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Protection of Paleontological Heritage in Costa Rica

Sánchez-Ocampo M*

Department of Natural History, National Museum, Costa Rica

***Corresponding author:** Marcela Sánchez-Ocampo, Natural History Department, National Museum of Costa Rica, Email: msanchez@museocostarica.go.cr

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Abstract

This monograph analyzes the critical importance of paleontological collections for ecosystem reconstruction and climate change studies in Costa Rica. It examines the existing legal void that leaves fossil heritage unprotected against looting and commerce, contrasting it with the robust protection of archaeological heritage and extant biodiversity.

Keywords: Biostratigraphy; Conservation; Legislation; Museology; Taphonomy

Introduction

Scientific paleontological collections constitute the most complete biological and geological archive for understanding the history of life on Earth. They are fundamental repositories, not only for taxonomy and systematics but as indispensable tools for the reconstruction of paleoecosystems and the modeling of future scenarios in the face of climate change. As noted by Allmon [1], these collections allow us to "travel back in time" to understand how biotas respond to severe environmental perturbations, offering empirical data on extinction rates and biological recovery. In the context of anthropogenic global change, the fossil record offers a profound perspective unattainable through short-term ecological studies [2].

However, the integrity of this record in Costa Rica faces a silent yet devastating threat. Unlike Pre-Columbian archaeological heritage, which enjoys a consolidated protection status in both the national psyche and the legal framework, paleontological heritage lies in a grey area. Monge-Nájera, et al. [3] highlight that, although Costa Rica is globally recognized for its current biodiversity ("The Biodiversity Law"), "paleodiversity" is often ignored in conservation policies. This has allowed any individual to extract, collect, and commercialize fossils without major restrictions, resulting in an irreparable loss of stratigraphic and taphonomic context—data that are as valuable as the specimen itself [4].

Unregulated extraction eliminates the possibility of performing precise biostratigraphic studies, which are essential for dating geological formations [5]. A fossil without its geological context loses more than 80% of its scientific value. Furthermore, the privatization of these assets prevents democratic access to knowledge and peer review, a fundamental pillar of science. Peyer, et al. [6] argue that public access to specimens is an ethical requirement for scientific validation; when fossils disappear into private collections, science stagnates.

In Costa Rica, paleontological richness is vast, ranging from Pleistocene megafauna to marine microfossils that narrate the closure of the Isthmus of Panama, a crucial event in global climatology [7]. Nevertheless, the lack of an explicit legal figure declaring fossils as public domain goods (bienes demaniales) allows for their commodification. This contrasts with the modern vision of heritage management, where natural assets are viewed as collective inheritance [8]. The loss of this heritage is not merely the loss of

curious objects, but the destruction of the pages of the book explaining the origin of the isthmus's modern biodiversity [9]. It is imperative to recognize that without the protection of fossiliferous sites and state custody of specimens, future generations of Costa Rican scientists will lack the raw material to understand their own territory [10].

Legislation in Costa Rica Regarding the Protection of Paleontological Heritage

The Contrast with Archaeological Heritage and Biodiversity

Costa Rica has been a pioneer in the protection of its cultural and natural heritage, yet with an asymmetrical approach. Law No. 6703 on National Archaeological Heritage [11] clearly establishes that Pre-Columbian objects are state property, inalienable, and imprescriptible. This law grants the National Museum of Costa Rica the authority to confiscate pieces and sanction looting, effectively protecting the memory of indigenous peoples.

Concurrently, the Biodiversity Law No. 7788 [12] protects the genetic and biochemical resources of current biodiversity, regulating access and guaranteeing the fair participation of indigenous and local communities. This regulation is so exhaustive that it even regulates bioprospecting. However, a conceptual void exists: fossils are not "biodiversity" in the active biological sense (most lack viable genetic material), nor are they "archaeology" (they are not products of human hand).

The Legal Framework of Mining and Fossil Extraction

Currently, the regulation that most closely approximates fossil management is the Mining Code, Law No. 6797 [13]. Under this lens, fossils are often implicitly treated as "minerals" or geological curiosities. While the State holds dominion over the subsoil, the extraction of "materials" other than hydrocarbons or strategic minerals often falls under lax concession regulations or simply under private surface property rights. The Mining Code lacks a clear distinction for the preservation of fossiliferous deposits due to their scientific value, unless they are declared protected areas under other figures [14].

This ambiguity allows fossil extraction to occur under the guise of earthworks or artisanal mining without environmental authorities (SETENA) systematically requiring paleontological impact studies, unlike practices in countries such as Chile or Spain [15]. The Organic Law of the Environment No. 7554 [16] mentions the protection of "landscape," but does not specify in situ paleontological heritage as an object of strict conservation.

Administrative Control without Coercive Force

The only technical regulation applicable to scientific collections falls under the National Commission for Biodiversity Management (CONAGEBIO). According to the Regulation on Access to Biodiversity Elements (Executive Decree No. 31514-MINAE), researchers must register their collections. However, this mechanism is designed for modern biological material. Although attempts have been made to extend it to paleontological material for inventory purposes, CONAGEBIO lacks police powers to confiscate fossils held by individuals who do not wish to register them, nor to stop internal trade, provided it does not involve illicit export [17].

The lack of legal "teeth" means that a paleontologist from the National Museum or the University of Costa Rica cannot legally intervene if they discover a sale of fossils on social media or at a mineral fair, a situation diametrically opposed to the discovery of a polychrome vessel or a stone sphere [18].

Typology of Samples and the Complexity of Their Protection

The Paleontological heritage is diverse, and its protection requires varied technical approaches. We are not only discussing vertebrate macrofossils (megafauna bones), which are the most coveted by collectors [19], but a vast range of microfossils:

- **Pollen and Spores (Palynology):** Crucial for reconstructing paleoclimates and ancient vegetation [20]. Their destruction occurs when soils are removed without sampling.
- **Dinoflagellates and Foraminifera:** Indicators of past ocean conditions and sea-level changes [21].
- **Scolecodonts:** Polychaete worm jaws, useful in biostratigraphy [22].
- **Ichnofossils:** Tracks and traces, which are immovable and require site protection [23].

Furthermore, associated geological heritage includes type rocks, meteorites, and rare minerals. Meteorites, for instance, fall into an absolute legal limbo in Costa Rica, often being sold to the highest international bidder, losing valuable information about the formation of the solar system [24].

The Conflict with Private Collecting and the Impossibility of Confiscation

Human fascination with possessing natural "trophies" is a major obstacle. The "Indiana Jones Effect" or the popularity of franchises like Jurassic Park have skyrocketed the market value of fossils [25]. In Costa Rica, researchers frequently face refusals from landowners or casual finders to hand over

pieces. There is a misconception that the fossil "is worth millions," incentivizing the black market and the concealment of findings [26].

Since the law does not authorize confiscation, state museums must resort to negotiation and moral persuasion, appealing to "collaboration with science." However, as Carrillo, et al. [27] point out, the desire for personal possession is often stronger than scientific altruism.

The purchase of pieces by the State is problematic for two reasons:

- **Ethical:** Buying fossils legitimizes the market and encourages looting [28].
- **Administrative:** The strict procedures of the Administrative Contracting Law (Law No. 7494) make it unfeasible for a state museum to compete in auctions or agile direct purchases against private collectors.

The result is a constant leakage of heritage. Entire collections of Costa Rican fossils currently reside in private display cases or foreign museums that acquired material prior to export regulations, or through current legal loopholes [29]. The absence of a specific "Paleontological Heritage Law" leaves scientists with their hands tied, watching as the country's natural history is fragmented and privatized.

Conclusions

The protection of paleontological heritage in Costa Rica is a scientific and cultural urgency. It is imperative to transcend the view of the fossil as a collectible curiosity to recognize it as irreplaceable scientific data. As established by Woodburne, et al. [30], the proper management of these assets is fundamental to correlating biological events with physical changes on Earth. In a country vulnerable to climate change, deep-time data are vital for modeling future scenarios of adaptation and extinction [31].

A legislative reform is required to homologate the protection of fossils with that of archaeological heritage, declaring them public domain goods (bienes demaniales). This must be accompanied by heritage education programs that foster citizen science, transforming collectors into guardians of heritage rather than owners [32]. Only through a robust legal framework and elevated social awareness can we ensure that the evolutionary history of Costa Rica remains in the public domain for the benefit of universal science.

References

1. Allmon WD (2005) The importance of museum collections in paleobiology. Paleobiology 31(1): 1-5.
2. Dietl GP, Flessa KW (2011) Conservation paleobiology: Putting the dead to work. Trends Ecol Evol 26(1): 30-37.
3. Monge-Nájera J, Hougaard A (2015) Costa Rican paleontology: A review of the literature. Rev Biol Trop 63(2): 345-356.
4. Dalton R (2004) Natural history museums: The endangered dead. Nature 427: 484-486.
5. Alvarado GE, Denyer P, Sussman D (2007) Cincuenta años de geología en Costa Rica. Rev Geol Am Cent 36: 1-2.
6. Peyer K, Charbonnier S, Allain R (2019) The role of private collections in paleontology. Geodiversitas. 41(8): 345-355.
7. O'Dea A, Lessios HA, Coates AG, Eytan RI, Restrepo-Moreno SA, et al. (2016) Formation of the Isthmus of Panama. Sci Adv 2(8): e1600883.
8. Lipps JH (2009) Paleo-parks: The protection and conservation of fossil sites worldwide. C R Palevol 8(2-3): 97-101.
9. Aguilar D, Alvarado GE, Ramírez C (2020) Registro fósil de vertebrados de Costa Rica: Una actualización. Rev Geol Am Cent 63: 1-32.
10. MacFadden BJ, Perez VJ, Hendy A (2017) Education, museums, and the protection of paleontological resources. Cambridge: Cambridge University Press.
11. (1981) Legislative Assembly of the Republic of Costa Rica. Law No. 6703: Law on National Archaeological Heritage. San José: Legislative Assembly.
12. (1998) Legislative Assembly of the Republic of Costa Rica. Law No. 7788: Biodiversity Law. San José: Legislative Assembly.
13. (1982) Legislative Assembly of the Republic of Costa Rica. Law No. 6797: Mining Code. San José: Legislative Assembly.
14. Denyer P, Alvarado GE (2007) Mapas geológicos y tectónicos de Costa Rica. San José: Editorial de la Universidad de Costa Rica.
15. Alcalá L, Morales J (1994) El patrimonio paleontológico y su protección legal. Coloquios de Paleontología 46: 13-24.
16. (1995) Legislative Assembly of the Republic of Costa Rica. Law No. 7554: Organic Law of the Environment. San José: Legislative Assembly.
17. Cisneros JC (2021) Fossil heritage in the Global South: Challenges and opportunities. Cambridge: Cambridge

University Press.

18. Corrales F (2000) An evaluation of the management of the archaeological heritage of Costa Rica. In: Messenger PM, Smith GS (Eds.), Cultural Heritage Management. Gainesville: University Press of Florida, pp: 120-134.

19. Laurito CA, Valerio AL (2012) Paleobiogeografía del arribo de mamíferos suramericanos a Costa Rica de los 7 Ma a los 2.7 Ma. Rev Geol Am Cent 46: 123-144.

20. Horn SP (2007) Paleoenvironmental history of Costa Rica. In: Kappelle L (Ed.), Biodiversity and conservation of Costa Rica. Santo Domingo de Heredia: INBio, pp: 51-68.

21. Collins LS, Coates AG, Berggren WA, Aubry MP, Zhang J (1996) The late Miocene Panama isthmian strait. Geology 24(8): 687-690.

22. Hints O, Eriksson ME (2007) Scolecodonts as biostratigraphic tools. Rev Palaeobot Palynol 145(3-4): 167-170.

23. Lockley M, Janke P, Theichart L (2012) Tracing the past: The importance of ichnology in heritage. Ichnos 19(1-2): 1-5.

24. Alvarado GE (2011) Los meteoritos de Costa Rica. Rev Geol Am Cent 45: 117-128.

25. Hickman CS (2003) The future of paleontology: A view from the museum. J Paleontol 77(6): 1152-1153.

26. Shimada K, Currie PJ, Scott E, Sumida SS (2014) The greatest challenge to 21st century paleontology: A plea for the protection of fossil resources. Palaeontol Electron 17(1): 1E.

27. Carrillo JD, Lucas SG (2010) The challenges of paleontological heritage conservation in developing countries. Geoheritage 5(2): 101-108.

28. Polly PD, Polyakov AV, Ilyashenko V, Onishchenko SS, White TA, et al. (2014) The ethics of selling fossils. Nature 513: 311.

29. Vargas A, Alvarado G (2018) Historia de la colección de fósiles del Museo Nacional de Costa Rica. Vínculos 39: 45-60.

30. Woodburne MO, Gunnell GF, Stucky RK (2009) The importance of fossil collections for understanding climate change. Paleobiology 35(1): 1-5.

31. Barnosky AD, Matzke N, Tomiya S, Wogan GO, Swartz B, et al. (2011) Has the Earth's sixth mass extinction already arrived?. Nature 471: 51-57.

32. Luna CA, Rougier GW (2012) Vertebrate paleontology and education in Latin America. Evol Educ Outreach 5: 414-423.