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The Comparative Institutions Approach to Wildlife Governance

Dean Lueck

Indiana University, deanlueck@gmail.com

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ARTICLE

THE COMPARATIVE INSTITUTIONS APPROACH TO WILDLIFE GOVERNANCE

by: *Dean Lueck**

ABSTRACT

This Article develops a comparative institutions approach to wildlife governance by examining the property rights to the habitat and the stocks of wild populations. The approach is based on the transaction cost and property rights approach and lies primarily in the traditions of Coase, Barzel, Ostrom, and Williamson. The approach recognizes the often-extreme costs of delineation and enforcement of property rights to wild populations and their habitats; thus, all systems are notably imperfect compared to the typical neoclassical economics approach. These costs arise because wildlife habitat and wildlife populations are part of the land which has many attributes and uses—most notably, residential and agricultural uses. In turn, the optimal ownership sizes (and shapes) vary across land uses (e.g., farming, urban, ranching, wildlife, parks). The organizations that govern wildlife tend to be ridden with transaction costs and imperfect property rights, and the most efficient system is one that maximizes the total value of the package less the enforcement and administrative costs. This Article develops a framework for considering different governance regimes for both the wild stocks and the habitats they require. A series of cases—focused especially on bison and caribou—show the range of governance regimes that have been used and how those governance regimes depend on history and on law.

TABLE OF CONTENTS

I. INTRODUCTION.....	148
II. GOVERNANCE OF HABITAT (LAND) AND POPULATIONS	150
A. <i>Some Basic Economics of Wildlife</i>	150
B. <i>Governance Regimes and Wildlife Exploitation</i>	152
C. <i>Property Rights to Land and Wildlife</i>	155
D. <i>Governing Landscape Assets</i>	157
III. CASE STUDIES IN WILDLIFE GOVERNANCE	160
A. <i>England versus America</i>	160
B. <i>Wildlife and Native Americans</i>	162
C. <i>Bison and Caribou</i>	162
1. <i>Bison: Hunter-Gatherer Governance</i>	164
2. <i>Bison: The Robe Hunt on the Northern Plains</i> .	164

* Department of Economics and Ostrom Workshop, Indiana University, Bloomington, Indiana. I can be contacted at lueck@indiana.edu. This Article was originally prepared for the conference, “Environmental Protection: Carrots or Sticks,” at Texas A&M School of Law on March 8–10, 2018. It also draws influence from a presentation given at the Wildlife Economy Workshop, Willows Country Lodge, Pretoria, South Africa, March 15–17, 2017, organized by Michael ‘t Sas-Rolfes and Frank Vorhies. Tom Frye provided valuable research assistance.

- 3. Bison: Open Access Extirpation, 1850–1900 165
- 4. Bison: Private Governance, 1900–Present..... 166
- 5. Bison: Yellowstone National Park 167
- 6. American Prairie Reserve: Private Contracting
for Wildlife 168
- 7. Caribou: Hunter-Gatherer Governance 169
- 8. North American Caribou: Modern Agency
Management 170
- 9. Porcupine Caribou Herd 171
- 10. The Saami Reindeer Culture 172
- 11. Norwegian Pasture Management..... 173
- 12. Norwegian Wild Reindeer 174
- 13. Reindeer Peoples in Russia 174
- D. *Migratory Waterfowl: Biological and Administrative
Flyways* 175
- IV. CONCLUSION 177

If it was the common law that sheep and lambs belonged to nobody, it would be impossible to preserve them from utter destruction. Each man, when he saw a sheep or lamb, would take and sequester it for his own use, lest his neighbor should get the start on him. There is no common or statute law [in the United States] protecting fish and game, therefore our fish and game are rapidly disappearing. What we need is a law, not simply protecting game and fish. . . but making game and fish the property of the owners of the land on which they are found, and the streams through whose territory they run.

–Forest and Stream, 1875¹

I. INTRODUCTION

The conservation and management of wildlife populations have been governed by many organizations and legal regimes over time and across space. Consider, for example, governance of the American bison (locally called the buffalo).² Today, many bison are privately owned like domestic cattle, but some are also under the administration of national park managers and state wildlife agencies where the ownership is less clear. Prior to extensive European contact, Native Americans governed bison as common property with enforcement of hunting territories against other tribes and internal tribal rules about hunting times and methods. During the nineteenth century, as the indigenous peoples were conquered, the bison stocks were subjected to

1. JAMES A. TOBER, WHO OWNS THE WILDLIFE?: THE POLITICAL ECONOMY OF CONSERVATION IN NINETEENTH-CENTURY AMERICA, 122 (1981).

2. Dean Lueck, *The Extermination and Conservation of the American Bison*, 31 J. LEGAL STUD. S609, S611 (2002) [hereinafter *The Extermination and Conservation of the American Bison*] (examining the economic history of the bison).

open-access depletion and nearly exterminated before they were governed largely as domestic animals under state agricultural laws.

Rangifer tarandus, or caribou, are governed as wild animals in North America, only subject to full ownership upon harvest. In Europe, however, where caribou are called reindeer, they are partly domesticated and governed as private (sometimes communal) property. Both are the same species, *rangifer tarandus*. This Article discusses several of the many other examples of the same species differently governed.

This Article develops a comparative institutions approach to wildlife governance by examining the property rights to the habitat and the stocks of wild populations. The approach is based on the transaction cost and property rights approach and relies primarily on the traditions of Ronald Coase, Yoram Barzel, Elinor Ostrom, and Oliver Williamson. The approach recognizes the often-extreme costs of delineation and enforcement of property rights to wild populations and their habitats. All systems are notably imperfect compared to the typical neoclassical economics approach. These costs arise because wildlife habitat and wildlife populations are part of the land which has many attributes and uses—most notably, residential and agricultural uses. In turn, the optimal ownership sizes (and shapes) vary across land uses (e.g., farming, urban, ranching, wildlife, parks). From this point, it is easy to see that land with more than one characteristic (e.g., farm land and wildlife habitat or a watershed) will create property regimes that may not match the geographic boundaries of habitats and populations. Even where wildlife and its habitat are the only valued characteristics of the land, the large scale may lead to large organizations effectively controlling the resources. These organizations will be burdened by transaction costs and imperfect property rights, and the most efficient system is one that maximizes the total value of the package less the enforcement and administrative costs.

The economic framework in this Article uses the property rights typology of Lueck and Miceli: open access, common property, private property, and state property. Open access means there are no exclusive rights, while common property means exclusive group property.³ Common property has a rich history in wildlife governance (e.g., Ostrom 1990) and is the regime that best fits wildlife governed by hunter-gatherer societies. Private property can include a mix of exclu-

3. Garrett Hardin, *The Tragedy of the Commons* 162 *Sci.* 1243, 1244 (1968) (discussing open access); see also ELINOR OSTROM, *GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION* 90–92 (1990) (noting that the terms “common property” or “commons” had ancient use, meaning property held by a well-defined group); see also Dean Lueck & Thomas J. Miceli, *Property Law, HANDBOOK OF LAW AND ECONOMICS* 239 (A. Mitchell Polinsky & Steven Shavell eds., vol. 1 2007) (highlighting the distinction between common property and open access).

sive property owned by individuals or private organizations.⁴ State property is perhaps the most complex and can be administered in various ways that might mimic private ownership, common property, or open access.

In Section II, I present an economic framework for considering different governance regimes for both the wild stocks and the habitat they require. In Section III, I present a series of cases—focused especially on bison and caribou—that show the range of governance regimes that have been used and how those governance regimes depend on history and on law.⁵ Section IV is a short conclusion.

II. GOVERNANCE OF HABITAT (LAND) AND POPULATIONS

The governance of wildlife requires analysis of the governance of land (i.e., wildlife habitat) and governance of wildlife populations. I begin by distinguishing the economic values of wild from domestic animals and reviewing basic bioeconomic models of harvest and use of wild populations. I then develop a general framework for examining landscape assets such as wildlife and focus on the particular governance regimes that predominate.

A. *Some Basic Economics of Wildlife*

Wild animals are distinguishable from domestic animals by the property rights associated with the various species.⁶ Ownership is a “key to understanding wildlife institutions and therefore the size and sustainability of these populations.”⁷ A population or stock of animals is completely wild only when there is open access.⁸ A stock is fully domestic only when property rights to the stock are perfectly defined and enforced.⁹ While populations (e.g., a herd of deer) or individuals

4. Note that common property and private property might become blurred in the case where a private owner becomes a large organization. In Ostrom’s (1990) work, common property typically referred to group property with relatively informal internal governance and often operating outside a formal legal system. OSTROM, *supra* note 3.

5. It is apparent that under the zero transaction costs Coase Theorem, any wildlife governance structure would yield identical outcomes. *See generally* Prateek Agarwal, *The Coase Theorem*, INTELLIGENT ECONOMIST (Jan. 1, 2018), <https://www.intelligenteconomist.com/the-coase-theorem/> [<https://perma.cc/R9RS-JRB9>]. Indeed, the evidence presented here implies that transaction costs are substantial and lead to wide variation in wildlife governance and wildlife allocation.

6. Dean Lueck, *Property Rights and the Economic Logic of Wildlife Institutions*, 35 NAT. RESOURCES J. 625, 635 (1995) [hereinafter *Property Rights and the Economic Logic of Wildlife Institutions*]; Dean Lueck, *Wildlife: Sustainability and Management*, PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA 133, 137 (Roger A. Sedjo ed., 2010) [hereinafter PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA].

7. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 635.

8. *Id.*

9. *Id.*

(e.g., a trained tiger) can be owned, the focus is on ownership of populations and other aggregations of individuals.¹⁰

One can also consider wild versus domestic in terms of the animals' habitats and behaviors.¹¹ The more natural the habitat, the wilder the animals.¹² In everyday usage "wild" implicates ownership and habitat.¹³ Ownership therefore affects animal behavior (and ultimately biology) by altering the natural parameters of the animals face.¹⁴ Humans also affect the population even without ownership because open-access exploitation can cause, among other things, overharvest.¹⁵

The net value of a wild population depends on the gross value it generates and the costs of generating it.¹⁶ "A stock of wildlife is valued for products derived from its carcass, which requires killing individuals, and from services derived from living animals, including ecosystem services.¹⁷ Costs arise, in the form of damage to other resources, because animals consume resources in their day-to-day lives."¹⁸ Ducks and geese feast on small grains, elk and deer forage in hay fields, and mountain lions attack sheep, pets, and even people.¹⁹

There are well-established markets for animal products such as feathers, flesh, hides, and pelts.²⁰ For a market transaction, property rights to some of the attributes of the product must be well-specified;

10. *See id.* at 627.

11. *Id.* at 635. There are often important, but subtle, biological factors that influence the cost of ownership of animals. For example, Indian elephants have been domesticated but African elephants have not. *See generally* JULIET CLUTTON-BROCK, *DOMESTICATED ANIMALS FROM EARLY TIMES* (1981) (discussing the domestication of wild populations); LEE ALAN DUGATKIN & LYUDMILA TRUT, *HOW TO TAME A FOX (AND BUILD A DOG): VISIONARY SCIENTISTS AND A SIBERIAN TALE OF JUMP-STARTED EVOLUTION* (2017) (studying the domestication of foxes in Siberia); CAROL O. SAUER, *AGRICULTURAL ORIGINS AND DISPERSALS* (1952); FRIEDRICH ZUENER, *A HISTORY OF DOMESTICATED ANIMALS* (1963).

12. *Property Rights and the Economic Logic of Wildlife Institutions, supra* note 6, at 635.

13. *Id.*

14. *Id.*; *PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, supra* note 6, at 137.

15. *Property Rights and the Economic Logic of Wildlife Institutions, supra* note 6, at 635.

16. *Id.* at 636; *PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, supra* note 6, at 138.

17. *PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, supra* note 6, at 138.

18. *Id.*

19. *Id.* For example, a mountain biker was stalked and killed by a mountain lion near North Bend, WA. Erik Lacitis, *1 Bicyclist Dead, 1 Hurt in Cougar Attack Near Snoqualmie*, *SEATTLE TIMES* (last updated May 20, 2018, 4:18 PM), <https://www.seattletimes.com/seattle-news/eastside/1-dead-1-injured-in-cougar-attack-on-eastside/> [<https://perma.cc/AW79-F6DC>].

20. *Property Rights and the Economic Logic of Wildlife Institutions, supra* note 6, at 636.

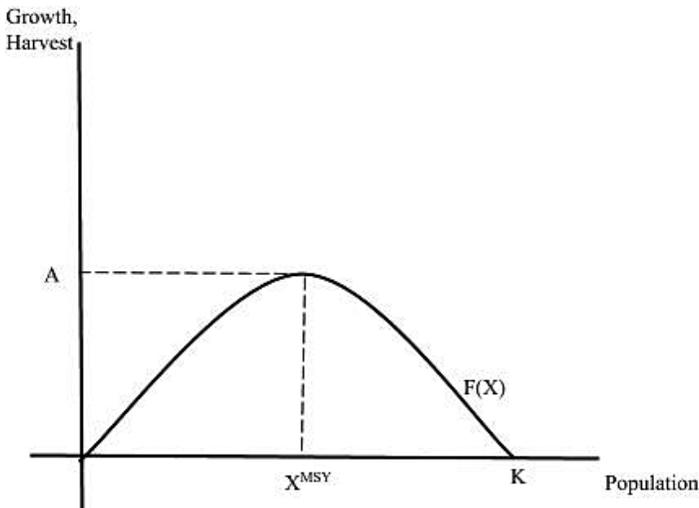
this is true for meat, hides, and pelts.²¹ Live animals are valuable because not only can they provide these products in the future but also during their lifetime they periodically provide antlers, manure, power, and wool. Simply their existence can also produce aesthetic value for those who view or photograph them.²² Wild populations can also potentially provide a wide variety of ecosystem services.

B. Governance Regimes and Wildlife Exploitation

Wildlife populations are renewable biological resources, and some basic elements of population dynamics are important for understanding wildlife economics and governance. Panel A of Figure 1 shows the basic features of biological growth.²³ A population tends to grow slowly at first, then rapidly, then ultimately slowing down as it reaches its maximum level or its “carrying capacity” (routinely labeled K) for a given habitat.²⁴ The panel plots the size of the population against the rate of growth of the population, showing there is no growth when the stock is zero or at the carrying capacity.

FIGURE 1

Panel A: Stock-Growth Relationship



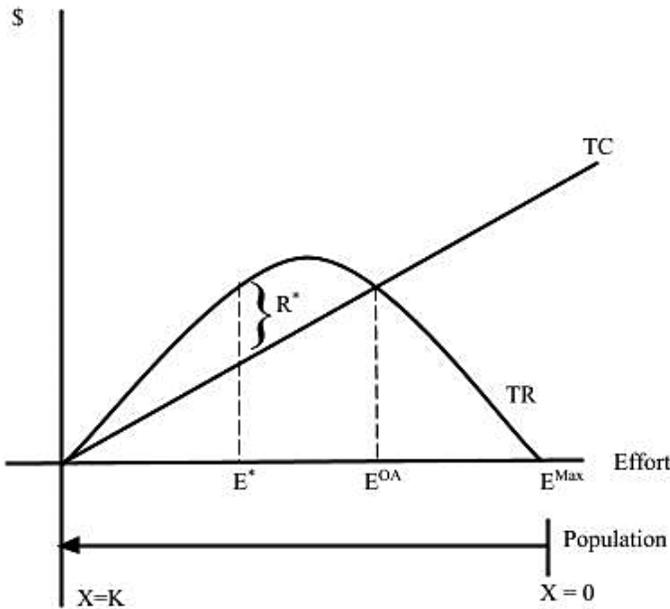
21. *Id.*

22. *Id.*

23. See *infra* Figure 1.

24. *Carrying Capacity*, ENCYCLOPEDIA BRITANNICA, <https://www.britannica.com/science/carrying-capacity> (last visited June 14, 2018) [<https://perma.cc/M4CM-EQEM>]. A more complex and real population model would incorporate uncertainty.

Panel B: Optimal Harvest of Wildlife Population



When the population growth rate is largest (A), it is said to be at “maximum sustainable yield” level, or “MSY.”²⁵ Therefore, at MSY (X^{MSY}) the largest possible level of harvest could be sustained indefinitely because growth would exactly offset it.²⁶ At a carrying capacity, however, the sustainable harvest is zero because the net growth rate is zero.²⁷ Thus, the simple features of biological growth show that population levels must be reduced from carrying capacity to increase sustainable harvest.²⁸

The economic problem is determining the optimal level of harvest. Property rights are important in determining effort, harvest (or preservation), stock size, and wealth generated from the stock.²⁹ If secure property rights to a population exist, the owner typically “harvest[s] an entire cohort at the same time and then restock[s] the habitat with another population.”³⁰ For wildlife, the issue is the level of harvest in

25. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 138.

26. *Id.*

27. *Id.*

28. *Id.*

29. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 638.

30. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 139. This is what economists call an optimal timing problem, and it is the framework that describes everything from timber cutting to grain harvest. This is the case for domestic cattle as well as for aquaculture. In addition, strong property rights give the owner an incentive to invest in habitat (changing K) or changing population dynamics

a period, such as a year or a season.³¹ This kind of regime can be found where populations are owned or where there is open access. If property rights are secure, the owner will choose the optimal amount of harvest each period.³² The bottom panel of Figure 1 uses the biological production process shown in the top panel of Figure 1³³ and couples it with market prices and costs of harvest to generate harvest outcomes under various property regimes.³⁴ The horizontal axis measures harvest effort (e.g., labor, equipment), and the vertical axis measures the revenues and costs of effort in dollars.³⁵ The total revenue (TR) curve denotes the market value associated with various levels of effort in yielding a harvest (e.g., bison meat) that can be sold in competitive markets.³⁶ The horizontal axis also shows that the wildlife stock size is directly and inversely linked to harvest effort.³⁷ When there is no effort, the stock is at carrying capacity and declines as effort increases. Under private ownership of the stock, the owner chooses the optimal level of effort (E^*) and earns a periodic rent (R) from this management.³⁸ Under private ownership, the total value of the stock will be the discounted present value of this stream of rents.

Under open access, the level of harvest is excessive because each user does not bear the cost his or her harvest imposes on the size and productivity of the population.³⁹ Effort is exerted to E^{oa} which exceeds E^* . If the marginal harvest costs are low, open access can lead to extreme reductions in population and even extinction.⁴⁰ Indeed, open-access exploitation is “a dominant cause of the many dramatic

(e.g., growth rates) themselves through animal husbandry (e.g., selective breeding, medicine). See Robert S. Pindyck, *Optimal Timing Problems in Environmental Economics*, 26 J. ECON. DYNAMICS & CONTROL 1677, 1678 (2002).

31. Of course, the optimal number need not be constant over time as conditions change.

32. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 140. This would include cases in which the population provided public goods because perfect property rights would still allow the owner to exclude.

33. See *supra* Figure 1.

34. JON M. CONRAD, *RESOURCE ECONOMICS* (2d ed. 2010) (explaining this model in detail).

35. *Supra* Figure 1.

36. *Id.*

37. *Id.*

38. The rent is the revenue less the costs at the optimal level of effort, or $TR(E^*) - TC(E^*)$.

39. Suboptimal use can also occur when investment is required for harvest; in this case, an open access regime can lead to under-exploitation. This has been a problem in oil production but less so in wildlife management. See generally Henning Bohn & Robert T. Deacon, *Ownership Risk, Investment, and the Use of Natural Resources*, 90 AM. ECON. REV. 526, 532–47 (2000).

40. It is not essential that X equal zero when the growth rate is zero; there may be a “minimum viable stock size” required to ensure positive growth rates, which makes extinction more likely. Note, however, that extinction of a single stock is not the same as biological extinction of a species, as a species is composed of many stocks. See generally Michael R. Caputo & Dean Lueck, *Natural Resource Exploitation Under Common Property Rights*, 16 NAT. RESOURCE MODELING 39, 40–46 (2003).

population reductions and extinctions.”⁴¹ Additionally, the rent (and its present value equivalent) is dissipated by overexploitation.⁴² Thus, not only is the wildlife resource damaged, but little or no economic value is generated from it.

As Ostrom notes, common property regimes can generate rents by reducing open access harvest levels.⁴³ In a wildlife harvest model, common property wildlife exploitation can lead to intermediate levels of effort and eliminates open access rent dissipation.⁴⁴ As Figure 1, Panel B shows, if effort is between E^* and E^{oa} , positive rents are generated, and the stock size is larger than under open access. This model can be used to approximate the implicit property rights held by hunter-gatherer peoples around the world.⁴⁵

C. *Property Rights to Land and Wildlife*

The property-rights regimes that govern wildlife are intimately linked to property rights to land, and, in general, ownership patterns of land do not coincide with the habitat requirements of wildlife populations.⁴⁶ In modern societies, land ownership patterns tend not to be determined by wildlife use but rather by agriculture (e.g., farms, ranches), mining, and commercial forestry. “If a wildlife population were the only valuable resource tied to a parcel of land, the value of the land would be maximized when land ownership coincided with the population’s territory.⁴⁷ In this situation, a landowner would implicitly own the wildlife population and have incentive to maximize its value by choosing the optimal level of use and population size.”⁴⁸ In this case, wildlife would be quite economically similar to domestic animals, although the habitat would still be “natural.” Usually, however, wildlife is not the only valuable use of land, and the analysis is not so clear-cut.⁴⁹

41. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 140.

42. *Id.*

43. ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION, 48–49 (1990).

44. Caputo & Lueck, *supra* note 40, at 45.

45. When non-consumptive values (i.e., values from the living stock, not harvest) dominate, a private owner may optimally choose to limit harvest or to not harvest at all. However, because many such uses (e.g., viewing, scientific research) are public goods, a private owner will have to overcome free-riding problems, which may depend on the owner’s ability to enforce his property rights.

46. The problem of game ownership is analytically similar to other large-scale landscape resources such as oil and gas reservoirs or groundwater basins. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 638 n.46.

47. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 140.

48. *Id.*

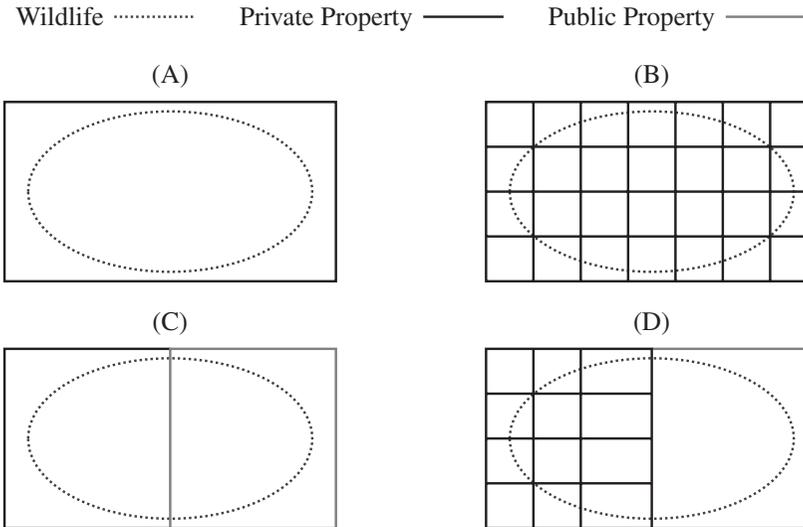
49. *Id.*

Figure 2 shows two possible scenarios that illustrate some fundamental issues. Both panels of Figure 2 show a square piece of land with a circular area inside indicating a wildlife habitat area.

For simplicity, assume the wildlife use all portions of the habitat equally.⁵⁰ In the left panel (A), there is only one landowner.⁵¹ In the right panel (B), there are seventeen different landowners with tracts of different sizes.⁵² Consequently, the landowner in panel (A) accrues all costs and benefits that come from the wildlife, excluding non-local values, such as existence value.⁵³ In panel (B), however, no one landowner faces the full costs and benefits.⁵⁴ Each landowner has an incentive to harvest animals that occupy their own tracts before they move on; thus no one has a strong incentive to improve the habitat.⁵⁵

FIGURE 2

Wildlife Ownership and Landowner Contracting



Sometimes wildlife values supersede agricultural and land use values and, accordingly, determine the land's ownership pattern. If wildlife is the land's most valued attribute, the wildlife manager would be the land's most efficient owner. The governing property rights for many aboriginal hunting and gathering societies fits this case.⁵⁶ In

50. *Id.* at 141.

51. *Id.*

52. *Id.*

53. *Id.*

54. *Id.*

55. *Id.*

56. *Id.*

those cases, property rights were designed to protect valuable wild populations that required greater territories than did agriculture. As discussed below, for example, the bison hunting tribes of the Great Plains defined their property rights to land largely in terms of expansive bison habitat.

The landowners can contract to jointly manage the wildlife. This would solve the problem of establishing ownership to wildlife populations whose habitat encompasses many landowners.⁵⁷ The landowners' abilities to establish rights to wildlife on their property depends on their incentive to resolve the conflict between the territorial requirements of a wild population and the optimal tract size of land used for other purposes.⁵⁸ Generally, it is more likely that it will be in the interest of the private landowners to assert rights to wildlife where wildlife values are highest, where the land is more productive (or of a better quality) for wildlife, where land holdings are large, and where the territorial requirement of wildlife is small.⁵⁹ Accordingly, where these conditions are not met, it is more likely that governments will assert control over wildlife.⁶⁰

D. *Governing Landscape Assets*

The wildlife contracting problem is an example of the more general problem of governing landscape assets.⁶¹ Oil-gas reservoirs and groundwater aquifers are landscape assets that often lie under many small and heterogeneous surface-rights holders. Airsheds, watersheds, and viewsheds, like wildlife stocks, are landscape assets that overlie surface holdings.⁶² History and law can generate different governance regimes for such landscape assets, including wildlife.⁶³

A starting point is a natural "landscape" that is unowned and (mostly) unused. The landscape might be an asset such as wildlife habitat, a watershed, a canyon, or even underground assets such as groundwater or an oil reservoir. The landscape is "large" in the sense that the area within the landscape can potentially be used for other assets that would require a much smaller scale of control. For example, the landscape might be an isolated mountain range that could also be used for cattle grazing in relatively small ranches. It might also be a floodplain potentially used by hundreds of small farmers. This Article's framework incorporates a variety of observed governance regimes including: a) sole ownership of the landscape by a private party;

57. *Id.* at 141–42.

58. *Id.*

59. *Id.*

60. *Id.*

61. See Karen Bradshaw Schulz & Dean Lueck, *Contracting for Control of Landscape-Level Resources*, 100 IOWA L. REV. 2507, 2511 (2015).

62. See *id.* at 2512.

63. *Id.* at 2529–43.

b) cooperative landscape control by private owners of small-scale assets; c) small-scale landowners contract with an agent to manage the landscape; d) state control of the landscape with retention of private control of the small-scale assets;⁶⁴ e) mixed control of the landscape by state and private parties; and f) state control of the landscape and both the large- and small-scale assets.⁶⁵

The landscape of size in acres (L) has two assets: s is a “small-scale” asset (e.g., farmland), and l is a “large-scale” asset (e.g., wildlife habitat) whose acreage is exactly L .⁶⁶ The total value of the landscape depends on the value of output from the two assets; that is, $V=V(s,l)$.⁶⁷ This net value will depend on the path of ownership and how the law structures that path.

Figure 3 summarizes the pathways of contracting and the ways in which history and law can affect outcomes. The two paths depend on the relative value of the two assets that comprise the landscape—the landscape-level assets (e.g., the bison habitat) and the small-scale assets (e.g., farms and ranches). The upper path shows how ownership is initially established at the landscape level and the lower path shows that ownership is initially established at the small-scale level.

As the figure shows, the natural starting point is a natural area of size L with two assets, s and l , and three stages of ownership. In Stage 1 the choice is to either establish property rights to the small-scale asset (lower path) or to leave the entire area as open access (upper path). The choice to demarcate would depend on the value of the land in the small-scale use.⁶⁸ The open access path is the default case in which no human property institutions are created.

64. This control could be achieved through laws, servitudes, or regulations. *See id.* at 2513.

65. I ignore such complications as a landscape with more than two assets, uncertainty about the size or location of the landscape, or heterogeneity within the landscape.

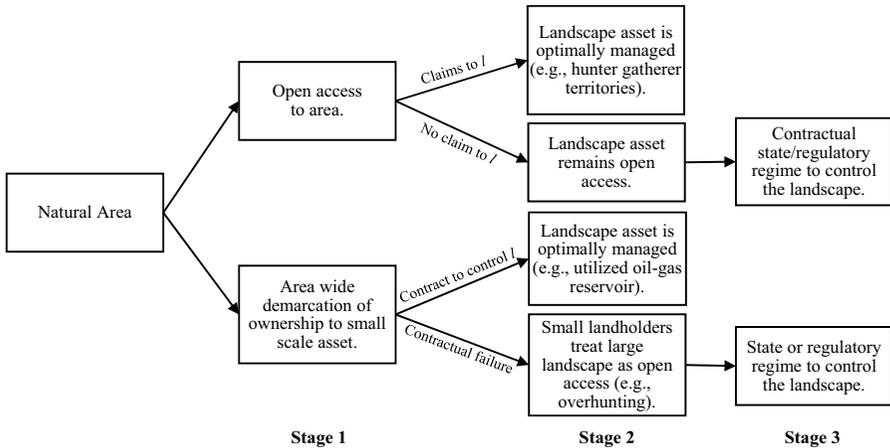
66. Dean Lueck & Dominic Parker, *The Origins and Extent of Environmental Agencies* (working paper, 2018).

67. If there are two assets with the same scale, the landscape “problem” vanishes.

68. Gary D. Libecap & Dean Lueck, *The Demarcation of Land and the Role of Coordinating Property Institutions*, 119 J. POL. ECON. 426, 435–36 (2011).

FIGURE 3

Decision Tree for Landscape Control



From each of these two nodes, there are two possible paths in Stage 2. Both paths assume the large-scale asset becomes more valuable. The upper path from the open access node depicts a case in which an initial large-scale claim (size l) is made effectively establishing ownership of the entire landscape⁶⁹ while the lower path depicts a case in which the landscape remains open access because claiming is too costly. This can result in overuse as in the fisheries or wildlife harvest case or underuse as in the case in which investment is important.⁷⁰ The figure also shows the potential for private contractual control or for state or regulatory control to emerge.⁷¹

There are also two paths from the small-scale asset demarcation node. The upper path indicates successful contracting among the small-scale parties to control the large-scale asset. The lower path indicates contractual failure among these parties so that the large-scale asset effectively remains an open access resource. The figure also shows the potential for state or regulatory control to emerge from contractual failures.

The path taken and its outcome depend on the costs and benefits of private contracting and on the costs of enforcing claims at different scales. The benefits depend on the values of the two assets. The costs depend on the number of small-scale parties that have rights to the larger landscape (s/L) and on the legal rules that govern the contracting process. Legal rules can affect these outcomes by necessitat-

69. I ignore the issue of small-scale assets within this landscape.

70. See generally Bohn & Deacon, *supra* note 39.

71. GARY D. LIBECAP, CONTRACTING FOR PROPERTY RIGHTS (1989).

ing the choice of demarcation, by affecting the size and types of parcels, and by explicitly structuring the rule for private contracting.⁷²

III. CASE STUDIES IN WILDLIFE GOVERNANCE

This Section examines several cases of wildlife governance that rely on the above framework.⁷³ The case studies show a range of governance regimes and history of those regimes. I focus on governance of bison and caribou, two large iconic mammals that have inhabited the Northern Hemisphere for millennia.

A. *England versus America*

Comparing England and America reveals how history and the natural landscape features can influence wildlife governance. The ecological character of wildlife and the pattern of land ownership in Great Britain and the United States were distinct during the crucial period of the nineteenth century when wildlife institutions in both countries were solidifying.⁷⁴ Private landholdings in the United States in the nineteenth century were small and widely dispersed. But in England, landholdings were relatively large and concentrated, and the government did not hold much land.⁷⁵

The wildlife stocks that inhabit the two countries also differ in important respects. For example, North American waterfowl typically nest during the summer in Alaska and northern Canada and migrate to Mexico and the southern states for the winter.⁷⁶ By contrast, most British waterfowl are not migratory, even though the types of species present are nearly identical to those in the United States.⁷⁷ North America is inhabited by many relatively large wide-ranging herbivores such as bison, deer, elk, moose, mountain goat, and pronghorn antelope, and by carnivores such as bear, cougar, coyote, and wolf—all of which require rather large territories.⁷⁸ Except for the red deer, wide-ranging herbivores and carnivores are not currently in Great Britain.⁷⁹

72. Compulsory unitization statutes are an example of law that lowers the costs of contracting among small-scale asset owners to create ownership of the large-scale asset.

73. See Bradshaw & Lueck, *supra* note 61 (using a similar framework to examine a wide range of natural resources).

74. Dean Lueck, *The Economic Nature of Wildlife*, 18 J. LEGAL STUD. 291, 292–93 (1989) [hereinafter *The Economic Nature of Wildlife*].

75. *Id.* I discuss the rationale for the United States system in detail. See generally *id.*; Dean Lueck, *Ownership and Regulation of Wildlife*, 29 ECON. INQUIRY 249 (1991); Dean Lueck & Dominic Parker, *The Origins and Extent of Environmental Agencies* (forthcoming 2018).

76. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 146.

77. *Id.*

78. *Id.*

79. *Id.*

Many of the large mammalian species native to Great Britain (and the rest of Europe) became extinct before modern nations emerged.⁸⁰

American wildlife law, which frames management institutions, has origins in English common law. But for wildlife, present-day American and English law differ sharply. In the United States, the law places most control of wildlife in the hands of state governments. In Great Britain, the law places dominant control in the hands of private landowners.

By the mid-nineteenth century, however, American law differed from its English origins.⁸¹ Property-rights institutions among American Indians during this period were largely replaced by state restrictions on takings (or harvest) beginning in the early 1800s.⁸² The earliest state controls simply restricted the time of year during which it was legal to kill game. When these restrictions were contested, numerous courts bolstered the states' authorities to regulate the taking and trading of wildlife.⁸³ Courts consistently upheld state wildlife regulations.⁸⁴

Today, states predominantly regulate wildlife control and use, typically vested in a state "fish and game" or "wildlife" agency.⁸⁵ The key components of modern game laws and regulations, administered and enforced by game departments, include seasonal restrictions (and sometimes prohibitions) on taking wildlife, prohibiting or severely restricting game trade, licensing requirements for legally taking game, and restricting the methods by which animals may be taken.⁸⁶ Game departments also administer state wildlife refuges and undertake research (e.g., population surveys, re-stocking programs).⁸⁷

Wildlife property-rights assignments in England and the United States reflect the disparity in land ownership and wildlife ecology between the two countries.⁸⁸ During the nineteenth and twentieth centuries, English landowners had a comparative advantage in wildlife ownership that landowners in the United States did not.⁸⁹

80. *Id.*

81. MICHAEL J. BEAN, *THE EVOLUTION OF NATIONAL WILDLIFE LAW* 12–17 (1983); *The Economic Nature of Wildlife*, *supra* note 74, at 295.

82. PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 144.

83. *Id.*

84. *Id.*; see, e.g., *Geer v. Connecticut*, 161 U.S. 519, 535 (1896).

85. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 633.

86. *Id.*

87. *Id.*

88. *Id.* at 648. The regulation of fisheries in the two countries is also supportive. In America, the government generally controls fisheries, but state laws ordinarily grant private control of fish in small lakes and private ponds. In Great Britain, however, private fishing rights are very common on the numerous, and rather small, countryside streams. At the same time, the Crown has long controlled the fisheries in open seas, navigable rivers, and the foreshore. *Id.* at 648 n.62.

89. *Id.* at 648.

B. *Wildlife and Native Americans*

American Indian tribes specified rights to live wildlife stocks by protecting hunting and fishing territories.⁹⁰ Native American game ownership bared an uncanny resemblance to current American institutions.⁹¹ “[American] Indian tribal societies, much like state agencies, controlled wildlife stocks by enforcing the rights to hunting and fishing territories and restricting the time and method of harvest by tribal members.”⁹² But “most often, rights to game were held as ‘common property’ among members of relatively small tribal units.”⁹³ Bailey finds similar arrangements for tribal groups outside of North America.⁹⁴ Native Americans found it difficult, if not impossible, to enforce their property rights to these regions as whites introduced agriculture and industry to the New World and caused the relative value of the land’s wildlife attributes to decline drastically.⁹⁵ “During this period of open access[,] ‘market hunting’ flourished[,] and many wildlife populations in the United States plummeted.”⁹⁶ There were well-established rights and markets for game products such as meat and hides, but rights to live wildlife stocks were practically nonexistent.⁹⁷ Today, Native Americans have jurisdiction over wildlife on their reservation lands and outcomes vary: some are governed as near-open access while some generate revenues.

C. *Bison and Caribou*

Bison bison (the American Bison) is a large herbivore also known as the buffalo.⁹⁸ Before Europeans colonized North America, there may have been 30 million bison or more. But by 1900, bison were reduced to approximately 1,000 animals.⁹⁹ Since that time, bison populations have increased to over one-half million animals inhabiting national parks and refuges, American Indian reservations, and private

90. *Id.* at 630.

91. *Id.*; PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 142.

92. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 630; PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 142; Martin J. Bailey, *Approximate Optimality of Aboriginal Property Rights*, 35 J. L. & ECON. 183, 195 (1992) (finding similar institutions for the Aborigine hunter-gatherer society).

93. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 630 n.11; PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 167.

94. Bailey, *supra* note 92, at 186.

95. *Property Rights and the Economic Logic of Wildlife Institutions*, *supra* note 6, at 630.

96. *Id.*; PERSPECTIVES ON SUSTAINABLE RESOURCES IN AMERICA, *supra* note 6, at 143.

97. *Id.*

98. *The Economic Nature of Wildlife Law*, *supra* note 74, at 315.

99. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S610.

lands. Generally, state laws that cover domestic livestock cover bison populations, so they are not typically treated as wildlife nor are they under the purview of state wildlife agencies.¹⁰⁰ *Rangifer tarandus*, known as caribou in North America and reindeer in Europe, is a medium-sized deer that inhabits the northern reaches of the Northern Hemisphere.¹⁰¹ *Rangifer* has been domesticated to various degrees in Europe and governed by pastoral societies, including the Saami people in Scandinavia. But in North America, *Rangifer* is now primarily governed by state and provincial wildlife laws. Figure 4 summarizes the wide range of regimes that have governed these two species.

FIGURE 4

Cases in Wildlife Governance

Bison/Buffalo	Habitat Ownership	Population Ownership	Outcomes
Hunter-Gatherer Governance	Tribal common property.	Tribal common property.	Sustainable subsistence harvest, culture tied to bison.
Northern Plains Robe Hunt	Tribal common property.	Tribal common property.	Sustainable native hunting, trading with whites.
19th Century Open Access	Private and public lands.	Open access with some private herds.	Increased open access. Some livestock.
20th Century – Present	Private lands, public lands (state/federal), tribal reservations.	Private ranchers, government agencies, tribes (recent).	Bison used as livestock. Some common ownership.
Yellowstone National Park	Public land.	U.S. Federal government.	Limited use, herds managed for conservation.
American Prairie Reserve	Private and public land	Private ownership of bison	???
Caribou/Reindeer	Habitat Ownership	Population Ownership	Outcomes
<i>US-Canada</i>			
Hunter Gatherer pre-white contact	Indigenous tribal common property.	Indigenous tribal common property.	Subsistence hunting. Communally owned wildlife and territory
Agency Management	Native corporations, private lands, public lands (State and national).	Subsistence hunters, state and national governments.	Sustainable herd management.
Porcupine Caribou Herd	Native lands/ corporations, private and public lands.	Subsistence hunters, state and national agencies	Sustainable herd management.
<i>Europe</i>			
Sami <i>Siida</i>	Sami families	Sami families	Sustainable use.
Pasture Management	Sami in pasture areas, Sami and non-Sami in Concession Zones.	Sami and non-Sami	Common property and private property use mix.
Wild Reindeer in Russia	Public lands, some private land. Predominantly public property, some private property.	Norwegian government. Predominantly public property, some private property.	Sustainable management. Public and private management conflict.

100. *Id.* at S646.

101. STEPHEN DEMARAIS & PAUL R. KRAUSMAN, *ECOLOGY & MANAGEMENT OF LARGE MAMMALS IN NORTH AMERICA* 658–63 (2000).

1. Bison: Hunter-Gatherer Governance

Prior to European settlement of North America, bison and their habitat were governed by institutions best understood as common property regimes by nomadic Native American tribes.¹⁰² While bison were sometimes hunted by village-dwelling tribes, due to their nomadic nature, bison were mostly hunted by tribes such as the Sioux or the Crow on the Great Plains, who moved with the bison herds. Indeed, Great Plains tribal organization mirrored that of the bison: small groups congregated in the winter and spring, and large groups congregated in the summer and early fall.¹⁰³ Before the establishment of robe and hide markets in the nineteenth century, these tribes hunted the bison for their subsistence.

2. Bison: The Robe Hunt on the Northern Plains

The establishment of trading posts along the Missouri River and Canadian border facilitated trade between the Native Americans for many wildlife products including bison robes.¹⁰⁴ From 1820 to 1880, white traders purchased robes (heavy winter hides) from American Indian hunters.¹⁰⁵ “Numerous reporters indicate that robe harvests shipped out of the Upper Missouri region (North Dakota and Montana) averaged between 50,000 and 100,000 robes [annually] for nearly 60 years.”¹⁰⁶ This robe market existed only on the Northern Plains where cold winters led bison to develop the heaviest and most valuable coats. The robe market led to an increase in bison harvest, but this short-lived market had little overall impact on bison population and no impact on bison habitat.¹⁰⁷ The robe market can be characterized as being governed by common property for roughly the first forty years and then by open access for the last fifteen.¹⁰⁸ Two important features of the robe trade distinguished it from the hide trade that followed. “First, the robe trade occurred mostly during a period (pre-1880s) when the land had no valuable alternative uses, so the carrying capacity of the habitat was not being reduced.”¹⁰⁹ Second, the optimal

102. American Indians living in the eastern forests were often engaged in agriculture and thus tended to have property rights to land defined over relatively small territories. In this setting, bison population were essentially open access.

103. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S631.

104. *Id.* at S619.

105. *Id.* at S632.

106. *Id.*

107. *Id.* at S632–33. *Contra* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 352 (1967) (finding introduction of the beaver hide market changed governance regimes among the Montaigne Indians).

108. *Id.* at S632

109. *Id.* at S633.

time to hunt bison for robes was only in the late fall and early winter when the robes were prime.¹¹⁰

3. Bison: Open Access Extirpation, 1850–1900

American expansion across and into the Great Plains began in earnest after 1850 and tribal governance of habitat and populations eroded quickly, effectively creating open access to the bison populations. This occurred even as bison habitat became privatized into relatively small holdings for farms and ranches that were much too small to control the territory of bison populations. Railroads and new long-range rifles lowered the cost of access and harvest, and the introduction of the hide market to eastern and European markets caused a rapid open-access depletion from 1870 to 1885. During this period, the exploitation of bison on the Great Plains transitioned generally into the hands of white hunters as most natives were either relocated to reservations or killed in conflicts with the American soldiers and settlers. Still, the last large herd of bison in the great plains was actually wiped out in what is now southwest North Dakota by a Sioux hunting party in 1883. By 1890, the bison were nearly extinct, reduced to roughly 1,000 animals at scattered locations including Yellowstone National Park, which was created in 1876 before the last great herds were extirpated.¹¹¹ “Although direct measures of the extent of rent dissipation are not available, Isenberg’s discussion of the hide hunters’ fate is consistent with open access and rent dissipation: ‘Euroamericans waged a scorched-earth campaign against the [American] Indians who impeded the expansion of industry. Yet the hide hunters’ victory was hollow; when the campaign was over, most of the hunters found themselves no wealthier than before.’”¹¹² This description of bison hide-hunting is similar to open-access exploitation by a group of homogeneous hunters with low opportunity costs.¹¹³

110. J.A. ALLEN, *THE AMERICAN BISONS, LIVING AND EXTINCT* 59 (1876) (explaining that November through January are the prime months for robes). Robes were also costlier to prepare than hides.

111. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S611.

112. ANDREW C. ISENBERG, *THE DESTRUCTION OF THE BISON: AN ENVIRONMENTAL HISTORY, 1750–1920* 163 (2000). “There was also a small market for meat for railroad workers and settlers. For example, William “Buffalo Bill” Cody became famous as a hunter hired by Kansas Pacific in 1867 and killed 4,280 bison. But this had little effect beyond the travel corridors. For example, Dodge accounts to settlers killing just 150,000 compared to 3.7 million killed in 1870–1874 for hides. During the hide trade, there was a limited amount of meat shipped east, but it was generally too costly to transport from a kill site to the railroad. After 1872, small amounts were shipped in refrigerated cars.” *The Extermination and Conservation of the American Bison*, *supra* note 2, at S620, S634–35 n.83.

113. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S635; Peter J. Hill, *Are All Commons Tragedies?: The Case of Bison in the Nineteenth Century*, 18 *INDEP. R.* 485, 487–88 (2014).

4. Bison: Private Governance, 1900–Present

During the period of the open-access hide market, a few private ranchers explored the possibility of profitably raising bison. Charles Goodnight captured three calves to start a herd in 1866 in Texas, and William and Charles Alloway captured three calves and James McKay captured five calves to start herds between 1872 and 1874 in Canada.¹¹⁴ The famous Pablo-Allard Herd began when a Pend d'Oreille Indian named Walking Coyote captured several calves in central Montana in 1873.¹¹⁵ Walking Coyote led the calves back to the Flathead Valley in western Montana where the herd thrived.¹¹⁶ The Pablo-Allard Herd led to the establishment of herds in parks and on ranches during the twentieth century.¹¹⁷

In 1905, Ernest Baynes and William Hornaday founded the American Bison Society, instigating the eventual appropriation of federal funding to establish parks and refuges to protect and grow bison populations.¹¹⁸ The American Bison Society purchased bison and donated them to herds on public lands, such as the National Bison Range in western Montana—not far from where the Pablo-Allard Herd once thrived.¹¹⁹ After these public herds grew, the American Bison Society disbanded in 1935, and the bison on public lands were placed under the arm of various federal agencies, such as the Fishing and Wildlife Service or the National Park Service.¹²⁰

Because the bison populations in most states were at or near zero, bison were not governed by the new state wildlife laws that emerged in the late nineteenth and early twentieth centuries.¹²¹ Outside Yel-

114. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S645; *Time Line of the American Bison*, U.S. FISH & WILDLIFE SERV., <https://www.fws.gov/bisonrange/timeline.htm> (last visited June 18, 2018) [<https://perma.cc/V899-PRM5>].

115. *Id.*

116. *Id.*

117. At this time, the Pablo-Allard herd was one of the largest private herds, totaling 700 animals. *Id.* Many regulations before 1900 meant to conserve bison or their harvest often came too late, usually after extirpation on the state level. *See id.* For example, in 1864, the Idaho legislature enacted laws protecting the bison, but bison no longer existed in the state. *Id.*

118. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S613; *see also Time Line of the American Bison*, *supra* note 114.

119. *Bison: American Buffalo (Bison Bison)*, U.S. FISH & WILDLIFE SERV., https://www.fws.gov/refuge/national_bison_range/wildlife_and_habitat/bison.html (last updated May 11, 2018) [<https://perma.cc/6K2L-MGG7>].

120. *Time Line of the American Bison*, *supra* note 114.

121. *See* THEODORE A. BOOKHOUT, *THE NORTH AMERICAN MODEL OF WILDLIFE CONSERVATION* 3 (2012), <http://wildlife.org/wp-content/uploads/2014/05/North-American-model-of-Wildlife-Conservation.pdf> [<https://perma.cc/UZ3A-5DNC>]; Shannon Petersen, *Bison to Blue Whales: Protecting Endangered Species Before the Endangered Species Act of 1973*, 22 *ENVIRONS: ENVTL. L. & POL'Y J.* 71, 74–75.

lowstone National Park, bison were on private lands¹²² and were thus governed by the law of domestic livestock like cattle, sheep, and pigs. Bison could therefore be bought, sold, and transported like cattle, and owners had the same rights, duties, and obligations as cattle owners. Under this legal regime, both private and public bison herds increased.¹²³ Of the approximate 500,000 bison now inhabiting North America, the vast majority are privately owned and inhabit private lands in the United States and Canada.¹²⁴ In recent decades, some Native American tribes have reestablished bison herds on their reservation lands.¹²⁵

5. Bison: Yellowstone National Park

Yellowstone National Park was created in 1872 out of federal lands that were part of the territories of Idaho, Montana, and Wyoming.¹²⁶ Yellowstone comprises over 2 million acres of unfenced terrain in the northern Rocky Mountains.¹²⁷ Bison were not widespread in the Yellowstone region compared to the Great Plains, but there were always bison in the scattered high-elevation grasslands. Largely due to geographic isolation, the bison in Yellowstone were not hunted to extinction, and today the Yellowstone herd is the only herd in the United States known to be free of domestic cattle DNA.¹²⁸ From a low of about two dozen in 1900, Yellowstone bison population today varies from 3,000 to 4,000.¹²⁹

The Yellowstone herd is an anomaly among private and public herds as it is not fenced and routinely roams outside Yellowstone boundaries in the winter to find better grazing on lower elevation lands outside the park.¹³⁰ These winter range lands are a mosaic of

122. *Yellowstone: History of Bison Management*, NAT'L PARK SERV., <https://www.nps.gov/yell/learn/management/bison-history.htm> (last visited July 6, 2018) [<https://perma.cc/7DMW-RSFB>].

123. *See id.*

124. *The Extermination and Conservation of the American Bison*, *supra* note 2, at S611.

125. *Rebirth on the Great Plains*, NAT'L WILDLIFE FED'N (Apr./May 1998), https://neonline.com/downloads/national_wildlife/wildlife/bison_box.pdf?CFID=59249015&CFTOKEN=42221205 [<https://perma.cc/E4U2-F3AB>].

126. *Yellowstone: Birth of a National Park*, NAT'L PARK SERV., <https://www.nps.gov/yell/learn/historyculture/yellowstoneestablishment.htm> (last updated June 4, 2018) [<https://perma.cc/NHS5-WCCA>].

127. *Main*, YELLOWSTONE NAT'L PARK, <http://www.yellowstonenationalpark.com/index.html> (last visited June 20, 2018) [<https://perma.cc/YH4G-6GXD>].

128. Julia A. Herman et al., *Genetic Analysis of a Bison bison Herd Derived from the Yellowstone National Park Population*, 20 WILDLIFE BIOLOGY 335, 341 (2014), available at https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2622&context=icwdm_usdanwrc [<https://perma.cc/ES4L-C7JY>].

129. *Yellowstone: History of Bison Management*, *supra* note 122.

130. *Yellowstone: Bison*, NAT'L PARK SERV., <https://www.nps.gov/yell/learn/nature/bison.htm> (last updated Jan. 4, 2018) [<https://perma.cc/YZW8-KSTB>].

private, state, and federal lands.¹³¹ The Yellowstone bison carry Brucellosis, a bacterial infection that can be transmitted to domestic livestock and can cause miscarriages, infertility, and lowered milk production.¹³² The threat of Brucellosis spreading into private livestock herds by intermingling of bison with domestic cattle just outside the park has led to conflicts.¹³³

6. American Prairie Reserve: Private Contracting for Wildlife

On the plains of north-central Montana, the American Prairie Reserve (“APR”) is creating a new bison governance structure. The APR was established in 2001 as a private non-profit organization to create a working wildlife preserve on the northern Great Plains in Montana.¹³⁴ The APR aims to create a reserve of 3.5 million acres (about 1.5 times the size of Yellowstone National Park) by consolidating private and public land through purchases, leases, and easements.¹³⁵ To date, the APR has 400,000 acres (“Reserve”).¹³⁶ Similar to private wildlife operations in South Africa, APR tends to eliminate fencing on its Reserve to facilitate large-scale contiguous prairie habitat.¹³⁷ One of the key objectives of the APR is to reduce the number of domestic cattle and maintain a bison population.¹³⁸ Bison were reintroduced to the Reserve in 2005 and now number approximately 900.¹³⁹ The APR projects a population of over 10,000 bison by 2030.¹⁴⁰

131. See *Yellowstone: History of Bison Management*, *supra* note 122.

132. *Brucellosis and Yellowstone Bison*, U.S. DEP’T OF AGRIC., https://www.aphis.usda.gov/animal_health/animal_dis_spec/cattle/downloads/cattle-bison.pdf (last visited June 20, 2018) [<https://perma.cc/3NZ9-FXLH>].

133. *Id.*

134. *Building the Reserve*, AM. PRAIRIE RES., <https://www.americanprairie.org/building-the-reserve> (last visited May 17, 2018) [<https://perma.cc/X7R9-UTDU>].

135. Ronald Bailey, *Where the Private Buffalo Roam and the Private Antelope Play*, REASON (July 13, 2015), <http://reason.com/archives/2015/07/13/where-the-private-buffalo-roam-and-the-p> [<https://perma.cc/BLG4-KHA4>].

136. *Building the Reserve*, *supra* note 134.

137. The APR’s work actually mirrors that of South Africa’s “wildlife ranching.” The law in South Africa grants private ownership of wild species if they are enclosed. In the last several decades, this has led to a rapid expansion of wild populations on large private holdings. Cousins et al., *Exploring the Role of Private Wildlife Ranching as a Conservation Tool in South Africa: Stakeholder Perspectives*, 13 *ECOLOGY & SOC’Y*, no. 43, 2008, at 1.

138. Kyrán Kunkel et al., *Reintroducing Plains Bison (Bos Bison) To American Prairie Foundation Lands In Northcentral Montana: 5-Year Conservation And Management Plan*, AM. PRAIRIE RES., <https://www.americanprairie.org/sites/default/files/2004%20APR%20Bison%20Reintroduction%20Plan.pdf> (last visited July, 6 2018) [<https://perma.cc/GHC2-XVBL>].

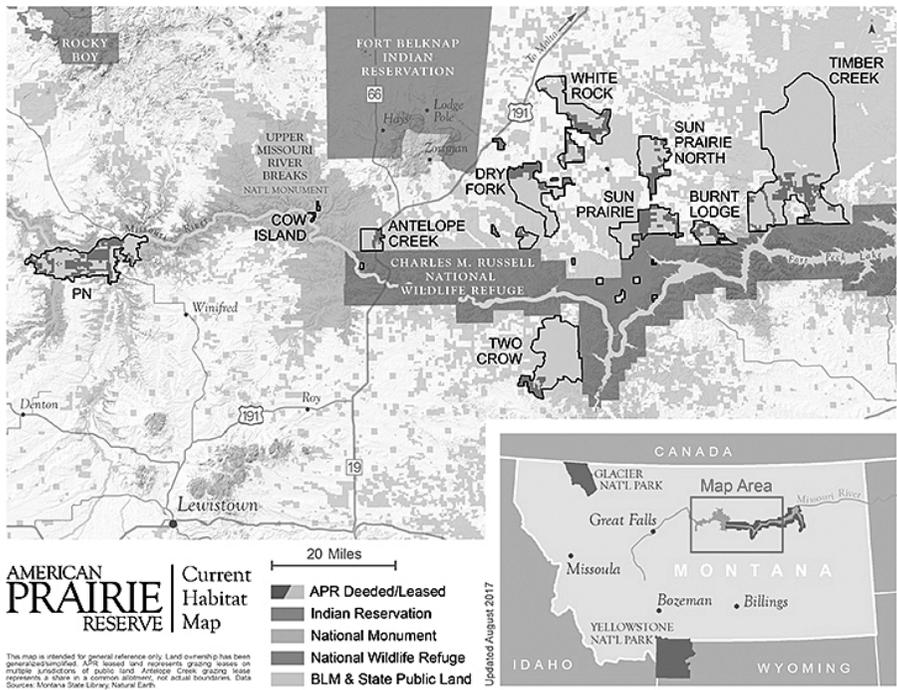
139. *Bison Restoration*, AM. PRAIRIE RES., <https://www.americanprairie.org/project/bison-restoration> (last visited May 27, 2018) [<https://perma.cc/YQ9T-4A62>].

140. *Id.* Bison population growth rates can be as high as 20% per year. *Yellowstone: Questions & Answers About Bison Management*, NAT’L PARK SERV. <https://www.nps.gov/yell/learn/management/bison-management-faqs.htm> (last updated June 26, 2018) [<https://perma.cc/B24T-4Q4V>]. Yellowstone notes its herd has grown 10–15% annually for many years. *Id.*

The APR's work is an example of private contracting to establish wildlife habitat, a practice that has emerged as the relative value of wildlife has increased. The key to the APR's ability to create the Reserve is bison's administration as private property. This governance allows the APR to buy bison to repopulate the habitat mostly without interference by the state wildlife agency.¹⁴¹ Figure 5 shows a recent map of the APR lands and the mosaic of private and public lands within which they operate.¹⁴²

FIGURE 5

Map of American Prairie Reserve and Surrounding Lands, Montana 2018¹⁴³



7. Caribou: Hunter-Gatherer Governance

The Inuit tribes of northern Alaska and Canada are subsistence hunters and exploit the caribou populations native to the tundra, bo-

141. See *Bison Restoration Timeline*, AM. PRAIRIE RES., <https://www.americanprairie.org/project/bison-restoration-timeline> (last visited Aug. 31, 2018) [<https://perma.cc/95QP-UK7Z>]. The APR has, however, faced some resistance from local interests concerned about the changing character of the cattle ranching-based economy.

142. See *infra* Figure 5.

143. *Building the Reserve*, *supra* note 134.

real forests, and mountainous landscapes.¹⁴⁴ While caribou have historically ranged from the west coast of Alaska to the coast of Newfoundland, the species is not uniformly distributed across this range—there are many separate herds.¹⁴⁵ Indigenous use of caribou was similar to the native plains tribes' use of the bison in that the indigenous managed the nomadic herds communally.¹⁴⁶ The caribou-hunting Inuit tribes of Alaska and Canada have never been contiguous—now composed of thirteen recognized Alaska-native corporations, primarily the western Subarctic First Nation Governments of Canada. Some groups even stretch as far eastward as Quebec. For millennia, these tribes were nomads: they followed the large herds on their annual paths throughout Canada and Alaska. For example, the western Subarctic tribes in Canada traversed the boreal forests of Yukon and the Northwest Territories, and the Iñupiat of Alaska traversed the northwestern tundra.¹⁴⁷ Unlike their indigenous counterparts in Europe and Asia, these people did not domesticate the caribou.

8. North American Caribou: Modern Agency Management

With the colonization of the United States and Canada, the Inuit governance structures gave way to state and provincial controls. In Alaska, the harvest of caribou is managed by the Alaska Department of Fish and Game, while in Canada, it is managed by the environmental departments of each respective province, primarily Yukon, Northwest Territories, Nunavut, and Quebec.¹⁴⁸ Each department regulates

144. *Gates of the Arctic: Subsistence: Preserving a Way of Life*, NAT'L PARK SERV., <https://www.nps.gov/gaar/learn/historyculture/subsistence.htm> (last updated July 28, 2016) [<https://perma.cc/W2VX-QEQK>].

145. *Animal Facts: Caribou*, CAN. GEOGRAPHIC (July 19, 2006), <https://www.canadiangeographic.ca/article/animal-facts-caribou> [<https://perma.cc/5SUX-28TN>].

146. *Caribou General*, TRADITIONAL ANIMAL FOODS OF INDIGENOUS PEOPLE OF N. AM., <http://traditionalanimalfoods.org/mammals/hoofed/page.aspx> (last visited July 6, 2018) [<https://perma.cc/MLP6-XETV>].

147. *Cultural and Ecological Value of Boreal Woodland Caribou Habitat*, DAVID SUZUKI FOUND. & ASSEMBLY OF FIRST NATIONS (June 2013), <https://www.afn.ca/uploads/files/report-caribou.pdf> [<https://perma.cc/Z7WC-PNRL>].

148. *See Hunting, Trapping, & Shooting*, ALASKA DEP'T FISH & GAME, <http://www.adfg.alaska.gov/index.cfm?adfg=hunting.main> (last visited July 7, 2018) [<https://perma.cc/MP2L-KVVY>] (regulating hunting and subsistence in the U.S. state of Alaska); *Barren-Ground Caribou*, YUKON ENVTL. DEP'T, <http://www.env.gov.yk.ca/animals-habitat/mammals/barrengroundcaribou.php> (last updated Jan. 26, 2018) [<https://perma.cc/A2BV-3XHB>] (regulating hunting and subsistence in the Canadian province of Yukon); *Species Management: Barrenground Caribou*, NUN. DEP'T ENVTL., <https://gov.nu.ca/environment/information/species-management> (last visited July 7, 2018) [<https://perma.cc/3XZ2-B398>] (regulating hunting and subsistence in the Canadian province of Nunavut); *Barren-Ground Caribou*, N.W.T. DEP'T ENVTL. NAT. RESOURCES, <https://www.enr.gov.nt.ca/en/services/barren-ground-caribou> (last visited July 7, 2018) [<https://perma.cc/XVT2-GCFX>] (regulating hunting and subsistence in the Canadian province of Northwest Territories); *Hunting-Fishing-Trapping*,

both recreational and subsistence hunting. In Alaska, one must win a license through a lottery to recreationally hunt caribou or purchase a tier II permit to strictly subsistence-hunt caribou. The caribou hunting season in Alaska is generally July through September, while in Canada it is generally August through January.¹⁴⁹ These caribou hunts are subject to bag limits—limits on the number of animals the hunter may kill and keep. In Alaska, depending on the zone, bag limits may be as low as one bull per licensed hunter to two caribou of any stock, while in Yukon, most recreational zones have a limit of one animal.¹⁵⁰

9. Porcupine Caribou Herd

The Porcupine Caribou herd is one of the largest caribou herds in North America.¹⁵¹ The herd ranges in size from 100,000 to 200,000 annually and uses habitat in Alaska and Canada (as shown in Figure 6). The herd migrates between the lands around the Brooks Range in north-central Alaska to the Richardson Mountains in Canada, and their summer calving grounds are along the Porcupine River.¹⁵² Indigenous people historically hunted the Porcupine Herd for subsistence.¹⁵³ Because the herd maintains habitat in both the United States and Canada, the International Porcupine Caribou Board¹⁵⁴ was founded in 1987, the product of an international agreement. This board consists of four members from both Canada and the United

QUE. DEP'T FORESTS, WILDLIFE & PARKS, <https://mffp.gouv.qc.ca/the-wildlife/hunting-fishing-trapping/?lang=EN> (last visited July 7, 2018) [<https://perma.cc/LD77-84GQ>] (regulating hunting and subsistence in the Canadian province of Quebec); Fisheries and Land Resources: Caribou, NFLD. DEP'T FISHERIES & LAND RESOURCES, <http://www.flr.gov.nl.ca/wildlife/caribou.html> (last updated May 1, 2018) [<https://perma.cc/MH2Q-BLRF>] (regulating hunting and subsistence in the Canadian province of Newfoundland).

149. *Know Alaska's Regulations*, ALASKA DEP'T OF FISH & GAME, <http://www.adfg.alaska.gov/index.cfm?adfg=hunting.main> (last visited June 11, 2018) [<https://perma.cc/5N5W-LSX8>].

150. *Id.*

151. *See About the Herd*, PORCUPINE CARIBOU MGMT. BOARD, <http://www.pcmb.ca/herd> (last visited June 11, 2018) [<https://perma.cc/77GY-N5Q6>].

152. James E. Heming, *The Distribution Movement Patterns of Caribou in Alaska*, ALASKA DEP'T OF FISH & GAME 13–17 (1971), http://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/research_pdfs/hemming_1971_adfg_tech_bull_1_the_distribution_and_movement_patterns_of_caribou.pdf [<https://perma.cc/J6YW-WM5E>].

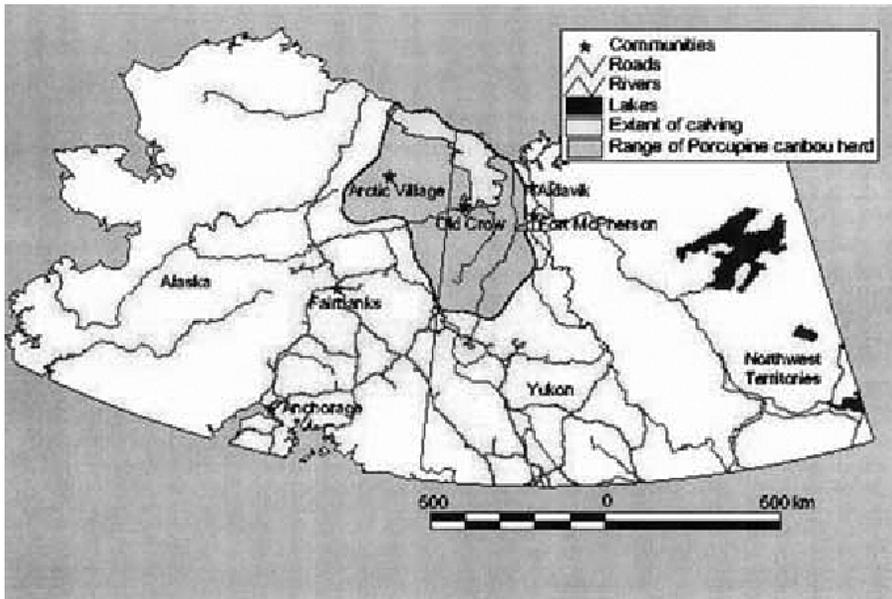
153. *See The Gwich'in of Alaska and Canada*, ARCTIC CIRCLE, <http://arcticcircle.uconn.edu/ANWR/anwrgwichin.html> (last visited July 6, 2018) [<https://perma.cc/MJ2B-KRRA>]. The Gwich'in people of Canada were one of the traditionally nomadic tribes and hunted the Porcupine Caribou the longest. *Gwich'in Culture*, ALASKAN NATIVES, <http://www.alaskan-natives.com/alaskan-native-cultures/gwichin-culture/> (last visited July 6, 2018) [<https://perma.cc/8D3Z-VV77>]. They ceased nomadism in 1870 to seek permanent settlement. *Id.*

154. *See Canada-US Agreement on Porcupine Caribou Herd Conservation*, GOV'T OF CAN., <https://www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-countries-regions/north-america/canada-united-states-porcupine-caribou-conservation.html> (last updated Aug. 10, 2017) [<https://perma.cc/WW54-2KVF>].

States who serve as an advisory committee to the regulatory agencies in each nation.¹⁵⁵ The habitat of the Porcupine Caribou herd can generally be described as a mosaic of private and public lands, predominantly the Arctic National Wildlife Refuge.¹⁵⁶ The harvest of the Porcupine Caribou herd is subject to the same regulatory oversight as most other herds. The dominant governing bodies are the Alaska Department of Fish and Game and the Yukon Environmental Department, whose management structures have been discussed.

FIGURE 6

Porcupine Caribou Herd Population Borders¹⁵⁷



10. The Saami Reindeer Culture

The Saami people of northern Europe are the indigenous people of the Scandinavian Peninsula, Finland, and the Kola Peninsula of Russia. Before the fifteenth century, the Saami people were primarily a semi-nomadic subsistence hunting culture. But in the sixteenth century, some began herding reindeer in response to assimilation and taxation by their countries.¹⁵⁸ The Saami traditionally used the *siida*

155. *Id.*

156. See *The Gwich'in of Alaska and Canada*, *supra* note 153.

157. Jack A. Kruse et al., *Modeling Sustainability of Arctic Communities: An Interdisciplinary Collaboration of Researchers and Local Knowledge*, 7 *ECOSYSTEMS* 815, 820 (2004).

158. Jesper Larsson, *Reindeer Husbandry, Sami Economy and the Evolution of Common-Pool Resources in Early Modern Northern Scandinavia 1550–1780*, 10 (Os-

system for reindeer husbandry.¹⁵⁹ The *siida* system was a communal agreement of several families to have individual rights to their respective resources but operate their reindeer herds communally.¹⁶⁰ The Saami herders were semi-nomadic groups that moved with their marked reindeer across lichen-rich pastures.¹⁶¹ Technological advancements of the mid-twentieth century, such as the snowmobile, helped ease the burden of such a lifestyle.¹⁶² Indeed, before the snowmobile, the Saami traversed the habitat with skis.¹⁶³

11. Norwegian Pasture Management

The current regime of Norwegian reindeer governance began in 1976 with the passing of the Norwegian Reindeer Herding Act. This Act gave the Saami the exclusive right to manage reindeer in six distinct pasture areas of Norway and allowed “non-Saami” parties to herd in concession areas of southern Norway.¹⁶⁴ Currently, there are approximately 3,000 people actively herding reindeer in Norway across 140,000 square kilometers of the country. Today, herds are still technically a part of a *siida* system, however, the “husbandry unit” or driftsenhet,¹⁶⁵ a legal ownership agreement, is owned by a single person or shared amongst spouses.¹⁶⁶ The husbandry units lie within districts that partition grazing lands. The partitions are enforced by the district committee.¹⁶⁷ An area board grants requests to move herds throughout the pasture area, determines grazing times, and comments on municipal development plans. Beyond the pasture areas, the Ministry of Agriculture’s Reindeer husbandry office drafts reindeer husbandry policy while the Norwegian Reindeer Husbandry Board executes the policy and day-to-day functions.¹⁶⁸ As of 2007, within each pasture area there are 90 districts¹⁶⁹ in the Saami-owned territo-

from Workshop, Ind. Univ. 2017), <https://ostromworkshop.indiana.edu/pdf/series-papers/2017spr-res/larsson-paper.pdf> [<https://perma.cc/4KVK-7A5C>].

159. See Johnny-Leo L. Jernsletten & Konstantin Klokov, *Sustainable Reindeer Husbandry*, ARTIC COUNCIL 5 (2000–2002), http://www.reindeer-husbandry.uit.no/online/Final_Report/final_report.pdf [<https://perma.cc/8D9N-G43J>].

160. *Id.*

161. See *Sámi – Norway*, INT’L CTR. FOR REINDEER HUSBANDRY, <http://reindeerherding.org/herders/sami-norway/> (last visited July 6, 2018) [<https://perma.cc/F3CD-6LJM>].

162. *Id.*

163. *Id.*

164. *Id.*

165. See Scott Forrest, *Territoriality and State-Sami Relations*, UNIV. OF NORTHERN B.C. (1997), <http://arcticcircle.uconn.edu/HistoryCulture/Sami/samisf.html> [<https://perma.cc/5K5H-PY49>]. There has been conflict with the current agency-led system of husbandry. In 1978, a committee of the Norwegian Legislature proposed to terminate the Husbandry Act and return to the Sami *siida* system. See *Sámi – Norway*, *supra* note 161.

166. Jernsletten & Klokov, *supra* note 159, at 5.

167. See *Sámi – Norway*, *supra* note 161.

168. Jernsletten & Klokov, *supra* note 159, at 86–87.

169. *Id.* at 86.

ries, and the primary responsibilities delegated to the district committees are containment and separation of herds in the district.

12. Norwegian Wild Reindeer

In Norway, there are also sizeable populations of (non-domesticated) wild reindeer. In a manner of governance analogous to semi-domesticated reindeer, wild reindeer lands are partitioned into twenty-three distinct wildlife areas;¹⁷⁰ however, these wild herds generally traverse private and public lands. The herds are managed by municipal boards that report to the national district committees under the national environmental directorate.¹⁷¹ Organized hunts and recreational spotting are the most common uses of wild reindeer. The wild reindeer on the island of Svalbard (also known as Spitzbergen) are managed similarly to those on the Norwegian mainland in that they are owned either by those hunting them as game or by the government.¹⁷² Unlike on the mainland, however, the Svalbard animals are not split by regional differences or governed by committee. Their day-to-day management is by the office of Svalbard's governor, who on those matters, reports to the environmental directorate in Oslo instead of a district committee.¹⁷³

13. Reindeer Peoples in Russia

Because the habitat for *Rangifer* is circumpolar, it is not surprising that reindeer peoples are found in Russia. Indeed, reindeer husbandry is more prominent in Russia than anywhere else in the world—approximately two-thirds of the world's stock of domesticated reindeer exist in Russia.¹⁷⁴ Unlike Norway or other Scandinavian countries, reindeer husbandry is not the right of the sixteen indigenous groups who have historically herded reindeer in Russia.¹⁷⁵ Instead, the ownership of reindeer in Russia falls into one of three categories: state, public, or private.¹⁷⁶ State ownership consists of those reindeer herded for agricultural research; it is an experiment-driven ownership.¹⁷⁷ With public ownership, the category in which most reindeer fall, the animals are owned by collective state farms operated by a public en-

170. Norsk Villreinsenter, *The Wild Reindeer Areas in Norway*, VILLREIN, <http://www.villrein.no/the-wild-reindeer-areas-in-norway/> (last visited July 6, 2018) [<https://perma.cc/6GP7-4PKA>]. The largest wild herd resides in Hardangervidda, totaling around 7,000 wild animals of the estimated 25,000 total wild reindeer in Norway. *Id.*

171. *Id.*

172. *Id.*

173. *Id.*

174. Jernsletten & Klokov, *supra* note 159, at 23.

175. *Id.* at 24. The only groups actively engaging in reindeer husbandry in Russia were indigenous people. *Id.*

176. *Id.* at 34.

177. *Id.* at 35.

terprise.¹⁷⁸ With private ownership, reindeer are generally owned by clans individually or communally.¹⁷⁹ It is difficult to classify reindeer as privately owned because many individual reindeer owners herd reindeer for public enterprises; thus, their privately owned reindeer are herded together with publicly held reindeer.¹⁸⁰ Further confusion arises because there is little discrepancy between state-owned and publicly owned reindeer. Indeed, the only difference in their management is the use of their resource—not who owns them.¹⁸¹ The difficulty of differentiating between public and private ownership does, however, answer the question of who owns and manages the habitat—predominantly public enterprises and the agricultural regulatory system of Russia.¹⁸²

Historically, the management of reindeer in indigenous Russian collectives only consisted of 20 to 100 individuals, however, under the public enterprise management system, there exists an entire “herding brigade” per herd owned by the enterprise.¹⁸³ There are often bureaucratic conflicts on the local and federal level over husbandry in the Russian system. The following is illustrative: The Department of Agriculture oversees management for the local Okrug Administration, or area administration, of the Yamal-Nenets, the State Committee Administration of Land-Use manages the pastures, and all deal directly with public enterprises but do not work with private reindeer.¹⁸⁴ This effectively means that in the Yamal-Nenets region, there is no regulatory arm or management body controlling private husbandry.¹⁸⁵ There has been a steady decline in the number of domesticated reindeer in Russia—it is now estimated to be about 1.2 million animals.¹⁸⁶

D. *Migratory Waterfowl: Biological and Administrative Flyways*

In North America there are vast populations of migratory birds that require continental swaths of habitat as they move north and south in their annual migrations. Known collectively as “migratory waterfowl,” these birds nest in the northern reaches of the continent during the long summer days and spend winter in the mild southern reaches of the continent.¹⁸⁷ These birds primarily belong to the family *Anatidae*

178. *Id.*

179. *Id.*

180. *Id.*

181. *Id.*

182. *Id.*

183. *Id.* at 41.

184. *Id.* at 40.

185. *See id.* This is primarily an issue in the tundra, while in the taiga, husbandry is a smaller resource with respect to the peoples’ overall subsistence. *Id.*

186. *Id.* at 23. The Russian reindeer population was recently near twice this size. *Id.* This decline in population size is most noticeable in the northeastern zone of Russia where there are communities in which herding is vanishing. *See id.*

187. *See, e.g.,* Greg Balkcon et al., *Waterfowl Management in Georgia*, GA. DEP’T OF NAT. RESOURCES, <https://georgiawildlife.com/sites/default/files/wrd/pdf/manage->

(ducks, geese, brant, and swans) but other migratory species are represented.¹⁸⁸ In their biannual migrations, North American waterfowl populations use “flyways,” which are groups of states and provinces that together administer their waterfowl resources and support distinct populations of birds.¹⁸⁹ Biologists have divided the continent into four north-south flyways that comprise these habitats: Pacific Flyway, Central Flyway, Mississippi Flyway, and Atlantic Flyway.¹⁹⁰ These four flyways are shown in Panel A of Figure 7.¹⁹¹

As is clear from the figure, these populations utilize a massive landscape stretching thousands of miles across many states and provinces in Canada, Mexico, and the United States. The ownership of this landscape is a mosaic of public and private land in tracts ranging from national parks to small residential lots. In the nineteenth century, populations were subject to open-access exploitation in a manner described in bottom pathway in Figure 3.¹⁹² During this period and in the early twentieth century, the exploitation led to dramatic reduction of these populations as hunters supplied meat and feathers to wildlife markets. Given the enormous number of landowners, neither a private contractual solution nor a state-based regulatory solution was feasible. In 1916, the United States and Great Britain (on behalf of Canada) entered into a treaty to protect migratory birds.¹⁹³ As a result of this treaty, the regulation of migratory waterfowl hunting is guided by several Flyway Councils composed of agencies from the appropriate states and provinces. Figure 7 shows maps of both biological and administrative flyways.

ment/Waterfowl_Management_in_Georgia.pdf (last visited July 7, 2018) [<https://perma.cc/97JP-4KY6>].

188. Additional species include: *Rallidae* (rails, gallinules, and coots), *Gruidae* (cranes), *Charadriidae* (plovers and lapwings), *Haematopodidae* (oystercatchers), *Recurvirostridae* (stilts and avocets), *Scolopacidae* (sandpipers, phalaropes, and allies), and *Columbidae* (pigeons and doves).

189. Balkcon et al., *supra* note 187.

190. *Flyways: Administrative*, U.S. FISH & WILDLIFE SERV., <https://www.fws.gov/birds/management/flyways.php> (last updated Mar. 8, 2018) [<https://perma.cc/VDY8-PE5U>].

191. *See infra* Figure 7.

192. *See infra* Figure 3.

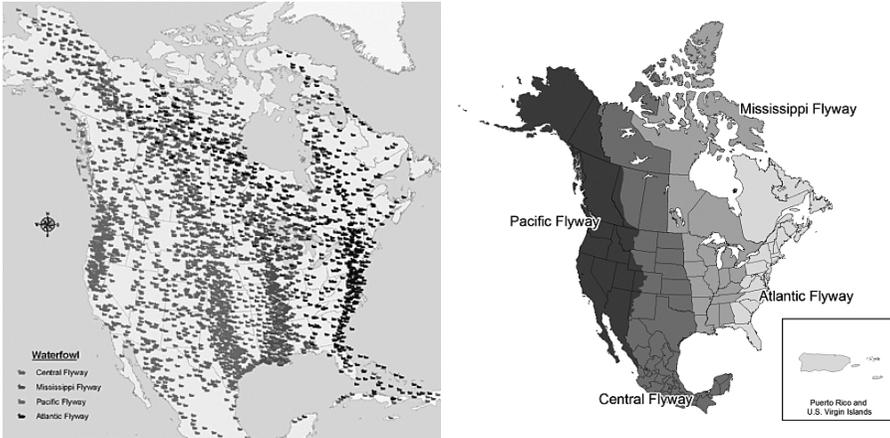
193. *Convention Between the United States and Great Britain for the Protection of Migratory Birds*, GR. BRIT.-U.S., Aug. 16, 1916, 39 Stat. 1702.

FIGURE 7

Migratory Waterfowl in North America

Panel A: Biological Flyways

Panel B: Administrative Flyways



IV. CONCLUSION

The conservation and management of wildlife continues to be an important issue in environmental policy. Debates about markets, land-owners’ rights, and the role of government are ongoing and often contentious. The comparative institutions approach to wildlife governance recognizes the wild variation in wildlife institutions and the role of history and law in determining these institutions. History is important because it sets a structure for ownership of land (habitat). Imperfect incentives and institutional “border” problems will always exist. Increasing relative wildlife value will put pressure on old institutions to change.

The comparative institutions approach to wildlife governance relies on an examination of the property rights to the habitat and the stocks of wild populations. The approach recognizes the often-extreme costs of delineation and enforcement of property rights to wild populations and their habitats. Thus, all systems are notably imperfect compared to the typical neoclassical economics approach. These costs arise because wildlife habitat and wildlife populations are part of the land that has many attributes and uses, most notably, residential and agricultural. The organizations that govern wildlife tend to be ridden with transaction costs and imperfect property rights, and the most efficient system is one that maximizes the total value of the package less the enforcement and administrative costs. An economic framework is developed for considering different governance regimes for both the

wild stocks and the habitat they require. The cases I examine, especially bison and caribou, show the range of governance regimes that have been used and how those governance regimes depend on history and on law.