Main Points

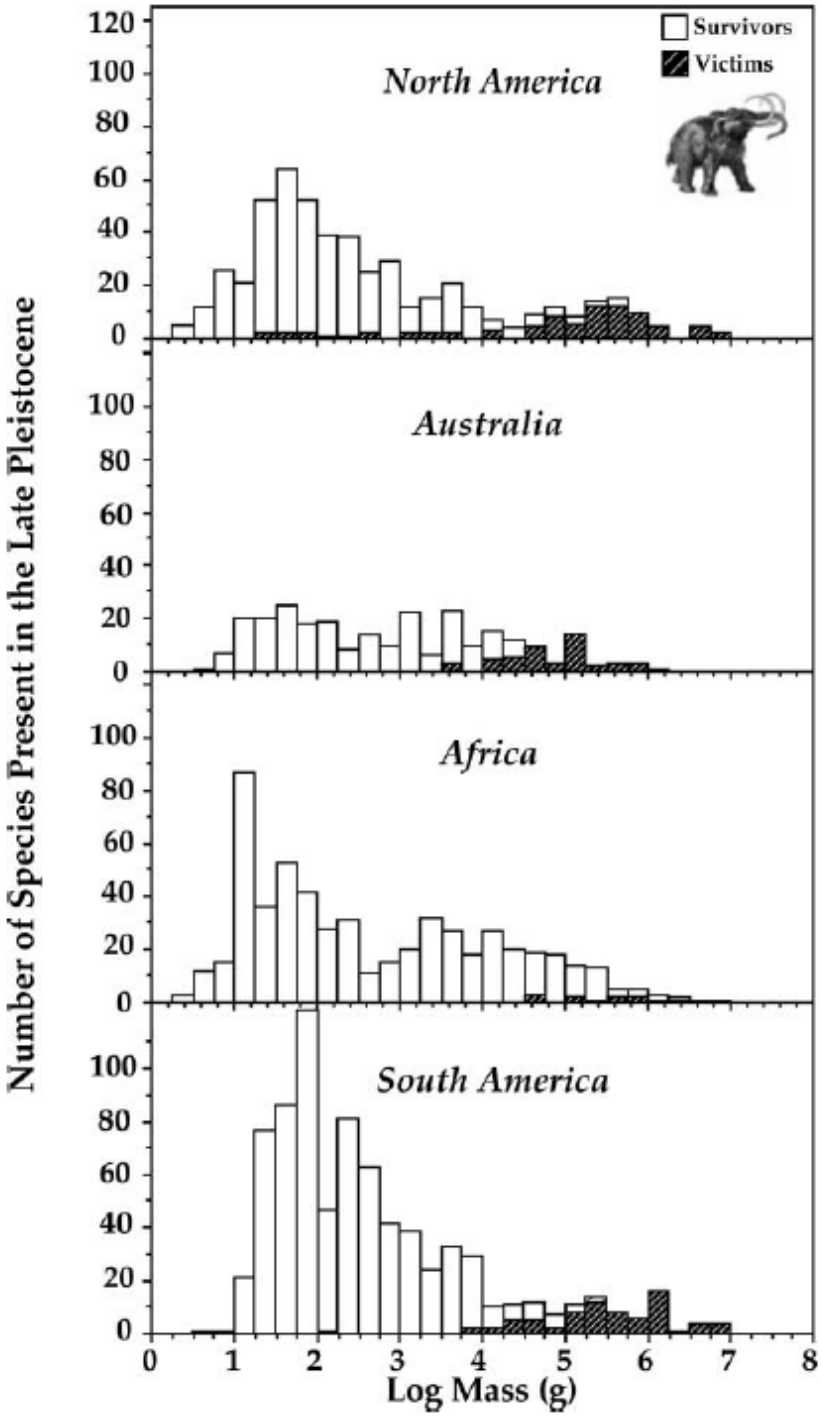
1) Ecological baselines and value judgments: defining "natural"
-- Pleistocene to Holocene transition
-- example: non-analog plant communities
-- example: an ecological anachronism to conserve an endangered fish
-- the shifting baseline syndrome

2) Why is genetic diversity important?
-- mutations, inbreeding, genetic drift, and gene flow
-- example: isolation management as a conservation strategy to combat hybridization (Novinger and Rahel)

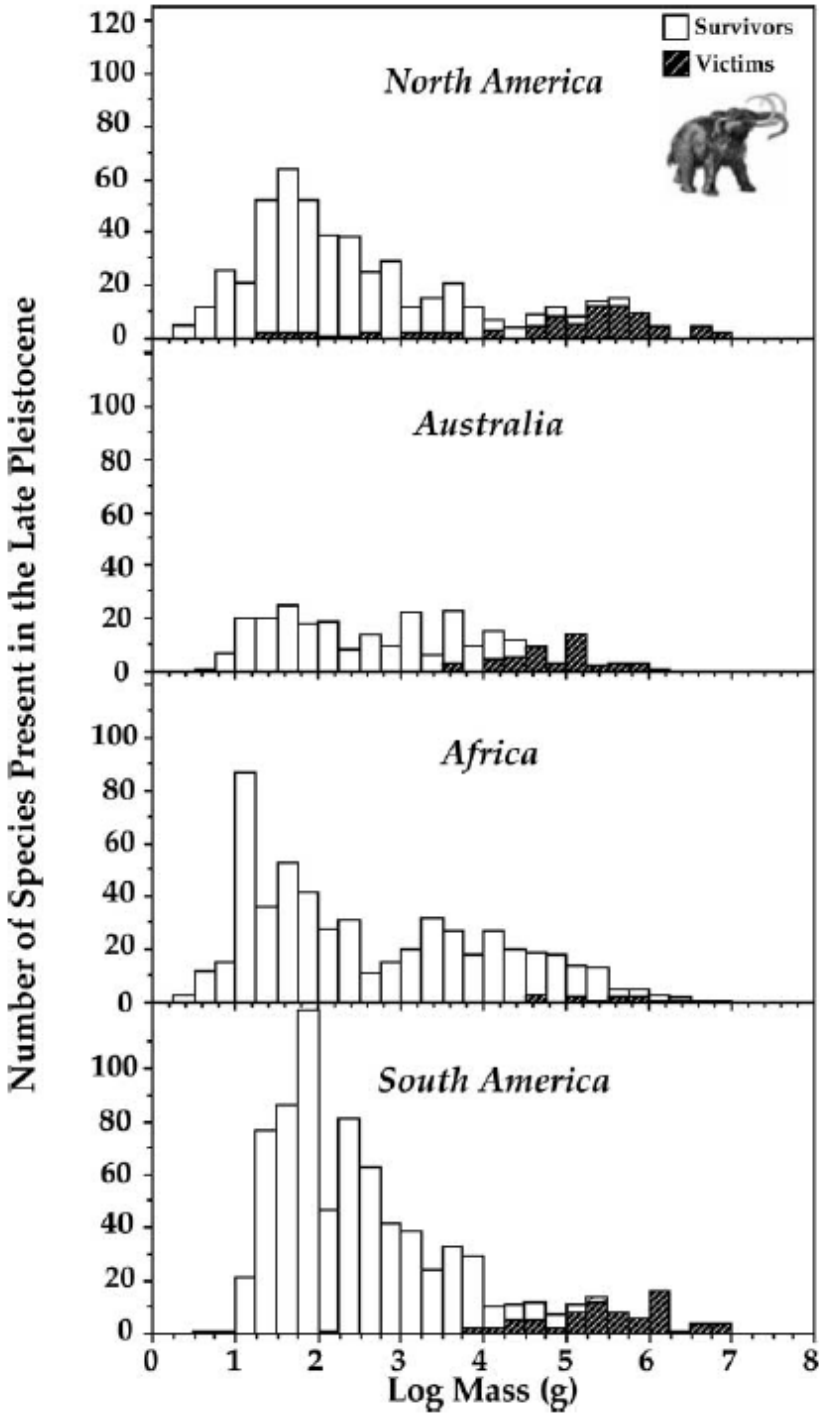
Pre-reading: Thursday 10 Sep = Drietz
Tuesday 15 Sep = no reading

Terms: non-analog community, ecological anachronism, integration, individualism, shifting baseline syndrome, panmictic, genetically effective population size, inbreeding depression, genetic drift, gene flow, outbreeding depression

Field trip to Wyoming toad captive breeding facility 9 September. Please be ready to leave at front of Berry Center by 115pm.



Lyons et al. 2004


Survivors
Victims
North America
Australia
Africa
South America
Number of Species Present in the Late Pleistocene
Log Mass (g)
0
1
2
3
4
5
6
7
8

?

Pleistocene Overkill Hypothesis (Martin 1973)

- **"America was the largest landmass undiscovered by hominids before the time of *Homo sapiens*. The Paleolithic pioneers that crossed the Bering Bridge out of Asia took a giant step. They found a productive and unexploited ecosystem of over 10 million square miles. As Bordes has said, 'There can be no repetition of this until man lands on a habitable planet belonging to another star'."**

  --Paul Martin 1973, "The Discovery of America"

Pleistocene Overkill Hypothesis (Martin 1973)

- **A potential contradiction?**

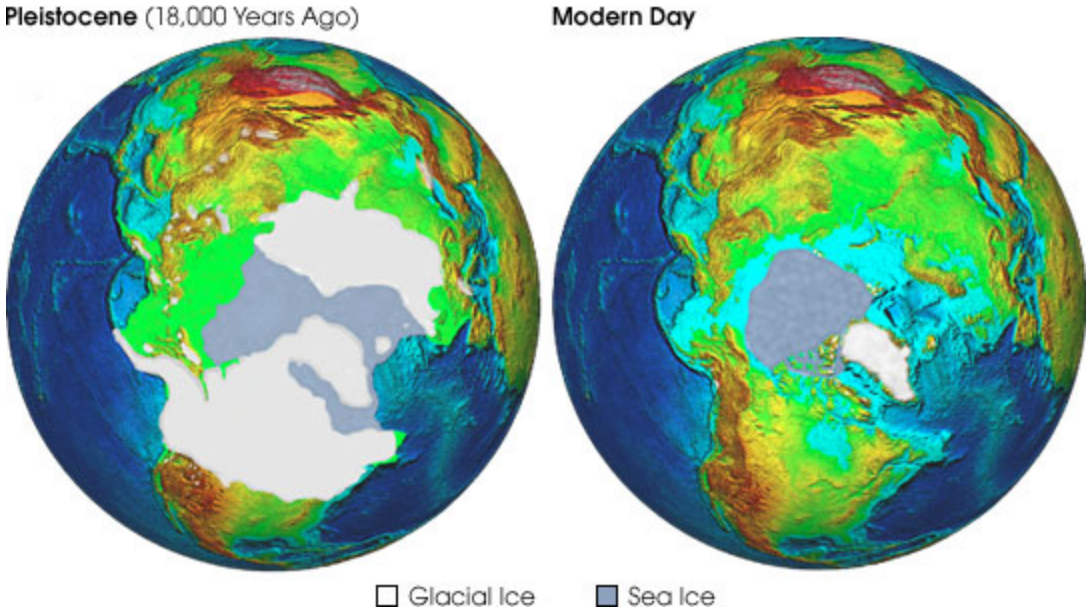
  -- 4 genera went extinct in Eurasia; 30 in N. America

  -- but in N. America, kill sites were rare and lacked artifacts

Pleistocene-Holocene Transition

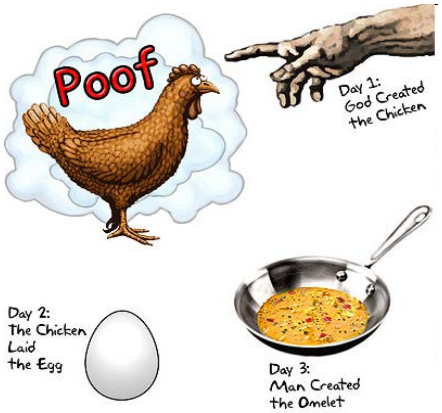
- **Changing fire regime—contemporary fire frequency and magnitude is higher than that ~15,000 years ago**

- **<u>Non-analog</u> plant communities existed**

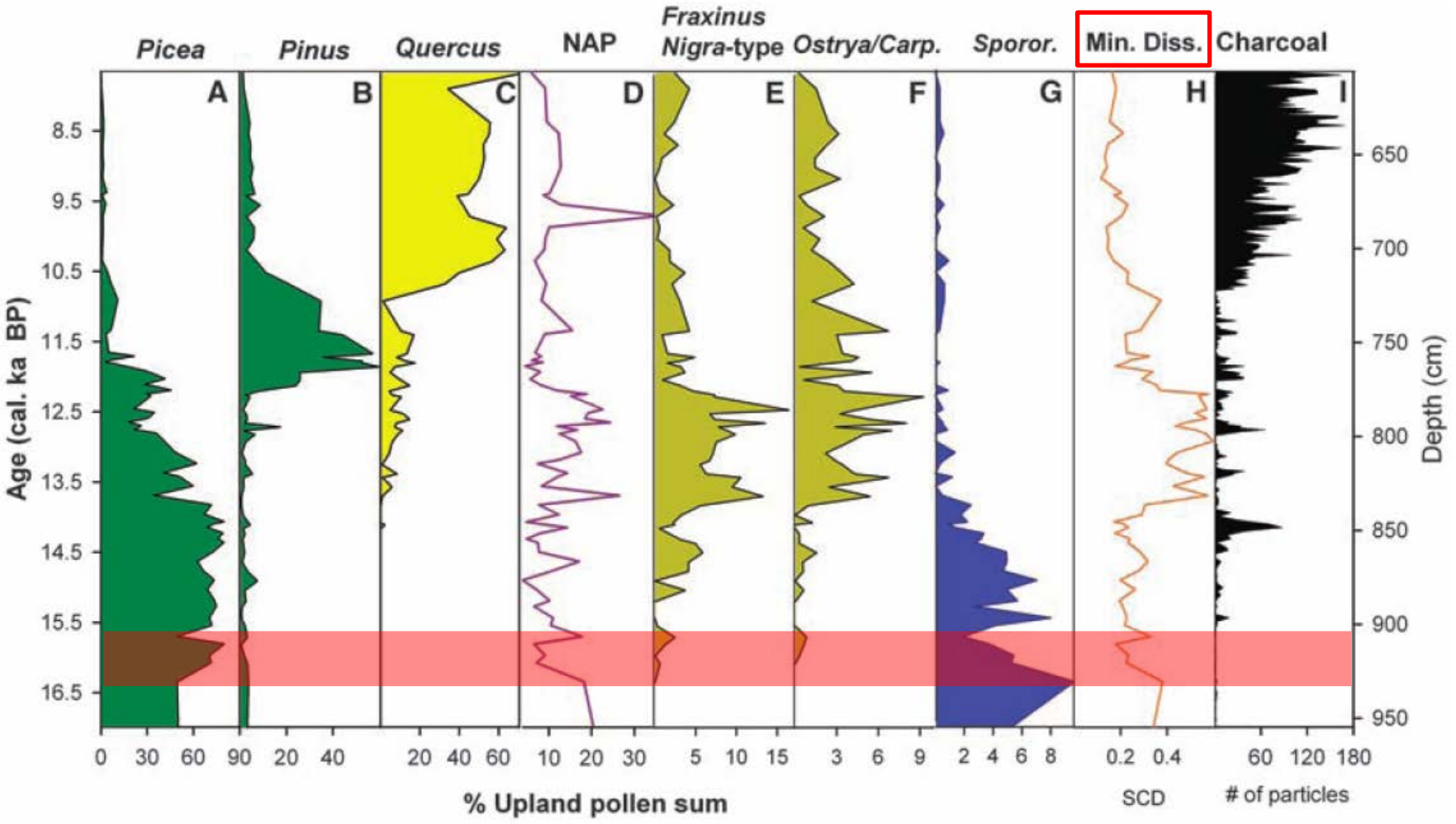


Pleistocene-Holocene Transition

- **Extinction of 30 genera of mammalian megafauna**
- **Changing fire regime—current fire frequency and magnitude is higher than that ~15,000 years ago**
- **<u>Non-analog</u> plant communities existed**
- **Which came first?**

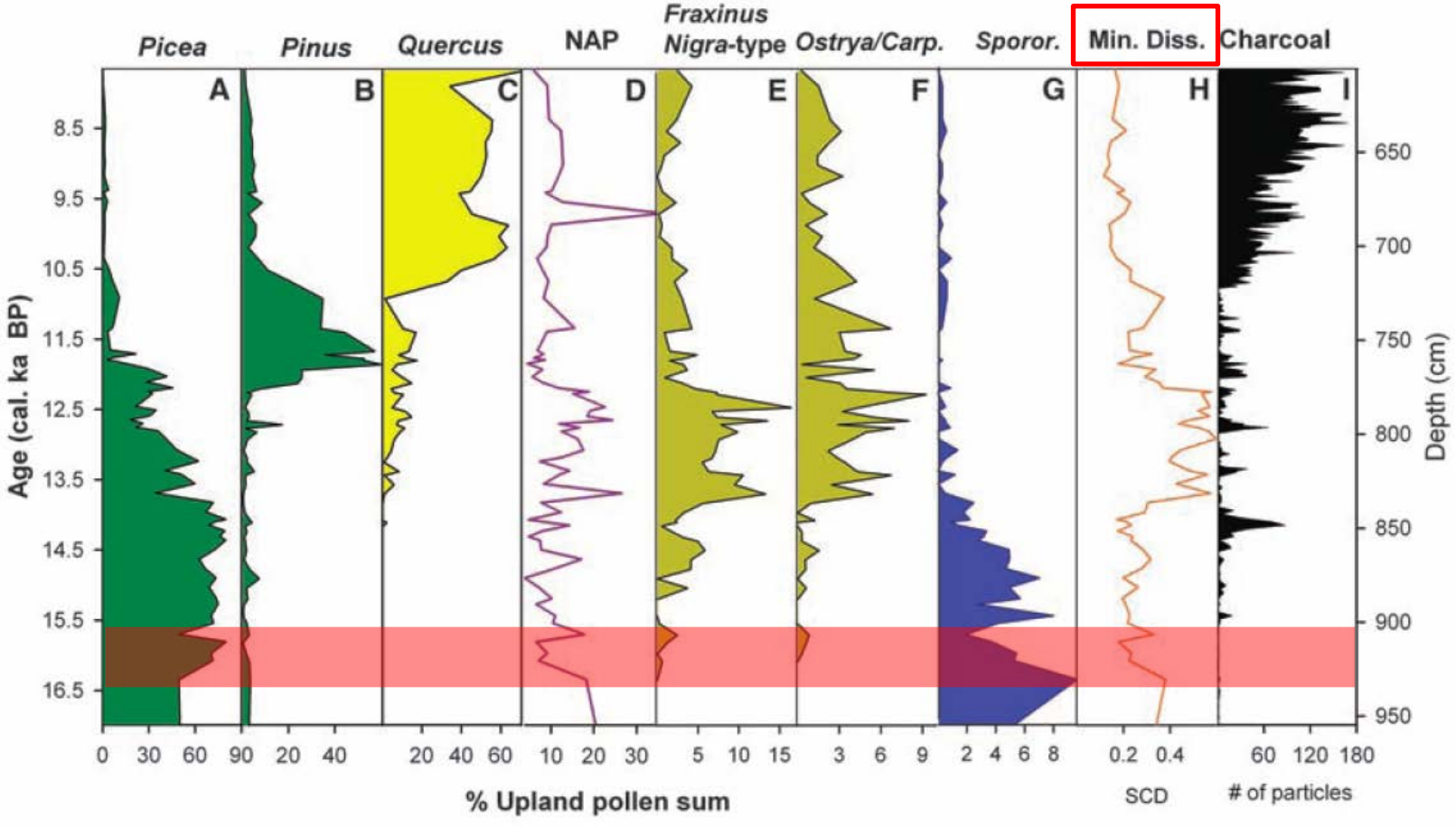


Non-analog Plant Communities in the Pleistocene



Gill et al 2009

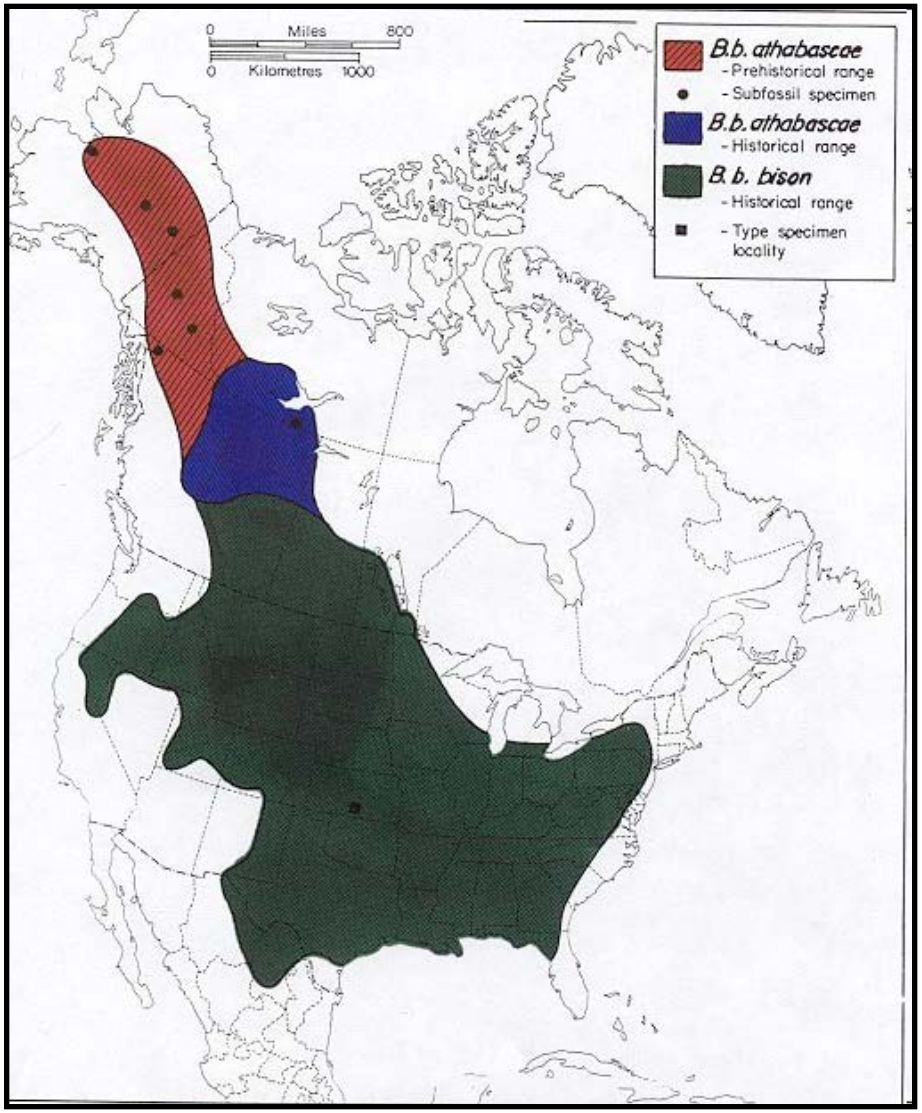
Non-analog Plant Communities in the Pleistocene



- **Megafaunal declines preceded (very closely) the rise of non-analog plant communities; therefore, changes in vegetation likely did not cause the extinction of megafauna.**

Gill et al 2009

War Zones, Game Sinks, and Lewis & Clark



War Zones, Game Sinks, and Lewis & Clark

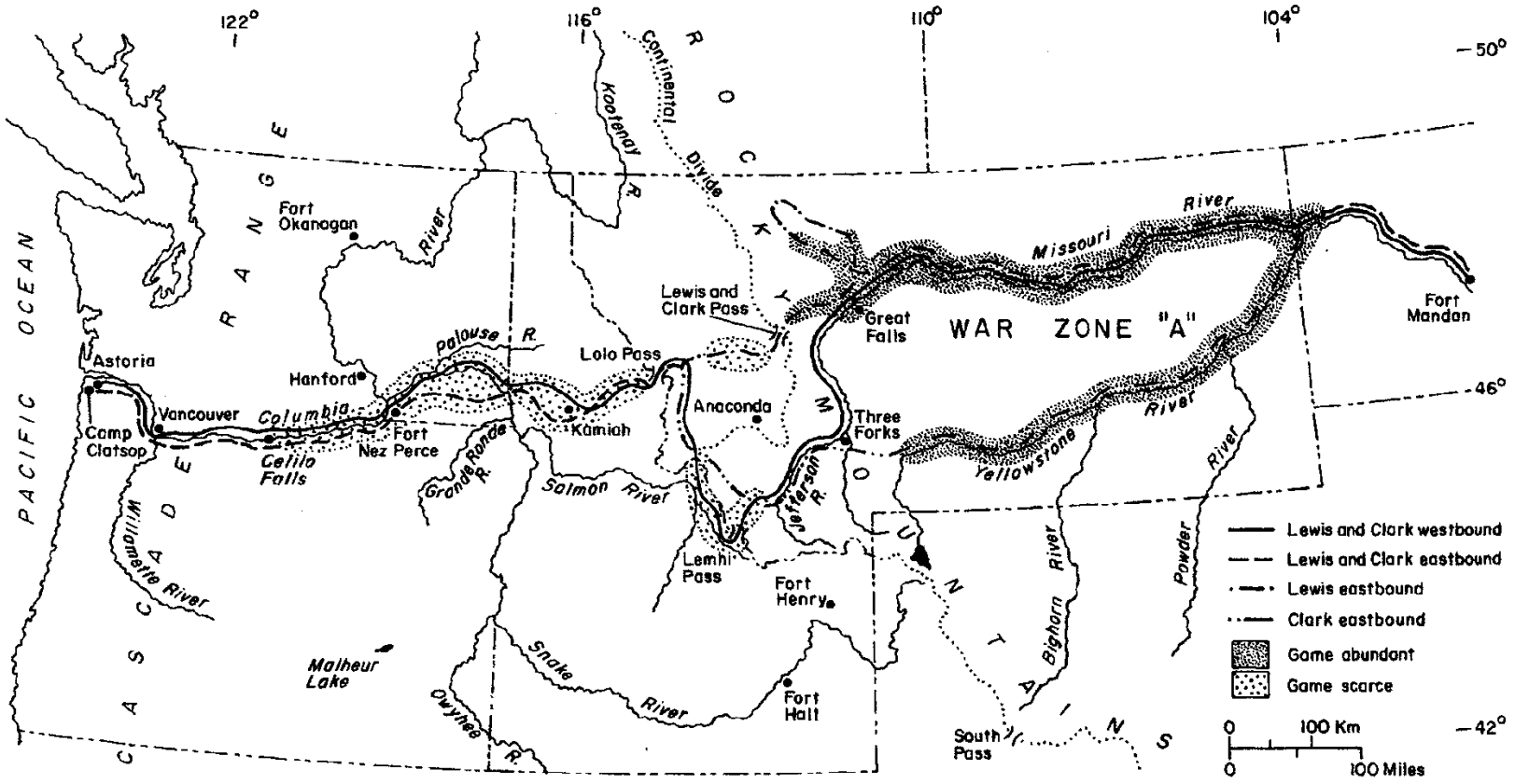
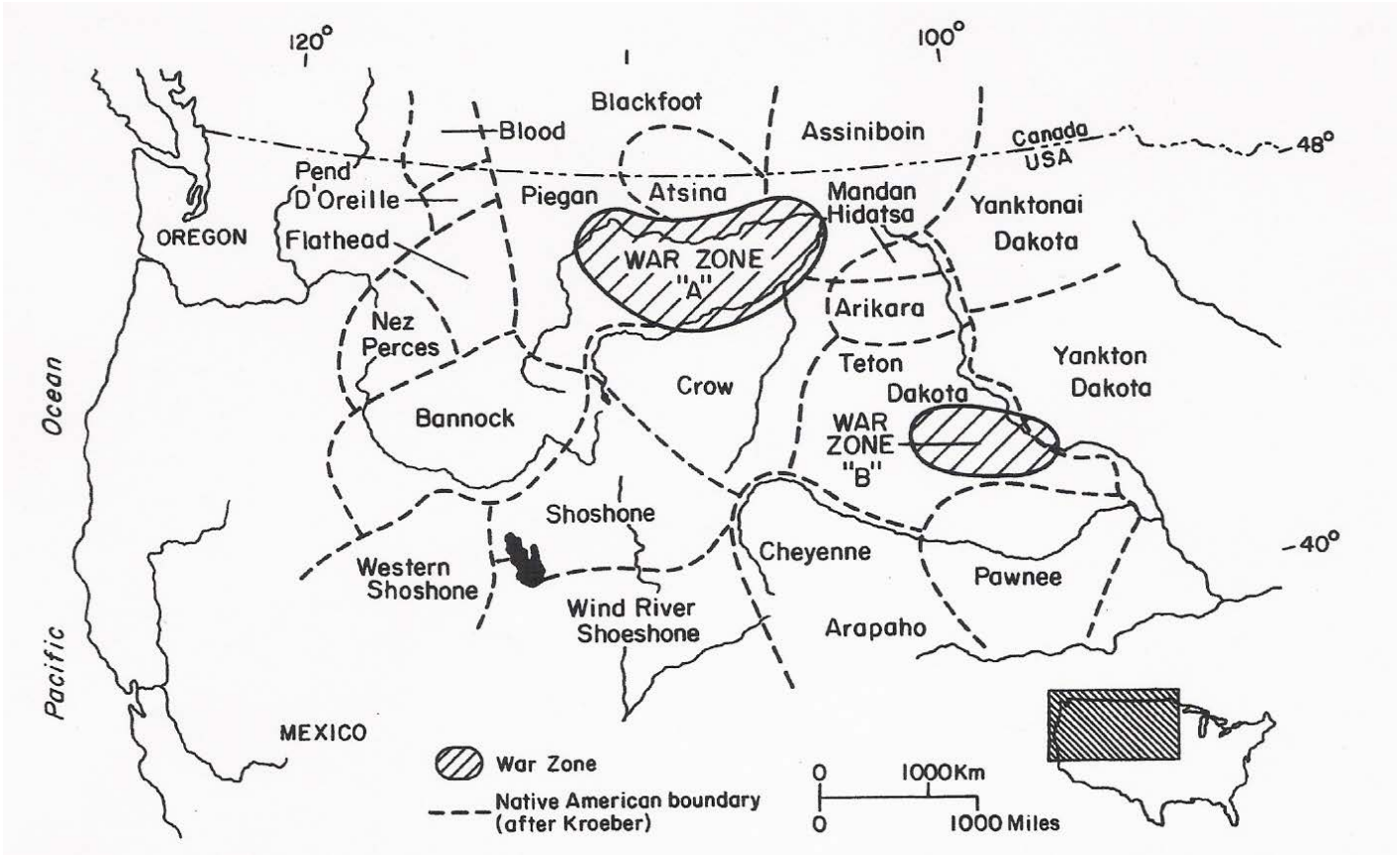


Figure 1. Route of Lewis and Clark, 1805–1806, showing regions of abundant and scarce big game. War zone A embraces the Upper Missouri from Three Forks and Grand Falls to the mouth of the Yellowstone. (For historic war zones and distributions of American Indian nations in the region, see Fig. 2.)


120°
100°
Blackfoot
Blood
Assiniboin
Canada
USA
48°
Pend
D'Oreille
Piegan
Atsina
Mandan
Hidatsa
Yanktonai
Dakota
OREGON
Flathead
WAR ZONE
"A"
Arikara
Nez
Perces
Teton
Dakota
Yankton
Dakota
Ocean
Crow
Bannock
WAR
ZONE
"B"
Shoshone
Cheyenne
40°
Western
Shoshone
Pawnee
Wind River
Shoeshone
Arapaho
Pacific
MEXICO
War Zone
Native American boundary
(after Kroeber)
0
1000Km
0
1000 Miles

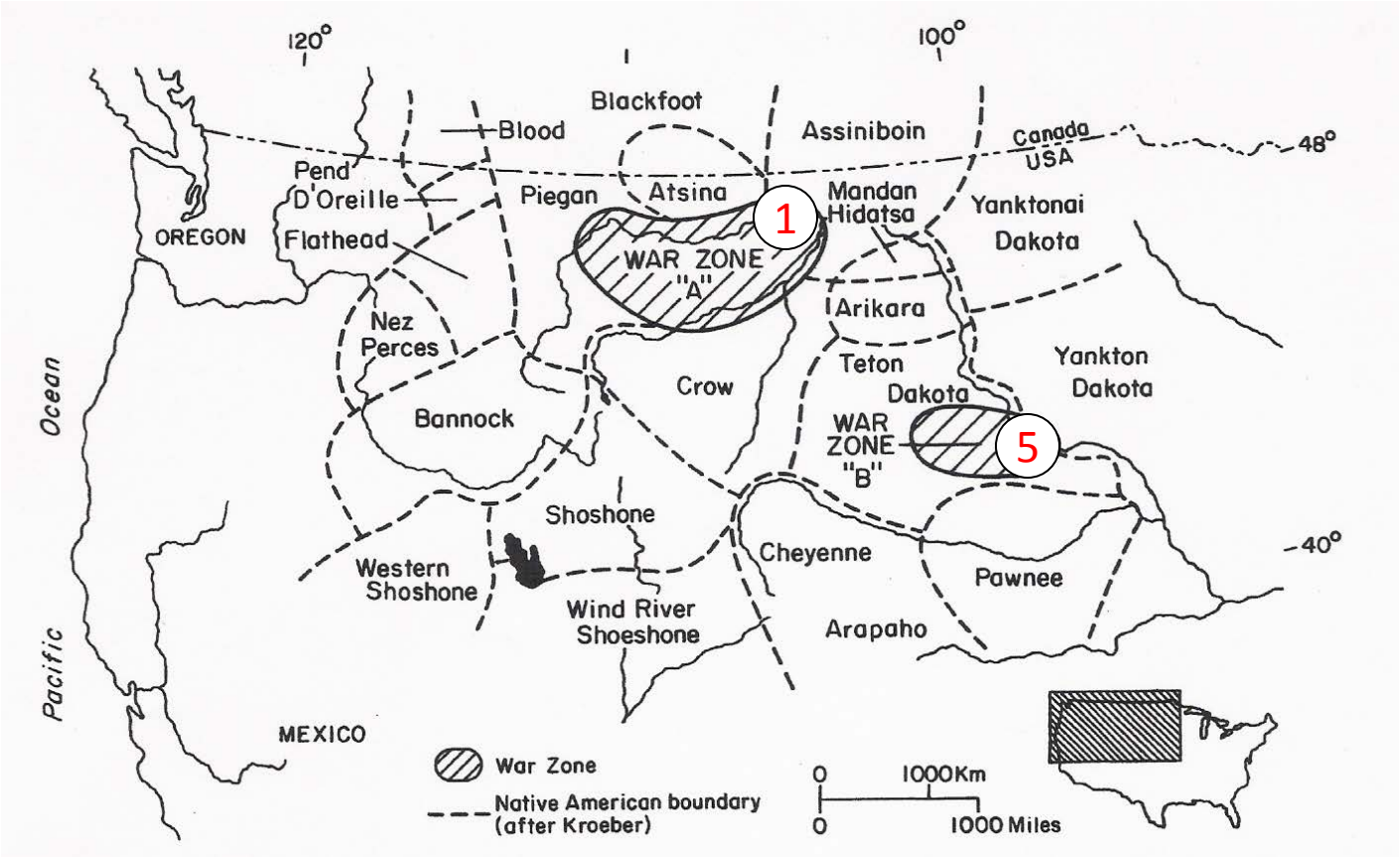


Table 2. Samples of Lewis and Clark's game kill during travel along the Upper Missouri River drainages and the interior Columbia River drainages, 1805–1806[a].

	1 *Upper Missouri River, 25 Apr.–13 Jul. 1805*	5 *Yellou and Upper Missouri rivers, 30 Jun.–18 Aug. 1806*
Deer	79	191
Elk	50	51
Bison	44	55
Pronghorn	8	9
Bear	12	12
Dog	0	0
Ration units[b]	105	150

[a]*Each sample spans 50 days; the Camp Clatsop sample is from a single locality. Daily game bag (kill) records from Moulton volumes 4 to 8.*
[b]*Lewis's ration unit, the number of animals needed to feed the party in 1 day, is computed as follows: bison* (Bison) *= 1.0; elk* (Cervus) *= 1.3; deer* (Odocoileus) *= 4.0; bear* (Ursus) *= 1.3; and pronghorn* (Antilocapra) *= 8.0.*

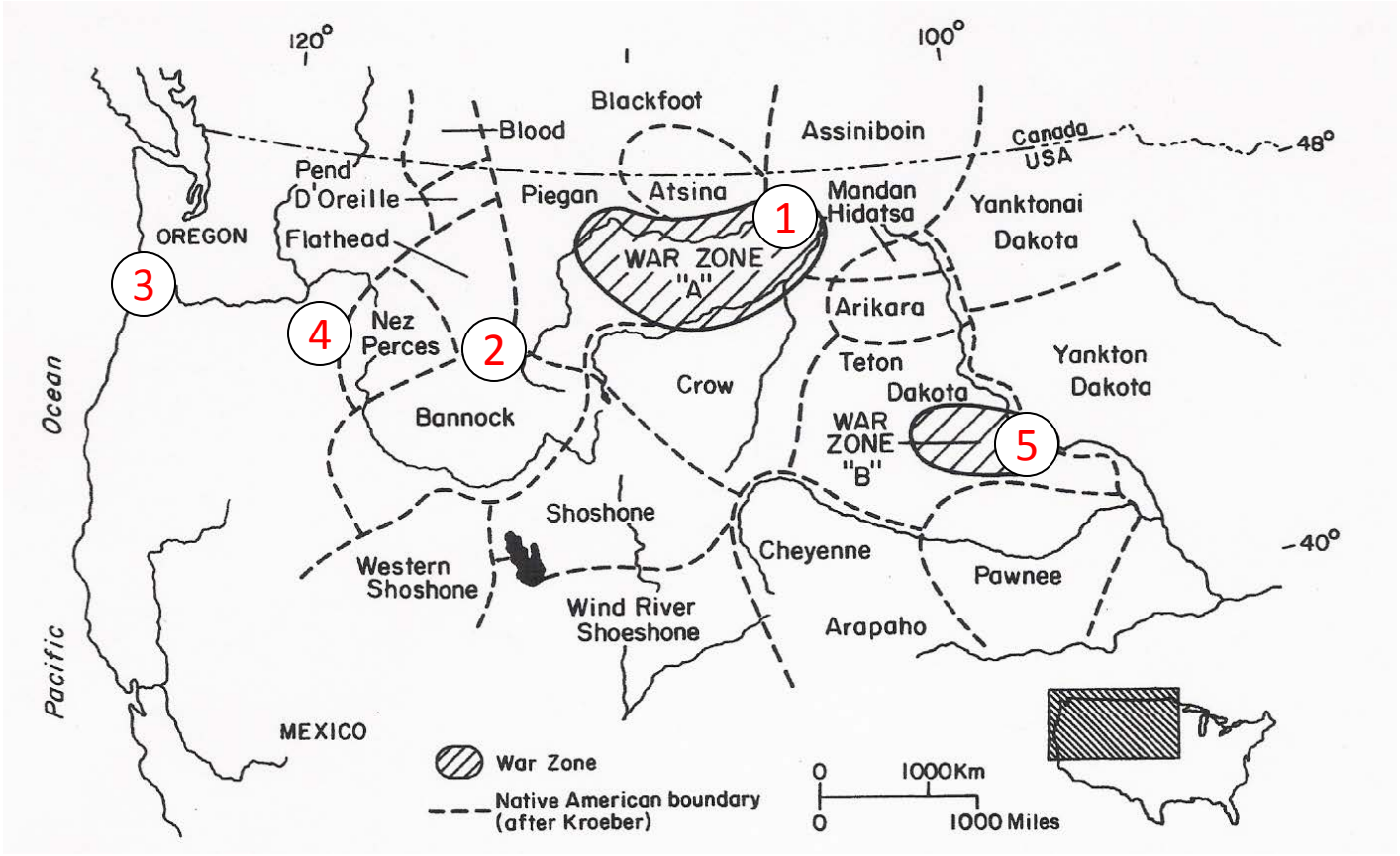


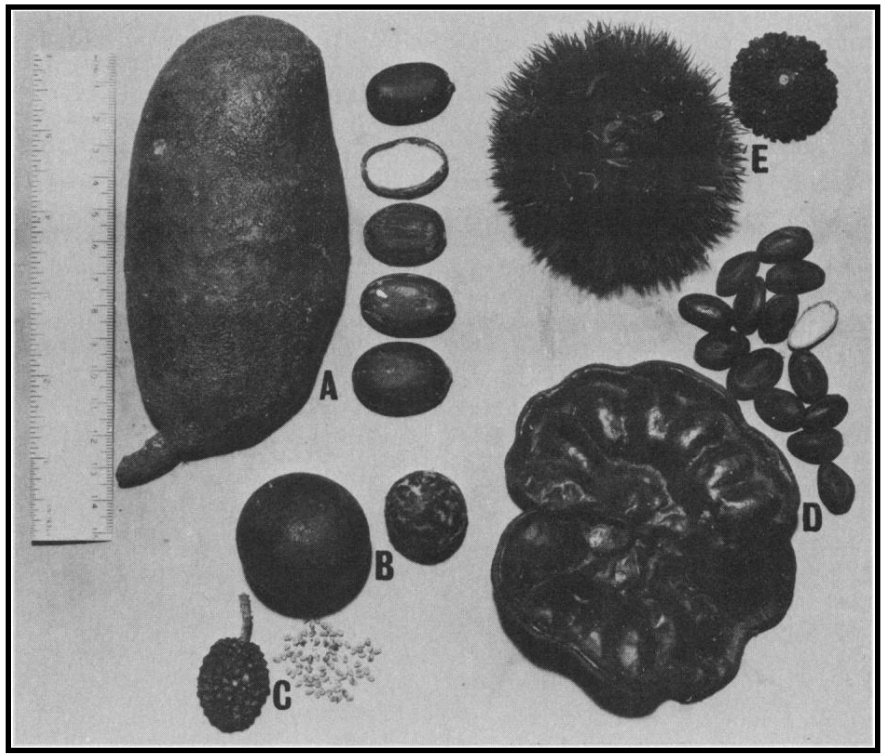
Table 2. Samples of Lewis and Clark's game kill during travel along the Upper Missouri River drainages and the interior Columbia River drainages, 1805–1806[a].

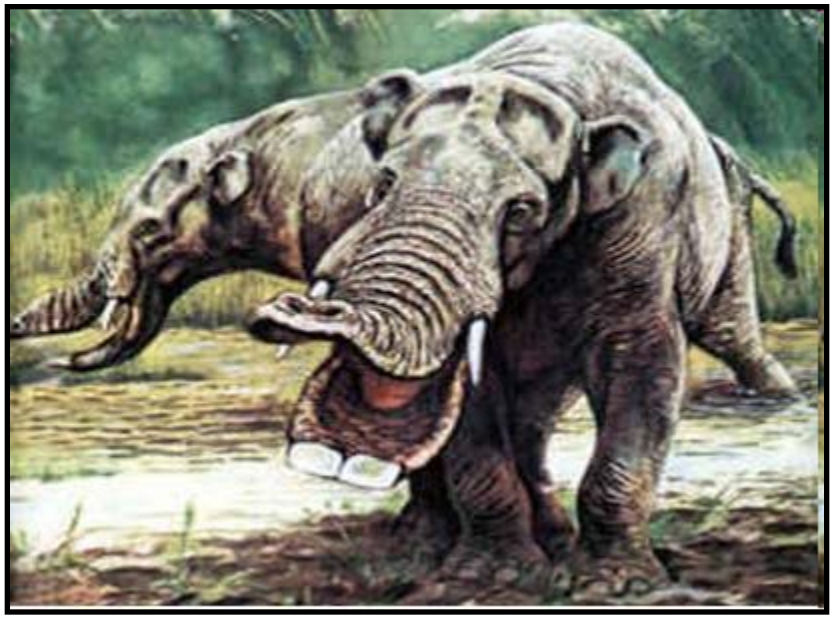
	1	2	3	4	5
	Upper Missouri River, 25 Apr.–13 Jul. 1805	*Columbia River, 18 Sep.–6 Nov. 1805*	*Camp Clatsop, 1 Jan.–19 Feb. 1806*	*Columbia River, 23 Mar.–11 May 1806*	*Yellou and Upper Missouri rivers, 30 Jun.–18 Aug. 1806*
Deer	79	28	8	38	191
Elk	50	0	51	22	51
Bison	44	0	0	0	55
Pronghorn	8	0	0	0	9
Bear	12	0	0	1	12
Dog	0	101+	5	83+	0
Ration units[b]	105	7	40	26	150

[a]*Each sample spans 50 days; the Camp Clatsop sample is from a single locality. Daily game bag (kill) records from Moulton volumes 4 to 8.*
[b]*Lewis's ration unit, the number of animals needed to feed the party in 1 day, is computed as follows: bison* (Bison) *= 1.0; elk* (Cervus) *= 1.3; deer* (Odocoileus) *= 4.0; bear* (Ursus) *= 1.3; and pronghorn* (Antilocapra) *= 8.0.*

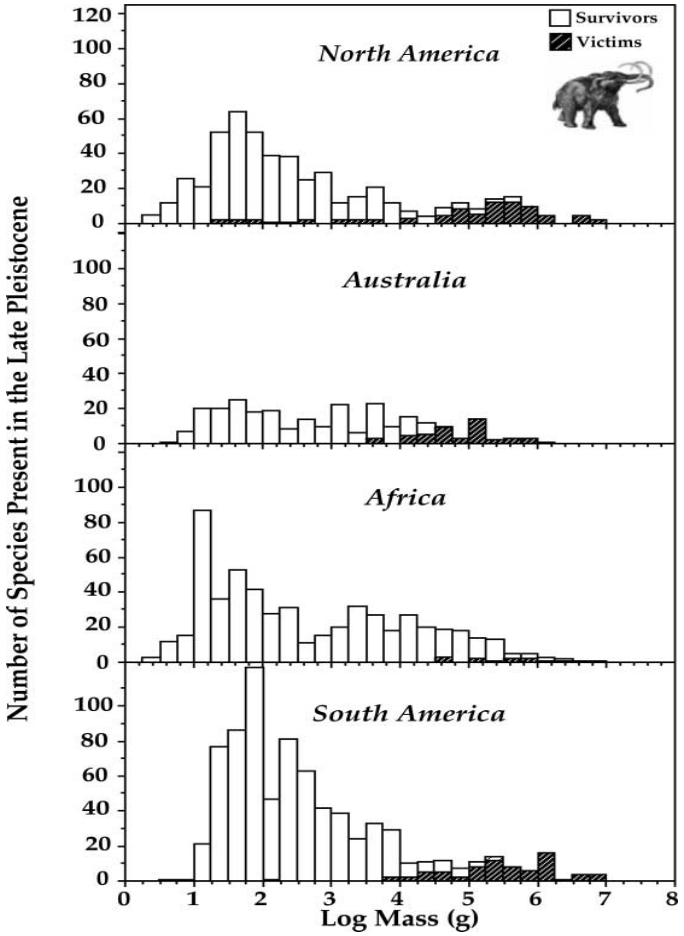
The Fruits the Gompotheres Ate

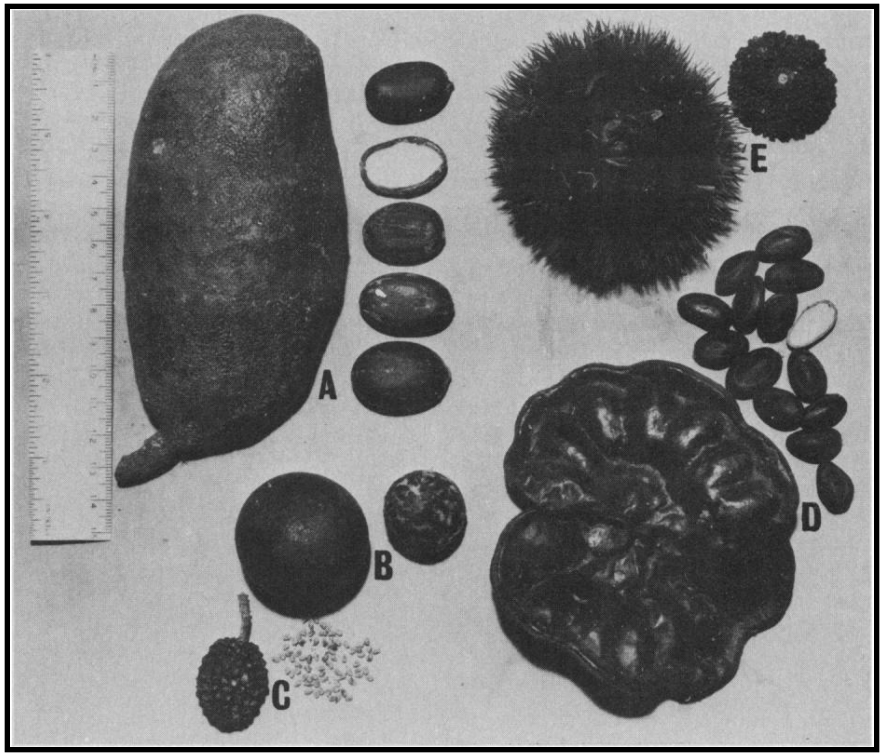
- **<u>ecological anachronism</u> = traits molded by past selective forces that haven't responded to the absence of those forces.**





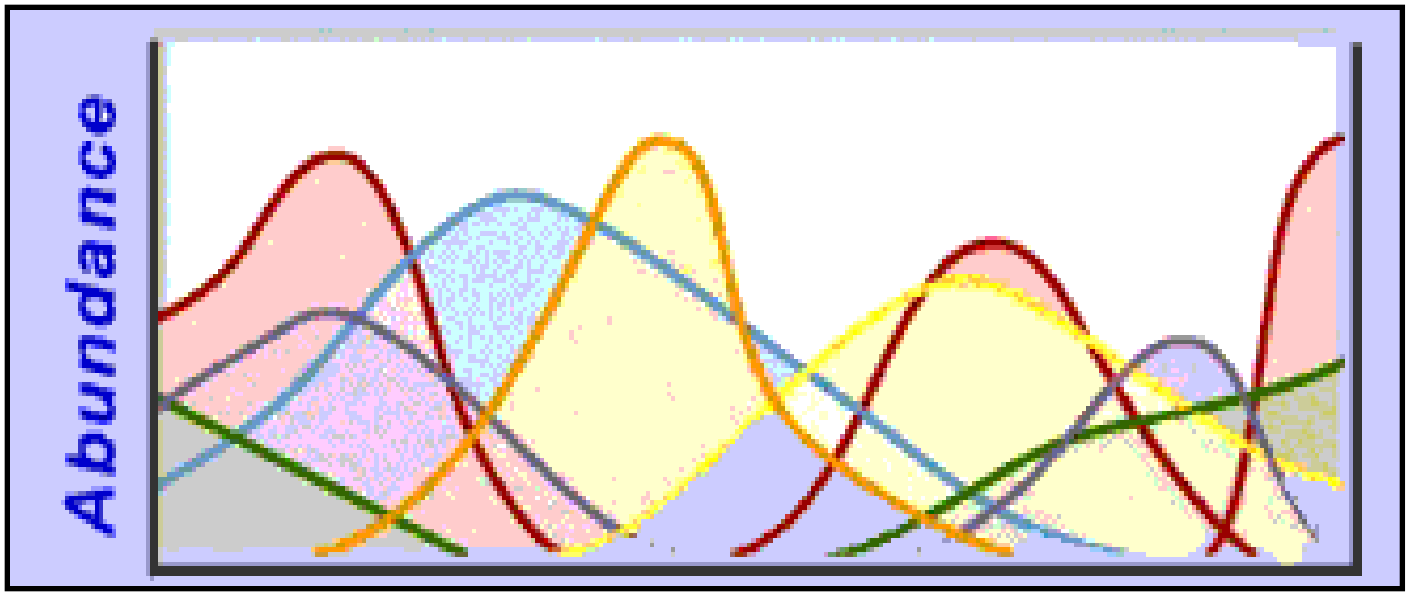
Discussion Q: Ecological anachronisms are found in many ecosystems, even after the agents selecting for them (for example, megaherbivores) have gone extinct. What does this say about the extent to which such anachronisms (for example, big fruits with hard shells) relied on megaherbivores?





The Non-Equilibrium View of Nature

- **<u>Individualistic concept</u> = opportunistic associations of species. Emphasis on stochasticity.**

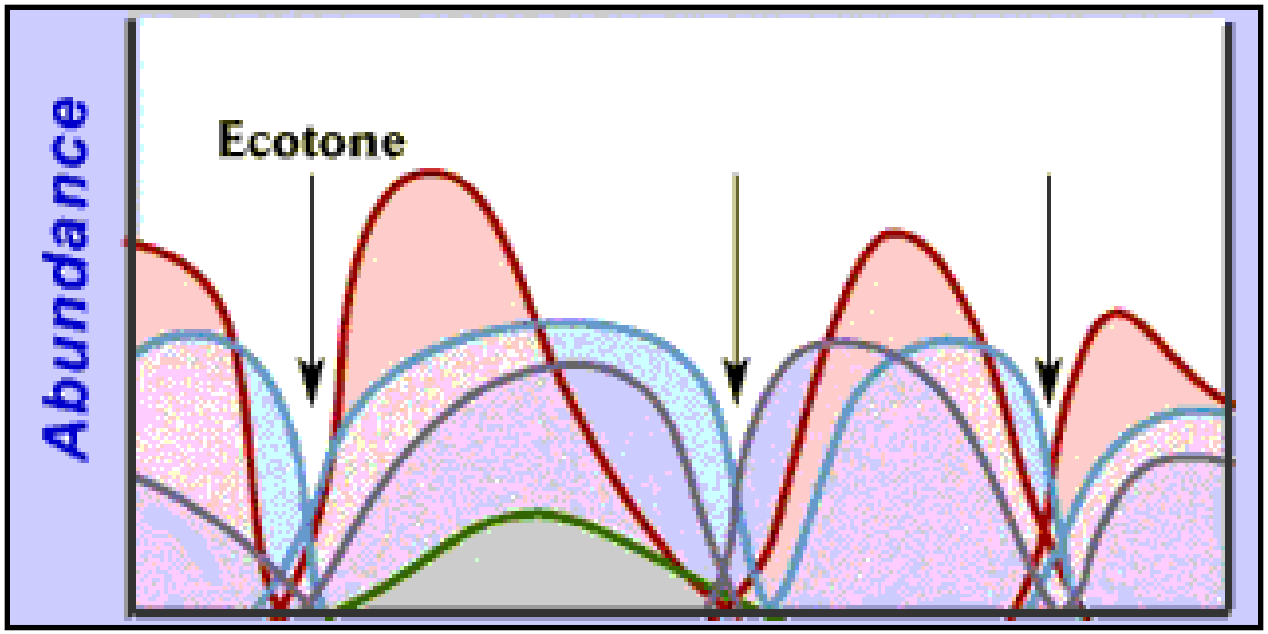


Ecological Anachronisms

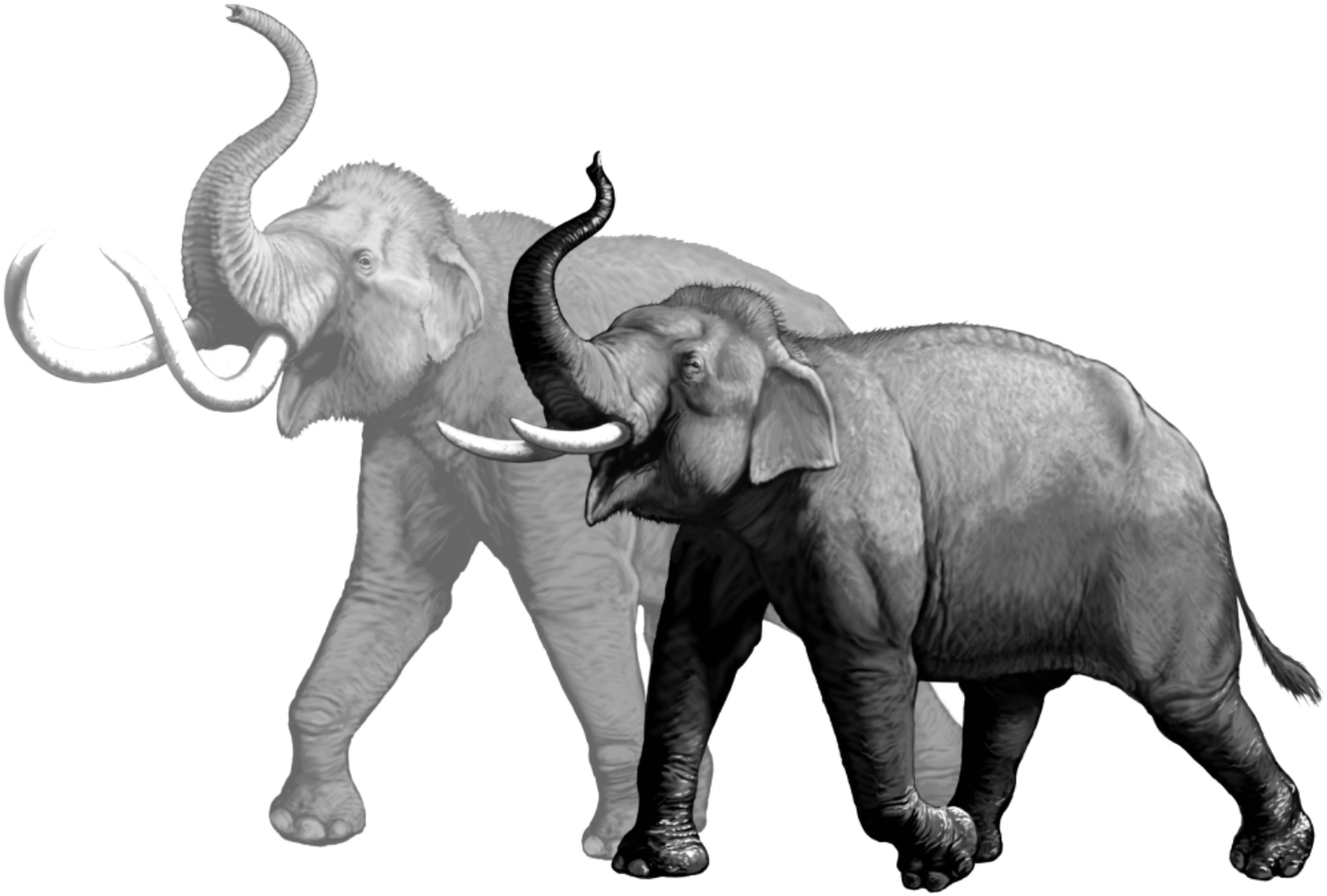
Figure 1. *Matched photographs of two large springs in Ash Meadows National Wildlife Refuge, Nevada. (a) Big Spring, March 1972 and (b) in March 2005. (c) Jackrabbit Spring, June 1967 and (d) in March 2005.*

The Non-Equilibrium View of Nature

- **<u>Integration concept</u> = associations of species represent coevolved (and thus predictable) sets of species affiliated with particular habitats.**



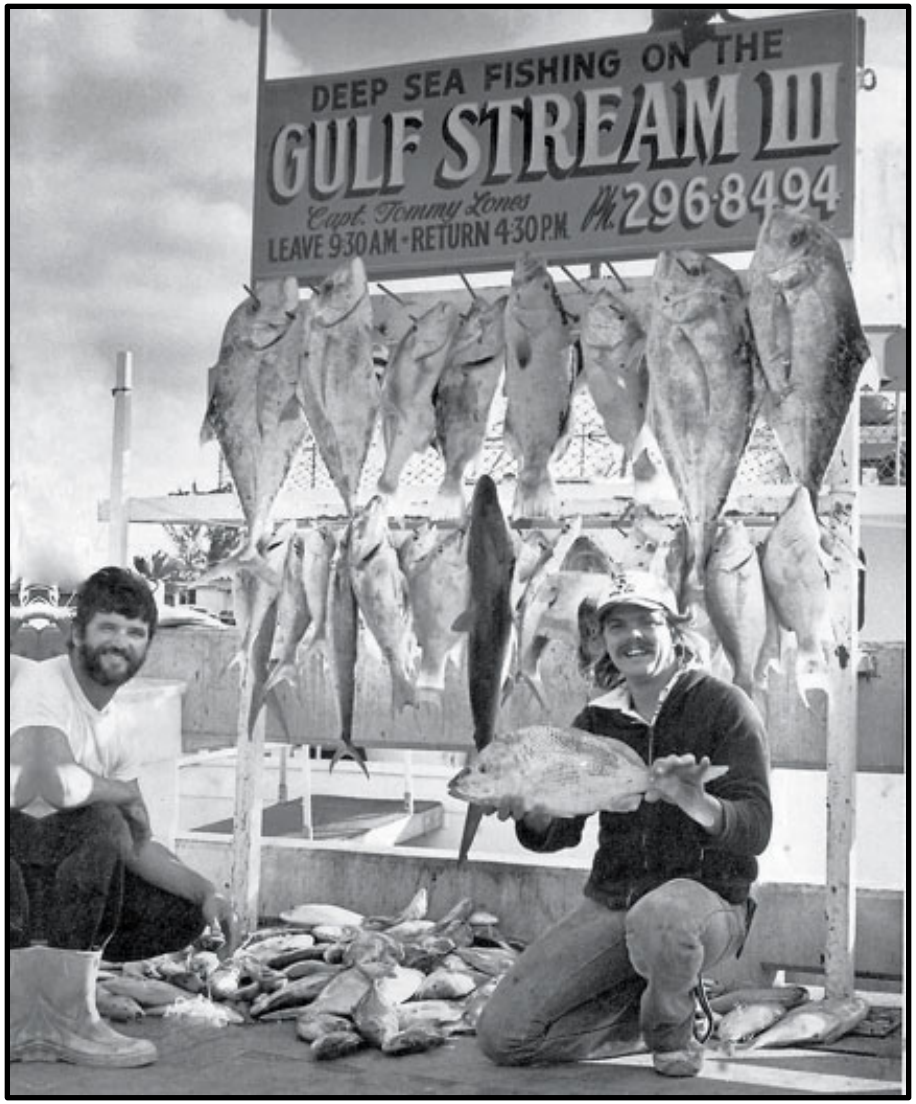
What is “natural”, and to what baseline should we attempt to “restore” ecosystems?



Red fish and snapper, 1 day of fishing, FL Keys, 2007

McClenachan. 2009.

White margate, 1 day of fishing, FL Keys, 1983



McClenachan. 2009.

Goliath grouper, 1 day of fishing, FL Keys, 1957

McClenachan. 2009.

Ecological restoration

- **shifting baseline syndrome = each generation accepts as "natural" the environmental conditions that occurred in their earliest memories.**

- **when a new generation begins, environmental conditions have changed, but it is the conditions at the time of this generations first memories that are the new baseline.**

Ecological restoration

- **shifting baseline syndrome = each generation accepts as "natural" the environmental conditions that occurred in their earliest memories.**

- **when a new generation begins, environmental conditions have changed, but it is the conditions at the time of this generations first memories that are the new baseline.**

- **risk that we will gradually accommodate the "creeping disappearance" of species, and inappropriate reference points toward which to steer restoration.**


Pleistocene Park
ARCTIC OCEAN
East Siberian Sea
Barents Sea
Kara Sea
Laptev Sea
Cherskii
SAKHA
Lena
Sea of Okhotsk
Yakutsk
RUSSIA
KAZAKHSTAN
MONGOLIA
megafaunamystery.blogspot.com/2011/12/pleistocene-park

Genetic Diversity

- **idealized population consists of:**

  1) panmictic individuals
  2) 1:1 sex ratios
  3) equal reproductive success among individuals

Why is genetic diversity important (or is it)?

- **genetic variation protects against the accumulation of deleterious mutations.**

- **genetic variation provides raw materials to adapt to environmental perturbations.**

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- **genetic variation reduces probability of <u>inbreeding depression</u>.**




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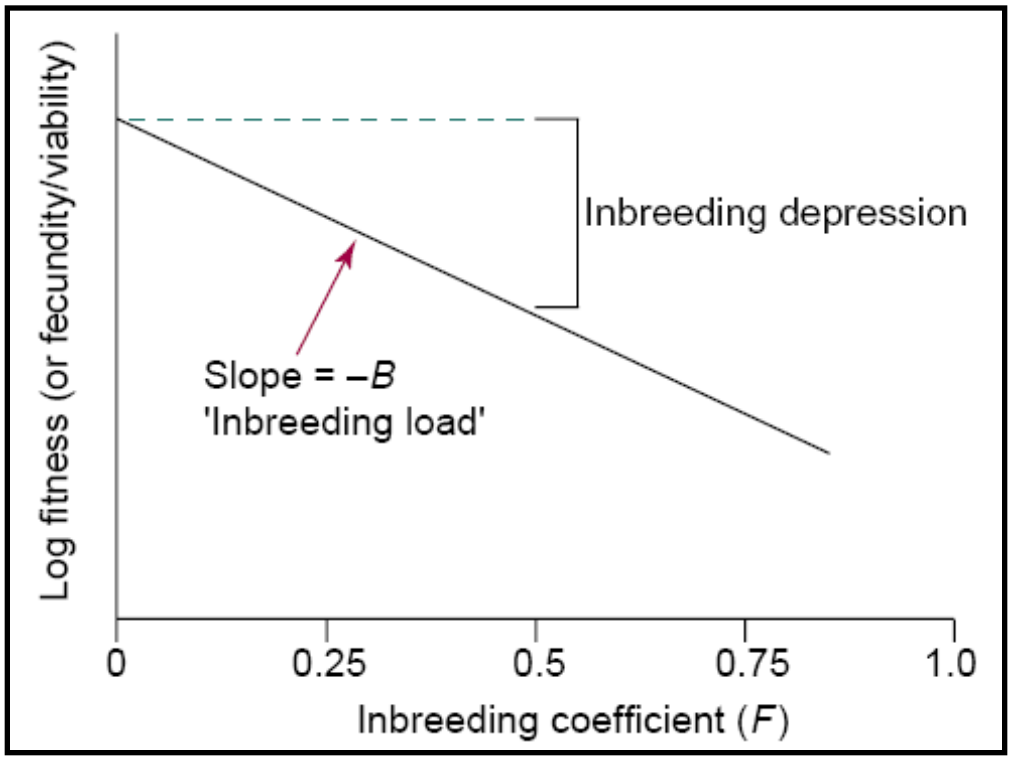

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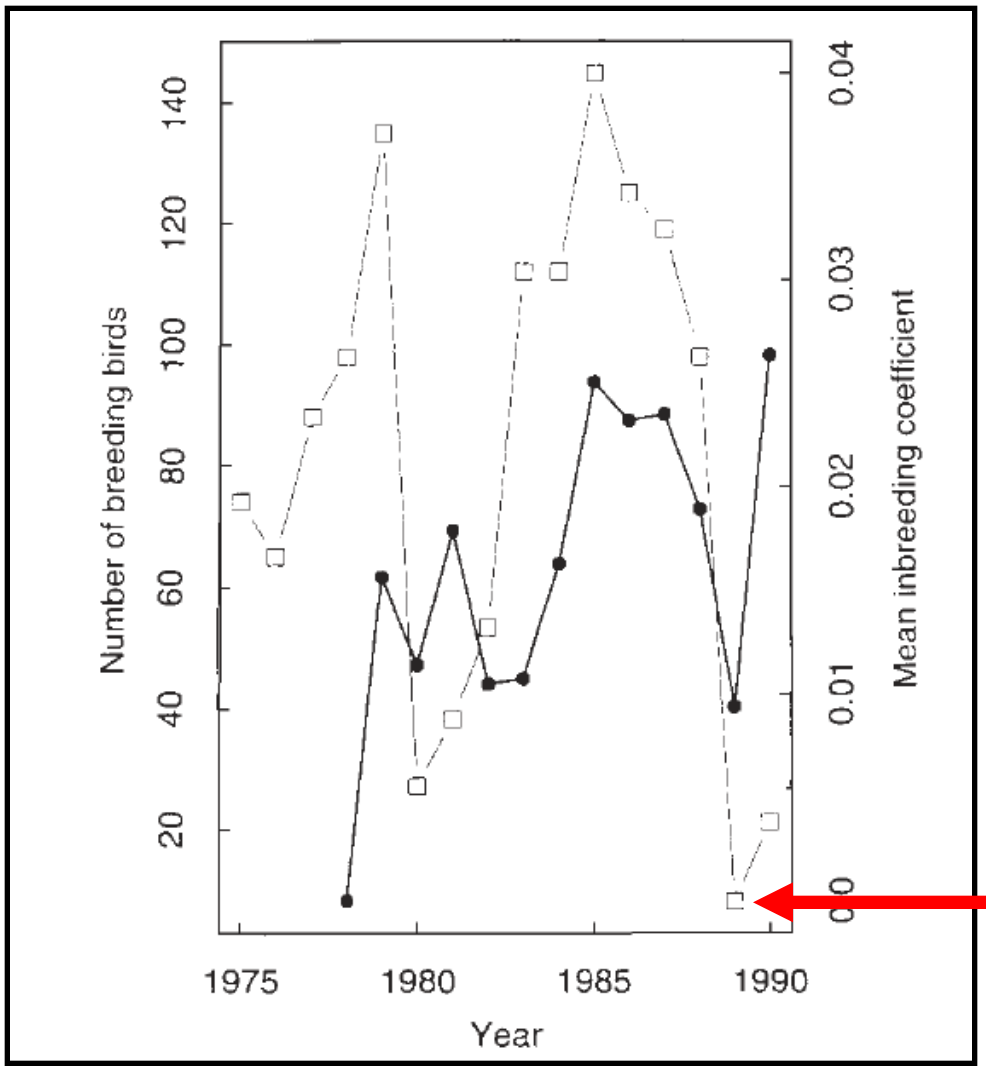

unusually severe winter

Keller et al. 1994.

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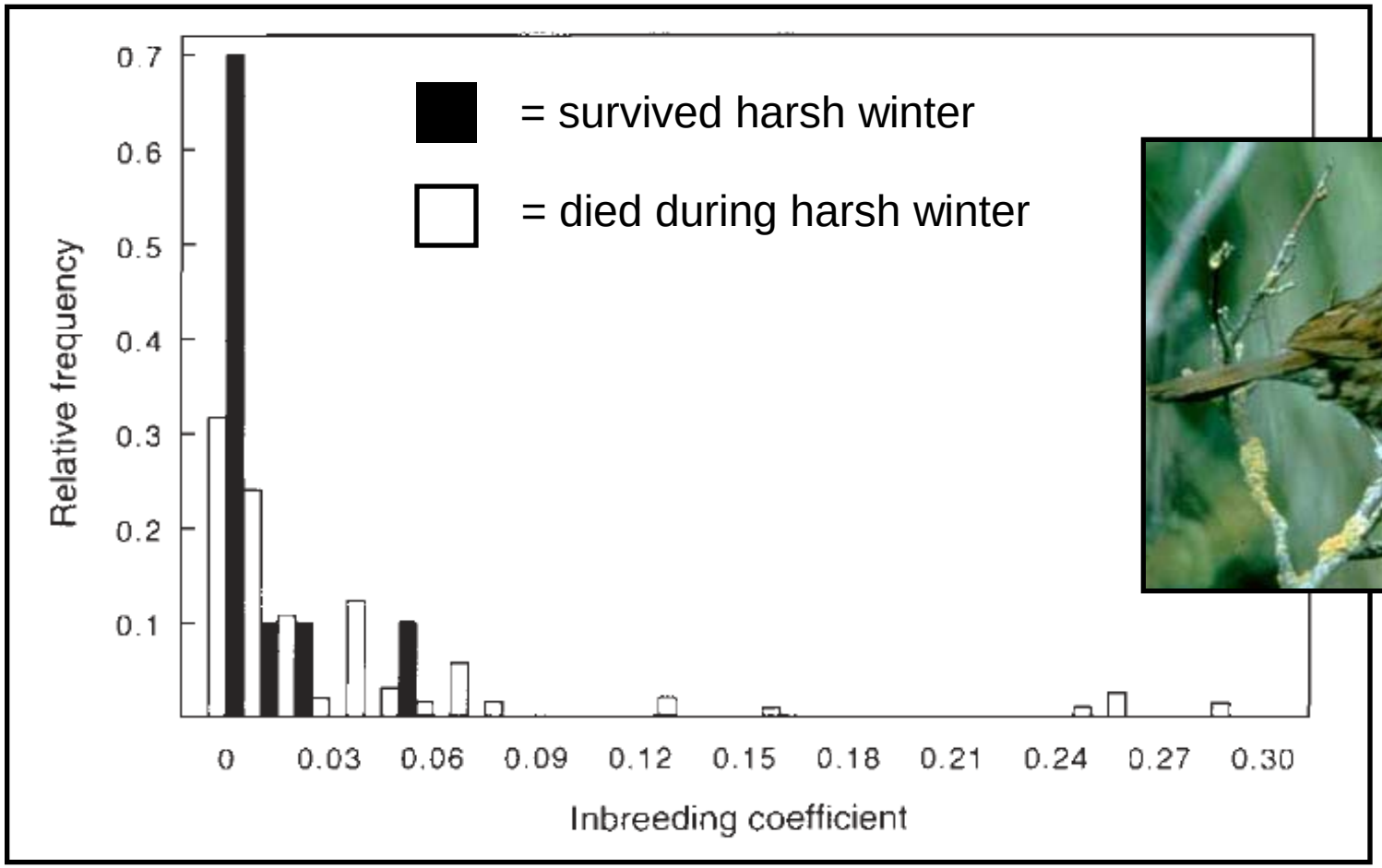

Keller et al. 1994.

Genetic Drift and Gene Flow

- **genetic variation reduces probability of genetic drift (and usually is maintained by gene flow).**

Outbreeding Depression and Hybridization

- artificially high levels of connectivity may result in outbreeding depression.

- genetic swamping of adaptive alleles may occur following the removal of dispersal barriers.

- in severe cases, may lead to hybridization in which two species interbreed.

Outbreeding Depression and Hybridization

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HUH?

Isolation Management as a Conservation Strategy

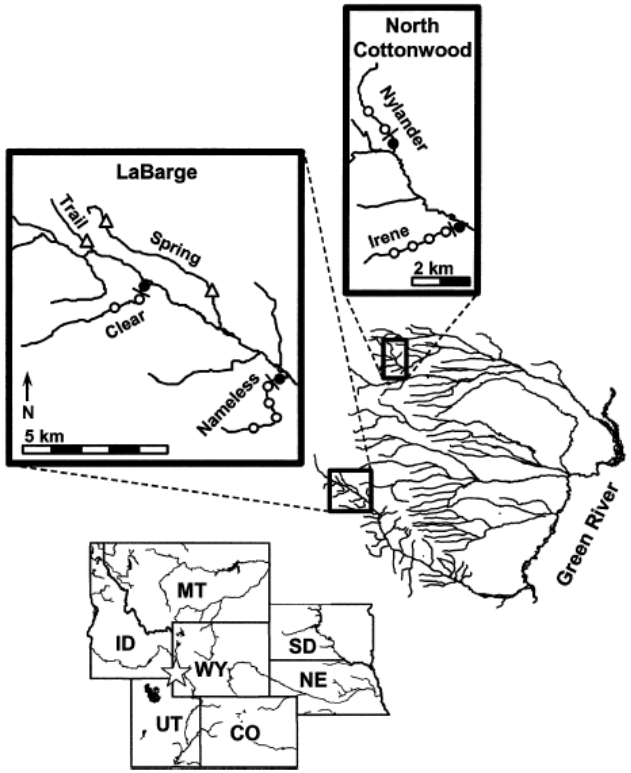
- **cutthroat trout, hybridization, and alien species**

-- many subspecies (now threatened or endangered) in the isolated streams of the Intermountain West.

Discussion Q: Novinger and Rahel 2003 reported on a series of management interventions conducted in attempt to protect Colorado River cutthroat trout.

What were these interventions? Did they work?

Why or why not? What potentially negative, unintended consequences did the authors mention might arise from their interventions?



Novinger and Rahel. 2003.