**Journal of Threatened Taxa**

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)


## Note

# Power lines as a threat to a canopy predator: electrocuted Harpy Eagle in southwestern Brazilian Amazon

Almério Câmara Gusmão, Danilo Degra, Odair Diogo da Silva, Lucas Simão de Souza, Angélica Vilas Boas da Frota, Carlos Augusto Tuyama, Maria Cristina Tuyama, Thatiane Martins da Costa, Ana Paula Dalbem, Adrian A. Barnett, Francisca Helena Aguiar-Silva & Manoel dos Santos Filho

26 September 2020 | Vol. 12 | No. 13 | Pages: 16904–16908
DOI: 10.11609/jott.6198.12.13.16904-16908



For Focus, Scope, Aims, Policies, and Guidelines visit https://threatenedtaxa.org/index.php/JoTT/about/editorialPolicies#custom-0
For Article Submission Guidelines, visit https://threatenedtaxa.org/index.php/JoTT/about/submissions#onlineSubmissions
For Policies against Scientific Misconduct, visit https://threatenedtaxa.org/index.php/JoTT/about/editorialPolicies#custom-2
For reprints, contact <ravi@threatenedtaxa.org>

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 September 2020 | 12(13): 16904–16908
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
DOI: https://doi.org/10.11609/jott.6198.12.13.16904-16908
#6198 | Received 20 May 2020 | Finally accepted 03 September 2020
PLATINUM OPEN ACCESS

NOTE

# Power lines as a threat to a canopy predator: electrocuted Harpy Eagle in southwestern Brazilian Amazon

**Almério Câmara Gusmão [1], Danilo Degra [2], Odair Diogo da Silva [3], Lucas Simão de Souza [4], Angélica Vilas Boas da Frota [5], Carlos Augusto Tuyama [6], Maria Cristina Tuyama [7], Thatiane Martins da Costa [8], Ana Paula Dalbem [9], Adrian A. Barnett [10], Francisca Helena Aguiar-Silva [11] & Manoel dos Santos Filho [12]**

[1,12] Programa de Pós-Graduação em Rede Bionorte, Av. Santos Dumont, s/n° - Cidade Universitária (Bloco II) CEP 78.200-000, Cáceres – MT, Brazil.
[2] Projeto Bioart. Av. São Paulo, 3898, Jardim Clodoaldo, CEP 76.963618, Cacoal – RO, Brazil.
[3,5,8,9,12] Programa de Pós-Graduação em Ciências Ambientais (PPGCA). Av. Santos Dumont, s/n° - Cidade Universitária (Bloco II) CEP 78.200-000, Cáceres – MT, Brazil.
[1,3,4,6,7,8] Projeto Harpia, Núcleo Rondônia. Grupo de Trabalho e Conservação do Gavião-real no Estado de Rondônia, Av. São Paulo 4835, CEP 76940-000, Rolim de Moura, Rondônia, RO, Brazil.
[10,11] Instituto Nacional de Pesquisas da Amazônia (INPA), Av. André Araújo, 2936 Aleixo CEP 69067-375, Manaus, AM, Brazil.
[11] Centro de Energia Nuclear na Agricultura (CENA), Universidade de São Paulo (USP), Av. Centenário, 303, São Dimas, CEP 13400-970, Piracicaba, São Paulo, Brazil.
[12] Centro de Pesquisa em Limnologia, Biodiversidade e Etnobiologia (CELBE) Pantanal, Universidade do Estado de Mato Grosso. Av. Santos Dumont, s / n ° - Cidade Universitária (Bloco II) CEP 78.200-000, Cáceres - MT, Brasil.
[1] almeriocg@hotmail.com (corresponding author), [2] projetobioart@hotmail.com, [3] odair_diogo@hotmail.com, [4] lucas_sdesouza@hotmail.com, [5] angelicafrotaa@gmail.com, [6] ctuyama@gmail.com, [7] cristinatuyama10@gmail.com, [8] thaticpcl@gmail.com, [9] pauladalbem11@gmail.com, [10] adrian.barnett.biology2010@gmail.com, [11] aguiarsilva.fh@gmail.com, [12] msantosfilho@gmail.com

Harpy Eagle *Harpia harpyja* Linnaeus, 1758 is the largest bird of prey in the Americas (Sick 1997). Globally listed as a Near Threatened (NT) species (Birdlife International 2017), it is threatened with extinction in several countries within its Central to South American geographic range. In Brazil, the species was classified in 2014 as Vulnerable (VU) (Brasil/MMA 2014a). Deforestation, habitat loss and hunting are the main impacts affecting Harpy Eagle populations (Álvarez-Cordero 1996; Trinca et al. 2008; DeLuca 2012; Gusmão et al. 2016; Birdlife International 2017). Electrocution from power transmission lines is another threat affecting large birds (e.g., eagle owls, Sergio et al. 2004; cranes, Shaw et al. 2010; raptors, Lasch et al. 2010; storks, Kaluga et al. 2011; condors, Rideout et al. 2012; vultures, Angelov et al. 2013). Such impacts

**Editor:** Priya Davidar, Sigur Nature Trust, Nilgiris, India. **Date of publication:** 26 September 2020 (online & print)

**Citation:** Gusmao, A.C., D. Degra, O.D. da Silva, L.S. de Souza, A.V.B. da Frota, C.A. Tuyama, M.C. Tuyama, T.M. da Costa, A.P. Dalbem, A.A. Barnett, F.H. Aguiar-Silva & M.d.S. Filho (2020). Power lines as a threat to a canopy predator: electrocuted Harpy Eagle in southwestern Brazilian Amazon. *Journal of Threatened Taxa* 12(13): 16904–16908. https://doi.org/10.11609/jott.6198.12.13.16904-16908



**Funding:** None.

**Competing interests:** The authors declare no competing interests.

**Acknowledgements:** We thank the Conselho de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for the ODS Master and ACG and AVB for PhD fellowship, and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for FHAS Postdoctoral fellowship. We also thanks the Universidade do Estado de Mato Grosso (UNEMAT). This is publication #12 of the Harpy Eagle Project.

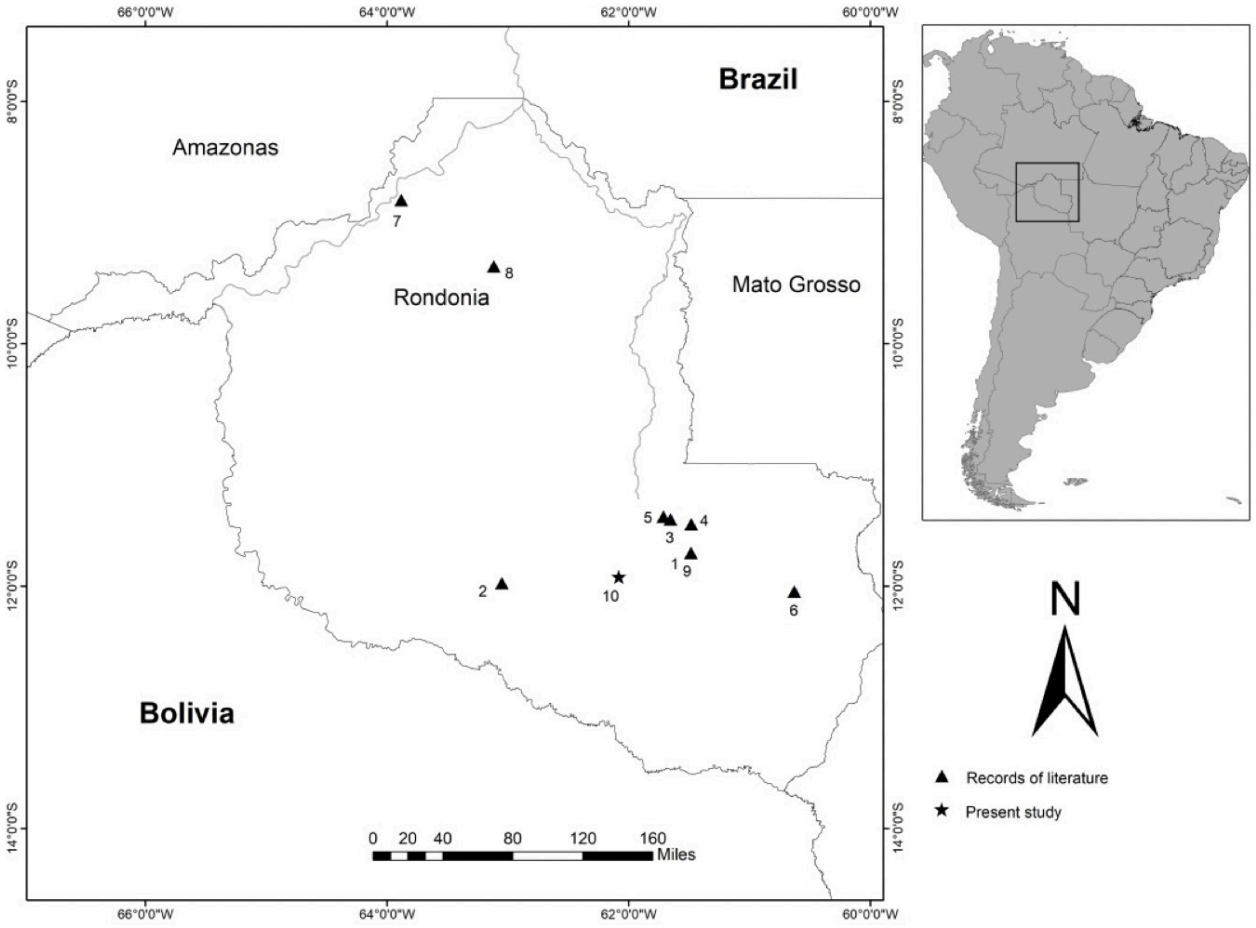


**Figure 1. Rondônia State, Brail: map with the records known from the literature, and the location of the Harpy Eagle electrocution event in the Alta Floresta D'Oeste, Seringueiras and Porto Velho municipalities.**

may sometimes be sufficiently severe to alter local species distributions (Sergio et al. 2004). The effects on Harpy Eagle population dynamics of electrocution from collisions with power lines is unknown. Modelling of a Bonelli's Eagle *Aquila fasciata* population predicted that even low levels of electrocution may threaten the overall population viability of long-lived raptors (Hernández-Matías et al. 2015).

Concern over negative interaction between birds and transmission lines began to emerge early in the 20th century (Michener 1928). Most reported case studies were of migratory birds and resident birds in North America, Europe, Africa, Asia, and Oceania (Avery 1978; Salvador & Ibanez 2006; Lehman et al. 2007; Kagan 2016; Mojica et al. 2018). More recently this problem started attracting attention in South American countries such as Argentina (Orellana & Cornejo 2010; Ibarra & DeLucca 2015; Galmes et al. 2017), however, there has been little attention in Brazil, a country that has an extensive network of high-tension transmission lines (see Raposo 2013). Transmission lines drive several threats to Brazilian Amazon conservation (Hyde et al. 2018), among which are bird collision risk and mortality. Studies of bird collision on high voltage lines are still limited to licensing studies and mitigation measures (such as bird flight diverters), with uncertainty as to their effectiveness (Biasotto et al. 2017; Biasotto & Kindel 2018).

Harpy Eagle nesting trees have been mapped in Rondonia State (Costa et al. 2015; Gusmão et al. 2016; Costa & Nunes 2017), a region of Brazilian Amazonia with extensive anthropic impacts on biodiversity over the last 50 years (Fearnside et al. 2012; Ochoa-Quintero et al. 2015). Here we present a case study of a juvenile Harpy Eagle electrocution in the southern region of the Amazon forest known as the "arc of deforestation".

The study site was located in Alta Floresta D'Oeste municipality, in the southwest center of Rondônia State, Brazil (Figure 1). In this area, the native forest is highly fragmented as a result of land-use changes,


**Image 1. Harpy Eagle adult male electrocuted and taxidermized specimen deposited in the UFMT collections (UFMT4910).**

resulting in a matrix of pasture and commercial crops, with small blocks of poorly-connected forest (Fearnside 1989; Piontekowski et al. 2019). The average annual precipitation is 2,000mm and the average annual temperature is 24°C (Alvares et al. 2014).

On 29 August 2018, a juvenile Harpy Eagle female was found dead (Image 1) below a Rural Aerial Power Distribution Network (RDR) with standardized voltage Level of 13.8kV (low voltage). The bird was found beside the Linha 47.5 Highway in a terra firme forest, 10km from the nearest urban area and 6.5km from a known Harpy Eagle nest (Gusmão et al. 2016). Inspection of external and internal morphology found no evidence of trauma, body lesions, or firearm-associated damage. The claws had a crumbled and flaking surface texture and appeared blackened, giving an overall appearance typical of burned tissue (Kagan 2016). Thus, while the incident was not witnessed, inspection of the body during dissection with the evidence of the burnt claws, and the positioning of the body near the pole and below the power transmission network were consistent with the animal having tried to perch on the high-tension wire, with subsequent death by electrocution. Post mortem examination at the Laboratório de Mastozoologia in Centro de Pesquisa em Limnologia, Biodiversidade e Biotecnologia (CELBE - Limnology, Biodiversity and Biotechnology Research Center), Mato Grosso State confirmed electrocution. The specimen was later taxidermized and deposited in the UFMT reference collection (accession number UFMT 4910).

This is the second record of a fatal Harpy Eagle electrocution in Rondonia. The first reported case was of an adult electrocuted in 2008, around 105km west Seringueira municipality on a similar type of power line, and 6km away from a Harpy Eagle breeding site (Gusmão et al. 2016). According to Urios et al. (2017), juvenile Harpy Eagles are known to disperse more than 35km from the natal nest.

There are two other records of Harpy Eagle interaction with power lines in Brazil. One was an adult female that was rescued and rehabilitated in the wild after a collision with a low voltage electricity distribution line in a rural area of Senador José Porfírio municipality, Para state (Aguiar-Silva et al. 2014). The other was a juvenile born in captivity and released as a part of a reintroduction program, that died in Panama after contact with power lines (Watson et al. 2016).

These data compiled from different reports indicate

that power transmission networks are potentially a threat to adult and dispersing juvenile Harpy Eagles (Urios et al. 2017; Mojica et al. 2018). Juvenile eagles in general were electrocuted at approximately twice the rate of subadults or adults (Mojica et al. 2018). Harpy Eagles are at particular risk in human-modified landscapes, as habitat discontinuity may force juveniles to cross deforested areas to pair up, and establish feeding territories and reproductive sites. Due to the loss of tall trees in forest fragments (Nascimento & Laurence 2006), Harpy Eagles might use the pylons of power line systems as perches (Rettig 1978).

The impact of habitat loss on electrocution of raptors has been noted in other sites, affecting species that include the Black-chested Buzzard Eagle *Geranoaetus melanoleucus* (Ibarra & DeLucca 2015), Griffon Vulture *Gyps fulvus*, Golden Eagle *Aquila chrysaetos*, Bonelli's Eagle *Aquila fasciata*, Eurasian Eagle Owl *Bubo bubo* (Hernández-Matías et al. 2015, Pérez-Garcia et al. 2017) and Crowned Solitary Eagle *Buteogallus coronatus* (Galmes et al. 2017).

A number of mitigation measures such as retrofitting (Fox & Wynn 2010; Chevallier et al. 2015; Dwyer et al. 2019) have been implemented successfully in Europe and elsewhere (Bevanger 1994; Janss & Ferrer 2001; Tintó et al. 2010). These practices could be followed in Brazil and included in action plans (Plano de Ação Nacional para Conservação das Aves da Amazônia, Brasil 2014b). In addition, future research should focus on impacts on juvenile raptors, since they seem to be disproportionately involved in collisions with power lines (Harness & Wilson 2001; Sergio et al. 2004; Tabolka 2014).

## References


**Aguiar-Silva, F.H., T.M. Sanaiotti, O. Jaudoin, F.D. Martins, D. Vasconcelos & V.S. Peres (2014).** Remoção e reintegração de gavião-real em área de conflito no Pará: conservação na Volta Grande do Rio Xingu. In: I International Symposium and V Meeting of the Post-Graduate Program in Tropical Biodiversity, Macapá. https://ppgbioconservation.weebly.com/uploads/2/7/5/7/27576775/abstract_book_ppgbio2014.pdf

**Angelov, I., I. Hashim & S. Oppel (2013).** Persistent electrocution mortality of Egyptian Vultures Neophron percnopterus over 28 years in East Africa. *Bird Conservation International* 23(1): 1–6. https://doi.org/10.1017/S0959270912000123

**Alvares, C.A., J.L. Stape, P.C. Sentelhas, J.L. Gonçalves, M. & G. Sparovek (2014)**. Köppen'sclimate classification map for Brazil. *Meteorologische Zeitschrift* 22(6): 711–728

**Álvarez-Cordero, E. (1996)**. *Biology and conservation of Harpy Eagle in Venezuela and Panamá*. PhD. Dissertation, University of Florida, Gainesville, FL U.S.A. 214pp.

**Avery, M.L. (1978).** *Impacts of transmission lines on birds in flight: proceedings of a workshop*. U.S. Fish and Wildlife Service, FWS/OBS 78/48, 151pp.

**Bevanger, K. (1994).** Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. *Ibis* 136(4): 412–414. https://doi.org/10.1111/j.1474-919X.1994.tb01116.x

**Biasotto, L.D., A. Barcelos-Silveira, C.E.Q. Agne & A. Kindel (2017).** Comportamento de voo de aves em resposta ao uso de sinalizadores em linhas de transmissão de energia elétrica. *Iheringia, Série Zoologia* 107: e2017047. https://doi.org/10.1590/1678-4766e2017047

**Biasotto, L.D. & A. Kindel (2018).** Power lines and impacts on biodiversity: A systematic review. *Environmental Impact Assessment Review*. 71:110–119. https://doi.org/10.1016/j.eiar.2018.04.010

**BirdLife International (2017).** *Harpia harpyja* (amended version of 2017 assessment). *The IUCN Red List of Threatened Species* 2017: e.T22695998A117357127. . Downloadedon 19 June 2019.

**Brasil (2014a).** Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção. Portaria Nº 444, 17 de dezembro de 2014. Brasília: MMA/ICMBio.

**Brasil (2014b)**. Plano de Ação Nacional para Conservação das Aves da Amazônia ameaçadas de extinção, PAN - Aves da Amazônia. Portaria Nº 35, 27 de Março de 2014. Brasília: MMA/ICMBio.

**Chevallier, C., A. Hernández-Matías, Real, J., N. Vincent-Martin, A. Ravayrol & A. Besnard (2015).** Retrofitting of power lines effectively reduces mortality by electrocution in large birds: an example with the endangered Bonelli's Eagle. *Journal of Applied Ecology* 52(6): 1465–1473. https://doi.org/10.1111/1365-2664.12476

**Costa, T.M., Souza, L. S., A.C. Gusmão, J. Costa, E.O. Silva (2015).** Nidificação de harpia (*Harpia harpyja* Linnaeus, 1758) (Accipitriformes: Accipitridae) na RESEX do Rio Cautário, sudoeste do estado de Rondônia, Brasil. *Atualidades Ornitolologicas* 185(3): 20–21.

**Costa, A.R. & R.O. Nunes (2017).** Ecologia e conservação de um casal de gavião-real, *Harpia harpyja* (Linnaeus) (Aves, Accipitridae), em uma área rural a 10 km do centro urbano no município de Porto Velho (Rondônia, Brasil). *Farol* 4(4): 56–71.

**DeLuca, J.J. (2012).** Birds of conservation concern in eastern Acre, Brazil: distributional records, occupancy estimates, human-caused mortality, and opportunities for ecotourism. *Tropical Conservation Science* 5(3): 301–319. https://doi.org/10.1177/194008291200500306

**Dwyer, J.F., T.I. Hayes, R. Thorstrom & R.E. Harness (2019).** Retrofitting power poles to prevent electrocution of translocated Ridgway's Hawks (*Buteoridgwayi*). *Journal of Caribbean Ornithology* 32: 4–10.

**Fearnside, P.M. (1989).** Ocupação humana de Rondônia: impactos, limites e planejamento. Relatórios de Pesquisa No. 5, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brasília, DF. 76pp.

**Fearnside, P.M., W.F. Laurance, M.A. Cochrane, S. Bergen, P.D. Sampaio, C.D. Barber, S. Angelo & T. Fernandes (2012).** O futuro da Amazônia: modelos para prever as consequências da infraestrutura futura nos planos plurianuais. *Novos Cadernos NAEA* 15(1): 25–52. https://doi.org/10.5801/ncn.v15i1.865

**Fox, N. & C. Wynn (2010).** The impact of electrocution on the New Zealand falcon (*Falco novaeseelandiae*). *Notornis* 57(2): 71–74.

**Galmes, M.A., J.H. Sarasola, J.M. Grande & F.H. Vargas (2017).** Electrocution risk for the endangered Crowned Solitary Eagle and other birds in semiarid landscapes of central Argentina. *Bird Conservation International* 28(3): 403–415. https://doi.org/10.1017/S0959270917000272

**Gusmão, A.C., A. Banhos, F.H. Aguiar-Silva, L.S. Souza, T.M. Sanaiotti, A.M. Silva, T.M. Costa, L. Oliveira, W.G. Morais & S.F. Ferrari (2016).** Records of the occurrence, nesting, and hunting of the Harpy Eagle (*Harpia harpyja*) (Aves: Accipitridae) in Rondônia, Southwestern Brazilian Amazonia. *Atualidades Ornitológicas* 190(2): 18–23.

**Harness, R.E. & K.R. Wilson (2001).** Electric-utility structures associated with raptor electrocutions in rural areas. *Wildlife Society Bulletin* 29(2): 612–623.

**Hernández-Matías, A., J. Real, F. Parés & R. Pradel (2015).** Electrocution threatens the viability of populations of the endangered Bonelli's Eagle (*Aquila fasciata*) in southern Europe. *Biological Conservation* 191(11): 110–116. https://doi.org/10.1016/j.biocon.2015.06.028

**Hyde, J.L., S.A. Bohlman & D. Valle (2018).** Transmission lines are anunder-acknowledged conservation threat to the Brazilian Amazon. *Biological Conservation* 228: 343–356. https://doi.org/10.1016/j.biocon.2018.10.027

**Ibarra, J. & E. De Lucca (2015)** Águilas Moras (*Geranoaetus melanoleucus*), víctimas de electrocución en Luján de Cuyo, Mendoza, Argentina. *Nótulas Faunísticas* 176(2015): 1–7.

**Janss, G.F. & M. Ferrer (2001).** Avian electrocution mortality in relation to pole design and adjacent habitat in Spain. *Bird Conservation International* 11(1): 3–12. http://doi.org/10.1017/S0959270901001022

**Kagan, R.A. (2016).** Electrocution of raptors on power lines: a review of necropsy methods and findings. *Veterinary Pathology* 53(5): 1030–1036. https://doi.org/10.1177/0300985816646431

**Kaługa, I., T.H. Sparks & P. Tryjanowski (2011).** Reducing death by electrocution of the white stork *Ciconiaciconia*. *Conservation Letters* 4(6): 483–487. http://doi.org/10.1111/j.1755-263X.2011.00203.x

**Lasch, U., S. Zerbe & M. Lenk (2010).** Electrocution of raptors at power lines in Central Kazakhstan. *Waldökologie, Landschaftsforschung und Naturschutz* 9(1): 95–100

**Lehman, R.N., P.L. Kennedy & J.A. Savidge (2007).** The state of the art in raptor electrocution research: a global review. *Biological Conservation* 136(2007): 159–174. https://doi.org/10.1016/j.biocon.2006.09.015

**Michener, H. (1928).** Where engineer and ornithologist meet: Transmission line troubles caused by birds. *Condor* 30(3): 169–175.

**Mojica, E.K., J.F. Dwyer, R.E. Harness, G.E. Williams & B. Woodbridge (2018).** Review and synthesis of research investigating Golden Eagle electrocutions. *Journal of Wildlife Management* 82(3): 495–506. https://doi.org/10.1002/jwmg.21412

**Nascimento, H.E.M. & W.F. Laurence (2006).** Area and edge effects on forest structure in Amazonian forest fragments after 13-17 years of isolation. *Acta Amazonica* 36(2): 183–192. https://doi.org/10.1590/S0044-59672006000200008

**Ochoa-Quintero, J.M., T.A. Gardner, I. Rosa, S.F.D.B. Ferraz & W.J. Sutherland (2015).** Thresholds of species loss in Amazonian deforestation frontier landscapes. *Conservation Biology* 29(2): 440–451. https://doi.org/10.1111/cobi.12446

**Orellana, S.A. & M.R. Cornejo (2010).** Electrocución en Águilas Moras *Geranoaetus melanoleucus* por tendido eléctrico en Calera de Tango, Chile. *Spizaetus* 9(1): 13–15.

**Pérez-Garcia, J.M., T.L. De Vault, F. Botella & J.A. Sánchez-Zapata (2017).** Using risk prediction models and species sensitivity maps for large-scale identification of infrastructure-related wildlife protection areas: The case of bird electrocution. *Biological Conservation* 210(2017): 334–342. https://doi.org/10.1016/j.biocon.2017.04.033

**Piontekowski, V.J., F.P. Ribeiro, E.A.T. Matricardi, I.M. Lustosa Junior, A.P. Bussinguer & A. Gatto (2019).** Modeling deforestation in the State of Rondonia. *Floresta e Ambiente* 26(3): e20180441. https://doi.org/10.1590/2179-8087.044118

**Rettig, N.L. (1978).** Remote wordofthe Harpy Eagle (*Harpia harpyja*). The Auk 95(4): 629–643.

**Raposo, M.A.F., C.P. Assis & D. Figueira (2013).** *Aves & Linhas de Transmissão - um Estudo de Caso*. Rio de Janeiro: Arte Ensaio, 124pp.

**Rideout, B.A., I. Stalis, R. Papendick, A. Pessier, B. Puschner, M. Finkesltein, D.R. Smith, M. Johnson, M. Mace, R. Stroud, J. Brand, J. Burnett, C. Parish, J. Petterson, C. Witte, C. Stringfield, K. Orr, J. Zuba, M. Wallace & J. Grantham (2012).** Patterns of mortality in free-ranging California Condors (*Gymnogyps californianus*). *Journal of Wildlife Diseases* 48(1): 95–112. https://doi.org/10.7589/0090-3558-48.1.95

**Salvador, D.J.I. & J.C. Ibanez (2006).** Ecology and conservation of Philippine Eagles. *Ornithological Science* 5(2): 171–176. https://doi.org/10.2326/1347-0558(2006)5[171:EACOPE]2.0.CO;2

**Sergio, F., L. Marchesi, P. Pedrini, M. Ferrer & V. Penteriani (2004).** Electrocution alters the distribution and density of a top predator, the eagle owl *Bubo bubo*. *Journal of Applied Ecology* 41(5): 836–845. https://doi.org/10.1111/j.0021-8901.2004.00946.x

**Shaw, J.M., A.R. Jenkins, J.J. Smallie & P.G. Ryan (2010).** Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. *Ibis* 152(3): 590–599. https://doi.org/10.1111/j.1474-919X.2010.01039.x

**Sick, H. (1997).** *Ornitologia Brasileira*. Rio de Janeiro: Nova Fronteira. 862pp.

**Tintó, A., J. Real & S. Mañosa (2010).** Predicting and correcting electrocution of birds in Mediterranean areas. *Journal of Wildlife Management* 74(8): 1852–1862. https://doi.org/10.2193/2009-521

**Tobolka, M. (2014).** Importance of juvenile mortality in birds' population: early post-fledging mortality and causes of death in White Stork *Ciconiaciconia*. *Polish Journal of Ecology* 62(4): 807–813. https://doi.org/10.3161/104.062.0403h

**Trinca, C.T., S.F. Ferrari & C.L. Alexander (2008).** Curiosity killed the bird: arbitrary hunting of Harpy Eagles. *Cotinga* 30(2008): 12–15.

**Urios, V., R. Muñiz-López & J. Vidal-Mateo (2017).** Juvenile dispersal of Harpy Eagles (*Harpia harpyja*) in Ecuador. *Journal of Raptor Research* 51: 439–445. https://doi.org/10.3356/JRR-16-54.1

**Watson, R.T., C.J.W. McClure, F.H. Vargas & J.P. Jenny (2016).** Trial restoration of the Harpy Eagle, a large, long-lived, tropical forest raptor, in Panama and Belize. *Journal of Raptor Research* 50(1): 3–22. https://doi.org/10.3356/rapt-50-1-3-22.1

Journal of Threatened Taxa

www.threatenedtaxa.org

PLATINUM OPEN ACCESS



**ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)**

**September 2020 | Vol. 12 | No. 13 | Pages: 16715–16926**
**Date of Publication: 26 September 2020 (Online & Print)**
**DOI: 10.11609/jott.2020.12.13.16715-16926**



Member

FJN

Publisher & Host

WILD ZOOREACH

Threatened Taxa