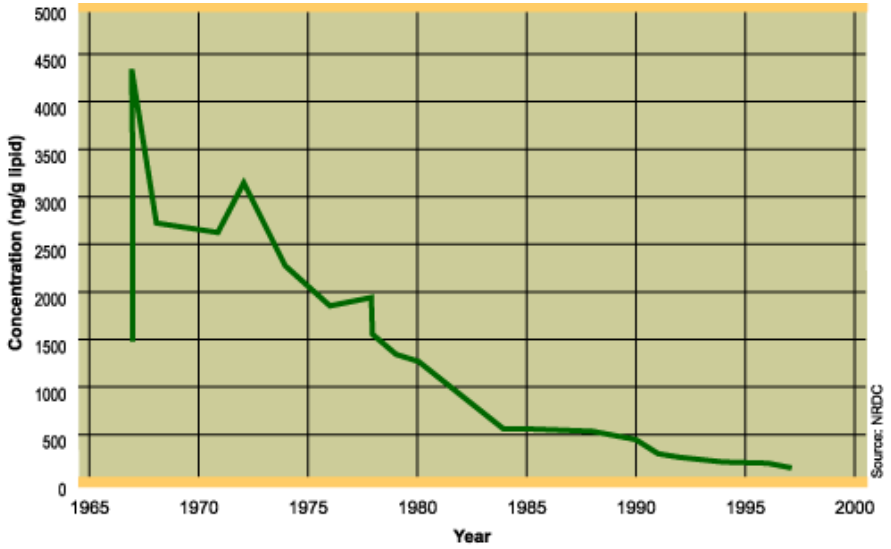
Establishing new populations

As populations decline or are lost there is a need to increase or replace them

Unless the factors that led to the problems are reduced or removed establishment programs are seldom successful

Remove problem before establishment program



Osprey numbers have returned to historic levels

This is in part due to establishing artificial nest platforms to replace trees that were cut down for development of coastal areas

It is also due to the reduction in levels of DDT in the environment

Three types of establishment programs

Reintroduction – release of captive bred or wild caught individuals into suitable habitat within their historic range

The hope of such programs is to re-establish extirpated populations

Restocking – release of captive bred or wild caught individuals into an existing but small population

The hope of such programs is to increase the likelihood of persistence

Introduction – release of captive bred or wild caught individuals into suitable habitat outside of their historic range

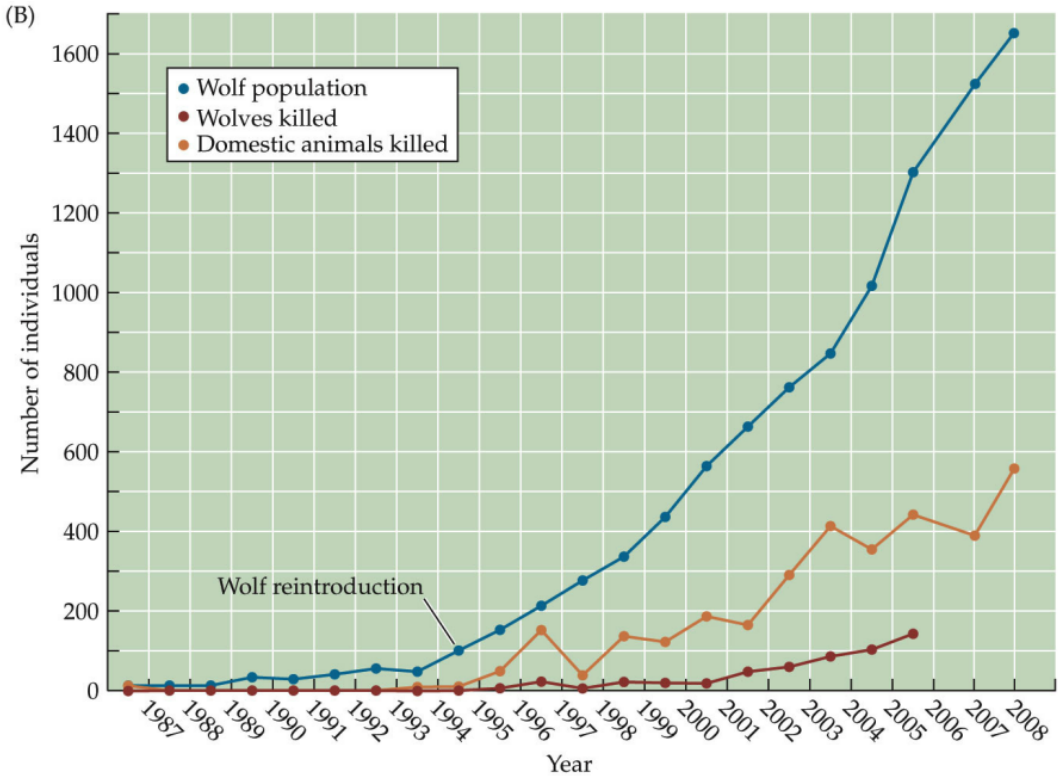
The hope of such programs is to preserve the population or species in habitat that does not involve the problems that led to local reduction or extirpation

Reintroduction of the gray wolf

Absence of this iconic top predator from Yellowstone National Park led to:

- explosion of large herbivores such as elk and deer
- destruction of the understory
- explosion of meso-predators such as skunks, raccoons and coyotes
- destruction of nesting ducks and other ground nesting bird species

The reintroduction was not without conflict



Ranchers and meat producing companies took advantage of laughably cheap land-lease deals to introduce cattle to portions of the Park and adjacent BLM lands (pennies per acre!)

Not surprisingly, the wolves kill some of the stock

Our tax dollars reimburse for any losses

But as part of a deal involving the Bush administration and pushed by the Tea Party, there is now a hunting season on wolves

Obama and company not reverse this although they could have and trump never will

Sport shooting of prairie dogs led to extirpation of the black-footed ferret over much of its range.

The habitat was then converted to crops such as corn and switch grass used in ethanol production

Suitable habitat was often outside historical ranges

Introductions of black-footed ferrets are complicated by the fact they are especially susceptible to diseases such as canine distemper that can wipe out newly introduced populations

As a consequence, extreme care must be taken in handling the animals and clearing the areas of other carriers of that disease

Many reintroduced species have to be given supplemental food

California condors have to have food supplements

This leads to competition for food with black bears and golden eagles

Golden eagle actually try to prey on the condors!

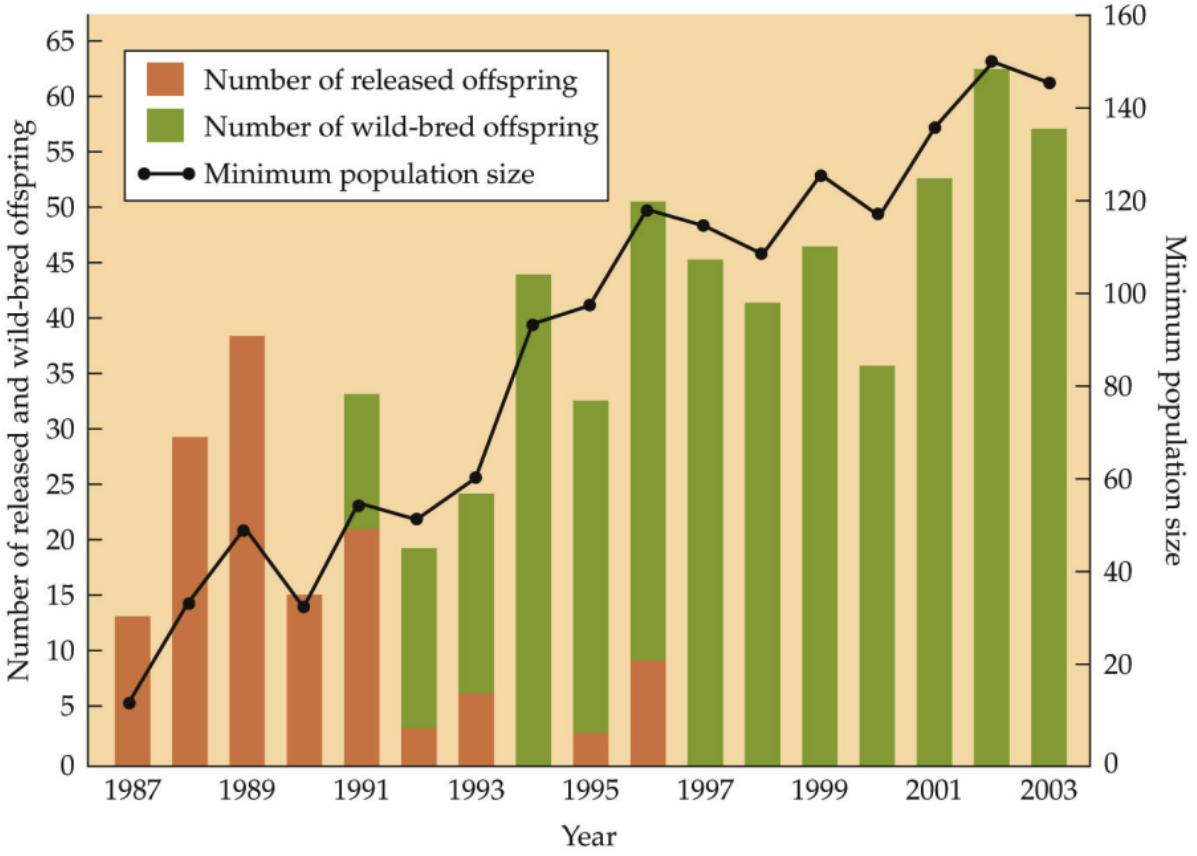
Successful reintroduction requires public support

Opposition to reintroduction is seldom based on facts, intelligence or an understanding of ecology

Cooperation ultimately came from offers to pay for damages

An education program is essential for success

Soft release programs provide initial feeding and shelter



Mauritius kestrel

This reintroduction of captive bred individuals took substantial work for the first 10 years

It now appears to be self-sustaining

Hard release programs do not include such tending

There have been many of these with game species

We have learned much from monitoring their success

- Success is greater when habitat is excellent (84%) versus marginal (38%)
- Success is greater in core of historical range (78%) versus periphery (48%)
- Success is greater with wild caught (75%) than captive reared (38%) stock
- Success is greater with herbivores (77%) than carnivores (48%)

Research to establish new populations has urgent needs

1. The cost of reintroduction must be tracked and compared to the cost of preserving existing populations
2. Most reintroductions have occurred in temperate, terrestrial habitats. There is an urgent need for research on tropical and aquatic reintroductions
3. We need more research on how to equip captive bred or captive reared individuals to succeed when reintroduced to the wild

Using hand puppets allows biologists to teach captive bred condors and whooping cranes to feed without habituating them to humans

Both skills increase chances of survival in the wild

Atlantic puffins

Extirpated from Maine due to overharvest of eggs and adults for food

Over 900 captive bred individuals were socialized with models, fed a vitamin rich diet and introduced to man-made burrows beginning in 1977

As of 2008 there were 101 members of the new colony

Red Wolf

Over 100 individuals now occupy a reserve in North Carolina following release of 42 captive born individuals

The current population is mating with local coyotes

This is not surprising since the red wolf is most likely a hybrid between gray wolves and coyotes

Their existence actually threatens the endangered species act

Kemp's Ridley sea turtle

Eggs of this species have been collected, hatched and released

Of the 24,000 juveniles released only 23 adult females have nested

While this may be an underestimate, it is not likely far off

Mortality due to "by-catch" is the main threat

Kakapo

This is a flightless, nocturnal and solitary species in New Zealand

65 of them were captured and released on islands lacking mammalian predators (likely introduced by the English originally)

They are breeding successfully and the current population is 86

Big Bend mosquitofish

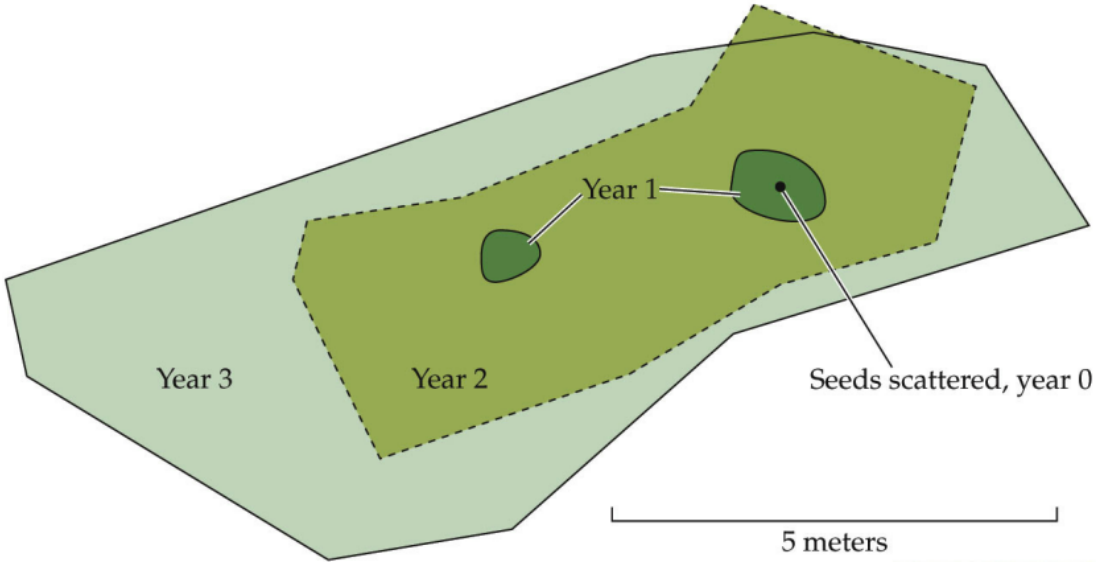
Two females and one males were removed from one of two remaining ponds in Big Bend National Park in the mid 1960's

They were bred and reintroduced into three spring-fed park ponds.

The population – in two ponds – now numbers in the thousands

This shows that highly inbred species (bottleneck N_e = 1.3) can persist

Impatiens capensis - jewelweed



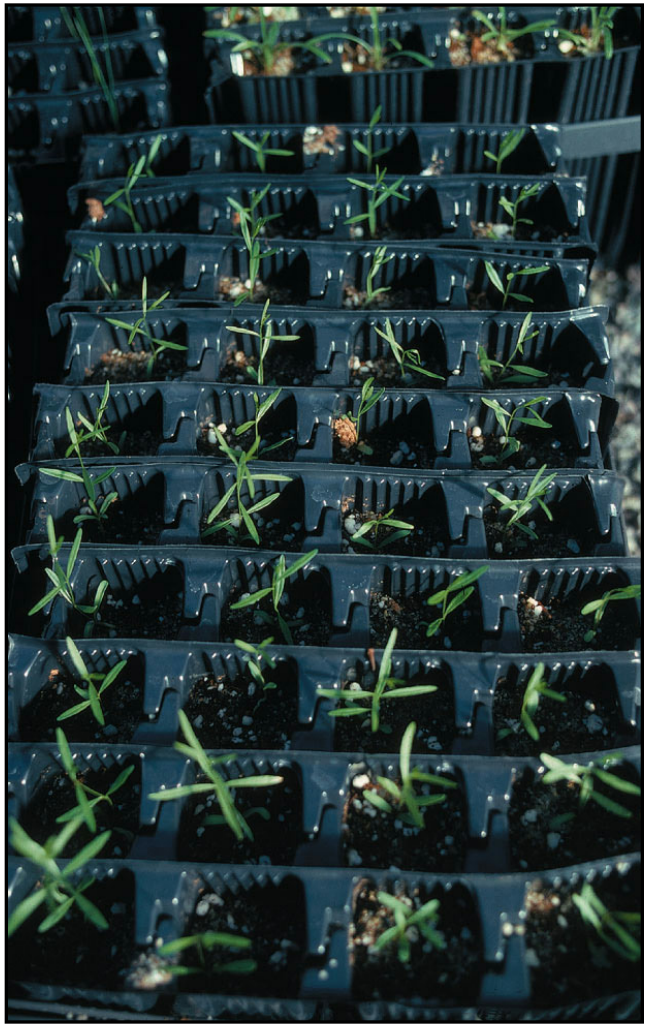
Seeds of this species were scattered in two suitable sites

They successfully established and are spreading

Most attempts are not as successful since the causes or original extirpation are unknown

In such cases it is hard to remove the factors causing the problems

Seedlings are often more successful than seeds

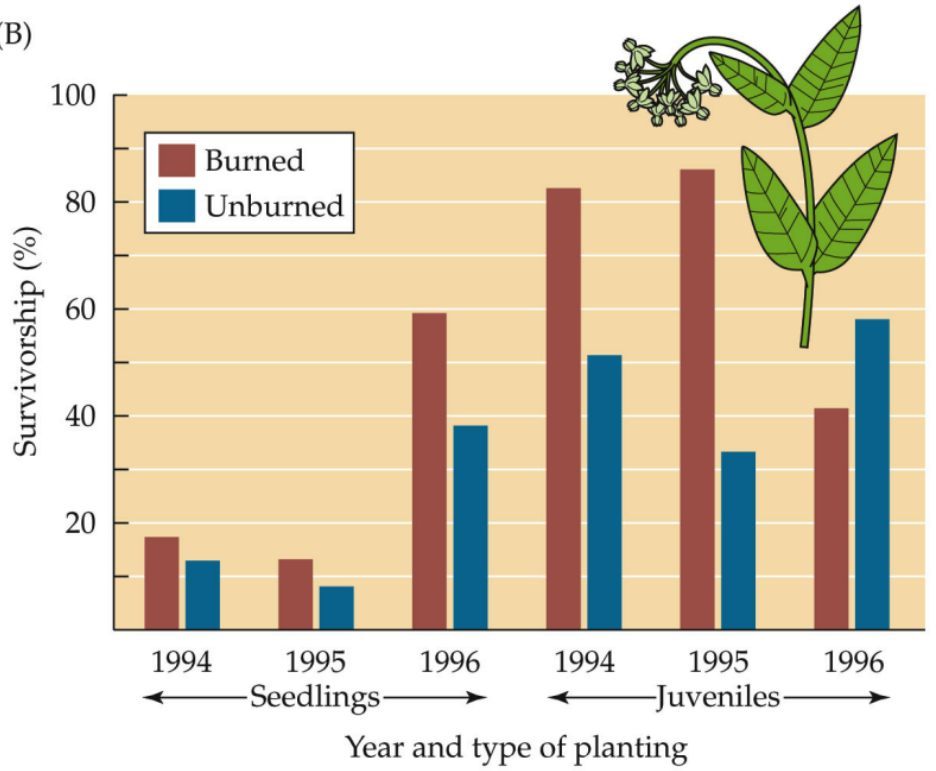


In many cases, the failure of reintroduction by seeds is due to lack of germination

This sometimes reflects depredation of seeds especially by birds or failure to germinate owing to physical or chemical conditions.

Germinating seeds in a greenhouse and then transplanting young plants with fertilizer and water is often a more successful route for reintroduction

Additional Complexities



There can be additional complications including depredation of the plants or a failure to thrive or set seed due to inadequacies of the soil

Success improves when more of the natural history of the plant and the habitat is known and remediation is attempted that excludes herbivores

In some cases knowing that the plant is fire adapted also helps

Knowlton's cactus

The plant is threatened through oil and gas exploration and collectors

The Nature Conservancy has acquired new locations and attempts are being made to establish additional populations

Ex Situ conservation

When it is clear that no habitat exists in the wild, species can be conserved by keeping them in captivity

If a breeding colony can not be established, extinction is certain

Przewalski's horse

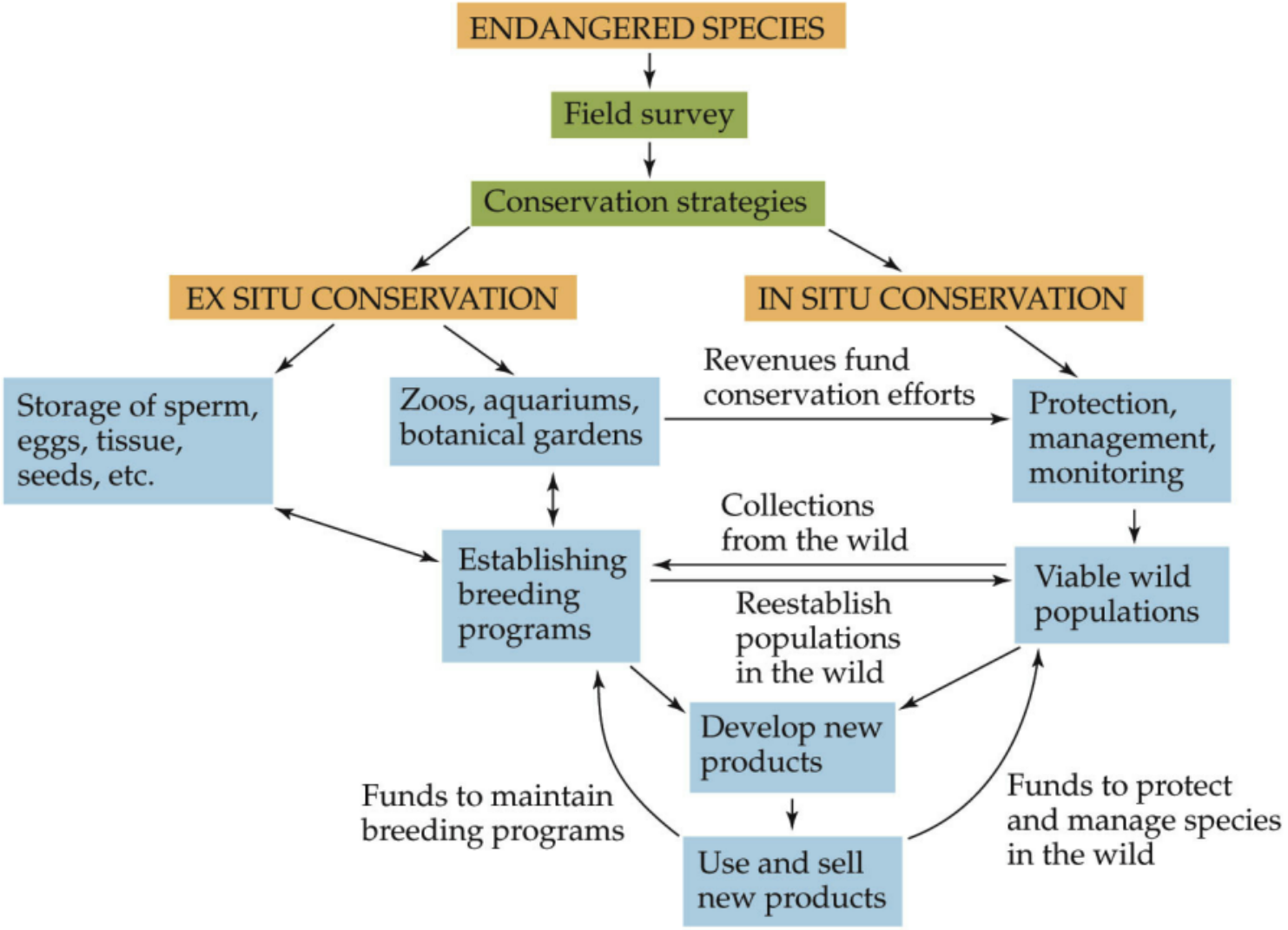
The remaining members of this species were removed from the wild more than 20 years ago

Several zoos managed to breed them in captivity.

They have recently been reintroduced to their native steppes in Mongolia

Reintroduction of zoo stock is a rare exception

Ex situ and in situ conservation are expensive and need to work hand in hand



Ex situ site conservation functions

Zoos and other such sites are useful for many reasons including:

- transformative value
- education
- wildlife health
- research

Zoological Parks

Most are greatly improved from the time that an array of species were simply housed in rows of cages

Most zoos now have more expansive compounds and try to mimic the native habitat of the species displayed

Educational programs are one of their most important functions

Increasingly they are involved with research and attempts to reintroduce captive bred animals

More efforts need to be placed on show-casing other than charismatic megafauna to highlight the plight of less known species

Every attempt must be made to minimize populating zoos with wild caught individuals

Terrestrial vertebrates maintained in zoos

Location	Mammals	Birds	Reptiles	Amphibians	Total
Europe	93,482	109,903	26,778	13,661	243,824
North America	54,393	57,668	29,967	25,208	167,236
Central America	11,630	4175	1195	65	17,065
South America	2372	3927	1682	177	8158
Asia	8437	22,624	3637	529	35,137
Australasia	6266	8629	3188	1288	19,371
Africa	6235	15,018	1278	293	22,824
Totals					
All species	182,725	221,944	67,725	41,221	513,615
Number of taxa[a]	2238	3753	969	544	7486
Percent wild-born[c]	5%	9%	15%	5%	
Rare species[b]	59,030	37,748	22,474	3398	122,650
Number of taxa[a]	527	344	207	29	1107
Percent wild-born[c]	7%	9%	18%	7%	

as zoos compete for revenue there is increasing temptation to add attractive species removed from the wild

Captive Breeding

Many threatened species reproduce fine with given healthy living conditions and food

Excess offspring are traded among zoos, removing the need to capture additional wild animals

However, other species are more problematic

This often reflects absence of both males and females at a given zoo or failure to sort out an environment conducive to mating and rearing

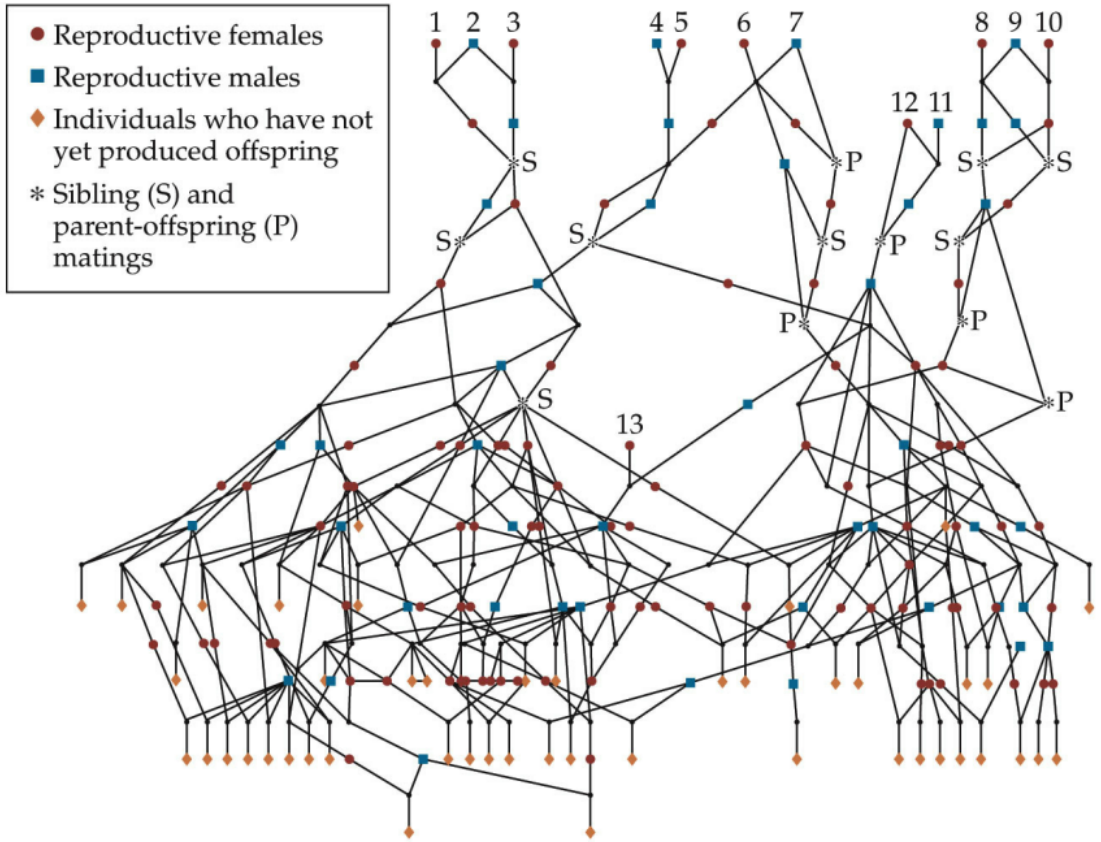
bongo calf with eland surrogate mother

This is where zoos have become creative and added to biological knowledge

Among the techniques developed and used are:

- *cross fostering* – offspring raised by another species
- *artificial incubation* – extra eggs incubated by another individual or species
- *artificial insemination* – useful for rare species or to minimize inbreeding
- *embryo transfer* – artificially fertilized eggs transplanted into surrogate species
- *genome resource bank* – cryological storage of eggs, sperm and embryos

Stud Books



Like horse and dog breeders zoos keep careful breeding records to reduce problems associated with inbreeding since N is quite small

The term derives from the artificial insemination industry of domestic stock

Zoos are increasingly maintaining varieties of domestic stock that have become rare

In many cases these strains are no longer economically favored but may have genetic traits that may someday be useful

Many zoos are maintaining their wild collections by providing these services


soay sheep


silver phoenix

Limitations of *ex situ* site conservation

- *Cost* – the cost is higher than protecting in the wild IF that was possible; zoos bring in huge amounts of money to offset the former
- *Population size* – no zoo can afford to maintain species at high enough N to avoid inbreeding issues so connections are mandatory (metapopulations)
- *Adaptation* – the captives are selected for survival and reproduction in non-natural habitats limiting the likelihood of reintroduction
- *Learning skills* – the captives have little idea how to cope in the wild
- *Genetic variability* – even with careful use of "stud books" and such the captive metapopulations will lose genetic variation
- *Continuity* – funding and support must be perpetual
- *Concentration* – there is the risk of a catastrophe wiping out the entire collection
- *Surplus animals* – something has to be done with newly produced individuals

Ethical Issues

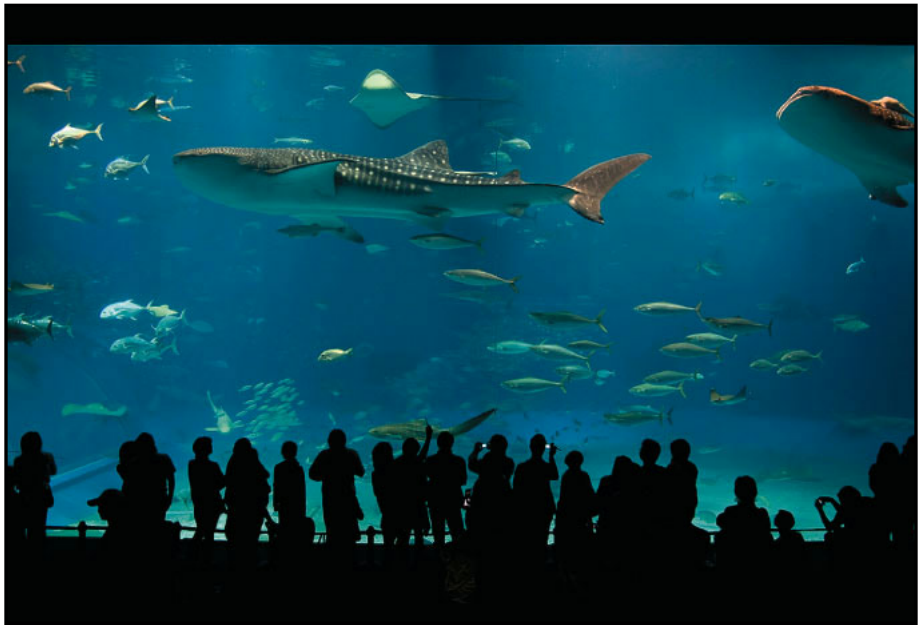
Most zoos have come a long way since individuals were simply caged, but:

- How will establishing an ex situ population help the wild species?
- Does a captive population with no hope of reintroduction save the species?
- Are species begin held and displayed for their benefit or profit?
- Are the individuals being cared for in a way consistent with their needs?
- Are sufficient efforts being expended to educate the public about species' needs?

Aquaria

Typically these ex situ sites have focused on displaying collections of unusual and attractive aquatic creatures

Often they increase public draw with trained marine mammal performances



More recently many aquaria have followed the lead of zoos and are more ecosystem oriented

They have increased educational programs and serve a valuable service

There is also an increase in local focus rather than global collections

The Monterey Bay Aquarium is a leading example

Captive breeding

Aquaria have also entered the captive breeding arena

They are often able to breed large numbers of species for release to augment depleted populations

They are often more successful than terrestrial programs

Botanical gardens and arboreta

These facilities are also becoming more educational and serve conservation goals quite well

Many have linked with zoos to integrate plants with threatened pollinating humming birds

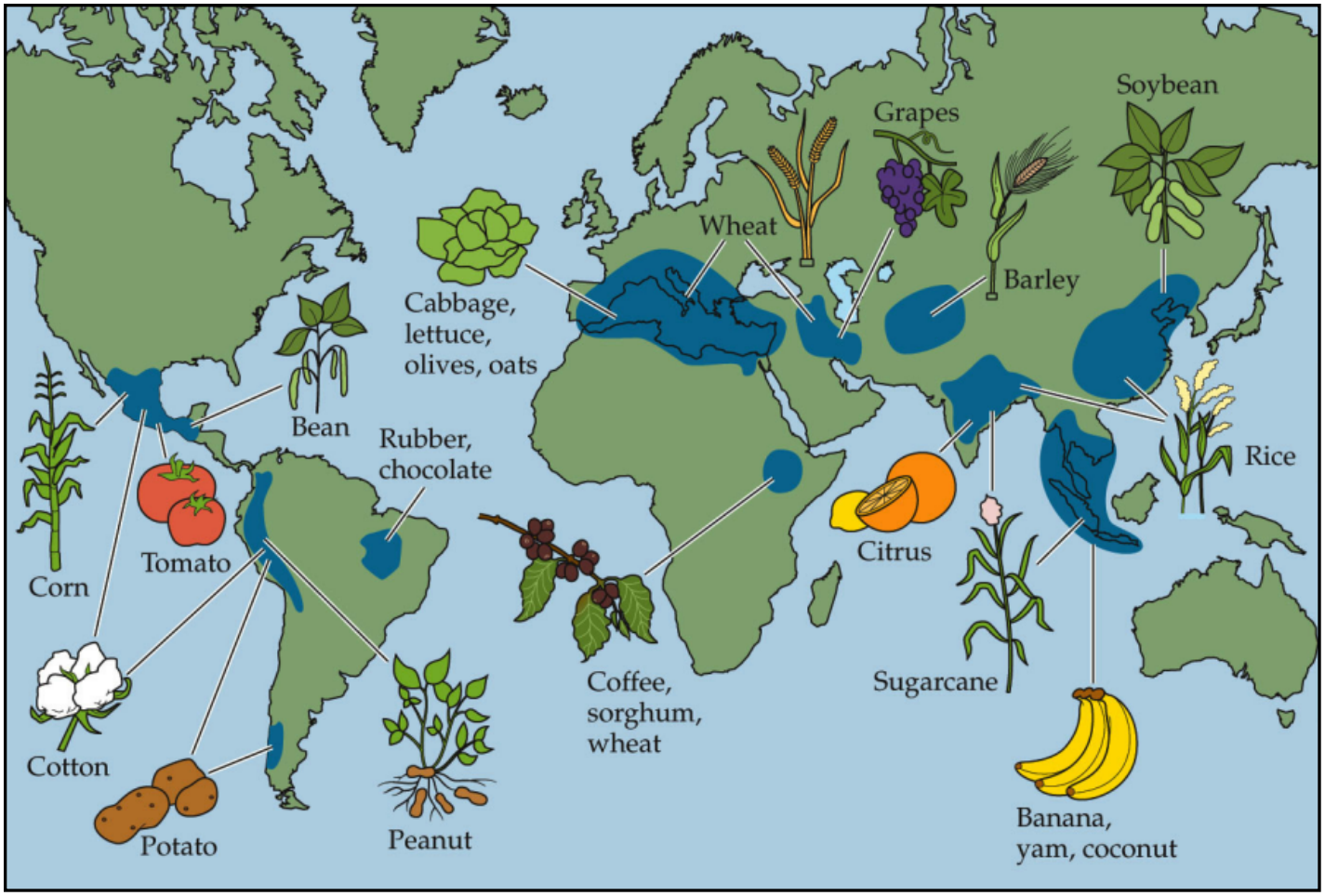
Seed Banks

Many arboreta and botanical gardens store seeds but there has been an increasing effort to create facilities exclusively focused on seed preservation

In part this reflects the fact you can do this with plants

In part too it is driven by an attempt to preserve genetic diversity for the future to maintain healthy agriculture, pharmaceuticals and even the floral portions of ecosystems

Agricultural seed banks



It is important to preserve seeds of crops from their points of origin as those populations usually capture most of the genetic variation