Conservation Letter

J. Raptor Res. 55(3):460–467

Conservation Letter: Deforestation—The Philippine Eagle as a Case Study in Developing Local Management Partnerships with Indigenous Peoples

J Kahlil Panopio
Haribon Foundation for the Conservation of Natural Resources, Incorporated, 100 A. de Legaspi St., Barangay Marilag, Quezon City, 1109 Philippines

Marivic Pajaro
Daluhay—Daloy ng Buhay, Incorporated, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Juan Manuel Grande
Colaboratorio de Biodiversidad, Ecología y Conservación, Instituto de Ciencias de la Tierra y Ambientales de La Pampa, Consejo Nacional de Investigaciones Científicas y Técnicas de Argentina, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina

Marilyn Dela Torre, Mark Raquino, and Paul Watts[1]
Daluhay—Daloy ng Buhay, Incorporated, and Dumagat Tribe of San Luis, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Key Words: *Philippine Eagle*; Pithecophaga jefferyi; *climate change*; *deforestation*; *Indigenous Peoples*; *Philippines*; *Southeast Asia*; *traditional knowledge*.

Deforestation and Raptors

Deforestation is one of many aspects of habitat loss and fragmentation that is negatively affecting raptor populations globally. This Conservation Letter provides a scientific review of deforestation's effects on raptors, highlighting lessons learned and potential solutions. This letter is not intended as an exhaustive literature review. Rather, the intent of the Raptor Research Foundation (RRF) is to provide evidence-based examples of deforestation's impacts on raptors so that readers can appreciate the scope and prevalence of the issue, understand some of the challenges associated with addressing deforestation's impacts on raptor populations, and gain insight from an example of how including local Indigenous communities in forest management can benefit raptor populations.

Although deforestation discussions are most often concerned with climate change and biodiversity, the impact on raptor conservation is profound and that linkage has the potential to create partnership synergies for conservation and sustainability. Sandker et al. (2017) estimated global deforestation at 39–46% prior to 1990, and additional losses by 2005 of 7% in the tropics, 4% in the subtropics, and under 2% elsewhere. Although only 13% of the Amazon rainforest has been deforested to date (Aleixandre-Benavent et al. 2018), over 30,000 km^2 of forest are removed annually. More than other areas of the globe, Asia has experienced a recent four-fold increase in deforestation rates (Rosa et al. 2016). In Southeast Asia, where we highlight the Philippine Eagle (*Pithecophaga jefferyi*) as a case study, deforestation has exceeded 90% (Ong et al. 2002).

In a significant proportion of the world's ecologically intact forest landscapes, deforestation is initiated by direct local and/or Indigenous attempts to mitigate protein-food and financial insecurity (Arroyo-Rodríguez et al. 2020), which can be both acute and chronic, even in North America (Sarkar et al. 2019). Specifically, Geist and Lambin (2002) determined that 96% of global deforestation is linked to agricultural expansion driven by local synergies of economics, institutions, technology, culture, and demographics. Curtis et al. (2018) recognized the significance of global forest practice issues but emphasized specific tropical deforestation drivers of commodity-driven agriculture expansion, including row crops, palm oil production, and cattle grazing. Although urban sprawl pressures agricultural expansion into forest areas (van Vliet 2019), urban sprawl does not explain much of the deforestation occurring globally; this knowledge gap underscores the

[1] Email address: pdwatts52@gmail.com

need to understand localized deforestation drivers (Geist and Lambin 2002, Jung and Polasky 2018). Strategies that advocate the use of raptors as indicator species (Björklund et al. 2020) have global potential for monitoring deforestation drivers and biodiversity. As we describe below, understanding and addressing local drivers of deforestation requires the inclusion of Indigenous peoples in conservation discussions.

Effects of Deforestation on Raptor Populations. Deforestation has caused range reductions, isolations of subpopulations, reduced gene flow, extirpation and even extinction of raptors. Concepcion et al. (2018) concluded deforestation may be more detrimental to raptors than to other birds due to raptors' large home ranges and low population densities. In Africa for example, deforestation threatens the African Crowned Eagle (*Stephanoaetus coronatus*) in Uganda (BirdLife International 2018) and has reduced the habitat of many large eagles, such as the Cassin's Hawk-Eagle (*Aquila africana*) and the Ayres's Hawk-Eagle (*Hieraaetus ayresii*). In Madagascar, where 40% of the forests were removed in the 20th century, deforestation threatens the Eleonora's Falcon (*Falco eleonorae*; Kassara et al. 2017). In French Guinea, raptor presence is inversely linked to a deforestation gradient (Jullien and Thiollay 1996).

Deforestation is particularly problematic in the Neotropical region, where related range reductions have led to Critically Endangered status for the White-collared Kite (*Leptodon forbesi;* BirdLife International 2018) and the Cuban Hook-billed Kite (*Chondrohierax uncinatus wilsonii;* BirdLife International 2020). Other species with formerly vast distributions, such as the Harpy Eagle (*Harpia harpyja*), the Crested Eagle (*Morphnus guianensis*), and the Orange-breasted Falcon (*Falco deiroleucus*), have disappeared from large areas with deforestation and although they are Near Threatened globally (BirdLife International 2016, 2017a, 2017b), the latter two are extirpated or endangered at national or regional levels (Ministério do Meio Ambiente do Brasil and Aves Argentinas 2017). The loss of former range for the Harpy Eagle is at least 41% (Miranda et al. 2019), and the Crested Eagle is probably similar considering their shared habitats (J. M. Grande unpubl. data). The Orange-breasted Falcon's range reduction could be up to 30% in the Amazon Basin alone (Bird et al. 2011), but there are likely further losses in other areas such as Central America and the Atlantic forest in South America.

In Asia, home to over 40% of the world's raptor species, 36 of 41 globally threatened raptor species are found in forests (Concepcion et al. 2018). Forest raptors are more likely to be threatened than non-forest species (Thiollay and Rahman 2002, Anoop et al. 2018, McClure et al. 2018).

Mitigating Deforestation's Effects on Raptor Populations. Preventing deforestation is a primary goal in global biodiversity conservation, where partnership efficacy is increasingly recognized as being linked to local and Indigenous rights (Gavin et al. 2018, Baldauf 2020, Ogar et al. 2020). For example, the reported decline in Amazon deforestation rates between 2005 and 2010 (Rosa et al. 2016) may in part be due to broad application of forest and biodiversity conservation partnerships such as local market-driven partnerships between nongovernmental organizations (NGOs) and corporate soybean (protein) producers (Jung and Polasky 2018). Involving local/Indigenous communities can help minimize deforestation (driven by local protein insecurity) through emphasis on partitioning management zones to optimize both production and conservation (Arroyo-Rodríguez et al. 2020). Primary raptor conservation considerations include the balancing of local protein-food security with forest values and optimizing the use of Indigenous traditional knowledge. Critically, worldwide raptor conservation efforts need to focus on the preservation and expansion of current intact forest landscapes, of which 36% are on Indigenous lands (Fa et al. 2020). Considering the reforestation potential of fringe areas around these landscapes, the development of forest conservation strategies with local Indigenous People has the potential to conserve and enhance perhaps half or more of the remaining prime raptor habitat, globally.

Globally, raptors are intricately linked to many Indigenous cultures (The Peregrine Fund 2011), providing potential for collaborative conservation. For example, in India local people turned from large-scale hunting to a caretaker role (Aiyadurai and Banerjee 2020) for the Amur Falcon (*Falco amurensis*). Further, Indigenous communities have been linked to improvements in Forest Owlet (*Athene blewitti*) habitat (Yosef et al. 2010), and local conservation engagement on the White-rumped Vulture (*Gyps bengalensis*) is considered important (Pande et al. 2013). Indigenous traditional knowledge of nature also supports conservation efforts in understanding raptor migration flight paths in North America (Tedlock 2014). Sacred areas identified by Indigenous Peoples are usually associated with high levels of biodiversity and intact forest landscapes, providing important habitat for forest-dwelling raptors. For example, in Africa, sacred areas that are also intact forest landscapes are critical for the African Goshawk (*Accipiter tachiro*) and the Gabar Goshawk (*Micronisus gabar*) and are significant for other forest raptors (Kühnert et al. 2019).

The Philippine Eagle Sierra Madre Case Study

With between 82 (Bueser et al. 2003) and 500 (Luczon et al. 2014) breeding pairs, the Philippine Eagle is Critically Endangered (BirdLife International 2018b) and is a prime example of a species decimated by deforestation (Salvador and Ibanez 2006, Watson 2018). In a country with <10% of mature forest remaining (Ong et al. 2002), the majority of the Philippines' intact forest landscape is on Indigenous lands extending across and beyond Aurora Province (Fig. 1), and associated with Indigenous Ancestral Domains (De Vera 2007). The Sierra Madre Biodiversity Corridor (SMBC), the focus of this case study, is also home to four other forest raptors that could be threatened by defores-

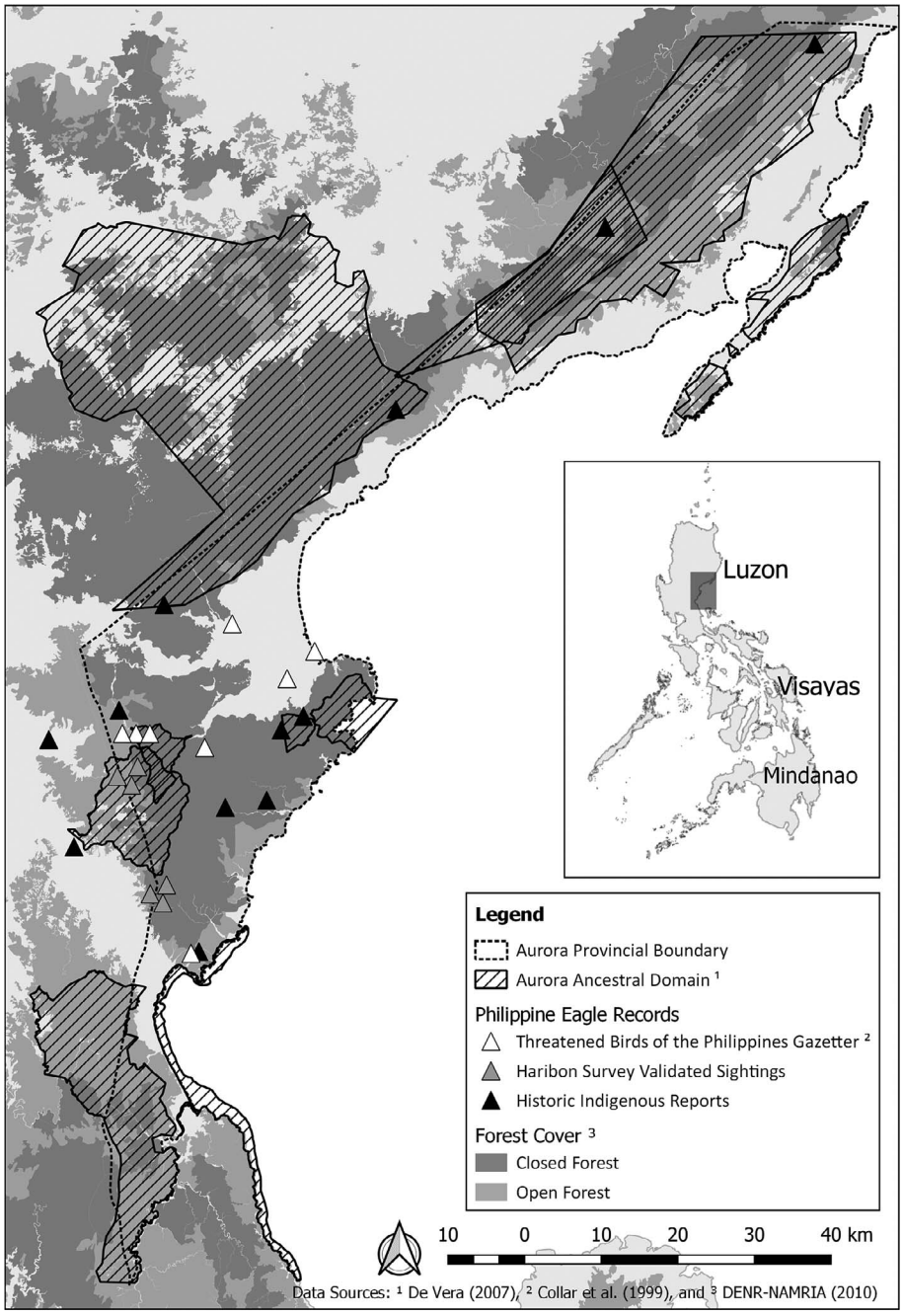

Figure 1. Philippine Eagle (*Pithecophaga jefferyi*) occurrence in the forests of the central Sierra Madre Biodiversity Corridor (SMBC). Note: DENR-NAMRIA is the Department of Environment and Natural Resources-National Mapping and Resource Inventory Authority.

tation; the Endangered North Philippine Hawk-Eagle (*Nisaetus philippensis*), as well as the more common Philippine Honey-Buzzard (*Pernis steerei*), Philippine Serpent-Eagle (*Spilornis holospilus*) and the Philippine Falconet (*Microhierax erythrogenys*; International Union for Conservation of Nature [IUCN] 2021).

Historically, commercial logging has been the primary threat to Philippine Eagle habitat. However, with a national logging ban in place (Presidential Executive Order No. 23, s. 2011), current challenges have shifted to agricultural expansion and small-scale illegal logging, even within government-run protected areas (van der Ploeg et al. 2011). The driver for these current challenges in this section of the SMBC is that Indigenous Dumagat-Alta settlements depend on forest, marine, and agricultural ecosystems for food and livelihood security. A recent report sponsored by the World Health Organization suggested that the Dumagat-Alta maternal protein intake may be as low as 20% of recommended levels (Partnership for Maternal Newborn and Child Health 2018). A coherent strategy to protect Philippine Eagle habitat must continue to consider mitigating protein insecurity in the settlements, reversing deforestation through planting and enforcement, and supporting the personal security of Forest Guards. In 2018, the Philippines was considered the most dangerous country in the world for environmental defenders, based on 30 reported homicides (Global Witness 2019). The year 2019 was even more deadly with 43 Philippine environmental defenders murdered (Global Witness 2020).

Although historic records include rare Philippine Eagle sightings in several parts of the Philippines, the breeding population is generally considered to be isolated within the southern one-third of the country, in a group of islands called the Mindanao. Deforestation in the Mindanao Islands is almost complete, and the species is supported by the Philippine Eagle Foundation through a captive breeding program. The few reported Philippine Eagle sightings in the remote SMBC mountains (Abate 1992, Abaño et al. 2016) are associated with Indigenous ancestral domains and sacred areas (Fig. 1), although the domain's inaccessibility (due to thick rainforest undergrowth and steep mountainous terrain) may mask additional nesting territories. Following documented survey strategies (Ibañez 2009), a partnership involving local guides and a Philippine NGO (the Haribon Foundation) located one new nesting territory on Mingan Mountain in the Municipality of Dingalan, near the border of Aurora Province (Fig. 1). This finding led to the development of a program called Indigenous Communities Saving the Philippine Eagle, based in the San Luis Municipality of Aurora province and involving local Indigenous settlements.

Critically, as suggested by Arroyo-Rodríguez et al. (2020), a second local NGO (Daluhay) works with the Indigenous People across the Philippine Province of Aurora to mitigate deforestation through GIS-based management that focuses on balancing protein access with agriculture (Amatorio et al. 2020). This program includes building local capacity for sustainable harvest of adjacent marine protein resources, reducing deforestation, and conducting forest restoration. A previous cycle of the Dumagat-Alta program resulted in 20 ha of reforestation involving 10,000 seedlings of threatened tree species and a localized 20% increase in marine fish protein harvest under sustainable management strategies (Daluhay 2018). A Participatory Action Research and Learning (PARL) cycle collaboration through Daluhay established the Indigenous and collaborative Save the Philippine Eagle project. This involved partnerships between local/national government agencies, settlements, and NGOs, which initiated resource assessment, forest protection, and enforcement. PARL is an iterative transdisciplinary approach to influencing policy and engaging the public while advancing development and conservation (Watts and Pajaro 2014) through four stages: Plan–Do–Evaluate–Analyze. As suggested elsewhere (Corrigan et al. 2018, Joa et al. 2018), the project began with the NGOs first learning about local conservation by considering the Indigenous perspective on values, goals, issues, strengths, weaknesses, opportunities, and threats. Traditional knowledge (historical sightings, local eagle food preferences, and preferred habitat) was combined with the ornithological expertise of the Haribon Foundation to create a local education strategy focused on resource assessments and training. The resultant collaboration verified the breeding Philippine Eagle population in the SMBC by confirming one nesting territory and initiated a certification process for local training on raptor habitat assessment and forest protection enforcement for more than 40 Indigenous Forest Guards. The program broadly supports the sustainable future of the community and the forest ecosystem. Formal local conservation plans, founded on the Philippine Eagle as an indicator species, are now recognized at various levels of government and internationally. As a result of regular monitoring and eagle sightings, surveys are now being planned to investigate a possible second Philippine Eagle nesting area. In addition, the international Forest Conservation Foundation has subsequently agreed to support an expanded long-term program titled: Philippine Eagle Ancestral Forest.

Lessons Learned: Future Conservation Directions. Raptor conservationists and NGOs can help others help raptors by including Indigenous communities. Considerations should include addressing protein insecurity as a priority in interventions on the poverty faced by local Indigenous communities, as well as Forest Guard safety and security. Adaptations within the participatory approach require both a knowledge and respect for the local context as well as conservationists being prepared to take different roles during phases of the project cycle. In the current PARL cycle, NGOs facilitated decision-making through "training while doing" and codeveloped monitoring, evaluation, and analysis regimens aimed at future priorities and potentials. The "Do" phase of this PARL cycle involved further facilitation to expand the local culture in a

reflective manner that addresses the goals of both local food security and conservation. Priority is now placed upon forest sustainability, overcoming the concept of open access to resources, and development of a legal enforcement strategy through partnerships that optimize environmental defender safety. The program led to the first ever in-forest local apprehension of illegal loggers (Daluhay 2020) through volunteer Indigenous Forest Guards who risk their lives to protect the future of their people, forests, biodiversity, and raptors.

Conservation action (Gavin et al. 2018) for raptors can be improved by including local and Indigenous rights-based designs (Ogar et al. 2020) in the Philippine Eagle habitats as outlined herein, and in other linked habitats where similar participatory programs have not yet been initiated (Hagen and Minter 2020). Local livelihoods have also been improved through limited Forest Guard honorariums and a recently initiated 500-km forest trail system designed to support ecotourism. Future goals for the program to save the Philippine Eagle include an Aurora Province-based wildlife rehabilitation center that will highlight Indigenous traditional knowledge in partnership with government. If the Save the Philippine Eagle paradigm were implemented with other Indigenous Peoples throughout Asia, raptor conservation directly focused on preventing deforestation could offer substantial benefits throughout the region, while also helping to mitigate climate change.

In the Neotropics where the loss of forest area is highest, Indigenous lands are extensive (e.g., as much as 12.5% of Brazil and up to 21% of Bolivia) and traditional knowledge of raptors has led to conservation success stories. For example, Indigenous land management has successfully protected forests from logging and deforestation more efficiently than nationally protected Neotropical areas (Schleicher et al. 2017). Furthermore, several raptor rainforest research projects have benefited from local Indigenous engagement and knowledge. Harpy Eagle nest searches and monitoring in the Cuyabeno Reserve in eastern Ecuador, in Darien in Panamá, in Infierno community in Madre de Dios, Peru, and in Reserva Forestal de Imataca in Venezuela, were effective due largely to the participation of local Indigenous communities (Álvarez-Cordero 1996, Vargas González and Vargas 2011, Muñiz 2016). The same strategies could be used to search for nests of other elusive endangered species such as the Black-and-chestnut Eagle (*Spizaetus isidori*), the Crested Eagle, or the Orange-breasted Falcon. Considering these examples, the expanded use of Indigenous partnerships to conserve raptors and combat deforestation has significant global conservation potential.

As a leading professional society for raptor researchers and raptor conservationists, the RRF is dedicated to the accumulation and dissemination of scientific information about raptors, and to resolving raptor conservation concerns (RRF 2020). Impacts of deforestation on raptor species, local settlements, biodiversity, and climate remain an ongoing conservation concern, presenting a global threat to raptor populations. Based on the science summarized herein, engaging Indigenous communities to combat deforestation and to conduct collaborative research and management while seeking sustainable solutions to address their basic needs will foster long-term co-occurrence of raptor populations with human populations.

ACKNOWLEDGMENTS

The authors thank the Raptor Research Foundation's Conservation Committee and Board of Directors for comments which improved this work. The Indigenous Communities Saving the Philippine Eagle Program co-sponsored through Daluhay and the Rainforest Trust Foundation is grateful for the support provided by the Municipalities of San Luis, Dingalan, and Gabaldon, as well as the provinces of Aurora and Nueva Ecija. Haribon thanks the EDGE of Existence Program of the Zoological Society of London and their other affiliates for their project support in the Sierra Madre Biodiversity Corridor. This initiative was also a direct result of efforts to harmonize mandates and proactive participation of federal Philippine government agencies, specifically the National Commission on Indigenous Peoples and the Department of Environment and Natural Resources.

LITERATURE CITED

Abaño, T. R. C., D. J. Salvador, and J. C. Ibanez (2016). First nesting record of Philippine Eagle *Pithecophaga jefferyi* from Luzon, Philippines. Forktail 32:86–88.

Abate, T. (1992). Into the northern Philippines rainforest. BioScience 42:246–251.

Aiyadurai, A., and S. Banerjee (2020). Bird conservation from obscurity to popularity: A case study of two bird species from northeast India. GeoJournal 85:901–912.

Aleixandre-Benavent, R., J. L. Aleixandre-Tudó, L. Castelló-Cogollos, and J. L. Aleixandre (2018). Trends in global research in deforestation. A bibliometric analysis. Land Use Policy 72:293–302.

Álvarez-Cordero, E. (1996). Biology and conservation of the Harpy Eagle in Venezuela and Panamá. Ph.D. dissertation. University of Florida, Gainesville, FL, USA.

Amatorio, R., M. Dela Torre, M. Pajaro, M. Raquino, P. Watts, and E. Zafra (2020). Egongot tribal development and an NGO as a catalyst for sustainability. Fourth World Journal 19:25–43.

Anoop, N. R., S. Babu, S. Bharathidasan, and R. Nagarajan (2018). Status of raptors in the Moyar River Valley, Western Ghats, India. Journal of Threatened Taxa 10:12317–12327.

Arroyo-Rodríguez, V., L. Fahrig, M. Tabarelli, J. I. Watling, L. Tischendorf, M. Benchimol, and J. C. Morante-Filho (2020). Designing optimal human-modified landscapes for forest biodiversity conservation. Ecology Letters 23:1404–1420.

Baldauf, C. (2020). Participatory Biodiversity Conservation: Concepts, Experiences, and Perspectives. Springer. Cham, Switzerland.

Bird, J. P., J. M. Buchanan, A. C. Lees, R. P. Clay, P. F. Develey, I. Yépez, and S. H. M. Butchart (2011). Integrating spatially explicit habitat projections into extinction risk assessments: A reassessment of Amazonian avifauna incorporating projected deforestation. Diversity and Distributions 18:273–281.

BirdLife International (2016). *Falco deiroleucus*. The IUCN Red List of Threatened Species 2016: e.T22696516A93569126. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696516A93569126.en.

BirdLife International (2017a). *Morphnus guianensis*. The IUCN Red List of Threatened Species 2017: e.T22695991A118209977. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22695991A118209977.en.

BirdLife International (2017b). *Harpia harpyja* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2017: e.T22695998A117357127. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22695998A117357127.en.

BirdLife International (2018a). *Stephanoaetus coronatus*. The IUCN Red List of Threatened Species 2018: e.T22696201A129914678. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22696201A129914678.en.

BirdLife International (2018b). *Pithecophaga jefferyi* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2018: e.T22696012A129595746. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696012A129595746.en.

BirdLife International (2018c). *Leptodon forbesi*. The IUCN Red List of Threatened Species 2018: e.T22724659A132176387. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22724659A132176387.en.

BirdLife International (2020). *Chondrohierax wilsonii*. The IUCN Red List of Threatened Species 2020: e.T22728485A181241481. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22728485A181241481.en.

Bueser, G. L. L., K. G. Bueser, D. S. Afan, D. J. I. Salvador, J. W. Grier, R. S. Kennedy, and H. C. Miranda, Jr. (2003). Distribution and nesting density of the Philippine Eagle *Pithecophaga jefferyi* on Mindanao Island, Philippines: What do we know after 100 years? Ibis 145:130–135.

Collar, N. J., N. A. D. Mallari, and B. R. Tabaranza, Jr. (1999). Threatened Birds of the Philippines: The Haribon Foundation/BirdLife International Red Data Book. Bookmark, Inc., Makati City, Metro Manila, Philippines.

Concepcion, C. B., K. L. Bildstein, N. J. Collar, and T. E. Katzner (2018). Conservation threats and priorities for raptors across Asia. In Birds of Prey: Biology and Conservation in the XXI Century (J. H. Sarasola, J. M. Grande, and J. J. Negro, Editors). Springer, Cham, Switzerland. pp. 395–418.

Corrigan, C., H. Bingham, Y. Shi, E. Lewis, A. Chauvenet, and N. Kingston (2018). Quantifying the contribution to biodiversity conservation of protected areas governed by indigenous peoples and local communities. Biological Conservation 227:403–412.

Curtis, P. G., C. M. Slay, N. L. Harris, A. Tyukavina, and M. C. Hansen (2018). Classifying drivers of global forest loss. Science 361(6407):1108–1111.

Daluhay (2018). Synergistic and Ecocentric Capacitation of Indigenous and Artisanal Sierra Madre Communities. Terminal Report, United Nations Development Program—SGP5. Baler, Aurora, Philippines

Daluhay (2020). Guardians of the forest—Success in working together. Daluhay Quarterly 5:6–7. https://daluhay.files.wordpress.com/2020/05/vol-5-2-april-2020-daluhay-q.pd.

Department of Environment and Natural Resources-National Mapping and Resource Inventory Authority (2010). Forest resources and forestry activities. In Philippine Forest Facts and Figures 2013. Forest Management Bureau-Department of Environment and Natural Resources, Quezon City, Philippines. p. 3.

De Vera, D. E. (2007). Indigenous Peoples in the Philippines: A country case study. Unpubl. report. http://www.iapad.org/wp-content/uploads/2015/07/devera_ip_phl.pdf.

Fa, J. E., J. E. Watson, I. Leiper, P. Potapov, T. D. Evans, N. D. Burgess, Z. Molnár, Á. Fernández-Llamazares, T. Duncan, S. Wang, B. J. Austin, et al. (2020). Importance of Indigenous Peoples' lands for the conservation of intact forest landscapes. Frontiers in Ecology and the Environment 18:135–140.

Gavin, M., J. McCarter, F. Berkes, A. Mead, E. Sterling, R. Tang, and N. Turner (2018). Effective biodiversity conservation requires dynamic, pluralistic, partnership-based approaches. Sustainability 10:1846. doi:10.3390/su10061846.

Geist, H. J., and E. F. Lambin (2002). Proximate causes and underlying driving forces of tropical deforestation. BioScience 52:143–150.

Global Witness (2019). Enemies of the state. London, UK. https://www.globalwitness.org/en/campaigns/environmental-activists/enemies-state/

Global Witness (2020). Defending tomorrow. London, UK. https://www.globalwitness.org/en/campaigns/environmental-activists/defending-tomorrow/

Hagen, R. V., and T. Minter (2020). Displacement in the name of development: How Indigenous rights legislation fails to protect Philippine hunter-gatherers. Society and Natural Resources 33:65–82.

Ibanez, J. C. (2009). Philippine Eagle *Pithecophaga jefferyi* breeding biology, diet, behavior, nest characteristics, and longevity estimate in Mindanao Island. M.S. thesis, Ateneo de Davao University, Davao City, Philippines.

International Union for the Conservation of Nature (IUCN) (2021). The IUCN Red List of threatened species. Version 2020–3. https://www.iucnredlist.org.

Joa, B., G. Winkel, and E. Primmer (2018). The unknown known—A review of local ecological knowledge in relation to forest biodiversity conservation. Land Use Policy 79:520–530.

Jullien, M., and J. M. Thiollay (1996). Effects of rain forest disturbance and fragmentation: Comparative changes of the raptor community along natural and human-made gradients in French Guiana. Journal of Biogeography 23:7–25.

Jung, S., and S. Polasky (2018). Partnerships to prevent deforestation in the Amazon. Journal of Environmental Economics and Management 92:498–516.

Kassara, C., L. Gangoso, U. Mellone, G. Piasevoli, T. G. Hadjikyriakou, N. Tsiopelas, and R. Silva (2017). Current and future suitability of wintering grounds for a long-distance migratory raptor. Scientific Reports 7:1–12.

Kühnert, K., I. Grass, and M. Waltert (2019). Sacred groves hold distinct bird assemblages within an Afrotropical savanna. Global Ecology and Conservation 18:e00656. doi:10.1016/j.gecco.2019.e00656.

Luczon, A. U., I. K. C. Fontanilla, P. S. Ong, Z. U. Basiao, A. M. T. Sumaya, and J. P. Quilang (2014). Genetic diversity of the critically endangered Philippine Eagle *Pithecophaga jefferyi* (Aves: Accipitridae) and notes on its conservation. Journal of Threatened Taxa 6:6335–6344.

McClure, C. J., J. R. Westrip, J. A. Johnson, S. E. Schulwitz, M. Z. Virani, R. Davies, and R. Buij (2018). State of the world's raptors: Distributions, threats, and conservation recommendations. Biological Conservation 227:390–402.

Ministério del Ambiente y Desarrollo Sustentable de la Nación and Aves Argentinas (2017). Categorización de las Aves de la Argentina Según su Estado de Conservación. Ministerio de Ambiente y Desarrollo Sustentable de la Nación and Aves Argentinas BirdLife International, Buenos Aires, Argentina.

Ministério do Meio Ambiente do Brasil (2014). Lista Nacional Oficial das Espécies da Fauna Brasileira Ameaçadas de Extinção. Brasilia, Federal District, Brazil.

Miranda, E. B. P., J. F. S. Menezes, C. C. Farias, C. Munn, and C. A. Peres (2019). Species distribution modeling reveals strongholds and potential reintroduction areas for the world's largest eagle. PLoS ONE 14:e0216323. doi:10.1371/journal.pone.0216323.

Muñiz López, R. (2016). Biología y conservación del águila harpía (*Harpia harpyja*) en Ecuador. Ph.D. dissertation. Universidad de Alicante, San Vicente del Raspeig, Alicante, Spain.

Ogar, E., G. Pecl, and T. Mustonen (2020). Science must embrace traditional and Indigenous knowledge to solve our biodiversity crisis. One Earth 3:162–165.

Ong, P. S., L. E. Afuang, and R. G. Rosell-Ambal (2002). Philippine Biodiversity Conservation Priorities: A Second Iteration of the National Biodiversity Strategy and Action Plan. Philippine Department of the Environment and Natural Resources, Quezon City, Philippines.

Pande, S., P. Mestri, P. Deshpande, A. Warange, and A. Mahabal (2013). Promising trend of in situ breeding of Oriental White-rumped Vulture *Gyps bengalensis* in Raigad District, Maharashtra, India: Conservation implications for re-introduction of ex situ populations. Journal of Threatened Taxa 5:4106–4109.

Partnership for Maternal Newborn and Child Health (2018). Multisectoral collaborations for women's, children's and adolescents' health: Country examples. https://custom.cvent.com/844E6E8B32B64D1AA32DC45C8802523C/files/23d337209a6e46e6bf66336ce8332e99.pdf.

Raptor Research Foundation (RRF) (2020). https://raptorresearchfoundation.org/about/history/.

Rosa, I. M. D., M. J. Smith, O. R. Wearn, D. Purves, and R. M. Ewers (2016). The Environmental Legacy of Modern Tropical Deforestation. Current Biology 26:2161–2166.

Salvador, D. J., and J. C. Ibanez (2006). Ecology and conservation of Philippine Eagles. Ornithological Science 5:171–176.

Sandker, M., Y. Finegold, R. D'annunzio, and E. Lindquist (2017). Global deforestation patterns: Comparing recent and past forest loss processes through a spatially explicit analysis. International Forestry Review 19:350–368.

Sarkar, D., J. Walker-Swaney, and K. Shetty (2020). Food diversity and indigenous food systems to combat diet-linked chronic diseases. Current Developments in Nutrition 4:3–11.

Schleicher, J., C. A. Peres, T. Amano, W. Llactayo, and N. Leader-Williams (2017). Conservation performance of different conservation governance regimes in the Peruvian Amazon. Scientific Reports 7:1–10.

Tedlock, B. (2014). Honoring Indigenous knowledge: Linking Native American cultural astronomy with meteorology and raptor migration. International Journal of Education and Social Science 1:123–130.

The Peregrine Fund (2011). Raptors—An Environmental Education Guide for Teachers. The Peregrine Fund, Boise, ID, USA.

Thiollay, J. M., and Z. Rahman (2002). The raptor community of Central Sulawesi: Habitat selection and conservation status. Biological Conservation 107:111–122.

van der Ploeg, J., M. van Weerd, A. B. Masipiqueña, and G. A. Persoon (2011). Illegal logging in the Northern Sierra Madre Natural Park, the Philippines. Conservation and Society 9:202–215.

van Vliet, J. (2019). Direct and indirect loss of natural area from urban expansion. Nature Sustainability 2:755–763.

Vargas González, J. de J., and F. H. Vargas (2011). Nesting density of Harpy Eagles in Darien with population size estimates for Panama. Journal of Raptor Research 45:199–210.

Watson, R. T. (2018). Raptor conservation in practice. In Birds of Prey: Biology and Conservation in the XXI Century (J. H. Sarasola, J. M. Grande, and J. J. Negro, Editors). Springer, Cham, Switzerland. pp. 373–498.

Watts, P. D., and M. G. Pajaro (2014). Collaborative Philippine-Canadian action cycles for strategic international coastal eco-health. Canadian Journal of Action Research, 15:3–21.

Yosef, R., S. A. Pande, A. P. Pawashe, R. Kasambe, and L. Mitchell (2010). Interspecific interactions of the critically endangered Forest Owlet (*Athene blewitti*). Acta Ethologica 13:63–67.

Received 26 October 2020; accepted 23 February 2021
Associate Editor: James F. Dwyer

Conservation Letter

J. Raptor Res. 55(3):460–467

Conservation Letter: Deforestation—The Philippine Eagle as a Case Study in Developing Local Management Partnerships with Indigenous Peoples

J Kahlil Panopio
Haribon Foundation for the Conservation of Natural Resources, Incorporated, 100 A. de Legaspi St., Barangay Marilag, Quezon City, 1109 Philippines

Marivic Pajaro
Daluhay—Daloy ng Buhay, Incorporated, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Juan Manuel Grande
Colaboratorio de Biodiversidad, Ecología y Conservación, Instituto de Ciencias de la Tierra y Ambientales de La Pampa, Consejo Nacional de Investigaciones Científicas y Técnicas de Argentina, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina

Marilyn Dela Torre, Mark Raquino, and Paul Watts[1]
Daluhay—Daloy ng Buhay, Incorporated, and Dumagat Tribe of San Luis, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Key Words: *Philippine Eagle*; Pithecophaga jefferyi; *climate change*; *deforestation*; *Indigenous Peoples*; *Philippines*; *Southeast Asia*; *traditional knowledge*.

Deforestation and Raptors

Deforestation is one of many aspects of habitat loss and fragmentation that is negatively affecting raptor populations globally. This Conservation Letter provides a scientific review of deforestation's effects on raptors, highlighting lessons learned and potential solutions. This letter is not intended as an exhaustive literature review. Rather, the intent of the Raptor Research Foundation (RRF) is to provide evidence-based examples of deforestation's impacts on raptors so that readers can appreciate the scope and prevalence of the issue, understand some of the challenges associated with addressing deforestation's impacts on raptor populations, and gain insight from an example of how including local Indigenous communities in forest management can benefit raptor populations.

Although deforestation discussions are most often concerned with climate change and biodiversity, the impact on raptor conservation is profound and that linkage has the potential to create partnership synergies for conservation and sustainability. Sandker et al. (2017) estimated global deforestation at 39–46% prior to 1990, and additional losses by 2005 of 7% in the tropics, 4% in the subtropics, and under 2% elsewhere. Although only 13% of the Amazon rainforest has been deforested to date (Aleixandre-Benavent et al. 2018), over 30,000 km^2 of forest are removed annually. More than other areas of the globe, Asia has experienced a recent four-fold increase in deforestation rates (Rosa et al. 2016). In Southeast Asia, where we highlight the Philippine Eagle (*Pithecophaga jefferyi*) as a case study, deforestation has exceeded 90% (Ong et al. 2002).

In a significant proportion of the world's ecologically intact forest landscapes, deforestation is initiated by direct local and/or Indigenous attempts to mitigate protein-food and financial insecurity (Arroyo-Rodríguez et al. 2020), which can be both acute and chronic, even in North America (Sarkar et al. 2019). Specifically, Geist and Lambin (2002) determined that 96% of global deforestation is linked to agricultural expansion driven by local synergies of economics, institutions, technology, culture, and demographics. Curtis et al. (2018) recognized the significance of global forest practice issues but emphasized specific tropical deforestation drivers of commodity-driven agriculture expansion, including row crops, palm oil production, and cattle grazing. Although urban sprawl pressures agricultural expansion into forest areas (van Vliet 2019), urban sprawl does not explain much of the deforestation occurring globally; this knowledge gap underscores the

[1] Email address: pdwatts52@gmail.com

need to understand localized deforestation drivers (Geist and Lambin 2002, Jung and Polasky 2018). Strategies that advocate the use of raptors as indicator species (Björklund et al. 2020) have global potential for monitoring deforestation drivers and biodiversity. As we describe below, understanding and addressing local drivers of deforestation requires the inclusion of Indigenous peoples in conservation discussions.

Effects of Deforestation on Raptor Populations. Deforestation has caused range reductions, isolations of subpopulations, reduced gene flow, extirpation and even extinction of raptors. Concepcion et al. (2018) concluded deforestation may be more detrimental to raptors than to other birds due to raptors' large home ranges and low population densities. In Africa for example, deforestation threatens the African Crowned Eagle (*Stephanoaetus coronatus*) in Uganda (BirdLife International 2018) and has reduced the habitat of many large eagles, such as the Cassin's Hawk-Eagle (*Aquila africana*) and the Ayres's Hawk-Eagle (*Hieraaetus ayresii*). In Madagascar, where 40% of the forests were removed in the 20th century, deforestation threatens the Eleonora's Falcon (*Falco eleonorae*; Kassara et al. 2017). In French Guinea, raptor presence is inversely linked to a deforestation gradient (Jullien and Thiollay 1996).

Deforestation is particularly problematic in the Neotropical region, where related range reductions have led to Critically Endangered status for the White-collared Kite (*Leptodon forbesi;* BirdLife International 2018) and the Cuban Hook-billed Kite (*Chondrohierax uncinatus wilsonii;* BirdLife International 2020). Other species with formerly vast distributions, such as the Harpy Eagle (*Harpia harpyja*), the Crested Eagle (*Morphnus guianensis*), and the Orange-breasted Falcon (*Falco deiroleucus*), have disappeared from large areas with deforestation and although they are Near Threatened globally (BirdLife International 2016, 2017a, 2017b), the latter two are extirpated or endangered at national or regional levels (Ministério do Meio Ambiente do Brasil and Aves Argentinas 2017). The loss of former range for the Harpy Eagle is at least 41% (Miranda et al. 2019), and the Crested Eagle is probably similar considering their shared habitats (J. M. Grande unpubl. data). The Orange-breasted Falcon's range reduction could be up to 30% in the Amazon Basin alone (Bird et al. 2011), but there are likely further losses in other areas such as Central America and the Atlantic forest in South America.

In Asia, home to over 40% of the world's raptor species, 36 of 41 globally threatened raptor species are found in forests (Concepcion et al. 2018). Forest raptors are more likely to be threatened than non-forest species (Thiollay and Rahman 2002, Anoop et al. 2018, McClure et al. 2018).

Mitigating Deforestation's Effects on Raptor Populations. Preventing deforestation is a primary goal in global biodiversity conservation, where partnership efficacy is increasingly recognized as being linked to local and Indigenous rights (Gavin et al. 2018, Baldauf 2020, Ogar et al. 2020). For example, the reported decline in Amazon deforestation rates between 2005 and 2010 (Rosa et al. 2016) may in part be due to broad application of forest and biodiversity conservation partnerships such as local market-driven partnerships between nongovernmental organizations (NGOs) and corporate soybean (protein) producers (Jung and Polasky 2018). Involving local/Indigenous communities can help minimize deforestation (driven by local protein insecurity) through emphasis on partitioning management zones to optimize both production and conservation (Arroyo-Rodríguez et al. 2020). Primary raptor conservation considerations include the balancing of local protein-food security with forest values and optimizing the use of Indigenous traditional knowledge. Critically, worldwide raptor conservation efforts need to focus on the preservation and expansion of current intact forest landscapes, of which 36% are on Indigenous lands (Fa et al. 2020). Considering the reforestation potential of fringe areas around these landscapes, the development of forest conservation strategies with local Indigenous People has the potential to conserve and enhance perhaps half or more of the remaining prime raptor habitat, globally.

Globally, raptors are intricately linked to many Indigenous cultures (The Peregrine Fund 2011), providing potential for collaborative conservation. For example, in India local people turned from large-scale hunting to a caretaker role (Aiyadurai and Banerjee 2020) for the Amur Falcon (*Falco amurensis*). Further, Indigenous communities have been linked to improvements in Forest Owlet (*Athene blewitti*) habitat (Yosef et al. 2010), and local conservation engagement on the White-rumped Vulture (*Gyps bengalensis*) is considered important (Pande et al. 2013). Indigenous traditional knowledge of nature also supports conservation efforts in understanding raptor migration flight paths in North America (Tedlock 2014). Sacred areas identified by Indigenous Peoples are usually associated with high levels of biodiversity and intact forest landscapes, providing important habitat for forest-dwelling raptors. For example, in Africa, sacred areas that are also intact forest landscapes are critical for the African Goshawk (*Accipiter tachiro*) and the Gabar Goshawk (*Micronisus gabar*) and are significant for other forest raptors (Kühnert et al. 2019).

The Philippine Eagle Sierra Madre Case Study

With between 82 (Bueser et al. 2003) and 500 (Luczon et al. 2014) breeding pairs, the Philippine Eagle is Critically Endangered (BirdLife International 2018b) and is a prime example of a species decimated by deforestation (Salvador and Ibanez 2006, Watson 2018). In a country with <10% of mature forest remaining (Ong et al. 2002), the majority of the Philippines' intact forest landscape is on Indigenous lands extending across and beyond Aurora Province (Fig. 1), and associated with Indigenous Ancestral Domains (De Vera 2007). The Sierra Madre Biodiversity Corridor (SMBC), the focus of this case study, is also home to four other forest raptors that could be threatened by defores-

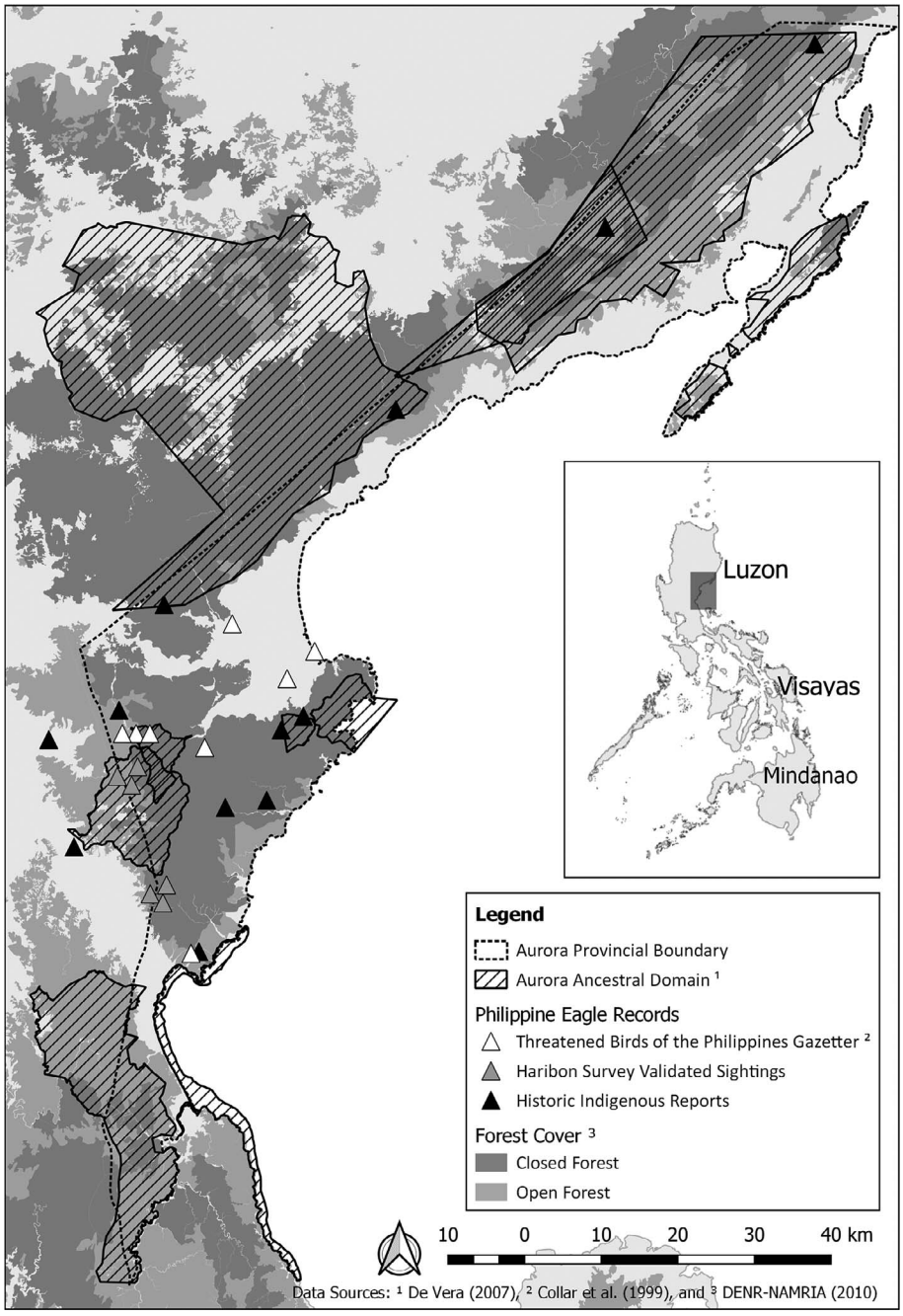

Figure 1. Philippine Eagle (*Pithecophaga jefferyi*) occurrence in the forests of the central Sierra Madre Biodiversity Corridor (SMBC). Note: DENR-NAMRIA is the Department of Environment and Natural Resources-National Mapping and Resource Inventory Authority.

tation; the Endangered North Philippine Hawk-Eagle (*Nisaetus philippensis*), as well as the more common Philippine Honey-Buzzard (*Pernis steerei*), Philippine Serpent-Eagle (*Spilornis holospilus*) and the Philippine Falconet (*Microhierax erythrogenys*; International Union for Conservation of Nature [IUCN] 2021).

Historically, commercial logging has been the primary threat to Philippine Eagle habitat. However, with a national logging ban in place (Presidential Executive Order No. 23, s. 2011), current challenges have shifted to agricultural expansion and small-scale illegal logging, even within government-run protected areas (van der Ploeg et al. 2011). The driver for these current challenges in this section of the SMBC is that Indigenous Dumagat-Alta settlements depend on forest, marine, and agricultural ecosystems for food and livelihood security. A recent report sponsored by the World Health Organization suggested that the Dumagat-Alta maternal protein intake may be as low as 20% of recommended levels (Partnership for Maternal Newborn and Child Health 2018). A coherent strategy to protect Philippine Eagle habitat must continue to consider mitigating protein insecurity in the settlements, reversing deforestation through planting and enforcement, and supporting the personal security of Forest Guards. In 2018, the Philippines was considered the most dangerous country in the world for environmental defenders, based on 30 reported homicides (Global Witness 2019). The year 2019 was even more deadly with 43 Philippine environmental defenders murdered (Global Witness 2020).

Although historic records include rare Philippine Eagle sightings in several parts of the Philippines, the breeding population is generally considered to be isolated within the southern one-third of the country, in a group of islands called the Mindanao. Deforestation in the Mindanao Islands is almost complete, and the species is supported by the Philippine Eagle Foundation through a captive breeding program. The few reported Philippine Eagle sightings in the remote SMBC mountains (Abate 1992, Abaño et al. 2016) are associated with Indigenous ancestral domains and sacred areas (Fig. 1), although the domain's inaccessibility (due to thick rainforest undergrowth and steep mountainous terrain) may mask additional nesting territories. Following documented survey strategies (Ibañez 2009), a partnership involving local guides and a Philippine NGO (the Haribon Foundation) located one new nesting territory on Mingan Mountain in the Municipality of Dingalan, near the border of Aurora Province (Fig. 1). This finding led to the development of a program called Indigenous Communities Saving the Philippine Eagle, based in the San Luis Municipality of Aurora province and involving local Indigenous settlements.

Critically, as suggested by Arroyo-Rodríguez et al. (2020), a second local NGO (Daluhay) works with the Indigenous People across the Philippine Province of Aurora to mitigate deforestation through GIS-based management that focuses on balancing protein access with agriculture (Amatorio et al. 2020). This program includes building local capacity for sustainable harvest of adjacent marine protein resources, reducing deforestation, and conducting forest restoration. A previous cycle of the Dumagat-Alta program resulted in 20 ha of reforestation involving 10,000 seedlings of threatened tree species and a localized 20% increase in marine fish protein harvest under sustainable management strategies (Daluhay 2018). A Participatory Action Research and Learning (PARL) cycle collaboration through Daluhay established the Indigenous and collaborative Save the Philippine Eagle project. This involved partnerships between local/national government agencies, settlements, and NGOs, which initiated resource assessment, forest protection, and enforcement. PARL is an iterative transdisciplinary approach to influencing policy and engaging the public while advancing development and conservation (Watts and Pajaro 2014) through four stages: Plan–Do–Evaluate–Analyze. As suggested elsewhere (Corrigan et al. 2018, Joa et al. 2018), the project began with the NGOs first learning about local conservation by considering the Indigenous perspective on values, goals, issues, strengths, weaknesses, opportunities, and threats. Traditional knowledge (historical sightings, local eagle food preferences, and preferred habitat) was combined with the ornithological expertise of the Haribon Foundation to create a local education strategy focused on resource assessments and training. The resultant collaboration verified the breeding Philippine Eagle population in the SMBC by confirming one nesting territory and initiated a certification process for local training on raptor habitat assessment and forest protection enforcement for more than 40 Indigenous Forest Guards. The program broadly supports the sustainable future of the community and the forest ecosystem. Formal local conservation plans, founded on the Philippine Eagle as an indicator species, are now recognized at various levels of government and internationally. As a result of regular monitoring and eagle sightings, surveys are now being planned to investigate a possible second Philippine Eagle nesting area. In addition, the international Forest Conservation Foundation has subsequently agreed to support an expanded long-term program titled: Philippine Eagle Ancestral Forest.

Lessons Learned: Future Conservation Directions. Raptor conservationists and NGOs can help others help raptors by including Indigenous communities. Considerations should include addressing protein insecurity as a priority in interventions on the poverty faced by local Indigenous communities, as well as Forest Guard safety and security. Adaptations within the participatory approach require both a knowledge and respect for the local context as well as conservationists being prepared to take different roles during phases of the project cycle. In the current PARL cycle, NGOs facilitated decision-making through "training while doing" and codeveloped monitoring, evaluation, and analysis regimens aimed at future priorities and potentials. The "Do" phase of this PARL cycle involved further facilitation to expand the local culture in a

reflective manner that addresses the goals of both local food security and conservation. Priority is now placed upon forest sustainability, overcoming the concept of open access to resources, and development of a legal enforcement strategy through partnerships that optimize environmental defender safety. The program led to the first ever in-forest local apprehension of illegal loggers (Daluhay 2020) through volunteer Indigenous Forest Guards who risk their lives to protect the future of their people, forests, biodiversity, and raptors.

Conservation action (Gavin et al. 2018) for raptors can be improved by including local and Indigenous rights-based designs (Ogar et al. 2020) in the Philippine Eagle habitats as outlined herein, and in other linked habitats where similar participatory programs have not yet been initiated (Hagen and Minter 2020). Local livelihoods have also been improved through limited Forest Guard honorariums and a recently initiated 500-km forest trail system designed to support ecotourism. Future goals for the program to save the Philippine Eagle include an Aurora Province-based wildlife rehabilitation center that will highlight Indigenous traditional knowledge in partnership with government. If the Save the Philippine Eagle paradigm were implemented with other Indigenous Peoples throughout Asia, raptor conservation directly focused on preventing deforestation could offer substantial benefits throughout the region, while also helping to mitigate climate change.

In the Neotropics where the loss of forest area is highest, Indigenous lands are extensive (e.g., as much as 12.5% of Brazil and up to 21% of Bolivia) and traditional knowledge of raptors has led to conservation success stories. For example, Indigenous land management has successfully protected forests from logging and deforestation more efficiently than nationally protected Neotropical areas (Schleicher et al. 2017). Furthermore, several raptor rainforest research projects have benefited from local Indigenous engagement and knowledge. Harpy Eagle nest searches and monitoring in the Cuyabeno Reserve in eastern Ecuador, in Darien in Panamá, in Infierno community in Madre de Dios, Peru, and in Reserva Forestal de Imataca in Venezuela, were effective due largely to the participation of local Indigenous communities (Álvarez-Cordero 1996, Vargas González and Vargas 2011, Muñiz 2016). The same strategies could be used to search for nests of other elusive endangered species such as the Black-and-chestnut Eagle (*Spizaetus isidori*), the Crested Eagle, or the Orange-breasted Falcon. Considering these examples, the expanded use of Indigenous partnerships to conserve raptors and combat deforestation has significant global conservation potential.

As a leading professional society for raptor researchers and raptor conservationists, the RRF is dedicated to the accumulation and dissemination of scientific information about raptors, and to resolving raptor conservation concerns (RRF 2020). Impacts of deforestation on raptor species, local settlements, biodiversity, and climate remain an ongoing conservation concern, presenting a global threat to raptor populations. Based on the science summarized herein, engaging Indigenous communities to combat deforestation and to conduct collaborative research and management while seeking sustainable solutions to address their basic needs will foster long-term co-occurrence of raptor populations with human populations.

ACKNOWLEDGMENTS

The authors thank the Raptor Research Foundation's Conservation Committee and Board of Directors for comments which improved this work. The Indigenous Communities Saving the Philippine Eagle Program co-sponsored through Daluhay and the Rainforest Trust Foundation is grateful for the support provided by the Municipalities of San Luis, Dingalan, and Gabaldon, as well as the provinces of Aurora and Nueva Ecija. Haribon thanks the EDGE of Existence Program of the Zoological Society of London and their other affiliates for their project support in the Sierra Madre Biodiversity Corridor. This initiative was also a direct result of efforts to harmonize mandates and proactive participation of federal Philippine government agencies, specifically the National Commission on Indigenous Peoples and the Department of Environment and Natural Resources.

LITERATURE CITED

Abaño, T. R. C., D. J. Salvador, and J. C. Ibanez (2016). First nesting record of Philippine Eagle *Pithecophaga jefferyi* from Luzon, Philippines. Forktail 32:86–88.

Abate, T. (1992). Into the northern Philippines rainforest. BioScience 42:246–251.

Aiyadurai, A., and S. Banerjee (2020). Bird conservation from obscurity to popularity: A case study of two bird species from northeast India. GeoJournal 85:901–912.

Aleixandre-Benavent, R., J. L. Aleixandre-Tudó, L. Castelló-Cogollos, and J. L. Aleixandre (2018). Trends in global research in deforestation. A bibliometric analysis. Land Use Policy 72:293–302.

Álvarez-Cordero, E. (1996). Biology and conservation of the Harpy Eagle in Venezuela and Panamá. Ph.D. dissertation. University of Florida, Gainesville, FL, USA.

Amatorio, R., M. Dela Torre, M. Pajaro, M. Raquino, P. Watts, and E. Zafra (2020). Egongot tribal development and an NGO as a catalyst for sustainability. Fourth World Journal 19:25–43.

Anoop, N. R., S. Babu, S. Bharathidasan, and R. Nagarajan (2018). Status of raptors in the Moyar River Valley, Western Ghats, India. Journal of Threatened Taxa 10:12317–12327.

Arroyo-Rodríguez, V., L. Fahrig, M. Tabarelli, J. I. Watling, L. Tischendorf, M. Benchimol, and J. C. Morante-Filho (2020). Designing optimal human-modified landscapes for forest biodiversity conservation. Ecology Letters 23:1404–1420.

Baldauf, C. (2020). Participatory Biodiversity Conservation: Concepts, Experiences, and Perspectives. Springer. Cham, Switzerland.

Bird, J. P., J. M. Buchanan, A. C. Lees, R. P. Clay, P. F. Develey, I. Yépez, and S. H. M. Butchart (2011). Integrating spatially explicit habitat projections into extinction risk assessments: A reassessment of Amazonian avifauna incorporating projected deforestation. Diversity and Distributions 18:273–281.

BirdLife International (2016). *Falco deiroleucus*. The IUCN Red List of Threatened Species 2016: e.T22696516A93569126. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22696516A93569126.en.

BirdLife International (2017a). *Morphnus guianensis*. The IUCN Red List of Threatened Species 2017: e.T22695991A118209977. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22695991A118209977.en.

BirdLife International (2017b). *Harpia harpyja* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2017: e.T22695998A117357127. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22695998A117357127.en.

BirdLife International (2018a). *Stephanoaetus coronatus*. The IUCN Red List of Threatened Species 2018: e.T22696201A129914678. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22696201A129914678.en.

BirdLife International (2018b). *Pithecophaga jefferyi* (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2018: e.T22696012A129595746. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22696012A129595746.en.

BirdLife International (2018c). *Leptodon forbesi*. The IUCN Red List of Threatened Species 2018: e.T22724659A132176387. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22724659A132176387.en.

BirdLife International (2020). *Chondrohierax wilsonii*. The IUCN Red List of Threatened Species 2020: e.T22728485A181241481. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22728485A181241481.en.

Bueser, G. L. L., K. G. Bueser, D. S. Afan, D. J. I. Salvador, J. W. Grier, R. S. Kennedy, and H. C. Miranda, Jr. (2003). Distribution and nesting density of the Philippine Eagle *Pithecophaga jefferyi* on Mindanao Island, Philippines: What do we know after 100 years? Ibis 145:130–135.

Collar, N. J., N. A. D. Mallari, and B. R. Tabaranza, Jr. (1999). Threatened Birds of the Philippines: The Haribon Foundation/BirdLife International Red Data Book. Bookmark, Inc., Makati City, Metro Manila, Philippines.

Concepcion, C. B., K. L. Bildstein, N. J. Collar, and T. E. Katzner (2018). Conservation threats and priorities for raptors across Asia. In Birds of Prey: Biology and Conservation in the XXI Century (J. H. Sarasola, J. M. Grande, and J. J. Negro, Editors). Springer, Cham, Switzerland. pp. 395–418.

Corrigan, C., H. Bingham, Y. Shi, E. Lewis, A. Chauvenet, and N. Kingston (2018). Quantifying the contribution to biodiversity conservation of protected areas governed by indigenous peoples and local communities. Biological Conservation 227:403–412.

Curtis, P. G., C. M. Slay, N. L. Harris, A. Tyukavina, and M. C. Hansen (2018). Classifying drivers of global forest loss. Science 361(6407):1108–1111.

Daluhay (2018). Synergistic and Ecocentric Capacitation of Indigenous and Artisanal Sierra Madre Communities. Terminal Report, United Nations Development Program—SGP5. Baler, Aurora, Philippines

Daluhay (2020). Guardians of the forest—Success in working together. Daluhay Quarterly 5:6–7. https://daluhay.files.wordpress.com/2020/05/vol-5-2-april-2020-daluhay-q.pd.

Department of Environment and Natural Resources-National Mapping and Resource Inventory Authority (2010). Forest resources and forestry activities. In Philippine Forest Facts and Figures 2013. Forest Management Bureau-Department of Environment and Natural Resources, Quezon City, Philippines. p. 3.

De Vera, D. E. (2007). Indigenous Peoples in the Philippines: A country case study. Unpubl. report. http://www.iapad.org/wp-content/uploads/2015/07/devera_ip_phl.pdf.

Fa, J. E., J. E. Watson, I. Leiper, P. Potapov, T. D. Evans, N. D. Burgess, Z. Molnár, Á. Fernández-Llamazares, T. Duncan, S. Wang, B. J. Austin, et al. (2020). Importance of Indigenous Peoples' lands for the conservation of intact forest landscapes. Frontiers in Ecology and the Environment 18:135–140.

Gavin, M., J. McCarter, F. Berkes, A. Mead, E. Sterling, R. Tang, and N. Turner (2018). Effective biodiversity conservation requires dynamic, pluralistic, partnership-based approaches. Sustainability 10:1846. doi:10.3390/su10061846.

Geist, H. J., and E. F. Lambin (2002). Proximate causes and underlying driving forces of tropical deforestation. BioScience 52:143–150.

Global Witness (2019). Enemies of the state. London, UK. https://www.globalwitness.org/en/campaigns/environmental-activists/enemies-state/

Global Witness (2020). Defending tomorrow. London, UK. https://www.globalwitness.org/en/campaigns/environmental-activists/defending-tomorrow/

Hagen, R. V., and T. Minter (2020). Displacement in the name of development: How Indigenous rights legislation fails to protect Philippine hunter-gatherers. Society and Natural Resources 33:65–82.

Ibanez, J. C. (2009). Philippine Eagle *Pithecophaga jefferyi* breeding biology, diet, behavior, nest characteristics, and longevity estimate in Mindanao Island. M.S. thesis, Ateneo de Davao University, Davao City, Philippines.

International Union for the Conservation of Nature (IUCN) (2021). The IUCN Red List of threatened species. Version 2020–3. https://www.iucnredlist.org.

Joa, B., G. Winkel, and E. Primmer (2018). The unknown known—A review of local ecological knowledge in relation to forest biodiversity conservation. Land Use Policy 79:520–530.

Jullien, M., and J. M. Thiollay (1996). Effects of rain forest disturbance and fragmentation: Comparative changes of the raptor community along natural and human-made gradients in French Guiana. Journal of Biogeography 23:7–25.

Jung, S., and S. Polasky (2018). Partnerships to prevent deforestation in the Amazon. Journal of Environmental Economics and Management 92:498–516.

Kassara, C., L. Gangoso, U. Mellone, G. Piasevoli, T. G. Hadjikyriakou, N. Tsiopelas, and R. Silva (2017). Current and future suitability of wintering grounds for a long-distance migratory raptor. Scientific Reports 7:1–12.

Kühnert, K., I. Grass, and M. Waltert (2019). Sacred groves hold distinct bird assemblages within an Afrotropical savanna. Global Ecology and Conservation 18:e00656. doi:10.1016/j.gecco.2019.e00656.

Luczon, A. U., I. K. C. Fontanilla, P. S. Ong, Z. U. Basiao, A. M. T. Sumaya, and J. P. Quilang (2014). Genetic diversity of the critically endangered Philippine Eagle *Pithecophaga jefferyi* (Aves: Accipitridae) and notes on its conservation. Journal of Threatened Taxa 6:6335–6344.

McClure, C. J., J. R. Westrip, J. A. Johnson, S. E. Schulwitz, M. Z. Virani, R. Davies, and R. Buij (2018). State of the world's raptors: Distributions, threats, and conservation recommendations. Biological Conservation 227:390–402.

Ministério del Ambiente y Desarrollo Sustentable de la Nación and Aves Argentinas (2017). Categorización de las Aves de la Argentina Según su Estado de Conservación. Ministerio de Ambiente y Desarrollo Sustentable de la Nación and Aves Argentinas BirdLife International, Buenos Aires, Argentina.

Ministério do Meio Ambiente do Brasil (2014). Lista Nacional Oficial das Espécies da Fauna Brasileira Ameaçadas de Extinção. Brasilia, Federal District, Brazil.

Miranda, E. B. P., J. F. S. Menezes, C. C. Farias, C. Munn, and C. A. Peres (2019). Species distribution modeling reveals strongholds and potential reintroduction areas for the world's largest eagle. PLoS ONE 14:e0216323. doi:10.1371/journal.pone.0216323.

Muñiz López, R. (2016). Biología y conservación del águila harpía (*Harpia harpyja*) en Ecuador. Ph.D. dissertation. Universidad de Alicante, San Vicente del Raspeig, Alicante, Spain.

Ogar, E., G. Pecl, and T. Mustonen (2020). Science must embrace traditional and Indigenous knowledge to solve our biodiversity crisis. One Earth 3:162–165.

Ong, P. S., L. E. Afuang, and R. G. Rosell-Ambal (2002). Philippine Biodiversity Conservation Priorities: A Second Iteration of the National Biodiversity Strategy and Action Plan. Philippine Department of the Environment and Natural Resources, Quezon City, Philippines.

Pande, S., P. Mestri, P. Deshpande, A. Warange, and A. Mahabal (2013). Promising trend of in situ breeding of Oriental White-rumped Vulture *Gyps bengalensis* in Raigad District, Maharashtra, India: Conservation implications for re-introduction of ex situ populations. Journal of Threatened Taxa 5:4106–4109.

Partnership for Maternal Newborn and Child Health (2018). Multisectoral collaborations for women's, children's and adolescents' health: Country examples. https://custom.cvent.com/844E6E8B32B64D1AA32DC45C8802523C/files/23d337209a6e46e6bf66336ce8332e99.pdf.

Raptor Research Foundation (RRF) (2020). https://raptorresearchfoundation.org/about/history/.

Rosa, I. M. D., M. J. Smith, O. R. Wearn, D. Purves, and R. M. Ewers (2016). The Environmental Legacy of Modern Tropical Deforestation. Current Biology 26:2161–2166.

Salvador, D. J., and J. C. Ibanez (2006). Ecology and conservation of Philippine Eagles. Ornithological Science 5:171–176.

Sandker, M., Y. Finegold, R. D'annunzio, and E. Lindquist (2017). Global deforestation patterns: Comparing recent and past forest loss processes through a spatially explicit analysis. International Forestry Review 19:350–368.

Sarkar, D., J. Walker-Swaney, and K. Shetty (2020). Food diversity and indigenous food systems to combat diet-linked chronic diseases. Current Developments in Nutrition 4:3–11.

Schleicher, J., C. A. Peres, T. Amano, W. Llactayo, and N. Leader-Williams (2017). Conservation performance of different conservation governance regimes in the Peruvian Amazon. Scientific Reports 7:1–10.

Tedlock, B. (2014). Honoring Indigenous knowledge: Linking Native American cultural astronomy with meteorology and raptor migration. International Journal of Education and Social Science 1:123–130.

The Peregrine Fund (2011). Raptors—An Environmental Education Guide for Teachers. The Peregrine Fund, Boise, ID, USA.

Thiollay, J. M., and Z. Rahman (2002). The raptor community of Central Sulawesi: Habitat selection and conservation status. Biological Conservation 107:111–122.

van der Ploeg, J., M. van Weerd, A. B. Masipiqueña, and G. A. Persoon (2011). Illegal logging in the Northern Sierra Madre Natural Park, the Philippines. Conservation and Society 9:202–215.

van Vliet, J. (2019). Direct and indirect loss of natural area from urban expansion. Nature Sustainability 2:755–763.

Vargas González, J. de J., and F. H. Vargas (2011). Nesting density of Harpy Eagles in Darien with population size estimates for Panama. Journal of Raptor Research 45:199–210.

Watson, R. T. (2018). Raptor conservation in practice. In Birds of Prey: Biology and Conservation in the XXI Century (J. H. Sarasola, J. M. Grande, and J. J. Negro, Editors). Springer, Cham, Switzerland. pp. 373–498.

Watts, P. D., and M. G. Pajaro (2014). Collaborative Philippine-Canadian action cycles for strategic international coastal eco-health. Canadian Journal of Action Research, 15:3–21.

Yosef, R., S. A. Pande, A. P. Pawashe, R. Kasambe, and L. Mitchell (2010). Interspecific interactions of the critically endangered Forest Owlet (*Athene blewitti*). Acta Ethologica 13:63–67.

Received 26 October 2020; accepted 23 February 2021
Associate Editor: James F. Dwyer

J. Raptor Res. 55(4):658

ERRATUM

Conservation Letter: Deforestation—The Philippine Eagle as a Case Study in Developing Local Management Partnerships with Indigenous Peoples

J Kahlil Panopio, Marivic Pajaro, Juan Manuel Grande, Marilyn Dela Torre, Mark Raquino, and Paul Watts

The Journal of Raptor Research regrets a misprint of author affiliations for the Conservation Letter printed in Issue 3 (*Journal of Raptor Research* 55:460–467). The correct author affiliations are:

J Kahlil Panopio
Haribon Foundation for the Conservation of Natural Resources, Incorporated, 100 A. de Legaspi St., Barangay Marilag, Quezon City, 1109 Philippines

Marivic Pajaro
Daluhay – Daloy ng Buhay, Incorporated, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Juan Manuel Grande
Colaboratorio de Biodiversidad, Ecología y Conservación, Instituto de Ciencias de la Tierra y Ambientales de La Pampa, Consejo Nacional de Investigaciones Científicas y Técnicas de Argentina, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, Uruguay 151, 6300 Santa Rosa, La Pampa, Argentina

Marilyn Dela Torre
Daluhay – Daloy ng Buhay, Incorporated, and Dumagat Tribe of San Luis, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines

Mark Raquino and Paul Watts
Daluhay – Daloy ng Buhay, Incorporated, Daluhay Building, Barangay Sabang, Baler, Province of Aurora, 3200 Philippines