

Zoogeographic vexillology of North America: exploring endemism in subnational flags

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Abstract

The biogeography of North America is complex. In biogeography – the study of the distribution of plants and animals – endemism, when species are found only in a specific area, is a concept commonly studied to understand species distribution patterns. Since many subnational flags incorporate animals in their design, this study catalogues all those flags in North America to identify endemic symbolism. A total of 4,804 subnational flags were analysed, with results showing 1,149 animals. Flags with animals portrayed in shields or subnational logos were excluded from more detailed study, which focused on the 267 flags depicting animals in their main design. Of these, five flags portray an endemic animal: Ciénaga de Zapata, Matanzas (Cuba) – Cuban crocodile; Río Grande (Puerto Rico) – Puerto Rican parrot; Jasper County, Illinois (USA) – prairie chicken; Terrace, British Columbia (Canada) – Kermodei bear; and the State of California (USA) – California grizzly bear (extinct). Many of these species are also in danger of extinction. Hence, these flags can serve as a tool for national or even global prioritisation of conservation and/or as an educational tool.

Introduction

Flags are a social communication tool with intentional and unintentional messages.¹ Symbolism in flags includes cultural, political and natural elements,² represented by colours, shapes,³ sun, moon, and most commonly, stars.⁴ Animals are also used:⁵ some flags include a coat of arms with an animal within their design, e.g. Ecuador, Mexico and Moldova, while others incorporate the animal into the design itself, e.g. Papua New Guinea and Christmas Island.⁶

Animals have been part of flag design since the earliest vexilloids.⁷ Vexilloids were essentially the first flags to be used, proto-flags.⁸ They consisted of a rod

- 1 W. Smith, 'Fundamental Theses of Vexillology', *Flag Research Quarterly*, 3 (2013), pp. 1-6.
- 2 W. Smith, 'Fundamental Theses of Vexillology'; C.A. Morales-Ramirez, 'Geographies of Vexillology: Learning Geography through Flags', *Pennsylvania Geographer*, 53, 2 (2015), pp. 93-106.
- 3 E.B. Kaye, *Good Flag, Bad Flag: How to Design a Great Flag* (Trenton: NAVA, 2006).
- 4 A.G. Bordeleau, *Flags of the Night Sky* (New York: Springer, 2014); Morales-Ramirez, 'Geographies of Vexillology'.
- 5 A. Kizilçaoğlu, 'Geographical Elements in Country Flags', *Procedia – Social and Behavioral Sciences*, 120 (2014), pp. 116-23.
- 6 *Ibid.*; Morales-Ramirez, 'Geographies of Vexillology'.
- 7 W. Smith, *Flags through the Ages and across the World* (New York: McGraw-Hill, 1975); A. Znamierowski, *World Encyclopedia of Flags* (London: Anness Publishing, 2010).
- 8 *Ibid.*

or spear with an ornament or emblem on the upper end.⁹ The earliest vexilloids sported animal parts, like a tiger's tail, or were carved in an animal shape.¹⁰ The oldest recorded vexilloid from Persia, 5,000 years ago, had an eagle shape carved to its overall design.¹¹ In 104 BC the eagle was ordered to be the only standard of the Roman legions,¹² and it remains a symbol used in modern flag design.¹³ Animals in flags have even given certain areas their name, like the Bear Republic of California.¹⁴

Animals continue to be used in current flags, specifically subnational ones, with varying symbolism.¹⁵ Animals serve to represent agriculture or primary industries, e.g. the cow in the flag of Irma, Alberta (Canada); human activities, e.g. the horse/cowboy in the flag of Bandera, Texas (USA); national symbols, e.g. the quetzal in the flag of Chiantla, Huehuetenango (Guatemala); and the name of a place, e.g. the quetzal in the flag of Quetzaltenango Department (Guatemala).



Irma, Alberta, Canada



Bandera, Texas, U.S.A



Chiantla, Huehuetenango, Guatemala



Quetzaltenango Department, Guatemala

Animal representations on North American subnational flags

They also allude to subjects like endemism – the topic addressed by this paper. Endemism represents a restriction in the distribution of species; therefore, endemic species are those found only in a specific area.¹⁶ This represents a very

9 Znamierowski, *World Encyclopedia of Flags*.
 10 Smith, *Flags through the Ages and across the World*.
 11 Znamierowski, *World Encyclopedia of Flags*.
 12 Smith, *Flags through the Ages and across the World*.
 13 Kizilçaoğlu, 'Geographical Elements in Country Flags'.
 14 Smith, *Flags through the Ages and across the World*.
 15 C.A. Morales Ramirez, 'Biogeographical Vexillology of Puerto Rico', *Vexilloid Tabloid* (August 2016), <https://portlandflag.files.wordpress.com/2016/07/vexilloid-tabloid-059-aug16.pdf> [accessed 1 March 2017].
 16 B.I. Crother and C.M. Murray, 'Ontology of Areas of Endemism', *Journal of Biogeography*, 38 (2011), pp. 1009-15.

important concept in order to establish global areas for conservation efforts.¹⁷

In biogeography, the study of the distribution of plants and animals through space and time,¹⁸ endemism represents one of the main targets of the discipline¹⁹ and is a concept commonly associated with distribution.²⁰ When studying biodiversity, biogeographers analyse patterns of endemism, richness, and/or uniqueness of the diversity of species.²¹ Identifying areas of endemism is commonly done by conducting species distribution models.²² Such models are used to 'explore potential impacts of climate change, establish conservation priority areas and select reserve designs, guide restoration efforts, identify new populations of rare and endangered species, predict distributions of known and unknown species, aid invasive plant management, and in phylogeographic studies'.²³

The biogeography of North America is very complex²⁴ and it is impossible to generalise species richness.²⁵ The continent has two of the world's biogeographic regions, Neartic and Neotropical, as well as one of the richest areas of endemism, the Transition Zone in Mexico.²⁶ This biogeographic complexity is particularly evident in Mexico and Central America – a region that is one of the world's most diverse places for species in the world.²⁷ Although this presents a challenge for biogeographers, attempts to emphasise centres of

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- 17 G. Kier et al., 'A Global Assessment of Endemism and Species Richness across Island and Mainland Regions', *Proceedings of the National Academy of Sciences of the United States* 106, 23 (2009), pp. 9322-7.
 - 18 D. Gavin, 'Biogeography', in Joseph P. Stoltman (ed.), *21st Century Geography: A Reference Handbook* (Thousand Oaks: SAGE Publications, 2012), pp. 77-88.
 - 19 T. Escalante et al., 'Identification of Areas of Endemism from Species Distribution Models: Threshold Selection and Nearctic Mammals', *TIP Revista Especializada en Ciencias Químico-Biológicas*, 16, 1 (2013), pp. 5-17.
 - 20 Crother and Murray, 'Ontology of Areas of Endemism'.
 - 21 B.A. Sorrie and A.S. Weakly, 'Conservation of the Endangered *Pinus palustris* Ecosystem Based on Coastal Plain Centers of Plant Endemism', *Applied Vegetation Science*, 9, 1 (2006), pp. 59-66.
 - 22 Escalante et al., 'Identification of Areas of Endemism from Species Distribution Models'.
 - 23 C.S. Jarnevich et al., 'Caveats for Correlative Species Distribution Modelling', *Ecological Informatics*, 29 (2015), pp. 6-7.
 - 24 T. Escalante et al., 'Biogeographic Regions of North American Mammals Based on Endemism', *Biological Journal of the Linnean Society*, 100 (2013), pp. 485-99.
 - 25 J.T. Kerr, 'Species Richness, Endemism, and the Choice of Areas for Conservation', *Conservation Biology*, 11, 5 (1997), pp. 1094-1100.
 - 26 J.J. Morrone, 'Biogeographic Areas and Transition Zones of Latin America and the Caribbean Islands Based on Panbiogeographic and Cladistic Analyses of the Entomofauna', *Annual Review of Entomology*, 51 (2006), pp. 467-94; Escalante et al., 'Biogeographic Regions of North American Mammals Based on Endemism'.
 - 27 C.J. Marshall and J.K. Liebherr, 'Cladistic Biogeography of the Mexican Transition Zone', *Journal of Biogeography*, 27 (2000), pp. 203-16; D. Espinosa Organista et al., 'El conocimiento biogeográfico de las especies y su regionalización natural', in J. Sarukhán (ed.), *Capital natural de México*, vol.1, *Conocimiento actual de la biodiversidad* (México, D.F.: CONABIO, 2008), pp. 33-65.

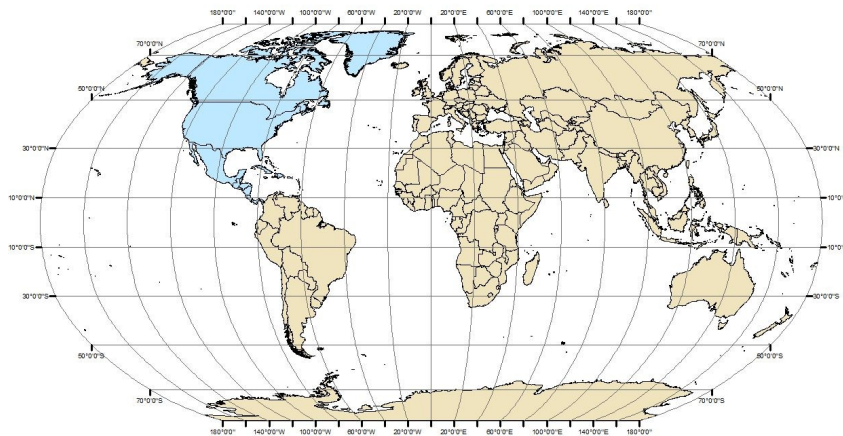
species richness and endemism have grown in past decades to optimise conservation efforts.²⁸ Since flags are a powerful tool of communication and sometimes of social participation,²⁹ this study intends to catalogue flags that include animals in their design to identify symbols of endemism and to analyse the usage of species. This can serve as a tool for education, or even of conservation, in the locations where endemism is identified.



Biogeographic regions of the world. The Physical Environment, http://www.earthonlinemedia.com/ebooks/tp_e_3e/biomes/biogeographical_realms.html

Study area

North America is one of the seven continents in the world. It is the third largest continent and is located in the Western Hemisphere.³⁰



North America (in blue)

To the east of the continent is the Atlantic Ocean and to the west is the Pacific Ocean. It starts north in the Arctic Ocean and ends in the south in Panama,

28 S. Ramírez-Barahona et al., 'Species Richness, Endemism, and Conservation of American Tree Ferns (Cyatheaales)', *Biodiversity Conservation*, 20 (2011), pp. 59-72.

29 Smith, *Flags through the Ages and across the world*.

30 M. McDaniel et al., 'North America: Human Geography', *National Geographic Society* (4 January 2012), <http://www.nationalgeographic.org/encyclopedia/north-america-human-geography/> [accessed 11 April 2017].

north-east of South America. It includes the island of Greenland and the Caribbean islands. The continent was named after the Italian navigator Amerigo Vespucci, since he was the first to suggest the area was separate from Asia.³¹ There are 23 countries and 22 dependencies or territories in the North American continent.

Methods

All the flags of the countries of North America were selected for this study, except for each country's national flag. Territories like Navassa Island, Martinique and Puerto Rico, were also included. A total of 4,804 subnational flags were analysed in November 2016. New flags introduced after this date are not included. Information about the flags was obtained from Flags of the World (FOTW) the world's largest vexillological website. All flags that portray animals in their design were catalogued, including flags that depict animals only in a device such as a shield, seal or logo. However, this second group was excluded from the analysis proper, which is restricted to those flags that incorporate an animal in their overall design. The final step was to identify if the animal incorporated in the flag design symbolised an endemic species or if it could be interpreted as such.



Aitkin County, Minnesota, U.S.A.



Benton County, Washington, U.S.A.



Oregon, U.S.A. (front)



Oregon, U.S.A. (back)

Animals included in a flag design and in a device upon it

Results

Of the 4,804 subnational flags identified, 961 (20 per cent) included an animal in the design. Of the 45 countries (including dependencies) in the North American continent, only 14 (31 per cent) had subnational flags with at least one animal in the design. A total of 1,149 animals were identified in subnational flags. Table 1 shows their distribution by country, while Table 2 shows their distribution by type. The highest proportion was found in the United States (52.1 per cent), followed by Canada (34 per cent), Guatemala (5 per cent), and El Salvador (2 per cent). The most popular animal was the eagle (11 per cent),

31 M. McDaniel et al., 'North America: Physical Geography', *National Geographic Society* (4 January 2012), <http://www.nationalgeographic.org/encyclopedia/north-america-physical-geography/> [accessed 11 April 2017].

followed by the horse (10 per cent), a fish (9.4 per cent), a bird (9.1 per cent), and the cow (8.4 per cent). No specific species is given for fish, bird and cow as it is not given in the description. Where the information was available, specific species are identified as a separate animal, e.g. pelican, seagull, salmon (see Appendix A). These results include all animals depicted on flags; however, as this study excludes animals depicted only a device such as a shield, seal or logo, the final analysis considers 267 (28 per cent) of the total of 961. Where a flag has an additional device depicting an animal, the study considers only the animal incorporated in the main design. These flags are: Aitkin County, Minnesota (USA), only the deer considered; Oregon State (USA), only the beaver on the reverse considered; and Benton County, Washington State (USA), only the fish and cow considered.

Table 1. All animals in subnational flags by country (includes shields, seals, logos)

Country	Number	%
USA	599	52.1
Canada	385	34
Guatemala	62	5
El Salvador	25	2
Mexico	16	1.4
Puerto Rico (USA)	13	1.1
Greenland (Denmark)	13	1.1
Nicaragua	12	1
Honduras	9	0.8
Dominican Republic	8	0.7
Trinidad & Tobago	4	0.4
Panama	1	0.13
Cuba	1	0.13
St Vincent & the Grenadines	1	0.13
Total	1149	

Table 2. All animals in subnational flags by type (including shields, seals, logos)

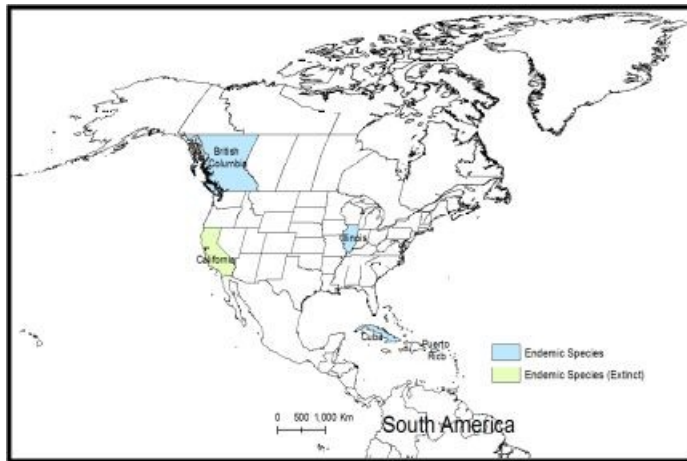
Animal type	Number	(%)
Eagle	122	11
Horse	111	10
Fish	108	9.4
Bird	105	9.1
Cow	96	8.4
Lion	64	6
Deer	63	5.5
Bear	34	3
Moose	32	2.7
Beaver	30	2.6
Goose	25	2.2

Animal type	Number	(%)
Bull	24	2.1
Dove	21	2
Elk	21	2
Duck	17	1.5
Seagull/gull	17	1.5
Pelican	16	1.4
Whale	13	1.1
Quetzal	11	1
Salmon	11	1
Sheep	10	0.9
Dog	9	0.8
Fox	9	0.8
Ox	9	0.8
Swan	9	0.8
Buffalo	8	0.7
Dolphin	8	0.7
Caribou	7	0.6
Rooster	6	0.5
Seal	6	0.5
Bison	5	0.4
Hawk	5	0.4
Lamb	5	0.4
Pheasant	5	0.4
Antelope	4	0.3
Butterfly	4	0.3
Cattle	4	0.3
Crab	4	0.3
Feline animal	4	0.3
Lobster	4	0.3
Pig	4	0.3
Snake	4	0.3
Steer	4	0.3
Turtle	4	0.3
Bee	3	0.2
Chicken	3	0.2
Hummingbird	3	0.2
Trout	3	0.2
Walrus	3	0.2
Elephant	2	0.1
Narwhal	2	0.1
Owl	2	0.1
Peacock	2	0.1
Porcupine	2	0.1

Animal type	Number	(%)
Ram	2	0.1
Scallops	2	0.1
Seahorse	2	0.1
Shrimp	2	0.1
Wolf	2	0.1
Badger	1	0.09
Bighorn	1	0.09
Cat	1	0.09
Cougar	1	0.09
Crocodile	1	0.09
Crow	1	0.09
Donkey	1	0.09
Falcon	1	0.09
Fawn	1	0.09
Fulmar	1	0.09
Giraffe	1	0.09
Goat	1	0.09
Gopher	1	0.09
Haddock	1	0.09
Iguana	1	0.09
Leopard	1	0.09
Loon	1	0.09
Manatees	1	0.09
Marlin	1	0.09
Otter	1	0.09
Parrot	1	0.09
Raccoon	1	0.09
Rhino	1	0.09
Sand dollar	1	0.09
Shark	1	0.09
Skunk	1	0.09
Snails	1	0.09
Squirrel	1	0.09
Tiger	1	0.09
Toucan	1	0.09
Turkey	1	0.09
Worm	1	0.09
Total	1149	

Subnational flags made use of animals that represent national symbols: the bald eagle (*Haliaeetus leucocephalus*) in the United States, the polar bear (*Ursus maritimus*) in Greenland and the quetzal (*Pharomachrus mocinno*) in Guatemala. Of the 514 subnational flags identified for the United States, 104 (20 per cent) depicted a bald eagle in its design. The polar bear is used in the design of the shield in the flag of Nanortalik, Greenland. Of the 53 subnational

flags identified for Guatemala, 11 (21 per cent) had a quetzal. However, neither the Greenland or the Guatemala flags were considered for more detailed analysis because they all depict the animal in a shield, seal or logo. None of these species were considered endemic to these countries since the bald eagle's native range includes Canada, Mexico and Saint Pierre and Miquelon,³² the polar bear is found in the Arctic Sea,³³ and the quetzal's range extends through Central America: Costa Rica, El Salvador, Panama, Nicaragua, Mexico, Honduras, and Guatemala.³⁴



North America: location of endemic animals in subnational flag design

The flag of Winneconne, Wisconsin (USA) also incorporates the official animal (skunk) as well as the official bird (dodo) in its design.³⁵ Although the flag does not specify a species, the skunk present in Wisconsin is the striped skunk (*Mephitis mephitis*),³⁶ which has a distribution range from Canada to Mexico.³⁷ The dodo (*Raphus cucullatus*) is an extinct flightless pigeon and endemic to Mauritius.³⁸

32 *Haliaeetus leucocephalus* (IUCN Red list of Threatened Species, 2016), e: T22695144A93492523, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695144A93492523.en> [accessed 8 May 2017].

33 G.M. Durner et al., 'Predicting 21st-Century Polar Bear Habitat Distribution from Global Climate Models', *Ecological Monographs*, 79, 1 (2009), pp. 25-58.

34 BirdLife International, *Pharomachrus mocinno* (IUCN Red list of Threatened Species, 2016), e.T22682727A92958465, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22682727A92958465.en> [accessed 8 May 2017].

35 Wisconsin Historical Society, 'Odd Wisconsin: Winneconne seceded to get back on the official Wisconsin state map', *Wisconsin State Journal* (27 October 2009), http://host.madison.com/wsj/news/local/odd-wisconsin-winneconne-seceded-to-get-back-on-the-official/article_91d75284-c349-11de-aa3a-001cc4c03286.html [accessed 20 January 2017].

36 Department of Natural Resources, 'Wisconsin's Biodiversity as a Management Issue', report (May 1995), <http://dnr.wi.gov/files/PDF/pubs/rs/rs0915.pdf> [accessed 14 April 2017].

37 K. Helgen and F. Reid, *Mephitis mephitis* (IUCN Red List of Threatened Species, 2016), e: T41635A45211301, <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41635A45211301.en> [accessed 8 May 2017].

38 M. Nowak-Kemp and J.P. Hume, 'The Oxford Dodo. Part 1: The Museum History of the Tradescant Dodo: Ownership, Displays and Audience',



Flag of Winneconne, Wisconsin (USA)

For some flags a description was unavailable or not detailed enough, so some animals could not be identified as an endemic species. The flags of Elk Grove, California (USA) and Stockton, California (USA) incorporated an elk in the shield depicted on the flag, but the description did not specify this as a tule elk (*Cervus canadensis nannodes*), an endemic species of the State of California.³⁹ (These flags are not considered for further analysis since the animal is shown on a shield.)



Elk Grove, California, USA



Stockton, California, USA



Cortes Department, Honduras



Grays Harbor County, Washington, USA

Flags with possible endemic species

The flag of the Cortes Department (Honduras) incorporates a bird in its design. Although the species is unspecified, it does not have the appearance of the country's endemic bird, the Honduran Emerald (*Amazilia luciae*).⁴⁰ The

Historical Biology, 29, 2 (2017), pp. 234-47.

39 S.M. Brook et al., *Cervus canadensis* (IUCN Red List of Threatened Species), e: T55997823A55997871, <http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T55997823A55997871.en> [accessed 5 May 2017].

40 E.C. Dickinson, *The Howard and Moore Complete Checklist of the Birds of the World*, 3rd ed (Princeton: Princeton University Press, 2003).

beardslee trout (*Oncorhynchus mykiss irideus* f. *beardsleei*) is an endemic subspecies of rainbow trout (*Oncorhynchus mykiss*) only present in Lake Crescent, Washington State (USA) and spawns thorough the Lyre River, north of the lake.⁴¹ Although not specified as such, the flag of Grays Harbor County, Washington State (USA) has a fish that closely resembles a trout, However, it is unlikely to be the beardslee trout as the county lies south of the lake and river.

The state flag of Wyoming (USA) uses the silhouette of an American bison (*Bison bison*), the state symbol and the US national mammal. Although the state is home to a population of this bison, the species is endemic neither to the state or the USA as a whole. Its distribution range extends into Canada and at one time also included Mexico.⁴² The symbolism of the bison in the flag of Wyoming is not an endemic one. It simply represents the local fauna of the state.

In other examples, animals formed part of a landscape. Subnational flags in North America incorporate landscapes in their design in which animals are part. The animals are depicted as a method of transportation, as part of the workforce activities, or just in their natural habitat.

Some examples include: Isle aux Morts, Newfoundland and Labrador (Canada); Nuckolls County, Nebraska (USA); and Burlington County, New Jersey (USA) among others.



Wyoming, USA



Isle aux Morts, Newfoundland and Labrador, Canada



Nuckolls County, Nebraska, USA



Burlington County, New Jersey, USA

Other examples of animals in subnational flags

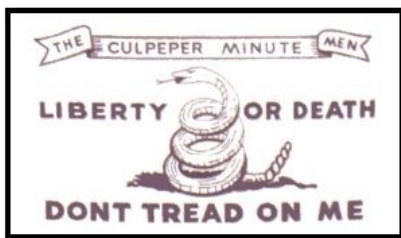
41 P. Trotter, *Cutthroat: Native Trout of the West*, 2nd ed. (Oakland: University of California Press, 2008).

42 C. Gates and K. Aune, *Bison bison* (IUCN Red List of Threatened Species, 2008), e: T2815A9485062, <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T2815A9485062.en> [accessed 23 April 2017].

Endemism in subnational flags

It must be noted that most subnational flags do not provide a detailed description of their symbolism. Most descriptions allude to the design itself and its meaning and/or rationale behind its choice and not the symbolism underlying individual elements. Of all the 267 flags considered here, only 5 (2 per cent) include an animal endemic to the area: Río Grande, Puerto Rico – Puerto Rican parrot]; Jasper County, Illinois (USA) – prairie chicken; Ciénaga de Zapata, Matanzas (Cuba) – Cuban crocodile; Terrace, British Columbia (Canada) – Kermodei bear; and California (USA) – California grizzly bear (extinct).

Four more USA flags may portray an endemic animal but lack the detailed description needed for a secure identification: Citrus County, Florida – a manatee (endemic species, West Indian manatee); Juno Beach, Florida – a turtle (endemic species, Florida chicken turtle); Westmoreland County, Pennsylvania and Culpeper County, Virginia – both have a coiled snake similar to that of the Gadsden Flag (endemic species, timber rattlesnake).



Culpeper County, Virginia, USA



Westmoreland County, Pennsylvania, USA



Citrus County, Florida, USA



Juno Beach, Florida, USA

Subnational flags with possible endemic animal

Discussion

The use of animals in subnational flags derives mainly from heraldry. Most of the representations come from other patriotic symbols such as a shield, seal or logo. Heraldry in North America was appropriated by the indigenous communities after the European invasion.⁴³ The Europeans used the eagle as part of their designs, which was also used in the vexilloids.⁴⁴ This explains why the eagle is the animal most often present in subnational flags. Since a description of the use and symbolism is rarely provided, the use of this animal can be associated with cultural/historic roots rather than biogeographic reasons (with the exception of the United States, since the eagle is the national symbol). Similar to the eagle, the lion has a historical use since it is also part of

43 G. Gutiérrez, 'Indigenous Coats of Arms in Títulos Primordiales and Techialoyan Códices: Nahuatl Corporate Heraldry in the Lienzos de Chiepetlan, Guerrero, Mexico,' *Ancient Mesoamerica*, 26 (2015), pp. 51-68.

44 Ibid.; Znamierowski, *World Encyclopedia of Flags*.

the animals used in heraldry.⁴⁵ The lion has been used for centuries in these patriotic tools.⁴⁶ It is also worthy of note that the lion's current distribution is not in North America, but mainly in African countries.⁴⁷ Hence, the use of the lion in North American subnational flags does not have any geographic symbolism. As discussed previously, most of the remaining animals were depicted within a landscape, thus not having any specific associated symbolism.

The flags that depict an endemic species serve as a communication tool to local and national inhabitants. Of the five flags identified, four portray an extant species that have a relatively small habitat and in some cases a declining population. The Puerto Rican parrot (*Amazona vittata*) represented in the flag of Río Grande, is a critically endangered species on the island.⁴⁸



Flag of Río Grande, Puerto Rico

By 1975 the population had declined from approximately one million birds to just thirteen.⁴⁹ Since then the species has become a high profile species for conservation, which has led to an increase in conservation programs throughout the years.⁵⁰ Its natural range extended through the Karst region in the northern and central parts of the island⁵¹ and now is restricted mainly to the area of *El Yunque*, Puerto Rico's tropical rainforest in the east, which is

45 A.V. Murray, 'Heraldry', in G.Owen-Crocker et al. (eds), *Encyclopedia of Medieval Dress and Textiles of the British Isles, c.450-1450* (Leiden: Brill, 2012).

46 Gutiérrez, 'Indigenous Coats of Arms in Títulos Primordiales and Techialoyan Códices'.

47 J. Riggio et al., 'The Size of Savannah Africa: a Lion's View', *Biodiversity and Conservation*, 22, 1 (2013), pp. 17-35.

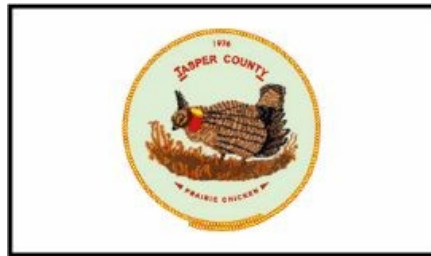
48 T.K. Oleksyk et al., 'A Locally Funded Puerto Rican Parrot (*Amazona vittata*) Genome Sequencing Project Increases Avian Data and Advances Young Researcher Education', *Giga Science*, 1, 1 (2012), <https://doi.org/10.1186/2047-217X-1-14>; BirdLife International, *Amazona vittata* (IUCN Red List of Threatened Species, 2016), e.T22686239A93104104, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22686239A93104104.en> [accessed 1 March 2017].

49 J. Earnhardt et al., 'The Puerto Rican Parrot Reintroduction Program: Sustainable Management of the Aviary Population', *Zoo Biology*, 33 (2014), pp. 89-98; S. Clubb et al., 'Health and Reproductive Assessment of Selected Puerto Rican Parrots (*Amazona vittata*) in Captivity', *Journal of Avian Medicine and Surgery*, 29, 4 (2015), pp. 313-25.

50 J. Earnhardt et al., 'The Puerto Rican Parrot Reintroduction Program: Sustainable Management of the Aviary Population'.

where Río Grande is located.⁵² The conservation efforts during the past four decades have increased the population of the bird to 535 species in 2015.⁵³

Like the Puerto Rican parrot, the prairie chicken (*Tympanuchus cupido*), depicted in the flag of Jasper County, Illinois (USA), has been declining in population for the past four decades. Once found throughout the United States and Canada, it is now limited mainly to the Midwestern states of the United States,⁵⁴ with two restricted distribution areas in southern Illinois, the location of Jasper County.⁵⁵ The decline in its population is correlated with the loss of native tallgrass,⁵⁶ a habitat needed by the species for reproduction and nesting.⁵⁷ Conservation efforts have been ongoing to increase the population of this species in the area, with several translocation efforts since 1950.⁵⁸ As Carrlson et al. point out, these attempts to move the prairie chicken from place to place have failed due to lack of empirical data regarding the bird's survival during this process. They do, however, suggest several methods of translocating the species with greater success.⁵⁹



Flag of Jasper County, Illinois (USA)

The Cuban crocodile (*Crocodylus rhombifer*), portrayed in the flag of Ciénaga de Zapata, Matanzas (Cuba), is another critically endangered species.⁶⁰ It is one of

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- 51 T.H. White Jr et al., 'Survival of Captive-Reared Puerto Rican Parrots Released in the Caribbean National Forest', *American Ornithological Society*, 107, 2 (2005), pp. 424-32.
 - 52 C.A. Morales Ramirez, 'Biogeographical Vexillology of Puerto Rico'.
 - 53 S. Clubb et al., 'Health and Reproductive Assessment of Selected Puerto Rican Parrots (*Amazona vittata*) in Captivity'.
 - 54 BirdLife International, *Tympanuchus cupido* (IUCN Red List of Threatened Species, 2016), e.T22679514A92817099, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22679514A92817099.en> [accessed 9 May 2017].
 - 55 Z.W. Bateson et al., 'Genetic Restoration of a Threatened Population of Greater Prairie-Chickens', *Biological Conservation*, 174 (2014), pp. 12-19.
 - 56 L.B. McNew et al., 'Alternative Rangeland Management Strategies and the Nesting Ecology of Greater Prairie-Chicken', *Rangeland Ecology & Management*, 68 (2015), pp. 298-304.
 - 57 J.A. Johnson et al., 'Greater Prairie-Chicken (*Tympanuchus cupido*)', in A. Poole (ed.), *The Birds of Northern America Online* (Ithaca: Cornell Laboratory of Ornithology, 2011), <https://birdsna.org/Species-Account/bna/species> [accessed 14 April 2017].
 - 58 K.M. Carrlson et al., 'Survival and Habitat Use in Translocated and Resident Greater Prairie-Chickens', *Journal for Nature Conservation*, 22 (2014), pp. 405-12.
 - 59 Ibid.
 - 60 Y. Milián-García et al., 'Genetic Evidence of Hybridization between the Critically Endangered Cuban Crocodile and the American Crocodile:

Earth's most endangered species with the smallest distribution range.⁶¹ Like the Puerto Rican parrot and the prairie-chicken, this animal also once had a wider distribution, with some fossil records found in the Bahamas and the Cayman Islands.⁶² It is now restricted to the Zapata Swamp due to illegal hunting and the degradation of its previous habitat.⁶³ As the habitat is not easily accessible, observations are limited. Unlike the two species mentioned above, conservation of this species is very limited, attributed to lack of knowledge about the ecology and reproduction of the reptile.⁶⁴ Although conservation is still challenging, in 2014 the Cuban government closed an area in the Zapata Swamp to future development, which would allow the protection of the land.⁶⁵



Flag of Ciénaga de Zapata, Matanzas (Cuba)

The Kermode bear or spirit bear (*Ursus americanus kermodei*), depicted in the flag of Terrace, British Columbia (Canada), is not an endangered species like those described above. However, it is restricted to a very small area, comprising the coastal area of British Columbia.⁶⁶ In general, bears are the most widely distributed terrestrial carnivores in North America.⁶⁷ They congregate mainly in rivers and coastal areas where their primary food source, salmon, is available.⁶⁸ The Kermode bear in British Columbia is a subspecies of the black bear, possessing a white coat colour variant.⁶⁹ In British Columbia there are conservancies that protect coastal and river areas. This allows the conservation

Implications for Population History and in Situ/ex Situ Conservation', *Heredity*, 114 (2015), pp. 272-80.

61 Y. Milián-García et al., 'Evolutionary History of Cuban Crocodiles *Crocodylus rhombifer* and *Crocodylus acutus* Inferred from Multilocus Markers', *Journal of Experimental Zoology*, 315 (2011), pp. 358-75.

62 Ibid.

63 Milián-García et al., 'Genetic Evidence of Hybridization between the Critically Endangered Cuban Crocodile and the American Crocodile'.

64 Y. Milián-García et al., 'Genetic Evidence for Multiple Paternity in the Critically Endangered Cuban Crocodile (*Crocodylus rhombifer*)', *Amphibia-Reptilia*, 37 (2016), pp. 273-81.

65 S. Reardon, 'Cuban Crocodiles Pose Conservation Conundrum', *Nature*, 537 (2016), pp. 596-7.

66 D.R. Klinka and T.E. Reimchen, 'Darkness, Twilight, and Daylight Foraging Success of Bears (*Ursus americanus*) on Salmon in Coastal British Columbia', *Journal of Mammalogy*, 90, 1 (2009), pp. 144-9; P.W. Hedrick and K. Ritland, 'Population Genetics of the White-Phased 'Spirit' Black Bear of British Columbia', *Evolution* 66, 2 (2011), pp. 305-13.

67 T.E. Reimchen and M.A. Spoljaric, 'Right Paw Foraging Bias in Wild Black Bear (*Ursus americanus kermodei*)', *Laterality: Asymmetries of Body, Brain and Cognition*, 16, 4 (2011), pp. 471-8.

68 Klinka and Reimchen, 'Darkness, Twilight, and Daylight Foraging Success of Bears (*Ursus americanus*) on Salmon in Coastal British Columbia'; Reimchen and Spoljaric, 'Right Paw Foraging Bias in Wild Black Bear'.

of this local subspecies of bear in the area.⁷⁰



Flag of Terrace, British Columbia (Canada)

In vexillology, flags are known as tools that provide information about a specific location.⁷¹ The accessibility and diverse information provided by flags can serve educators of all fields when trying to convey their message or aim in a lecture or conference. Many disciplines have taken advantage of such information; in mathematics, for example, flags are used to explore measurements and pair numbers.⁷² Visual materials have increased the engagement of individuals in conservation efforts.⁷³ Blewitt suggests that most humans are likely to watch and act upon seeing visuals of animals than more urban settings.⁷⁴ Conservation actions require critical and constructive engagement in order to understand concepts and tackle issues.⁷⁵ This opens the possibility of using flags as a conservation/education tool before species become extinct like the endemic California grizzly bear (*Ursus arctos californicus*) used in the flag of the State of California (USA).



Flag of the State of California (USA)

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- 69 H.D. Marshall and K. Ritland, 'Genetic Diversity and Differentiation of Kermode Bear Populations,' *Molecular Ecology*, 11 (2002), pp. 685-97.
- 70 K.L. Turner and C.P.H. Bitonti, 'Conservancies in British Columbia, Canada: Bringing Together Protected Areas and First Nations' Interests,' *International Indigenous Policy Journal*, 2, 2 (2011), p. 3, <http://ir.lib.uwo.ca/iipj/vol2/iss2/3> [accessed 30 January 2017].
- 71 Znamierowski, *World Encyclopedia of Flags*; Morales Ramirez, 'Geographies of Vexillology: Learning Geography through Flags'.
- 72 B. Schad et al., 'Flags by the Numbers', *Teaching Children Mathematics*, 15, 4 (2008), pp. 218-20; J.B. Howe et al., 'Capture the Flags', *Mathematics Teaching in Middle School*, 16, 2 (2010), pp. 72-5.
- 73 J. Blewitt, 'The Media, Animal Conservation and Environmental Education', *Environmental Education Research*, 17, 6 (2011), pp. 711-18.
- 74 Ibid.
- 75 D.M. Evans et al., 'Biodiversity Offsetting: What are the Challenges, Opportunities and Research Priorities for Animal Conservation?', *Animal Conservation*, 18 (2015), pp. 1-3.

Conclusion

This research shows that subnational flags in North America have animals as part of their design. Most of these are taken from external sources like the shield, seal or logo of a location. Nowadays, animals are integrated in flags through the addition of these external sources. Only 267 subnational flags portrayed an animal as part of their design rather than in a shield, seal or logo. Of these, only five had an animal endemic to the location or surrounding area, including one that was already extinct. Flags, as a communication tool, are an opportunity for people to express their idiosyncrasies and ideals. Although many countries have endemic species that may be endangered, these are not represented in their flags. This lack of representation is not clear, since subnational flags rarely provide a detailed explanation for the usage of symbols. Animals were part of the design of the first proto-flags. Usage of animals has a cultural/historic symbolism, dating back to the vexilloids. These vexilloids and other heraldry elements were introduced in North America by the Europeans. Its influences are still seen in subnational flags, since animals like the lion and eagle continue to be used, and the lion is not found on this continent.

The five flags with endemic species demonstrate how we can use existing resources to convey a message. Providing an interpretation of the symbolism underlying such flags and adducing a conservation meaning can awaken interest among other individuals. This can lead to a quick online search about the species, which in return may provide new information. In depth analysis of symbolism in flags goes beyond understanding the reason for using brown instead of green to represent flora. Taking a symbol such as an animal, and exploring its possible use or importance in a flag design, allows for a better understanding of the location which uses it. It tells us how important the species is for the local community, and the priorities of the individuals living there. Using these flags can be an integral part of the education of individuals inside and outside the area. As many endemic species in this study are endangered species, the flags can serve as another tool to create awareness. Awareness and involvement of other individuals in conservation efforts has been proven to be more effective when using external visual tools. This allows for the integration of flags as didactical tools. This study shows the importance of analysing a flag beyond what we see. It provides an insight into the information that can be obtained if detailed research is conducted. This research does not intend to persuade anyone of any particular opinion, especially personal opinion. Instead, it intends to motivate individuals and researchers to look deeper into existing tools that can provide a vehicle into educated conservation knowledge.

Images

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Appendix A

Animal types in subnational flags by country

Animal	USA	CAN	GTM	SLV	PRI	NIC	MEX	HND	DOM	GRL	TTO
Eagle	106	11			1		3			1	
Horse	78	19	10				1	1	2		
Fish	43	53	1	2	1	2	1	1	1	1	2
Bird	69	30	2	2				1			
Cow	32	26	20	11		3		3	1		
Lion	24	26	1		1	3	7	1	1		
Deer	45	13	2	1			1			1	
Bear	14	19								1	
Moose	4	28									
Beaver	3	27									
Goose	14	11									
Bull	8	6	5	1	1			1	2		
Dove	8	6	2	1	2	2					
Elk	11	10									
Duck	12	5									
Seagull/gull	12	4			1						
Pelican	14	2									
Whale	3	7								1	1
Quetzal			11								
Salmon	2	9									
Sheep	8	2									
Dog	4	5									
Fox	1	6					1			1	
Ox	6	2								1	
Swan	2	5	2								
Buffalo	6	2									
Dolphin	4	1	1		1			1			
Caribou		7									
Rooster	2	2	1				1				
Seal		5								1	
Bison		5									
Hawk	5										
Lamb	3				2						
Pheasant	3	2									
Antelope	2	2									
Butterfly	4										
Cattle	2	2									
Crab	4										
Feline animal	2	1					1				
Lobster	1	2		1							

Animal	USA	CAN	GTM	SLV	PRI	NIC	MEX	HND	DOM	GRL	TTO
Shark	1										
Skunk	1										
Snails						1					
Squirrel	1										
Tiger	1										
Toucan				1							
Turkey	1										
Worm				1							
Totals	599	385	62	25	13	12	16	9	8	13	4

Also: Cuba: 1 (crocodile); Panama: 1 (bird); St Vincent and the Grenadines: 1 (whale)

Bibliography

- Z.W. Bateson, P.O. Dunn, S.D. Hull et al., 'Genetic Restoration of a Threatened Population of Greater Prairie-Chickens', *Biological Conservation*, 174 (2014), pp. 12-19
- BirdLife International, *Amazona vittata* (IUCN Red List of Threatened Species, 2016), e.T22686239A93104104, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22686239A93104104.en> [accessed 1 March 2017]
- *Haliaeetus leucocephalus* (IUCN Red list of Threatened Species, 2016), e: T22695144A93492523, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695144A93492523.en> [accessed 8 May 2017]
- *Pharomachrus mocinno* (IUCN Red list of Threatened Species, 2016), e.T22682727A92958465, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22682727A92958465.en> [accessed 8 May 2017]
- *Tympanuchus cupido* (IUCN Red List of Threatened Species, 2016), e.T22679514A92817099, <http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22679514A92817099.en> [accessed 9 May 2017]
- J. Blewitt, 'The Media, Animal Conservation and Environmental Education', *Environmental Education Research*, 17, 6 (2011), pp. 711-18
- A.G. Bordeleau, *Flags of the Night Sky* (New York: Springer, 2014)
- S.M. Brook, J. Pluháček, R. Lorenzini et al., *Cervus canadensis* (IUCN Red List of Threatened Species), e: T55997823A55997871, <http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T55997823A55997871.en> [accessed 5 May 2017]
- K.M. Carrlson, D.C. Kesler and T.R. Thompson, 'Survival and Habitat Use in Translocated and Resident Greater Prairie-Chickens', *Journal for Nature Conservation*, 22 (2014), pp. 405-12
- S. Clubb, J. Velez, M.M. Garner et al., 'Health and Reproductive Assessment of Selected Puerto Rican Parrots (*Amazona vittata*) in Captivity', *Journal of Avian Medicine and Surgery*, 29, 4 (2015), pp. 313-25
- B.I. Crother and C.M. Murray, 'Ontology of Areas of Endemism', *Journal of Biogeography*, 38 (2011), pp. 1009-15
- Department of Natural Resources, *Wisconsin's Biodiversity as a Management Issue* (May 1995), <http://dnr.wi.gov/files/PDF/pubs/rs/rs0915.pdf> [accessed 14 April 2017]
- E.C. Dickinson, *The Howard and Moore Complete Checklist of the Birds of the World*, 3rd ed (Princeton: Princeton University Press, 2003)
- G.M. Durner, D.C. Douglas, R.M. Nielson et al., 'Predicting 21st-Century Polar Bear Habitat Distribution from Global Climate Models', *Ecological Monographs*,

79, 1 (2009), pp. 25-58

J. Earnhardt, J. Vélez-Valentín, R. Valentin et al., 'The Puerto Rican Parrot Reintroduction Program: Sustainable Management of the Aviary Population', *Zoo Biology*, 33 (2014), pp. 89-98

T. Escalante, G. Rodriguez-Tapai, M. Linaje, 'Identification of Areas of Endemism from Species Distribution Models: Threshold Selection and Nearctic Mammals', *TIP Revista Especializada en Ciencias Químico-Biológicas*, 16, 1 (2013), pp. 5-17

T. Escalante, J.J. Morrone and G. Rodriguez-Tapia, 'Biogeographic Regions of North American Mammals Based on Endemism', *Biological Journal of the Linnean Society*, 100 (2013), pp. 485-99

D. Espinosa Organista, S. Ocegueda Cruz, C. Aguilar Zúñiga et al., 'El conocimiento biogeográfico de las especies y su regionalización natural', in J. Sarukhán (ed.), *Capital natural de México*, vol.1, *Conocimiento actual de la biodiversidad* (México, D.F.: CONABIO, 2008), pp. 33-65

D.M. Evans, R. Altwegg, T.W.J. Garner et al., 'Biodiversity Offsetting: What are the Challenges, Opportunities and Research Priorities for Animal Conservation?', *Animal Conservation*, 18 (2015), pp. 1-3

C. Gates and K. Aune, *Bison bison* (IUCN Red List of Threatened Species, 2008), e: T2815A9485062, <http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T2815A9485062.en> [accessed 23 April 2017]

D. Gavin, 'Biogeography', in Joseph P. Stoltman (ed.), *21st Century Geography: A Reference Handbook* (Thousand Oaks: SAGE Publications, 2012), pp. 77-88

G. Gutiérrez, 'Indigenous Coats of Arms in Títulos Primordiales and Techialoyan Códices: Nahuatl Corporate Heraldry in the Lienzos de Chiepetlan, Guerrero, Mexico', *Ancient Mesoamerica*, 26 (2015), pp. 51-68

P.W. Hedrick and K. Ritland, 'Population Genetics of the White-Phased 'Spirit' Black Bear of British Columbia', *Evolution*, 66, 2 (2011), pp. 305-13

K. Helgen and F. Reid, *Mephitis mephitis* (IUCN Red List of Threatened Species, 2016), e: T41635A45211301, <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T41635A45211301.en> [accessed 8 May 2017]

J.B. Howe, J.A. Badillo and H. Sherard, 'Capture the Flags', *Mathematics Teaching in Middle School*, 16, 2 (2010), pp. 72-5

C.S. Jarnevich, T.J. Stohlgren, S. Kumar et al., 'Caveats for Correlative Species Distribution Modelling', *Ecological Informatics*, 29 (2015), pp. 6-15

J.A. Johnson, M.A. Schroeder and L.A. Robb, 'Greater Prairie-Chicken (*Tympanuchus cupido*)', in A. Poole (ed.), *The Birds of Northern America Online* (Ithaca: Cornell Laboratory of Ornithology, 2011), <https://birdsna.org/Species-Account/bna/species> [accessed 14 April 2017]

E.B. Kaye, *Good Flag, Bad Flag: How to Design a Great Flag* (Trenton: NAVA, 2006)

J.T. Kerr, 'Species Richness, Endemism, and the Choice of Areas for Conservation', *Conservation Biology*, 11, 5 (1997), pp. 1094-1100

G. Kier, H. Kreft, T.M. Lee et al., 'A Global Assessment of Endemism and Species Richness across Island and Mainland Regions', *Proceedings of the National Academy of Sciences of the United States*, 106, 23 (2009), pp. 9322-7

A. Kizilçaoğlu, 'Geographical Elements in Country Flags', *Procedia – Social and Behavioral Sciences*, 120 (2014), pp. 116-23

D.R. Klinka and T.E. Reimchen, 'Darkness, Twilight, and Daylight Foraging Success of Bears (*Ursus americanus*) on Salmon in Coastal British Columbia', *Journal of Mammalogy*, 90, 1 (2009), pp. 144-9

C.J. Marshall and J.K. Liebherr, 'Cladistic Biogeography of the Mexican Transition Zone', *Journal of Biogeography*, 27 (2000), pp. 203-16

H.D. Marshall and K. Ritland, 'Genetic Diversity and Differentiation of Kermode Bear Populations', *Molecular Ecology*, 11 (2002), pp. 685-97

M. McDaniel, E. Sprout, D. Boudreau and A. Turgeon, 'North America: Human

- Geography', *National Geographic Society* (last modified 4 January 2012), <http://www.nationalgeographic.org/encyclopedia/north-america-human-geography/> [accessed 11 April 2017]
- M. McDaniel, E. Sprout, D. Boudreau and A. Turgeon, 'North America: Physical Geography', *National Geographic Society* (last modified 4 January 2012), <http://www.nationalgeographic.org/encyclopedia/north-america-physical-geography/> [accessed 11 April 2017]
- L.B. McNew, V.L. Winder, J.C. Pitman and B.K. Sandercock, 'Alternative Rangeland Management Strategies and the Nesting Ecology of Greater Prairie-Chicken', *Rangeland Ecology & Management*, 68 (2015), pp. 298-304
- Y. Milián-García, M. Venegas-Anaya, R. Frias-Soler et al., 'Evolutionary History of Cuban Crocodiles *Crocodylus rhombifer* and *Crocodylus acutus* Inferred from Multilocus Markers', *Journal of Experimental Zoology*, 315 (2011), pp. 358-75
- Y. Milián-García, R. Ramos-Targarona, E. Perez-Fleitas et al., 'Genetic Evidence of Hybridization between the Critically Endangered Cuban Crocodile and the American Crocodile: Implications for Population History and in Situ/ex Situ Conservation', *Heredity*, 114 (2015), pp. 272-80
- Y. Milián-García, E.K. Jensen, S. Ribalta Mena et al., 'Genetic Evidence for Multiple Paternity in the Critically Endangered Cuban Crocodile (*Crocodylus rhombifer*)', *Amphibia-Reptilia*, 37 (2016), pp. 273-81
- C.A. Morales Ramirez, 'Geographies of Vexillology: Learning Geography through Flags', *Pennsylvania Geographer*, 53, 2 (2015), pp. 93-106
- C.A. Morales Ramirez, 'Biogeographical Vexillology of Puerto Rico', *Vexilloid Tabloid* (August 2016), <https://portlandflag.files.wordpress.com/2016/07/vexilloid-tabloid-059-aug16.pdf> [accessed 1 March 2017]
- J.J. Morrone, 'Biogeographic Areas and Transition Zones of Latin America and the Caribbean Islands Based on Panbiogeographic and Cladistic Analyses of the Entomofauna', *Annual Review of Entomology*, 51 (2006), pp. 467-94
- A.V. Murray, 'Heraldry', in G.Owen-Crocker, E. Coatsworth and M. Hayward (eds), *Encyclopedia of Medieval Dress and Textiles of the British Isles, c.450-1450* (Leiden: Brill, 2012) [accessed 25 May 2017]
- M. Nowak-Kemp and J.P. Hume, 'The Oxford Dodo. Part 1: The Museum History of the Tradescant Dodo: Ownership, Displays and Audience', *Historical Biology*, 29, 2 (2017), pp. 234-47
- T.K. Oleksyk, J.-F. Pombert, D. Siu et al., 'A Locally Funded Puerto Rican Parrot (*Amazona vittata*) Genome Sequencing Project Increases Avian Data and Advances Young Researcher Education', *Giga Science*, 1, 1 (2012), DOI: <https://doi.org/10.1186/2047-217X-1-14>
- S. Ramírez-Barahona, I. Luna-Vega and D. Tejero-Díaz, 'Species Richness, Endemism, and Conservation of American Tree Ferns (Cyatheaales)', *Biodiversity Conservation*, 20 (2011), pp. 59-72
- S. Reardon, 'Cuban Crocodiles Pose Conservation Conundrum', *Nature*, 537 (2016), pp. 596-7
- T.E. Reimchen and M.A. Spoljaric, 'Right Paw Foraging Bias in Wild Black Bear (*Ursus americanus kermodei*)', *Laterality: Asymmetries of Body, Brain and Cognition*, 16, 4 (2011), pp. 471-8
- J. Riggio, A. Jacobson, L. Dollar et al., 'The Size of Savannah Africa: a Lion's View', *Biodiversity and Conservation*, 22, 1 (2013), pp. 17-35
- B. Schad, J. Georgeson and S. Bunten, 'Flags by the Numbers', *Teaching Children Mathematics*, 15, 4 (2008), pp. 218-20
- W. Smith, *Flags through the Ages and across the world* (New York: McGraw-Hill, 1975)
- W. Smith, 'Fundamental Theses of Vexillology', *Flag Research Quarterly*, 3 (2013), pp. 1-6
- B.A. Sorrie and A.S. Weakly, 'Conservation of the Endangered *Pinus palustris*

Ecosystem Based on Coastal Plain Centers of Plan Endemism', *Applied Vegetation Science*, 9, 1 (2006), pp. 59-66

P. Trotter, *Cutthroat: Native Trout of the West*, 2nd ed. (Oakland: University of California Press, 2008)

K.L. Turner and C.P.H. Bitonti, 'Conservancies in British Columbia, Canada: Bringing Together Protected Areas and First Nations' Interests,' *International Indigenous Policy Journal*, 2, 2 (2011), p. 3, <http://ir.lib.uwo.ca/iipj/vol2/iss2/3> [accessed 30 January 2017]

T.H. White Jr, J.A. Collazo and F.J. Vilella, 'Survival of Captive-Reared Puerto Rican Parrots Released in the Caribbean National Forest', *American Ornithological Society*, 107, 2 (2005), pp. 424-32

Wisconsin Historical Society, 'Odd Wisconsin: Winneconne seceded to get back on the official Wisconsin state map', *Wisconsin State Journal* (27 October 2009), http://host.madison.com/wsj/news/local/odd-wisconsin-winneconne-seceded-to-get-back-on-the-official/article_91d75284-c349-11de-aa3a-001cc4c03286.html [accessed 20 January 2017]

A. Znamierowski, *World Encyclopedia of Flags* (London: Anness Publishing, 2010)