality and crop yield. More land is cultivated in 1995). Such misinformation allowed blame to be shifted to the

an attempt to maintain total yield, leading to the degradation of poor. In reality, logging, followed by agriculture, are

even more land. Thus, when large numbers of lowlanders are inseparable as parts of a two-step process that resulted in

forced by adverse socioeconomic conditions to migrate to the postwar deforestation in the Philippines. While the

uplands to practice kaingin, negative environmental impacts are concessionaires and their partners in government have been

not unexpected. Even among various indigenous groups, the motivated primarily by financial gain, those who practice

pressure to increase productivity in response to increased kaingin have done so just to survive. The human dimensions of

population size results in the low sustainability of their kaingin kaingin in the Philippines are subjected to detailed analysis in a

(Cuevas 1991). fine review by Cuevas (1991) who concludes, as Kummer (1992a) does, that Philippine deforestation and kaingin can be

Kummer (1992b) summarizes empirical evidence fully understood only in the context of socioeconomic and

supporting the view that most forms of upland agriculture political conditions in the country (Figure 1). Among the

practiced in the postwar period, referred to loosely as kaingin, outcomes of commercial logging and migration of lowlanders to

actually involve sedentary agriculture. Now that the primary upland areas is the socioeconomic marginalization and

forests are mostly gone, what little forest remains is considered detribalization of indigenous groups (Cuevas 1991, Eder 1990).

as mostly secondary growth and this is where most kaingin is currently practiced (Lasco et al. 2001, Viloria et al. 2005). The Types of Kaingin

view that most migrants to the uplands actually practice It is necessary to recognize that the term “swidden

sedentary (rather than shifting) agriculture is supported by the farming”, often used by social scientists and commonly called

work of other researchers, e.g., Viloria et al. (2005) in Mindanao “kaingin” in the Philippines, encompasses a variety of

and Lawrence (1997) in Leyte and Bohol. The latter conducted agricultural practices with differing environmental effects

a detailed examination of the agricultural practices of 6 (Cuevas 1991, Kummer 1992a, Russell 1988). As traditionally

communities. Depending on the site, there may have been practiced worldwide, swidden farming involves the cutting

commercial logging or the cutting down of trees for local use down and burning of plant growth, followed by the planting and

preceding agricultural activity. There may have been crop harvesting of crops. Farming is conducted until soil fertility is

rotation, short periods of fallow or the burning of fallow. exhausted and the swidden farmers move on to other areas. In

However, the practices at these sites differ significantly from the this condition, the fields are left fallow for a sufficient period

shifting agriculture characteristic of the traditional, more until soil fertility and vegetative growth return. This makes

environmentally-benign forms of kaingin, as traditionally possible significant recovery to its original state and repetition of

practiced by indigenous people at low population density. the cycle of “slash and burn” (Noble and Dirzo 1997, Russell 1988). Relatively benign forms of kaingin have been described

In this article, we accept a loose definition wherein the term as practiced by indigenous people in the Philippines, e.g., Igorot

kaingin is applied to a broad spectrum of agricultural practices in the Cordillera (Kowal 1966), T’boli in Cotabato (Hyndman et

that are part of (or follow) the process of forest destruction. al. 1994), and Hanunoo in Mindoro (Russell 1988). Regarding

Despite variation in the manner in which it is practiced, kaingin the latter, Russell (1988) states “The system is often practiced

has been and remains an integral part of the process of forest with great sophistication. The Hanunoo people, for instance, of

destruction in the Philippines. Mindoro Island in the Philippines are expert botanists and ecologists (Conklin 1957). Their soil classification stands up to

Effects on Floral Biodiversity modern scientific analysis. They know all about slopes, erosion,

The Philippines is endowed with many plant species, and the value of litter as mulch. They can recognize 1600

majority of which are endemic (Sodhi et al. 2004) (Figure 2). different kinds of plants (including varieties as well as species)

An excellent starting point in attempting to appreciate tree and treat them all differently and appropriately, and they

biodiversity in Philippine forests is the recent work of Co et al. cultivate more than 400 kinds of plants in the swidden, a

(2006) on a 16 hectare plot in a mixed dipterocarp forest in veritable botanic garden.” The Hanunoo are said to till a given

Palanan, Isabela. 78,205 trees were counted; 323 species plot for only 2-4 years, leaving it fallow for 8-10 years to allow

belonging to 160 genera and 67 families were identified. The regeneration of soil and forest vegetation. Performed in this

family Dipterocarpaceae, represented by 10 species, accounted way, kaingin can be regarded as superior to traditional

for 50% of basal area. Biodiversity is usually measured as agriculture because, despite low yield per unit area, it protects

species richness in a community or ecosystem. Recognizing the the soil and requires no fossil energy-based inputs such as

confounding effects of statistical artifacts, e.g., resulting from commercial fertilizer, herbicide or insecticide. However,

variation in sample size, ecologists have developed various kaingin is only sustainable at low population density because of

metrics for species richness. One metric is Fisher’s α (Fisher et the need for free access to large areas of land. Beyond the

al. 1943), computed from S, the total number of species and N,

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by the total number of individuals, according to the equation S = α

regeneration of at least some dipterocarp species. However, log [1+N/α]. Co et al. (2006) estimate Fisher’s α = 43.19 in their

these results as well as data from other Southeast Asian plot which, although lower than the values for other equatorial

countries demonstrate that the return to pristine conditions is a tropical forests in Southeast Asia, is the highest reported in the

slow process (Sodhi et al. 2004). The primary forests described Philippines. In contrast, a study of a 1 hectare submontane

above represent productive, protective and sustainable tropical rainforest plot in Negros (Hamann et al. 1999) yielded

ecosystems where the interactions of different components are 92 species, 54 genera and 39 families. Species richness was

manifested as biodiversity. By virtue of the interactions among high (metrics other than Fisher’s α were used); no species or

components, desirable characteristics and ecosystem services are family dominated over others in relative abundance, and

manifested. numerous rare species populated the Negros plot. Given the dominance of secondary growth in what remains of Philippine

Although Fisher’s α values of kaingin plots in the forest cover, it is instructive to examine results obtained from

Philippines are unavailable, the cultivation of “400 kinds of Mt. Makiling, Laguna. Using data from Brown (1919), who

plants in the swidden” by the Hanunoo (Russell, 1988) suggests studied a 0.25 hectare plot of primary forest, Luna et al. (1999)

that this indigenous group had evolved an agricultural practice estimate that dipterocarp species accounted for 8.6% of basal

that promoted a high degree of biodiversity. But this was a area and Fisher’s α = 28.2. For comparison, Luna et al. (1999)

sustainable form of kaingin, practiced at low population density. studied a 4 hectare site that had recovered for 50 years after

When kaingin is practiced at high population density with short having been logged. They counted 179 species of trees, 4

periods of fallow, or when it is practiced as sedentary dipterocarp species that accounted for 2% of basal area, and

agriculture, the outcomes would be expected to be different. estimated Fisher’s α = 39.5, a value close to that reported by Co

Indeed, Briones (2007) lists biodiversity loss, along with et al. (2006) in Palanan. While the results from Palanan and

accelerated soil erosion and river sedimentation, among the Negros illustrate that Philippine primary forests have high

negative impacts of kaingin. The process of biodiversity loss is species richness, those from Mt. Makiling demonstrate how,

described by Russell (1988) as follows: when periods of given enough time, secondary forests can recover to levels of

cultivation last only 10-20% of the total cycle in sustainable species richness similar to those of primary forests, accompanied

swidden agriculture (in some cases, fallow periods last 30 years),

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Figure 2. Number of plant, amphibian, reptile, bird, mammal species, and number of endemics, redrawn from Sodhi et al. (2004) with permission from the publisher. Bars indicate % of species that are endemic to the Philippines. At the right of each bar, the first number in parenthesis is the total number of species; the second is the number of endemics. Many species evolved as forest specialists, given that about 90% Philippine land area was once forested. Because many of these species are endemic, i.e., found nowhere else in the world, loss of forest cover is considered likely to lead to their global extinction.

number forest vegetation has sufficient time to regenerate and the soil

of threatened endemic birds throughout Southeast Asia. recovers before farmers return to slash, burn and cultivate again.

In the Philippines, however, the number of species listed as However, prolonged periods of cultivation and insufficient

threatened exceed the estimate based on the species-area periods of fallow result in soil erosion and depletion of nutrients

relationship by 2-fold; thus, loss of forest area alone is not a so severe that when the site is abandoned (for lack of

sufficient mechanistic explanation. An additional explanation productivity), forest regeneration does not occur. Instead, a

offered is that majority (78%) of endemic bird species in the common scenario involves invasion by grasses. Two tough

Philippines inhabit lowland forests where most deforestation has grasses of the genera Imperata and Hyparrhenia already covered

occurred and these are highly fragmented and degraded. As a 40% of the Philippines in 1966 (Russell, 1988). Because grasses

result, more species are threatened than declining habitat area are inferior to forests in holding the soil and restoring fertility,

alone would predict. further soil degeneration occurs and the traditional, sustainable kaingin cycle stops. This process is illustrated by the following

Tropical forests are complex habitats that offer many example: based on studies of communities engaged in kaingin in

ecological niches to which various species have become adapted Northern Luzon, Wallace (1996) estimated an average per capita

over evolutionary time. Habitat complexity and the specialized consumption of 1.53% of a hectare of secondary forest per year.

niches available to animals are lost due to deforestation. In a Deforestation was followed by invasion of Imperata cylindrica

study on 9 forest fragments in Southwestern Negros, Alcala et (commonly known as cogon). He states that if kaingin is

al. (2004) estimate a 16-25% loss (local extinction) of reptile and practiced in secondary forest and sufficient period of fallow is

amphibian species over the past 50 years. Loss of canopy cover, allowed, the forest can regenerate. However, if cogon moves in,

loss of epiphytes that provide microhabitats for some species, it renders the land “useless”, a process he observed in many

lower relative humidity and elevated substrate temperature were parts of the Cagayan Valley over a 30-year period. Cogon

identified as proximate contributors to biodiversity loss, along produces a phenolic compound that may be allelopathic (Koger

with forest fragmentation and edge effects. and Bryson 2004, Sajise and Lales 1975). Together with competition for space, soil nutrients and light, allelopathy could

A study of 21 species of Philippine raptors (Gamauf et al. play a role in preventing forest vegetation from becoming

1998) revealed that 13 preferred forest cover of > 50% and 8 reestablished. Sajise et al. (1976) also showed that Imperata-

preferred open habitats. Morphological traits were analyzed in dominated areas become fire-prone and that fire promotes the

relation to habitat and foraging mode. Among the forest competitive dominance of this grass species. If fire becomes a

dwellers, 4 species hunted below while 9 hunted within and dominant and regular disturbance factor, Imperata cylindrica

above the forest canopy. Below-canopy forest hunters tended to becomes a “disclimax species”, promoting the establishment of

have smaller bodies, low aspect ratio (length2/area) wings, high an Imperata-fire-Imperata cycle. This cycle prevents forest

wing-loading (body mass/wing area) and were adapted for “sit regeneration and has made reforestation efforts with weak fire

and wait” hunting modes in dense vegetation. High wing prevention measures ineffective.

loading tends to increase the energetic cost of flight, so this mode of hunting involves much sitting and waiting, with Effects on Faunal Biodiversity

sporadic bursts of high-speed pursuit for short durations. The Philippine forests are renowned for having among the

open area species tend to have larger bodies, higher aspect world’s highest levels of faunal biodiversity and endemism (see

ratios, lower wing loading, and are adapted for long-distance reviews by Persoon and van Weerd 2006, Sodhi et al. 2004).

flight and active searching. The above-canopy hunters possess Taking into account vertebrate animals only, there are as many

features that represent a compromise between the need to perch as 176 mammal, 576 bird, 258 reptile, and 101 amphibian

high and soar above the canopy versus the need to dive into the species, large fractions of which are endemic (Figure 2). The

forest in pursuit of prey. Thus, although they tend to have larger country’s 5.7 endemic vertebrate species per 100 km2 of forest is

bodies than the below-canopy hunters, their wings tend not to be surpassed only by endemism in the coastal forests of Tanzania

as long as those of open area species. The authors point out that and Kenya; but, along with high levels of endemism, the

as forest cover declines, the specialized forest dwellers are Philippines has the greatest number of threatened vertebrate

constrained by the suite of traits that make them effective forest species per unit area in the world (Myers et al. 2000, Persoon

hunters; i.e., these features make them ineffective at making a and van Weerd 2006).

living in open habitat.

Given that most species of animals evolved and became

The 60 or so known species of endemic Philippine rodents adapted to the islands when 90% of total land area was covered

are hypothesized to have descended from only a handful of by forest, habitat loss through deforestation is easily seen as one

ancestral species that underwent adaptive radiation as they of the major drivers of biodiversity loss. If the relation between

spread to other islands (Rickart et al. 2005, Steppan et al. 2003). species number and habitat size is known, it should, in principle,

As in the case of frogs, reptiles and birds, mammalian forest be possible to predict the effect of reduced habitat size on the

specialists are threatened by deforestation in various areas of the number of species. Applying this approach, Brooks et al. (1997)

Philippines, e.g., Palawan (Esselstyn et al. 2004) and Mt. found that degree of deforestation can be used to predict the

Katinglad in Bukidnon (Heaney et al. 2006).

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ecosystem In Bohol and Leyte, farmers in low-income communities

function and properties providing for sustainability practicing kaingin (mainly sedentary) showed recognition of

and ecosystem services. Simply counting species and estimating some of the problems brought about by their agricultural

population sizes does not consider these. practices; a survey revealed that they planted 24-35 species and protected 39-62 native tree species per village (Lawrence 1997).

In the Mount Makiling area, biodiversity was compared Whether (and to what extent) the replanting of trees might be

between primary and mid-montane forest, Imperata-Saccharum beneficial is an empirical question. A study conducted at Subic

grasslands, and shifting upland cultivation (Sajise et al. 2005). Bay (Posa and Sodhi 2006) where 26 bird species occur revealed

The shifting cultivation area is characterized as a combination of that 100% forest cover is required for all 26 species to be

perennial fruit trees and annual crops where the annual crops are present; 24 of 26 species of birds require 60% of forest cover,

shifted on a cyclical basis while the perennials are more or less while none remain when cover is less than 35%. In the Cagayan

left in place. The study indicated that plant biodiversity values Valley, a study of 11 sites (Van Weerd and Snelder 2008)

of this type of shifting cultivation area were as high as the showed the presence of 58 species of birds and 16 species of

primary mid-montane forest (Sajise et al. 2005). The bats. However, these represent “only 13 percent of lowland

combination of natural dispersal of surrounding forest vegetation forest birds, 15 percent of endemic lowland birds and eight

and the species of crops introduced by farmers resulted in high percent of threatened lowland birds known to occur in the

plant diversity. However, this type of biodiversity in swidden region” and “44 percent of all lowland bats, 42 percent of

cultivation and in a forest differ significantly in terms of endemic bats and 29 percent of forest bats in the region”. Most

functional attributes for carbon sequestration, soil and water species were found to occur only in areas bordering the forest.

conservation and many other ecological services. Biodiversity, The authors conclude that “the human-altered landscape fails to

measured in terms of its specific components does not take into serve as an alternative for closed-canopy forest habitat”.

account the totality of interactions among various ecosystem components. These interactions should be understood in the Measuring and Comparing Biodiversity

context of the ecosystem’s interactions with the social system Given the global mass-extinction event that humans are

and its components (Dove et al. 2005). currently causing (Pimm et al. 1995) as well as the imminent disappearance of Philippine forests and the consequent

How ecosystem function should be measured, how many extinctions likely to result, number and kinds of species, as well

species are required for an ecosystem to be stable and resilient, as population sizes are appropriate metrics with which to

and how ecosystem services should be assigned value are still measure biodiversity as well as to test ecological hypotheses

developing, active areas of research (Balmford and Bond 2005). concerning the effects of deforestation and kaingin on Philippine

Ultimately, an issue Filipinos must confront is whether artificial biodiversity. Such data have led to widespread recognition that

communities, consisting of mostly exotic species, can be the Philippines is a center of great biodiversity and endemism.

considered acceptable substitutes for forest ecosystems that have Much less abundant and often much less quantitative are studies

existed for millennia. The valuation of ecosystem services of biodiversity at sites where various forms of kaingin are

(Costanza et al. 1997) may prove to be a useful conservation practiced. Thus, when newspaper (e.g., Fernandez 2009) or

tool, given the need to formulate policy, provide for human journal articles report high biodiversity, a number of issues arise.

needs, and conserve what biodiversity remains. For example, High, compared with what? In a study conducted by Caringal

recent application of this approach revealed that the conservation and Panganiban (2008), secondary forest, consisting of “27 tree

or selective utilization of a Sumatran forest would more greatly species belonging to 22 genera and 15 families” was cleared to

benefit a broad range of stakeholders than deforestation. The make way for the cultivation of “53 species in 52 genera

value of benefits derived from either scenario would exceed distributed to 30 families”. Further breakdown reveals that these

those derived from deforestation by more than $2 billion over a consisted of “at least 10 species and 6 families of vegetables, 7

30 year period (van Beukering et al. 2003). species and 6 families of root crops, 13 fruit trees by 10 families, 5 species of legumes and pulses under 2 families, 7 spices under

CONCLUSIONS 4 genera and 3 families, 4 forage and pasture species belonging to 3 families and 7 species of valuable crops”. Taking into

Although we have not attempted an all-inclusive review of account both the number and kinds of species, it is reasonable to

the existing literature, we have used published information from ask whether kaingin, in this example, is truly as benign as

multiple disciplines to evaluate the combined effects of claimed with respect to biodiversity. First, the comparison is

deforestation and kaingin on Philippine biodiversity. Based on between cultivated sites and secondary forest with only 27 tree

the work of social scientists, deforestation and kaingin are seen species (no other diversity metric is reported). Second, many of

as integral parts of the process of forest destruction, best the cultivated species are exotic plants, raising the issue of

understood in the context of socioeconomic conditions and whether, for example, tomatoes originating from South America

politics in the country. Available scientific evidence concerning (Jenkins 1948) are ecologically equivalent to the indigenous or

both number and kinds of species leads to our rejection of the endemic forest species displaced. Third, comparisons must

null hypothesis that deforestation, accompanied by kaingin, is associate biodiversity levels with ecosystem attributes including

“not bad” for Philippine biodiversity.

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ACKNOWLEDGEMENTS Certainly, different forms of kaingin have been practiced. At the most benign end of the continuum of practices is the kaingin of indigenous people, sustainable at low population

We thank Virginia C. Cuevas, Daniel C. Suarez and density. At the most destructive end are many of the current

Agripina C. Suarez for valuable input. R.K. Suarez thanks the practices of lowland Filipinos who, as victims of social and

US National Science Foundation (IOB 0517694) for research economic inequities, have become an invasive species of the

support. forests. At population densities higher than critical limits, they practice various forms of kaingin that cause severe erosion, loss

REFERENCES of soil nutrients, damage to watersheds, loss of floral and faunal biodiversity. Between these two extremes are the more benign

Alcala AC. Biodiversity research in the Philippines from agricultural practices that are said to increase plant biodiversity,

1998-2003. ASEAN Biodiversity 2004; 4: 26-31. favor the growth of native trees, minimize erosion and protect

Alcala EL, Alcala AC, Dolino CN. Amphibians and reptiles in watersheds. However, the ecosystem attributes of these types of

tropical rainforest fragments on Negros Island, the agricultural practices have not been sufficiently or holistically

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254-261. Balmford A, Bond W. Trends in the state of nature and the From the perspective of conservation biology, the

implications for human well-being. Ecol Letts 2005; 8: Philippines, because of its status as a hotspot of biodiversity and

1218-1234. endemism, could soon become a major contributor to the

Bankoff G. One island too many: reappraising the extent of currently unfolding global mass extinction event. It is

deforestation in the Philippines prior to 1946. J Historical reasonable to expect the extinction of many forest species within

Geography 2007; 33: 314-334. the next decade if the current rate of habitat loss through

Briones ND. Environmental sustainability issues in Philippine deforestation, followed by kaingin, continues. However, in

agriculture. Asian J Agriculture and Development 2007; 2: considering biodiversity loss and its consequences, it is

67-78. important to distinguish between the “global extinction” that the

Brooks TM, Pimm SL, Collar NJ. Deforestation predicts the remaining Philippine endemic species have, thus far, avoided

number of threatened birds in insular Southeast Asia. and “local extinctions” that have probably been widespread due

Conservation Biol 1997; 11: 382-394. to massive habitat loss throughout the country. Of great

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Bureau of Print, 1919: 1-434. extinction” (Estes et al. 1989), i.e., the idea that reduction in

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Luzon Island. J Nature Studies 2008; 7: 193-202. between population size and ecological function may be non-

Co L, LaFrankie J, Lagunzad D, Pasion K, Consunji H, linear such that, as population size declines, function is largely

Bartolome N, Yap S, Molina J, Ferreras U, Davies S, lost before the species becomes rare (e.g., McConkey and Drake

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Integrative and Development Studies, University of the respective thresholds to the point of ecological extinction.

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system of shifting cultivation in the Philippines. Rome: socioeconomic factors, politics and biology are complex; this

Food and Agriculture Organization of the United Nations, makes the prevention of biodiversity loss an extraordinarily

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