Types of ecosystem services

Provisioning services

Products obtained from ecosystems

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

Regulating services

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Pest regulation
- Runoff regulation
- Water purification
- Pollination
- Erosion regulation

Cultural services

Non-material benefits obtained from ecosystems

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic and inspirational
- Educational
- Cultural heritage
- Existence values

Supporting services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production
- Provision of habitat
- Oxygen production

Biodiversity: Life on Earth

Pereira and Cooper, 2006

Ethical considerations of conservation

Postulates about ethical value of nature

1. diversity is good
2. complexity in ecosystems is good
3. natural evolutionary development is good
4. biological diversity should be valued for and protected for itself regardless of utilitarian values

from Michael Soule, cofounder of Society for Conservation Biology

Criteria for assessing threatened species

TABLE 15.1 A Summary of Mace and Lande (1991) Criteria for Assessing Threatened Species

	Degree of Threat		
Observations	**Critical**	**Endangered**	**Vulnerable**
Range	< 100 sq km 1 location	< 5000 sq km <5 locations	< 20,000 sq km < 10 locations
Population size	< 250 total < 50 at each location	<2500 < 250 at each location	<10,000 <1000 at each location
Declining	80% decline	50% decline	20% decline
Population	per-decade or per-3 generations	per-decade or per-3 generations	per-decade or per-3 generations
Projected decline	>25% per-3 years or per-1 generations	>20% per-5 years or per-2 generations	>20% per-10 years or per-3 generations
Extinction probability	> 50% per-10 years or per-3 generations	>20% per-20 years or per-5 generations	>10% per-100 years

Sources: Mace and Lande, 1991; Dobson, 1996.

Range Collapse

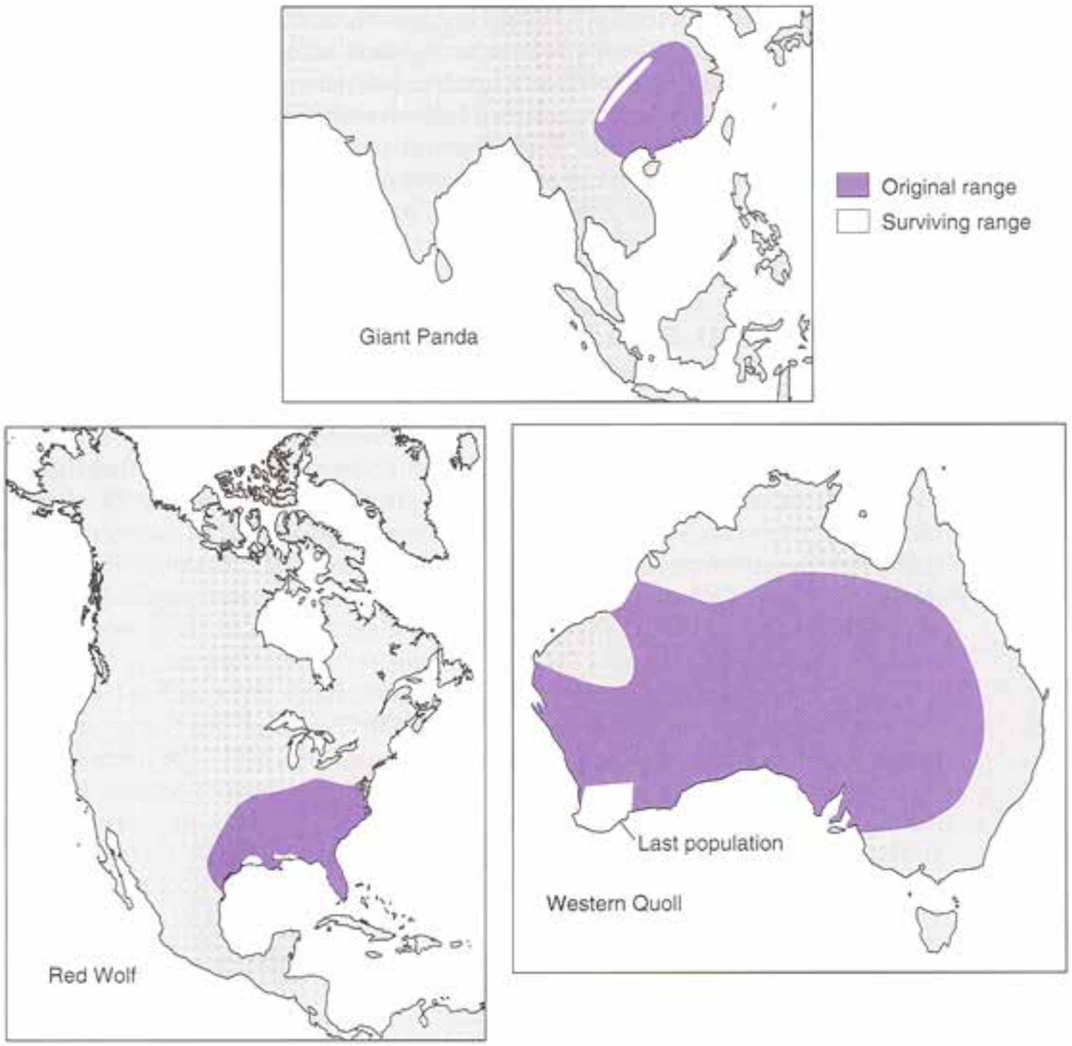


FIGURE 15.5 Examples of geographic range collapses with survival on the periphery of the former range; giant panda *(Ailuropoda melanoleuca)* in China, the red wolf *(Canis rufus)* in the southeastern United States, and the western Quoll *(Dasyurus geoffroii)* in Australia (after Lomolino and Channel, 1995; Brown and Lomolino, 1998).

Species-area curves and extinctions

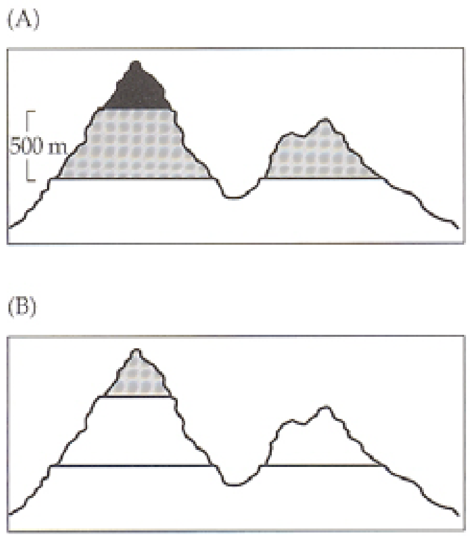
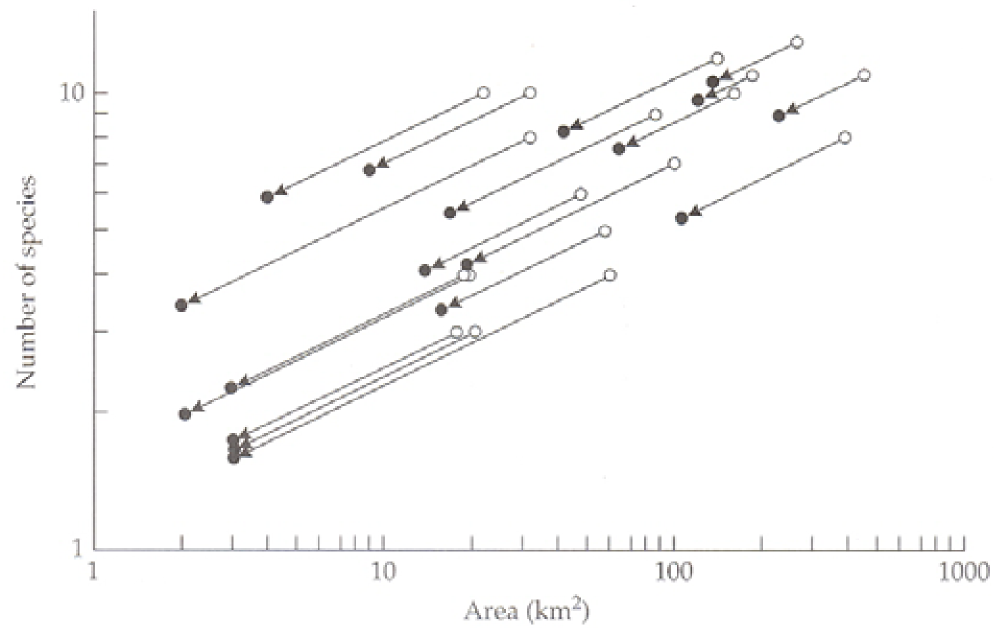


FIGURE 16.30 The approximate elevational boundaries of the vegetation types on the isolated mountain ranges of the Great Basin (A) today and (B) in the future after postulated climatic warming of approximately 3° C. Unshaded = desert shrub; gray = piñon-juniper woodland; black = mixed coniferous forest. An elevational shift of 500 m would decrease the area of woodland on all mountain ranges in the region and eliminate coniferous forest from some of them. (After McDonald and Brown 1992.)

FIGURE 16.31 The species-area relationship can be used to predict changes in boreal mammal species richness among the isolated mountain ranges of the Great Basin as a result of climatic warming. Numbers of species were plotted as a function of the area above 2280 m elevation. Arrows show the changes in area and numbers of species predicted to be caused by climatic warming; the open circle at the base of each arrow indicates the present number of species in each mountain range, and the solid circle at the point of the arrow indicates the number of species predicted to remain after a 3° C increase in average temperature. (After McDonald and Brown 1992.)



Shapes of conservation areas

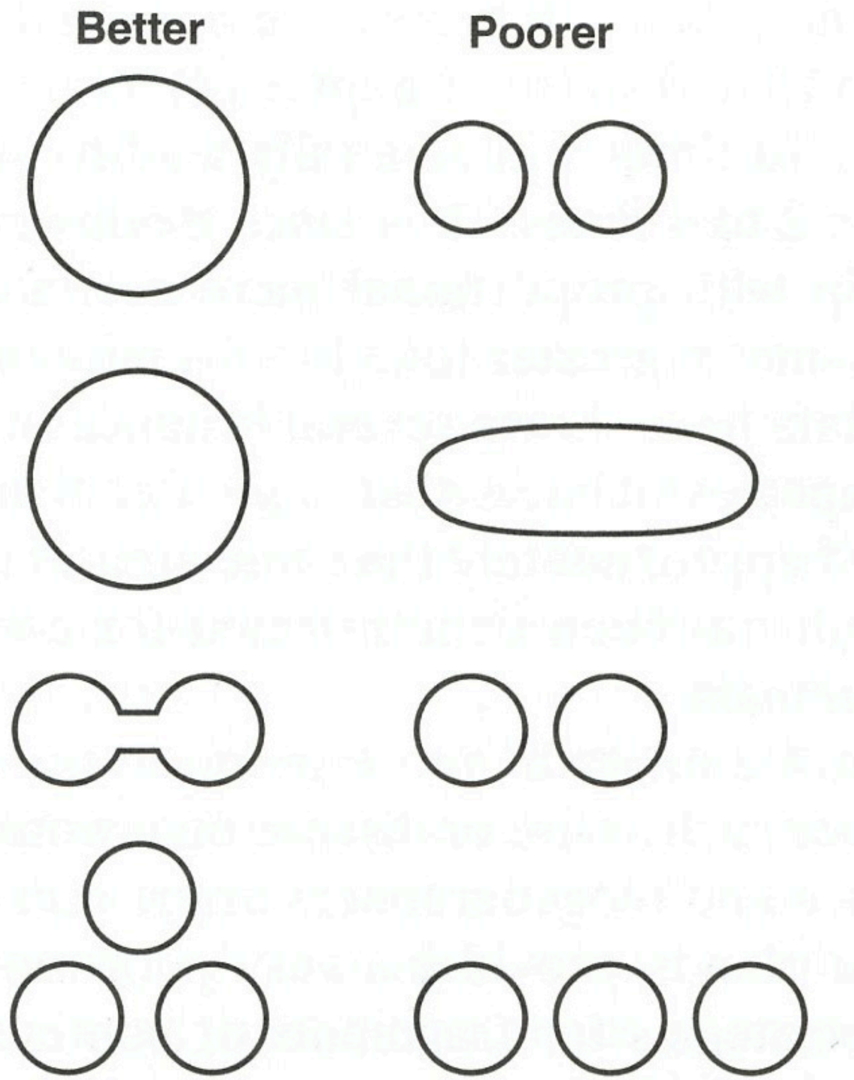


FIGURE 15.7 Different shapes and configurations of conservation areas compared. All areas incorporate the same amount of area. Shapes that provide the maximum amount of continuous habitat with the lowest ratio of area to perimeter are optimal. (Based on Wilson and Willis, 1975.)

Gap analysis

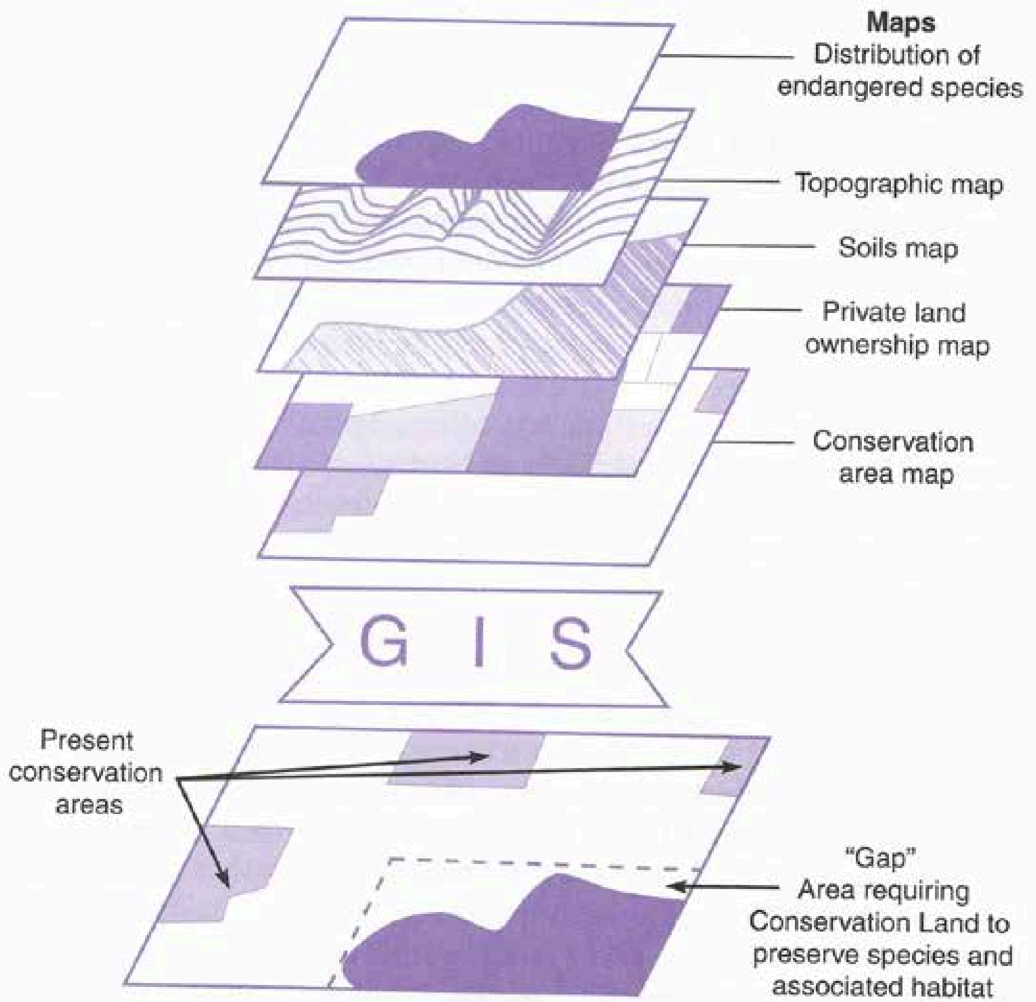
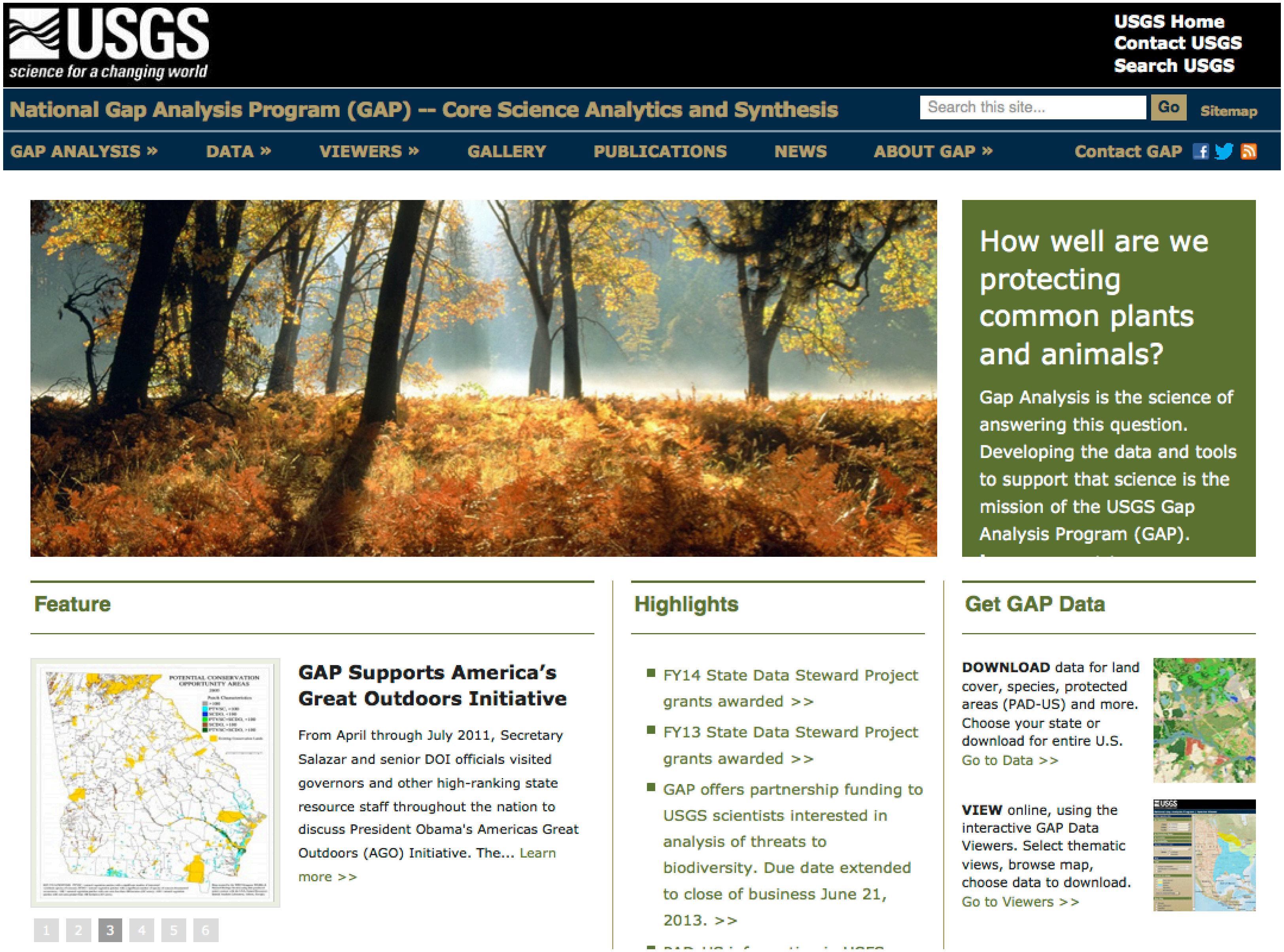
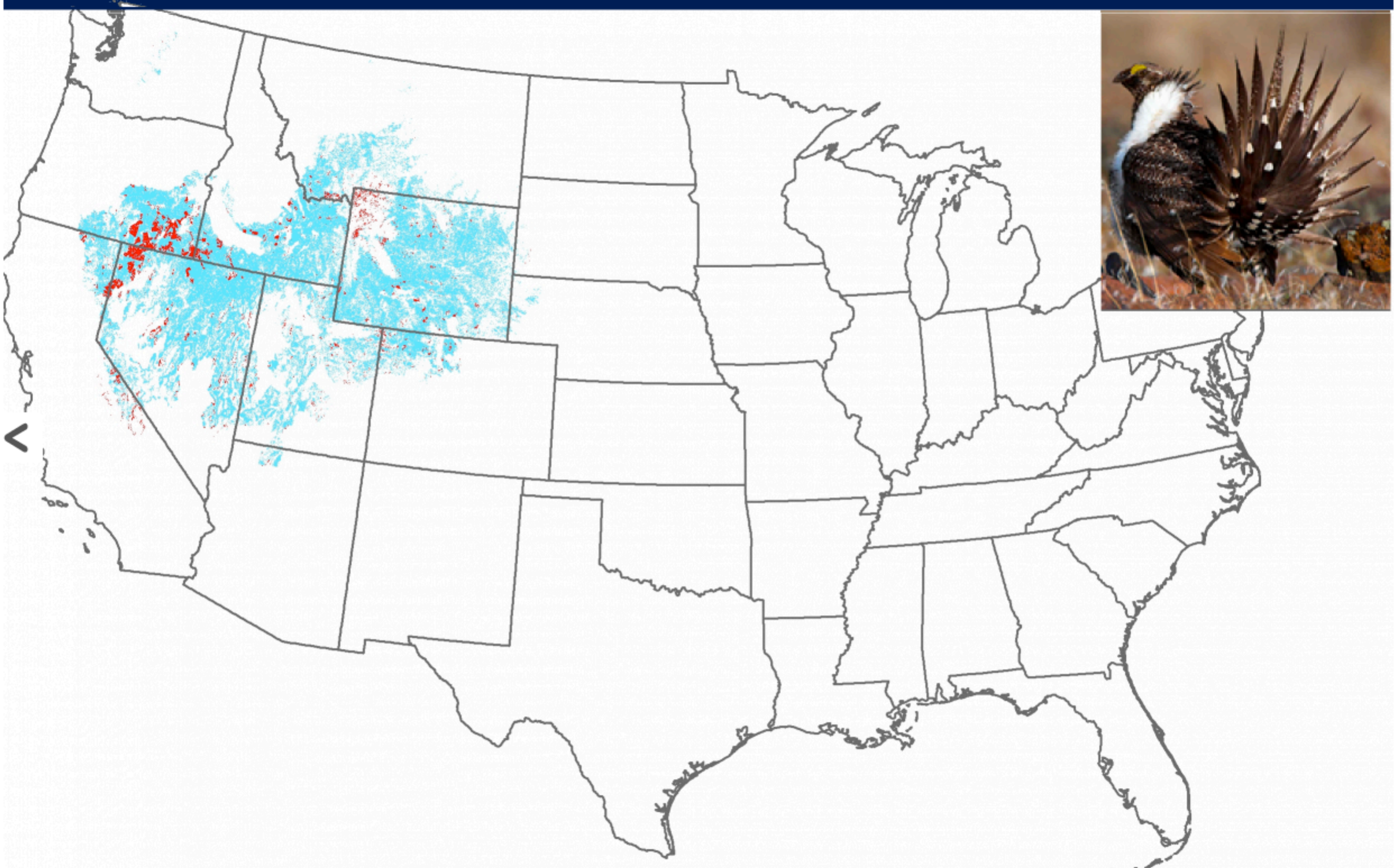


FIGURE 15.8 A schematic diagram of the application of gap analysis using a geographic information system to overlie species ranges, environmental conditions, and land ownership information.

Gap analysis for US



Greater Sage-Grouse Gap Analysis



Restoration goals and outcomes

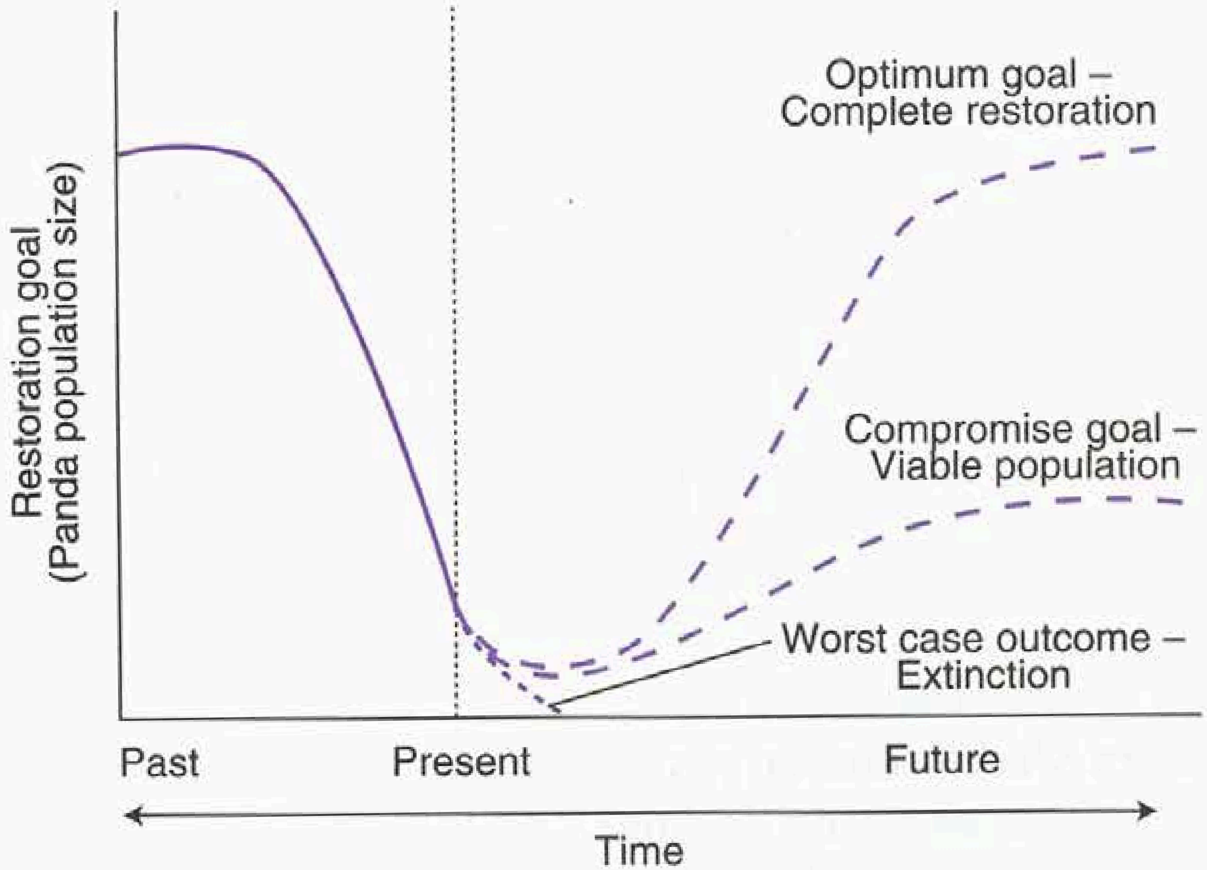
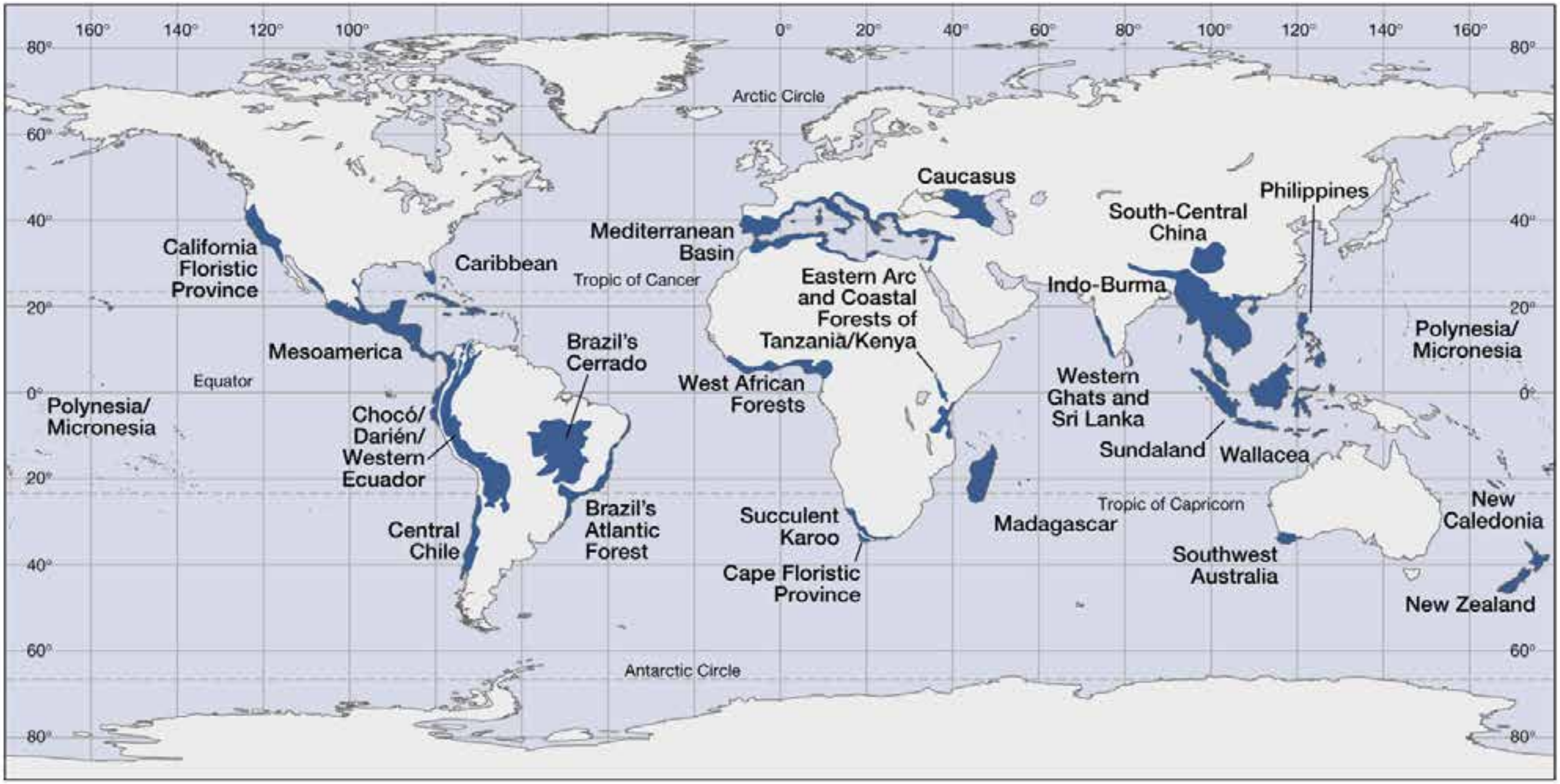


FIGURE 15.9 A graphical representation of restoration aims and tradeoffs (after National Research Council, 1992). In this case the goal is restoration of habitat to support giant pandas.

Efforts to conserve keystone species

Meyer’s hot spots for conservation priority based on endemism + habitat loss



Kump et al. 2004

TABLE 18-1

The 25 Hotspots identified by Norman Myers and Colleagues

Hotspot	*Remaining primary vegetation (km²) (% of original extent)*		*Plant species*	*Endemic plants (% of the 300,000 global plants)*		*Endemic vertebrates (% of 27,298 global vertebrates)*[1]	
Tropical Andes	314,500	(25.0)	45,000	20,000	(6.7)	1,567	(5.7)
Mesoamerica	231,000	(20.0)	24,000	5,000	(1.7)	1,159	(4.2)
Caribbean	29,840	(11.3)	12,000	7,000	(2.3)	779	(2.9)
Brazil's Atlantic Forest	91,930	(7.5)	20,000	8,000	(2.7)	567	(2.1)
Choc/Darien/Western Ecuador	63,000	(24.2)	9,000	2,250	(0.8)	418	(1.5)
Brazil's Cerrado	356,630	(20.0)	10,000	4,400	(1.5)	117	(0.4)
Central Chile	90,000	(30.0)	3,429	1,605	(0.5)	61	(0.2)
California Floristic Province	80,000	(24.7)	4,426	2,125	(0.7)	71	(0.3)
Madagascar[2]	59,038	(9.9)	12,000	9,704	(3.2)	771	(2.8)
Eastern Arc & Coastal Forests of Tanzania/Kenya	2,000	(6.7)	4,000	1,500	(0.5)	121	(0.4)
Western African Forests	126,500	(10.0)	9,000	2,250	(0.8)	270	(1.0)
Cape Floristic Province	18,000	(24.3)	8,200	5,682	(1.9)	53	(0.2)
Succulent Karoo	30,000	(26.8)	4,849	1,940	(0.6)	45	(0.2)
Mediterranean Basin	110,000	(4.7)	25,000	13,000	(4.3)	235	(0.9)
Caucasus	50,000	(10.0)	6,300	1,600	(0.5)	59	(0.2)
Sundaland	125,000	(7.8)	25,000	15,000	(5.0)	701	(2.6)
Wallacea	52,020	(15)	10,000	1,500	(0.5)	529	(1.9)
Philippines	9,023	(3.0)	7,620	5,832	(1.9)	518	(1.9)
Indo-Burma	100,000	(4.9)	13,500	7,000	(2.3)	528	(1.9)
South-Central China	64,000	(8.0)	12,000	3,500	(1.2)	178	(0.7)
Western Ghats/Sri Lanka	12,450	(6.8)	4,780	2,180	(0.7)	355	(1.3)
SW Australia	33,336	(10.8)	5,469	4,331	(1.4)	100	(0.4)
New Caledonia	5,200	(28.0)	3,332	2,551	(0.9)	84	(0.3)
New Zealand	59,400	(22.0)	2,300	1,865	(0.6)	136	(0.5)
Polynesia/Micronesia	10,024	(21.8)	6,557	3,334	(1.1)	223	(0.8)
Totals	2,122,891	(12.2)	*	133,149	(44)	9,645	(35.0)

[1]Excludes fish.
[2]Madagascar includes nearby islands of Mauritius, Reunion, Seychelles, and Comores.
*Totals cannot be calculated because of overlap between hotspots.

Kump et al. 2004