A BONE TO PICK: THE PALEONTOLOGICAL RESOURCES PRESERVATION ACT AND ITS EFFECT ON COMMERCIAL PALEONTOLOGY

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INTRODUCTION

Fossil regulation is not a controversial national issue. As Pat Lieggi, winner of the Gregory Award from the Society of Vertebrate Paleontology, commented, "It's not national healthcare or the economy or a lot of things that are on people's minds . . . [y]ou've got to get it on their radar and get them interested."[1] But every now-and-then, a fossilized skeleton or footprint is found, capturing imaginations and furthering scientific knowledge. In August 2012, amateur dinosaur tracker Ray Stanford discovered a large, deep footprint left by a nodosaur at what is now the NASA Goddard Space Flight Center in Maryland.[2] The footprint, left by a "four-footed tank" 112 million years ago, excited NASA officials who, instead of creating a public attraction, blocked off the site to protect the footprint from harm.[3] As Jennifer Groman, NASA's federal preservation officer, stated, "ultimately, we want people to be able to see it because it's very exciting. . . . [but] we don't want people barreling down there with shovels. We can't have anyone pick it up and take it off property."[4] In this short statement, Groman summarized two things to consider when managing a significant paleontological resource. First, people should be able to see it, as a fossil that remains hidden underground or locked away cannot be enjoyed by the public nor studied by scientists. Second, some restrictions on public and private access are necessary to preserve the resource for future study and enjoyment.

In 2009, President Obama signed the Omnibus Public Land Management Act.[5] Within this huge omnibus bill was the Paleontological Resources Preservation Act (PRPA)—the first comprehensive federal law regulating the management of paleontological resources on federal land.[6] Before Congress passed the PRPA, federal land management agencies relied on outdated and scattered federal laws when exercising their

[1] *Montana State University Paleontologist Receives Major Award for Protecting Fossils on Federal Land*, NEWSRX HEALTH, Dec. 26, 2010, at 4.

[2] Brian Vastag, *Dinosaur Age Meets the Space Age*, WASH. POST, Aug. 18, 2012, at A01.

[3] *Id.*

[4] *Id.*

[5] Omnibus Public Land Management Act of 2009, Pub L. No. 111–11, 123 Stat. 991 (codified in scattered sections of 16 U.S.C.).

[6] Paleontological Resources Preservation Act, 16 U.S.C. §§ 470aaa–470aaa–11 (2012).

authority to manage paleontological finds within their jurisdictions. This was especially prevalent during the 1990s, when high public interest in fossils challenged the federal government's ability to regulate excavations and protect scientifically valuable specimens.[7] Although public interest in dinosaurs has waned since the 1990s, results from a recent private fossil auction suggest that the market for dinosaur fossils remains very strong.[8] Also, the development of the Internet as a global marketplace has increased the volume of fossils on the black market, and fossil poaching is now a very lucrative career path.[9] The Department of the Interior (DOI) has yet to promulgate regulations enforcing the PRPA but the language of the new law, and the answers it provides to old problems are encouraging and will likely lead to more uniform and reliable preservation of rare paleontological finds on federal land. But it has one nagging flaw.

This article evaluates the soundness of the PRPA and its likely effect on the Department of the Interior policies. Part I explains the scientific importance of paleontological resources and why they should be protected. Part II discusses how the United States managed paleontological resources before the PRPA. Part III explains the PRPA and the changes it will likely make to the current permit systems. Potential problems are then discussed. Part IV posits that the PRPA kept what was good about federal fossil management, including the Bureau of Land Management's permit system, and made some improvements, including explicit protections, policies, and penalties. However, the PRPA goes too far in fossil protection at the expense of fossil proliferation. This article advocates an amendment that would allow commercial collectors to participate in the PRPA's permit system, leading to the preservation of more fossils for public enjoyment and scientific research.

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[7] *See* Matt Kohlman, *Fossil Poachers Steal Potentially Valuable Relics from Public Lands*, L.A. TIMES, May 9, 1993, at 3. The success of the film 'Jurassic Park' encouraged public interest. Alexa Z. Chew, Note, *Nothing Besides Remains: Preserving the Scientific and Cultural Value of Paleontological Resources in the United States*, 54 DUKE L.J. 1031, 1032 (2005).

[8] *See, e.g.*, Russ Buettner, *Sale of $1 Million Dinosaur Skeleton Is Halted After Paleontologist Questions Origin*, N.Y. TIMES, June 20, 2012, at A21.

[9] James Munson, *Chasing the Fossil Dealers*, YUKON NEWS, Apr. 13, 2009, at 3.

I. THE IMPORTANCE OF PALEONTOLOGICAL RESOURCES

A. What is a Paleontological Resource?

The federal government defines a "paleontological resource" as "any evidence of fossilized remains of multicellular invertebrate and vertebrate animals and multicellular plants, including imprints thereof."[10] Sometimes, plants or dead animals are buried in sediment before they have time to decompose, leaving impressions in the sediment that are later filled in by minerals.[11] These minerals take the form of the plants or the hard body parts of the animals, resulting in a fossil.[12] Though very common in ocean beds, fossilization on land is rare in comparison.[13] When an animal dies on land, other animals usually eat its body, scattering and breaking its bones.[14] Wind, sunlight, bacteria, and water often erode bones before they are trapped by sediment.[15] Assuming the bones are covered by sediments before this happens, the fossilization process must also contend with the movements, pressures, and heat of the earth.[16] This destructive process usually ensures that, if a fossil is created, only the hardest parts of a plant or animal—wood, teeth, bones, shells, etc.—are fossilized.[17] Despite all of this, billions of fossils have survived, embedded in the earth's crust.[18] Erosion exposes a few of these fossils at any given time.[19]

Once exposed, the fossil must be quickly discovered before it is destroyed by erosion, giving paleontologists a small window to intervene.[20] Although fossils are technically a renewable

[10] 36 C.F.R. § 261.2 (2013). Although not the same as the fossil itself, "paleontological resource" will be used interchangeably with "fossil," as the former requires that there be evidence of the latter.

[11] RICHARD FORTEY, FOSSILS: THE KEY TO THE PAST 7–8 (3rd ed. 2002) [hereinafter KEY TO THE PAST].

[12] *Id.*

[13] IAN TATTERSALL, PALEONTOLOGY: A BRIEF HISTORY OF LIFE, 10–11 (2010).

[14] *Id.*

[15] *Id.*

[16] *Id.*

[17] RICHARD FORTEY, FOSSILS: THE HISTORY OF LIFE, 15 (Sterling Publishing Co. 2d ed. 2009). Very rarely, "geological miracles" occur, preserving the soft parts of plants and animals, including feathers and even internal organs. *Id.* at 19.

[18] David J. Lazerwitz, Note, *Bones of Contention: The Regulation of Paleontological Resources on the Federal Public Lands*, 69 IND. L.J. 601, 604 (1994).

[19] *Id.*

[20] *See id*. *See also,* TATTERSALL, *supra* note 14, at 11.

resource, fossils are more akin to finite resources because of their rarity and the unlikely circumstances that lead to their creation and discovery.[21] Also, ninety-nine percent of the species that have lived on this planet are extinct, and most of these species are known only by fossil record.[22]

The lessons that fossils teach scientists affect our understanding of the origins of life, the theory of evolution, the development of the earth, and mankind's place in history.[23] As David J. Lazerwitz stated:

> Fossils provide the only direct means by which to measure the history of life on the Earth, which dates back as far as 3.5 billion years. This knowledge of the history of life on this planet has had a profound impact not only upon our understanding of the evolution of life and the ability to measure changes in the Earth's environments, but also upon human inquiry into our own existence in a perspective of time and evolution.[24]

Although billions of these fossils exist and each one can contain a wealth of individualized information about that fossilized plant or animal,[25] some fossils are more scientifically significant than others.[26] For instance, fossilized vertebrate skeletons can provide scientists with more direct information about human development.[27] But size does not equal importance.[28] In rare cases, DNA becomes fossilized, increasing the accuracy of evolutionary trees, and presenting exciting new prospects.[29] In any case, the importance of fossils, to science, cannot be overstated.

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[21] COMM. ON GUIDELINES FOR PALEONTOLOGICAL COLLECTING, NAT'L RESEARCH COUNCIL, PALEONTOLOGICAL COLLECTING 15–16 (1987) [HEREINAFTER PALEONTOLOGICAL COLLECTING].

[22] Chew, *supra* note 8, at 1034.

[23] FORTEY, *supra* note 18, at 160–64, 180–86, 194, 196–97.

[24] Lazerwitz, *supra* note 19, at 604.

[25] *Id.*

[26] PALEONTOLOGICAL COLLECTING, *supra* note 22, at 13–15.

[27] MICHAEL J. BENTON, VERTEBRATE PALEONTOLOGY: BIOLOGY AND EVOLUTION, vii (1990).

[28] Indeed, the tiny, abundant microorganisms fossilized in fossil fuels are responsible for most of our modern conveniences. FORTEY, *supra* note 18, at 224. However, this is an alternate use for a very abundant fossil type. Therefore, when this article refers to "fossils," it is not referring to fossil fuels.

[29] FORTEY, *supra* note 18, at 214–15, 218–21. For a more advanced discussion of molecular paleogenetics, *see* Ananias A. Escalante & Francisco J. Ayala, *Molecular Paleogenetics: The Evolutionary History of Plasmodium and Related Protists*, *in* EVOLUTIONARY PALEOBIOLOGY 21–22 (David Jablonski, et al. eds., 1996).

B. Who Collects Paleontological Resources?

The importance of an individual fossil cannot be known until it is studied—and it cannot be studied until it is found. Discoverers and collectors of fossils are generally split into three groups: amateur, scientific, and commercial.[30] Amateur collectors collect for their own enjoyment and are considered the "foot soldiers of paleontology."[31] Scientific collectors discover and gather resources for scientific purposes and are usually associated with educational organizations and museums.[32] Commercial collectors gather resources and sell them for personal gain.[33] These distinctions are not absolute and, regardless of these groupings, inexperienced excavators pose a great danger to exposed fossils.[34]

C. What Role does the Federal Government Play?

The federal government owns thirty percent of its territorial holdings, including much of the South western desert, where many fossils are discovered.[35] Because of this, the federal government should take an active role in protecting fossils from poaching and damage. However, as explained above, collectors must find exposed fossils before erosion affects the fossil's scientific value.[36] Therefore, the federal government must protect fossils on federal land, but must do so in a way that facilitates the

[30] Robert W. Malsheimer & Alisa S.H. Hilfinger, *In Search of a Paleontological Resources Policy for Federal Lands*, 43 Nat. Resources J. 587, 588–89 (2003).

[31] Letter from Tracie Bennitt, Pres., Ass'n of Applied Paleontological Sci., to U.S. House of Rep. (Jan. 15, 2009) (http://www.aaps.net/message_from_the_president.html).

[32] Malmsheimer & Hilfinger, *supra* note 31, at 589.

[33] *Id.*

[34] ALAN MAJOR, COLLECTING FOSSILS 19–20 (1974) ("It is wrongfully thought by many beginners that all they have to do is bash away at the rock face with a hammer until the rock splits and, lo and behold, the fossils are revealed. All that these tactics usually produce is a heap of crumbled rock. . . . Many a fossil has been ruined by a perhaps excitedly-placed blow hitting the fossil surface.").

[35] *See* Frank Jacobs, *Federal Lands in the U.S.*, BIG THINK, (June 16, 2008, 8:23 PM), http://bigthink.com/strange-maps/291-federal-lands-in-the-us.

[36] David J. Lazerwitz, *supra* note 19, at 604, 630 ("The dilemma is that the science of paleontology requires the discovery and collection of fossil remains and, thus, from a policy standpoint requires as much collection as possible. Yet, unless the recovered resources are documented and available to the scientific community at large, the scientific significance of the fossil resource may never be known.").

discovery and safe excavation of significant finds.[37]

As discussed below, the PRPA had the potential to do this, but failed, by excluding commercial paleontologists from permitted collecting on federal land.

II. PROBLEMS BEFORE THE PRPA

Before 2009, federal agencies relied on a hundred-year-old law for general authority to protect paleontological finds on federal land, and a few scattered statutes, for authority in particular situations. As a result, the various agencies under the Department of the Interior enforced inconsistent rules that were based on outdated and questionable statutory authority.

A. The Antiquities Act

In 1906, Congress passed three laws, collectively known as the "Antiquities Act of 1906," to protect cultural, historical, and scientifically important resources found on federal land.[38] First, the Antiquities Act gave the President authority "to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the Government of the United States to be national monuments."[39] This part of the Antiquities Act has been used to protect certain areas of paleontological interest. For example, in 1915, President Woodrow Wilson used his Antiquities Act authority to establish Dinosaur National Monument in parts of Utah.[40] The proclamation gave warning "to all unauthorized persons not to appropriate, excavate, injure or destroy any of the fossil remains . . . ."[41] Dinosaur National Monument was later

[37] These are the two important considerations expressed by Jennifer Groman. Vastag, *supra* note 3. *See also* Lazerwitz, *supra* note 19, at 604, 630 ("Because both commercial collectors and amateurs—who do make significant contributions to the science—are motivated by a desire to retain ownership rights over the property they collect for either sale or personal possession, the policymaker faces the problem of encouraging the field reconnaissance activity while restricting the use of the resource once it is recovered.").

[38] 16 U.S.C. § 431, 432, 433 (2012).

[39] 16 U.S.C. § 431.

[40] Proclamation No. 1313, 39 Stat. 1752 (Oct. 4, 1915). In 1938, President Roosevelt expanded Dinosaur National Monument to include portions of the Green and Yampa Rivers. Proclamation No. 2290, 53 Stat. 2454 (July 14, 1938).

[41] Proclamation No. 1313, 39 Stat. 1752.

expanded into parts of Colorado and is currently under the authority of the National Park Service.[42]

Second, and most importantly for this article, the Antiquities Act made it illegal for any person to "appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity," situated on federal land without the permission of the federal government.[43] The Antiquities Act only provided for penalties of up to five-hundred dollars and/or ninety days in prison.[44]

Finally, the Antiquities Act gave the Secretaries of the Interior, Agriculture, and Army the power to grant permits for "the excavation of archeological sites, and the gathering of objects of antiquity upon the lands under their respective jurisdictions . . . ."[45] Although the Antiquities Act does not specifically refer to paleontological resources, it had the potential to give federal agency authority to protect fossils as "objects of antiquity."[46] However, the law's own wording and indefinite terms forced regulatory agencies to enforce their own interpretations of the law's scope, sometimes deciding that fossil regulation was outside the Antiquities Act powers.[47]

B. Black Hills and Antiquities Act Problems

The Antiquities Act is very brief, which led to voids in regulation and questionable acts by the government. This

[42] Proclamation No. 2290, 53 Stat. 2454. Congressman Bishop from Utah criticized Congress's actions in considering the PRPA during the recent recession. Although Bishop discussed the beauty of Dinosaur National Monument and the apparent disrepair of facilities there, he stated: "what I don't understand is as you are trying to solve these kinds of problems and putting money in the stimulus bill, why do we then pass an omnibus land bill that adds another $10 billion worth of backlog on top of what we already have? Why are we trying to expand and divert the resources that we have instead of taking care of what we have first? That would simply make sense. It is, indeed, countereffective." 155 CONG. REC. H1073–H1704 (daily ed. Feb. 9, 2009) (statement of Rep. Bishop).

[43] 16 U.S.C. § 433.

[44] *Id.*

[45] 16 U.S.C. § 432.

[46] Lazerwitz, *supra* note 19, at 609 (quoting 16 U.S.C. § 432).

[47] Patrick K. Duffy & Lois A. Lofgren, *Jurassic Farce: A Critical Analysis of the Government's Seizure of "Sue™," a Sixty-Five-Million-Year-Old Tyrannosaurus Rex Fossil*, 39 S.D. L. Rev. 478, 491 (1994) (construing Memorandum from Deputy Solicitor, Department of Interior to Assistant Secretary for Fish and Wildlife and Parks, 5–6 (Jan. 19, 1977) [hereinafter Duffy & Lofgren].

problem arose most famously in the case of "Sue," the most complete Tyrannosaurus Rex skeleton ever discovered.[48]

While exploring part of the Cheyenne River Sioux Reservation in August 1990, Black Hills Institute researchers, led by institute president Peter Larson, discovered a fossilized T-Rex skeleton and paid the Indian resident of the land, Maurice Williams, five-thousand dollars for the right to excavate.[49] Almost two years later, the Federal Bureau of Investigation (FBI) surrounded the Black Hills Institute and seized the skeleton, acting on a warrant that classified the bones as evidence in a criminal investigation for stealing from government land, stealing from tribal land, and violations of the Antiquities Act.[50]

Black Hills immediately brought suit to recover the skeleton.[51] As the Eighth Circuit later observed, "[u]pon remand, a three-day hearing ensued. Not unlike the dinosaur in size, this hearing built up 628 pages of transcript, with 14 witnesses and 114 exhibits."[52] The District Court denied Black Hills injunctive relief, and the fossil remained at the South Dakota School of Mines and Technology during litigation.[53] After "a somewhat convoluted and checkered past[,]"[54] Sue had her trial in February, 1993.[55] The court ruled that the fossil was "an interest in land" and could not be alienated from the Indian land, held in trust, without the consent of the Secretary of the Interior.[56] Because of this, any right Black Hills might have received from Williams was void, and Black Hill's claim to recover Sue was dismissed.[57] The federal government sold Sue in an auction for $8.36 million on behalf of Williams.[58]

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[48] Malcolm W. Browne, *A Dinosaur Named Sue Divides Fossil Hunters*, N.Y. TIMES, July 21, 1992 at C1.

[49] Duffy & Lofgren, *supra* note 48, at 481–82.

[50] *Id.* at 482.

[51] *Id.*

[52] Black Hills Inst. of Geological Res. v. U.S. Dep't of Justice, 978 F.2d 1043, 1044 (8th Cir. 1992).

[53] *Id*. at 1045.

[54] Black Hills Inst. of Geological Res. v. U.S. Dep't of Justice, 812 F.Supp. 1015, 1016 (D.S.D. 1993) ("*Black Hills III*").

[55] *Id*. at 1015.

[56] *Id.* at 1020.

[57] *Id.* at 1020, 1022 *aff'd* 12 F.3d 737, 745 (8th Cir. 1993). For a more in-depth trial history of the "Sue" controversy, *see generally* Duffy & Lofgren, *supra* note 48, at 481–87.

[58] Malmsheimer & Hilfinger, *supra* note 31, at 589; Duffy & Lofgren, *supra* note 48, at 487 (stating that Sue was held in a trust on behalf of Williams by the U.S.).

This case was decided on property law and Indian law grounds, not through an interpretation of the Antiquities Act. By the time the final property issue was decided, the U.S. Department of Justice (DOJ) had dropped its assertion that Black Hills had violated the Antiquities Act—one of the reasons the DOJ claimed it could take the fossil in the first place.[59] This action was likely prompted by the absence of reported cases applying the Antiquities Act to paleontological fossils,[60] the legislative intent in passing the Act,[61] the Ninth Circuit's position that Antiquities Act is unconstitutionally vague,[62] and the statute's most obvious flaw—weak punishments.[63] Also, in 1977, the Department of the Interior stated that the authority to manage paleontological resources was not within the powers granted by the Antiquities Act.[64] However, even the Department of the Interior was not consistent with this interpretation.[65]

As Patrick Duffy and Lois Lofgren stated, the Sue fiasco "prompted an in-depth analysis of the Antiquities Act and other federal regulations which revealed that current statutes [were] ambiguous and cannot reasonably be read as applicable to fossil excavations."[66] Fossil regulation under the Antiquities Act was plagued by the statute's vague terms, restrictive legislative history, and weak punishments that discouraged enforcement instead of violation. Though other laws gave federal agencies authority to manage paleontological resources, they only applied in specific situations.

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[59] *See* Duffy & Lofgren, *supra* note 48, at 482, 485 (citing Brief for Appellant at 7, Black Hills Inst. of Geological Research v. Dep't of Justice, 12 F.3d 737 (8th Cir. 1993) (No. 93-1602).

[60] Duffy & Lofgren, *supra* note 48, at 494.

[61] H.R. REP. NO. 59–2224, at 1–2 (1906); S. REP. NO. 59–3797, at 1 (1906).

[62] United States v. Diaz, 499 F.2d 113, 115 (9th Cir. 1974); United States v. Jones, 607 F.2d 269, 273 (9th Cir. 1979). Though these cases involved archeological artifacts, they likely shook the confidence of federal agencies relying on the Antiquities Act to manage paleontological resources. *But see* United States. v. Smyer, 596 F.2d 939, 942–43 (10th Cir. 1979) (holding that the prosecution of defendants who excavated at a prehistoric ruin in New Mexico was constitutional).

[63] 16 U.S.C. § 433.

[64] Duffy & Lofgren, *supra* note 48, at 491 (citing Memorandum from Deputy Solicitor, Department of Interior to Assistant Secretary for Fish and Wildlife and Parks, 5–6 (Jan. 19, 1977)).

[65] In 1984, the Department of the Interior redelegated authority to issue permits for the excavation of paleontological finds, citing the Antiquities Act and ARPA as the authorizing law. Issuance of Archeological and Paleontological Permits, 49 Fed. Reg. 40226 (Oct. 15, 1984).

[66] Duffy & Lofgren, *supra* note 48, at 487.

C. Other Scattered Statutes and Congressional Assessments

Before the passing of PRPA, only a few statutes mentioned paleontological resources specifically. The Archeological Resources Protection Act of 1979 (ARPA)[67] explicitly excludes most paleontological resources from its application.[68] Agencies like the National Forest System (FS), National Park System (NPS), and the Bureau of Land Management (BLM) were left to fill these gaps with their own regulations, relying sometimes on the Antiquities Act, and sometimes on other laws that granted them discretionary powers.[69] However, the inconsistent and lax (or sometimes overzealous) enforcement posed problems.[70] Congress began considering these problems in the 1980s.

Before the passage of the 1987 Omnibus Spending Bill, Congress asked the National Research Council (NRC) to assess these problems and report on the current state of paleontological collecting regulations on federal land.[71] Rather surprisingly, the NRC admitted that "an uncollected and unstudied fossil is of no value" and advocated *less* regulation in order to encourage fossil proliferation.[72] The NRC gave ten recommendations to Congress, summarized as follows: (1) a uniform national policy on paleontological collecting should be adopted by all federal agencies; (2) each state should adopt their own uniform policy for state lands; (3) all public lands should be opened to fossil collecting for scientific purposes and only quarrying or commercial collecting should be subject to permit requirements; (4) fossils of scientific significance should be deposited in institutions where there are established research and educational programs in paleontology; (5) in order to regulate commercial

[67] 16 U.S.C § 470aa–470mm.

[68] 16 U.S.C. § 470bb states in part: "Nonfossilized and fossilized paleontological specimens, or any portion or piece thereof, shall not be considered archaeological resources ... unless found in an archaeological context."

[69] *See* Preservation of Natural, Cultural and Archeological Resources, 36 C.F.R. § 1002.1(a)(1)(iii); What is the Scope of this Subpart?, 43 C.F.R. § 3809.2.

[70] *See* PALEONTOLOGICAL COLLECTING, *supra* note 22, at 2 (noting that around sixty federal agencies had claimed jurisdiction over paleontological resources and giving two examples of overzealous regulatory enforcement leading to the arrests of a hobbyist and a Harvard professor under seemingly innocent circumstances).

[71] *Id.* at 8. Interestingly, the committee put in charge of this task included Peter Larson, president of the Black Hills Institute. *Id.* at 27.

[72] *Id.* at 3.

collecting on public lands and minimize the risk of losing important fossils, applicants wishing to engage in such collecting should be required to receive the endorsement of a paleontologist and deposit specimens of special scientific interest into a public institution; (6) private landowners should require thorough scientific oversight when allowing commercial collecting on their land; (7) agencies should not undertake, fund, or require blanket paleontological inventories, mitigation, or salvage activities; (8) agencies in need of scientific guidance or advice on perceived paleontological problems should first contact the U.S. Geological Survey; (9) DOI should identify and evaluate potential paleontological localities of national significance (both on public and private lands) for designation as National Natural Landmarks (NNLs); and (10) paleontological societies should educate and inform landowners and commercial and amateur collectors of the research needs of professional paleontologists.[73]

It is important to note that in their first recommendation, the NRC stated that no additional statutes were needed—only a uniform national policy to unify federal agencies and promote consistency. It is perhaps for this reason that Congress chose not to include a paleontological resource act in its 1987 spending bill. Also, if adopted, their third recommendation would have opened all public lands (except national parks) to paleontological collecting and, as long as the collecting was not done for commercial purposes, no permit would be required for such collecting.[74] However, if the specimen was of "scientific significance," it should be deposited into a university or museum for study and education.[75] This proposal would have allowed commercial paleontologists to continue contributing to fossil proliferation, while channeling important scientific finds into museums and universities, thus striking a balance between proliferation and protection. Congress failed to achieve such a balance when passing the PRPA.

Congress again called for a study of federal fossil management in 1998, this time requesting the help of the Department of the Interior in developing a unified national policy as suggested in the NRC report.[76] The DOI performed a comprehensive study

[73] *Id.* at 3–4.
[74] *Id.*
[75] *Id.* at 4.
[76] U.S. DEP'T OF INTERIOR, FOSSILS ON FEDERAL AND INDIAN LANDS, ASSESSMENT OF FOSSIL MANAGEMENT ON FEDERAL & INDIAN LANDS 11 (2000)

comparing each of its agencies' permit requirements for removing paleontological resources.[77]

Table 1: Practices of the DOI for Collecting Fossils[78]

Agency	Invertebrates	Vertebrates	Petrified Wood[79]	Other Fossil Plants
[Bureau of Land Management][80]	Reasonable amounts for personal use, no permit required	Must have a permit	Up to 25 lbs/day/person + 1piece; not to exceed 250 lbs/year, for noncommercial use. BLM treats petrified wood as a mineral material	Reasonable amounts for personal use, no permit required
[Bureau of Reclamation]	Permit required; scientific purposes only	Permit required; scientific purposes only	Permit required; scientific purposes only	Permit required; scientific purposes only
[Fish and Wildlife Service]	Special Use permit required; scientific or educational purposes only	Special Use permit required; scientific or educational purposes only	Special Use permit required; scientific or educational purposes only	Special Use permit required; scientific or educational purposes only
[National Park Service]	Permit required; scientific or educational purposes only	Permit required; scientific or educational purposes only	Permit required; scientific or educational purposes only	Permit required; scientific or educational purposes only

[hereinafter FOSSILS ON FEDERAL AND INDIAN LANDS].

[77] *See id.* at 20, Table 1.

[78] FOSSILS ON FEDERAL AND INDIAN LANDS, *supra* note 77, at 20 (explaining DOI fossil collection before the PRPA).

[79] The federal government considers petrified wood to be a saleable mineral. 43 C.F.R. 3600 (2011).

[80] The BLM permit system is discussed in greater detail below, as this appears to be the system adopted by the PRPA. *See* discussion, *infra* Part IIIa.

In its report, the DOI suggested a more "coordinated approach" that included: (1) recognizing fossils as part of America's heritage, (2) understanding that most vertebrate fossils are rare, (3) understanding that some invertebrate fossils are rare, (4) strengthening penalties for poaching, (5) seeking more accurate management information, including subterranean surveying, (6) preserving federal collections for study and education, and (7) encouraging public involvement.[81] As discussed below, the PRPA adopts the DOI's suggestions and goes further, adopting a uniform permit system for most federal land.[82]

D. Failed Legislation

Congress considered two competing fossil management bills in the 1990s.[83] First, the Vertebrate Paleontological Resources Protection Act (VPRPA) in 1992,[84] then the Fossil Preservation Act (FPA) in 1996.[85] Neither of these bills passed, and paleontologists had to wait a decade for the PRPA.

Senator Max Baucus introduced the VPRPA to Congress just ten weeks after the government's raid on the Black Hills Institute.[86] The VPRPA would have included amateurs into the permit system, allowing them to keep fossils they found unless they were of "significant scientific value."[87] However, amateurs would only be granted permits if they were affiliated with an approved institution, and would lose this privilege if they sold their fossils.[88] All commercial collecting would have been prohibited.[89] Finally, the VPRPA would have increased the civil and criminal penalties for collecting without a permit.[90]

Though scientific paleontologists generally supported the bill, some scholars argued that it did not go far enough. For example, David J. Lazerwitz argued that the VPRPA should extend its

[81] FOSSILS ON FEDERAL AND INDIAN LANDS, *supra* note 77, at 23, 25, 27–28, 30, 32, 34.

[82] *See* discussion, *infra* III (b) & (c).

[83] Chew, *supra* note 8, at 1046.

[84] Vertebrate Paleontological Resources Protection Act, S. 3107, 102d Cong. (1992).

[85] Fossil Preservation Act of 1996, H.R. 2943, 104th Cong. § 2(b)(1)–(2) (1996).

[86] Chew, *supra* note 8, at 1046.

[87] S. 3107 § (7)(b)(1).

[88] *Id.* at §§ (4)(1)(B), 7(b)(3).

[89] *Id.* at § 6(b)(1)(E).

[90] *Id.* at § 8(d).

reach into private land and create a centralized fossil management agency.[91] Both Lazerwitz and Dorna Sachiko Sakurai supported a change to the VPRPA that would recognize the federal government's ownership of all fossils, only granting ownership of insignificant fossils upon application to the land manager.[92] Sakurai also advocated for a more international approach through import and export law reform.[93]

The FPA was more commercial friendly. It contained a commercial collecting permit provision that would have allowed collectors to profit from the sale of fossils, with fees and royalties paid to the federal government.[94] To help preserve a fossil's scientific value, the federal government would have required commercial collectors to preserve paleontological records and deposit them with the U.S. Geological Survey.[95] A newly created National Fossil Council would have assisted in protecting scientifically unique specimens.[96] Finally, the FPA did not include criminal penalties, but allowed land managers to assess civil penalties.[97] Because the FPA included commercial collectors in its permit system, some scientific collectors denounced the bill as an insufferable blow to fossil preservation.[98]

III. THE PALEONTOLOGICAL RESOURCES PRESERVATION ACT (PRPA)

A. Overview

The PRPA authorizes and requires the Secretary of the Interior to "manage and protect paleontological resources on Federal land using scientific principles and expertise" in a way that "emphasize[s] interagency coordination and collaborative efforts where possible with non-Federal partners, the scientific

[91] Lazerwitz, *supra* note 19, at 630–32.

[92] *Id.* at 630–31; Dorna Sachiko Sakurai, *Animal, Mineral, or Cultural Antiquity?: The Management and Protection of Paleontological Resources*, 17 LOY. L.A. INT'L & COMP. L. J. 197, 230–31 (1994-1995).

[93] Sakurai, *supra* note 93, at 240–43.

[94] Fossil Preservation Act of 1996, H.R. 2943, 104th Cong. § 5(d)(1)(A)–(B) (1996).

[95] *Id.* at § 5(d)(1)(C).

[96] *Id.* at § 9(a), (b)(1)(B).

[97] *Id.* at § 8(a).

[98] *See* Chris Beard, *Save the Dinosaurs: Don't Let Congress Pass a Law Permitting Commercial Fossil Collection on Federal Land*, PITTSBURGH POST-GAZETTE, Feb. 28, 1996, at A11.

community, and the general public."[99] To help achieve this goal, the statute requires that paleontological resources may not be collected from Federal land without a permit.[100] However, the PRPA makes a concession to amateurs, allowing for "casual collecting" without a permit.[101] This potential for ownership will encourage amateurs to discover fossils on federal land.[102] As Alexa Z. Chew stated, "[n]ot all amateur collectors are out to make a buck; some people simply enjoy the adventure."[103]

The permits for non-casual collecting must require that:

> (1) the paleontological resource that is collected from Federal land under the permit will remain the property of the United States; (2) the paleontological resource and copies of associated records will be preserved for the public in an approved repository, to be made available for scientific research and public education; and (3) specific locality data will not be released by the permittee or repository without the written permission of the Secretary.[104]

Once collected, the resource must "be deposited in an approved repository."[105] The PRPA also directs the Secretary to "establish a program to increase public awareness about the significance of paleontological resources."[106]

Finally, the PRPA defines specific criminal acts and imposes harsher criminal and civil penalties than the Antiquities Act. It is now explicitly illegal to:

> (1) excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage, or otherwise deface any paleontological resources located on Federal land . . . ; (2) exchange, transport, export, receive, or offer to exchange, transport, export, or receive any paleontological resource if the person knew or should have known such resource to have been excavated or removed from Federal land in violation of [Federal law]; or (3) sell or purchase or offer to sell or purchase any paleontological resource if the person knew or should have known such resource to have been excavated, removed, sold, purchased,

[99] 16 U.S.C. § 470aaa–1(a).

[100] *Id.* § 470aaa–3(a)(1).

[101] *Id.* § 470aaa–3(a)(2). PRPA defines "casual collecting" as: "the collecting of a reasonable amount of common invertebrate and plant paleontological resources for non-commercial personal use, either by surface collection or the use of non-powered hand tools resulting in only negligible disturbance to the Earth's surface and other resources." *Id.* § 470aaa(1).

[102] Chew, *supra* note 8, at 1055–56.

[103] *Id.* at 1056.

[104] 16 U.S.C. § 470aaa–3(c).

[105] 16 U.S.C. § 470aaa–4.

[106] 16 U.S.C. § 470aaa–2.

exchanged, transported, or received from Federal land.[107]

Violating PRPA could bring fines and/or imprisonment for up to five years.[108]

B. Permit System under the PRPA

Though the DOI has not yet promulgated regulations implementing the PRPA permit system, the statutory permit requirements are similar to those already in force by the BLM.[109] Both allow hobbyists to collect reasonable amounts of invertebrate fossils for personal use without a permit, unlike the National Park Service, which required a permit for even casual collecting.[110] As Senator Akaka, the PRPA's primary advocate, stated: "The [PRPA] never intended to undermine the current practice of casual collecting that is being enjoyed on Federal lands."[111] For non-casual collecting, the BLM states on its website that "[t]he PRPA does not change BLM's requirement for issuance of a paleontological resources use permit for the collection of vertebrate and other paleontological resources of paleontological interest by qualified researchers."[112] Also in line with the PRPA, the BLM issues only land-use authorization permits that allow permit holder to study or excavate paleontological resources that continue to be owned by the United States.[113] This places the cost of examining and excavating on the permit holder, while allowing the federal government to decide the best way to handle the fossil after study or excavation, like placing it in a museum.[114] The BLM permit process also protects

[107] 16 U.S.C. § 470aaa–5(a).

[108] *Id*. § 470aaa–5(c).

[109] *See* FOSSILS ON FEDERAL AND INDIAN LANDS, *supra* note 77, at 20, Table 1.

[110] 16 U.S.C. § 470aaa–3(a)(2); FOSSILS ON FEDERAL AND INDIAN LANDS, *supra* note 77, at 20, Table 1. It should be noted that the PRPA does not include land managed by the NFS within its scope. 16 U.S.C. § 470aaa(2).

[111] 155 CONG. REC. S3982–01, S3983 (daily ed. Mar. 30, 2009) (statement of Sen. Akaka).

[112] *Hobby Collection*, U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MGMT., http://www.blm.gov/wo/st/en/prog/more/CRM/paleontology/fossil_collecting.html (last visited Oct. 22, 2013).

[113] U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MGMT, FORM 1221-2, GENERAL PROCEDURAL GUIDANCE FOR PALEONTOLOGICAL RESOURCE MANAGEMENT IV-1 (1998) [hereinafter FORM 1221-2].

[114] *See id.* at IV-4-IV-5; 16 U.S.C. § 470aaa–4. If the current BLM permit system is maintained, the burden would actually be on the petitioners to find an accepted repository that's willing to house the fossil specimen after excavation. FORM 1221-2, *supra* note 114 at IV-5.

fossils from inexperienced hands, requiring that permits are only issued to those qualified by education, training, or experience.[115]

Though the PRPA "add[s] little to the procedural system that federal agencies currently employ to regulate collection of paleontological resources[,]" its greatest contribution lies in its penalty provisions.[116] The PRPA explicitly lists prohibited behavior and provides for fines and jail time.[117] This ensures that another "Sue fiasco" will not happen. It will now be easier for prosecutors to win convictions with an explicit prohibition and explicit penalties, as opposed to the "jumble" of laws before PRPA.[118]

C. Commentary on PRPA

Most commentary on the PRPA from paleontologists came while the law was pending congressional approval. Support and criticism of the PRPA and its predecessors from the scientific community reveal two embattled camps: academic (or "scientific") paleontologists led by the Society of Vertebrate Paleontology (SVP) and commercial paleontologists led by the Association of Applied Paleontological Sciences (AAPS).[119] The former supports the policy of fossil preservation, often arguing for the exclusion of commercial paleontologists to help keep fossils available and well preserved for museums.[120] The latter supports the policy of fossil proliferation, arguing, as the NRC did, that the federal government should encourage people to look for fossils in the constant race against natural erosion.[121]

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[115] FORM 1221-2, *supra* note 114 at IV-3.

[116] Chew, *supra* note 8, at 1049; Scott E. Foss, Michelle L. Mary, & Lucia Kuizon, NEW PUBLIC LAW TO PROTECT AND PRESERVE PALEONTOLOGICAL RESOURCES ON FEDERAL LAND, GEOL. SOC'Y. OF AM. (2009), *available at* https://gsa.confex.com/gsa/2009AM/finalprogram/abstract_166631.htm (last visited Oct. 22, 2013).

[117] 16 U.S.C. § 470aaa–5.

[118] Chew, *supra* note 8, at 1049.

[119] *Advocacy*, SOC'Y VERTEBRATE PALEONTOLOGY, http://vertpaleo.org/The-Society/Advocacy.aspx (last visited Oct. 22, 2013); Letter from Tracie Bennitt, *supra* note 32.

[120] *See generally, Fossils Protected in U.S. Land Legislation*, NATURE, Apr. 1, 2009; http://www.nature.com/news/2009/090401/full/458562e.html; *Society of Vertebrate Paleontology Hails Fossil Preservation Bill*, SOC'Y VERTEBRATE PALEONTOLOGY, http://vertpaleo.org/The-Society/Statements-and-Guidelines/SVP-Hails-Passage-of-Fossil-Preservation-Bill.aspx (last visited Oct. 22, 2013).

[121] Letter from Tracie Bennitt, *supra* note 32.

The SVP advocated strongly for the PRPA in Congress.[122] Upon the passage of the PRPA, SVP president Hans-Dieter Sue stated that "[the SVP is] pleased to see legislation that recognizes that vertebrate fossils from public lands are an educational and scientific resource for our generation and those yet to come" and hoped that the PRPA would "ensure that these fossils will not be removed from the public domain, but preserved for the enjoyment and education of all Americans for all time."[123] The SVP supported the PRPA because "[t]he Society is organized exclusively for educational and scientific purposes," not for commercial purposes.[124]

The SVP bylaws specifically state that "[t]he barter, sale or purchase of scientifically significant vertebrate fossils is not condoned, unless it brings them into, or keeps them within, a public trust."[125] The PRPA also received support from individual paleontologists, such as Glenn W. Storrs, Director of Science Research and Curator of Vertebrate Paleontology at Cincinnati Museum Center, who applauded an earlier version of the act, stating that "this is finally the bill that addresses all of our needs and the one that we can, and must, all support."[126] Storrs cited the PRPA's respect for amateur collecting, uniform permit requirements, education encouragement, and tough penalties in his approval.[127]

Opposing the SVP are the AAPS and commercial paleontologists. While the House of Representatives considered a version of the PRPA, Tracie Bennitt, President of the AAPS, sent a letter to Congress expressing concerns AAPS had with certain provisions of the bill.[128] AAPS also communicated its concern that Congress had left it out of the drafting process.[129] Choosing to

[122] *Advocacy, supra* note 120; *Fossils Protected in U.S. Land Legislation*, *supra* note 121.

[123] *Society of Vertebrate Paleontology Hails Fossil Preservation Bill*, *supra* note 121. The SVP also presented plaques as tokens of their appreciation to Senator Akaka and Congressman James P. McGovern for their help in passing the PRPA. *Advocacy, supra* note 120.

[124] *Society of Vertebrate Paleontology Hails Fossil Preservation Bill*, *supra* note 121.

[125] *Member Bylaw on Ethics Statement*, SOC'Y VERTEBRATE PALEONTOLOGY, http://vertpaleo.org/The-Society/Governance-Documents/Bylaw-on-Ethics-Statement.aspx (last visited Oct. 9, 2013).

[126] Glenn W. Storrs, *Paleontological Resource Preservation Act*, XFOSSILS, http://www.xfossils.com/helpwnt4.htm (last visited Oct. 9, 2013).

[127] *Id.*

[128] Letter from Tracie Bennitt, *supra* note 32.

[129] *Id.*

exclude AAPS was, perhaps, a tactical move by Congress. Unlike the SVP, the AAPS is organized as a "professional association of commercial fossil and mineral collectors and preparators" and therefore has a commercial interest in the proliferation of fossils.[130] Bennitt's letter listed some concerns with the statute, which deserve some discussion.[131]

(1) The confidentiality provision flies in the face of scientific principles that scientific knowledge should be made public.[132] The confidentiality provision exempts the Secretary from having to disclose to the public the location of specific paleontological resources.[133] The Secretary may choose to disclose if it furthers the purpose of the PRPA, "[does] not create [a] risk of harm to or theft or destruction" of the specific paleontological resource, and complies with other applicable laws.[134] This provision does not bar the Secretary from disclosing locations of fossils. This information may be disclosed if it is safe to do so. Furthermore, the PRPA calls the Secretary to manage these resources "using scientific principles and expertise."[135] Thus, the statute calls the Secretary to follow the general scientific principle that scientific knowledge should be made public.

(2) Section 470aaa–5(b) prohibits the making or submitting of "any false record, account, or label for, or any false identification of, any paleontological resource excavated or removed from Federal land."[136] Paleontology is an ever-changing science, and as new information about specimens is brought to light, people could inadvertently mislabel a fossil and face the same penalties as someone who stole a fossil.[137]

This concern is dealt with in section 470aaa–5(c), which states that a person must "knowingly violate[]" the provisions of the act to be subject to criminal fines or imprisonment.[138] Therefore, accidentally or unknowingly mislabeling a fossil would not

[130] *Who Is The Association of Applied Paleontological Sciences*, AAPS, http://www.aaps.net/introduction.htm (last visited Oct. 9, 2013).

[131] As the wording of the final version of the bill is different than the language quoted by the AAPS letter, only the relevant concerns are included and these concerns are broadly stated. Letter from Tracie Bennitt, *supra* note 32.

[132] *Id*.

[133] 16 U.S.C. § 470aaa–8.

[134] *Id.*

[135] 16 U.S.C. § 470aaa–1(a).

[136] *Id*. § 470aaa–5(b).

[137] Letter from Tracie Bennitt, *supra* note 32.

[138] 16 U.S.C. § 470aaa–5(c).

subject the mislabeler to criminal liability.

(3) In assessing penalties, the statute includes the terms "the sum of the commercial and paleontological value of the paleontological resources involved."[139] The term "paleontological value" is unclear and only the "commercial value" should be considered.[140]

Although this claim is true and courts may have a hard time deciding what the "paleontological value" of a fossil might be, this provision is limited in its scope to mitigating penalties and only applies when the total value of the fossils is less than $500.[141] Though the term is vague, its limited scope presents no major challenge to the soundness of the PRPA.

(4) There are "no provisions for commercial exploration, collecting, processing, and sale of fossils on public lands."[142] It is better to allow commercial paleontologists to excavate and sell fossils than have the fossils deteriorate.[143]

This is the strongest claim against the PRPA. The statute favors the policy of protecting paleontological resources at the expense of the policy of fossil proliferation as encouraged by the NRC report. The casual collecting exception, and the permit requirements, do not include commercial collecting. Thus, even if an experienced fossil hunter sought a permit to excavate a scientifically important fossil, the permit could not be granted. Unless the Secretary could find someone willing to excavate for "the purpose of furthering paleontological knowledge or for public education," the resource would go unexcavated.[144] Although the need to preserve fossils is great, it should not overshadow the need to proliferate fossils. While zealously protecting against the misappropriation of fossils, Congress is inadvertently decreasing the number of fossils discovered on federal land.

An amendment that allows commercial paleontologists to receive a permit under certain circumstances could remedy this. For example, a requirement that the commercial paleontologist have a museum or other proper repository lined up to buy the fossil once excavated would serve both policy concerns.[145] A

[139] *Id.*

[140] *See generally,* Letter from Tracie Bennitt, *supra* note 32.

[141] 16 U.S.C. § 470aaa–5(c).

[142] Letter from Tracie Bennitt, *supra* note 32.

[143] *Id.*

[144] 16 U.S.C. § 470aaa–3(b)(2).

[145] This would extend section 470aaa–4 which states that "[a]ny paleontological resource, and any data and records associated with the resource,

provision similar to the commercial collecting provision of the FPA could also be considered.[146] This system could allow commercial paleontologists to profit from their efforts, while still requiring that the information from the find be transmitted to the federal government, to be used for scientific research.[147]

The greatest risk to paleontological resources is the risk of not being discovered before the elements take their toll. As commercial fossil collector and merchant Kenneth Kolb notes, "[t]he fact of the matter is, there are not enough professionals to hunt, identify, and collect the numerous fossils that are currently exposed above-ground and subject to destructive weathering. There is too much land, too many fossils, and too few paleontologists."[148] The PRPA neglects this consideration in favor of a more protective statute that eliminates commercial collecting on federal land. In this regard, the PRPA fails to successfully balance these two policy considerations and should be amended to include this currently excluded manpower.

(5) Indian land is not included in the PRPA definition of "federal land."[149] This leaves large parcels of land, and potentially large numbers of fossils, unprotected.

This definition of "federal land" is likely a concession to the nature of Indian land and fossils found on it. As the court stated in *Black Hills III*, fossils on Indian land are considered "interests in land" held in trust and cannot be alienated from the Indian land without the consent of the Secretary of the Interior.[150] Because depositing fossils into approved repositories without compensation may not be in the best interest of the Indian's residing on the land on which the fossil was found, it naturally

collected under a permit, shall be deposited in an approved repository. The Secretary may enter into agreements with non-Federal repositories regarding the curation of these resources, data, and records." 16 U.S.C. § 470aaa–4.

[146] *See supra* Section D para. 3.

[147] Fossil Preservation Act of 1996, H.R. 2943, 104th Cong. § 5(d)(1)(C) (1996).

[148] *Bone Laws*, BONEMASTERS, http://www.bonemasters.com/bone-laws.html (last visited Oct. 9, 2013); *see also* Donovan Webster, *The Dinosaur Fossil Wars*, SMITHSONIAN (Apr. 2009) (quoting Ron Frithiof), http://www.smithsonianmag.com/science-nature/The-Dino-Wars.html?c=y&page=6 (""The fossils are out there, wind and rain weathering them, while people argue about who is allowed to collect them and who isn't. After a year or two of exposure, any fossil begins to disintegrate and crumble to dust.' And then, [Frithiof] adds, 'Well, nobody gets them. They're just gone.'").

[149] 16 U.S.C. § 470–aaa(2).

[150] Black Hills Inst. of Geological Res. v. U.S. Dep't of Justice, 812 F. Supp. 1015,1020.

follows that PRPA should not apply. Following *Black Hills*, Duffy and Lofgren stated "a proposed regulatory scheme which encompasses lands held in trust for Native Americans raises some significant concerns for Native American landowners and their tribes. Accordingly, Congress must be sensitive to these concerns and the potential impact of federal regulations that sweep into Indian country."[151] The PRPA's Indian land exclusion allows for Indian land law to be sensitive and develop with more tribal autonomy, free of restrictive fossil law.

For the most part, the PRPA addresses the problems of federal fossil regulation that existed before its passage. However, commercial paleontologists should not be excluded, but embraced within the permit system.

CONCLUSION

The PRPA is a step in the right direction. It is the solution to most problems the federal government experienced under previous statutory authority. Rather than a jumble of separate regulations and policies promulgated by multiple federal agencies, the PRPA provides a unifying policy enforced by the Secretary of the Interior. Whereas previous cases of fossil poaching were pursued hesitantly, unevenly, and under outdated authority, the federal government now has explicit authority to act and to punish those responsible. The act kept the BLM's permit procedure, and expanded it to other agencies under the DOI, allowing hobbyists to pursue their interests reasonably and uniformly. The PRPA also encourages the flourishing of museums and other public repositories of fossils, ensuring that the fossils will be preserved properly so they can be studied and enjoyed for generations. Given the importance of fossils to science, these measures are welcome.

However, Congress made a distinct policy decision when passing the PRPA that could have troublesome long-term consequences. By choosing to maintain the BLM restriction on commercial collecting and favoring protection over proliferation, Congress will decrease the number of fossil hunters on federal land and, therefore, decrease the number of discovered and excavated fossils. Fossils must first be found if they are to be preserved. Although unfettered commercial excavation would be

[151] Duffy & Lofgren, *supra* note 48, at 527.

too threatening to fossil protection, the integration of commercial collectors into the permit system under certain circumstances would strike a better balance and lead to more fossils being discovered and preserved.