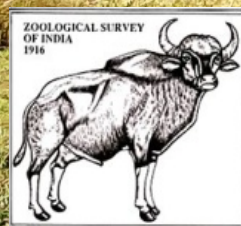


Anil Agarwal Dialogue 2022

The Twin Challenge

Session : 10

The Great Extinction: The state of biodiversity (India and the world)



Dr. Dhriti Banerjee
Director
Zoological Survey of India, Kolkata





DIVERSITY = RESILIENCE

- The greater the genetic diversity, species diversity, and habitat diversity in a landscape, the greater the resilience of that landscape to disturbances such as pollution, invasive species, etc.
- This is similar to a city – the more variety you have in people, businesses, and buildings, the more secure a community will be.



WHY DOES BIODIVERSITY MATTER?

➤ **Biodiversity matters because it is a measure of the health of an ecosystem.**

- To understand why this is the case, we have to understand the basics of how an ecosystem works.

➤ **For an ecosystem to function, it must be able to serve different roles and provide various services.**

- The main ecosystem services are energy flow, nutrient cycling, waste removal, and reproduction.

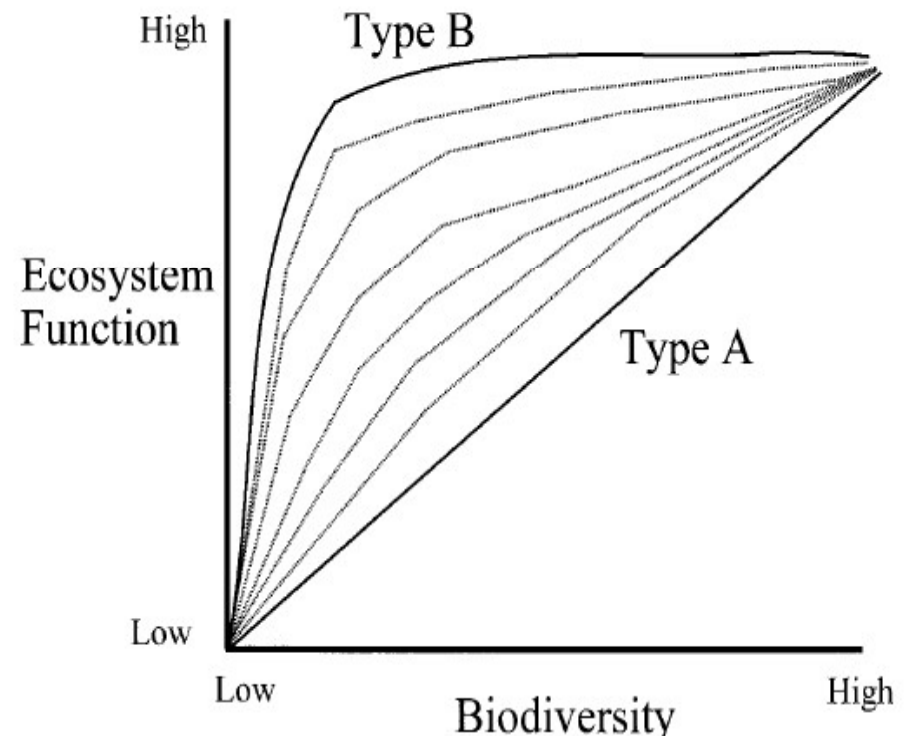
RELATIONSHIP BETWEEN BIODIVERSITY AND ECOSYSTEM FUNCTION

In the case of Type A ecosystems, any loss of biodiversity is immediately noticeable. These ecosystems tend to be the most fragile.

In the case of Type B ecosystems, losses to biodiversity show little impact on ecosystem function and services until it is likely too late to repair it. This means that by the time the damage is noticeable, it is probably too late.

Most ecosystems resemble Type B.

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- Source: Schwartz, *et. al.* 1999. Linking biodiversity to ecosystem function: implications for conservation ecology. UC-Davis

IF BIODIVERSITY IS LOST...

- **As biodiversity is lost, ecosystem function and ecosystem services decrease.**
 - The permanent loss of a species makes it harder for all other species to survive.
 - Extinction: the permanent loss of a species.
- **As ecosystem functions decrease, each individual and each species is put at greater risk for loss because of species association.**
 - The loss of one species increases the risk of losing more species.

WHAT IS EXTINCTION?

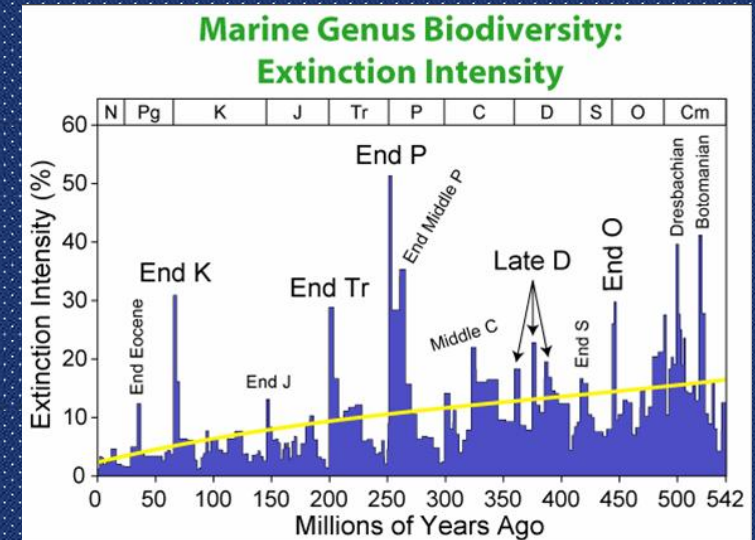
- ❑ Extinction is the process through which a species or higher taxonomic category ceases to exist.
- ❑ Can be defined as the disappearance of any evolutionary lineage (from populations to species to higher taxonomic categories) because of death or the genetic modification of every individual.
- ❑ Where a lineage has changed such that a new (daughter) species is recognised, the extinction of the original (parent) species may also be called pseudoextinction.
 - ❑ The new and original species are known as chronospecies.
- ❑ It is a natural process.

CAUSES OF MASS EXTINCTIONS

- ❑ Most of the extinction events are likely to have been caused by a combination of factors.
- ❑ Postulated consequences of the asteroid strike that caused the end Cretaceous (K/T) mass extinction include acid rain, widespread fires, climate cooling due to dust and smoke, earthquakes and increased volcanic activity elsewhere in the world and a tsunami (an enormous tidal wave). The aforementioned consequences would have caused ecological disruption leading to further extinctions.
- ❑ Some previously postulated causes of mass extinctions may be unlikely or even impossible:
 - ❑ A supernova explosion,
 - ❑ A nearby gamma ray burst,
 - ❑ Biological causes.

EXTINCTIONS CAN BE NATURAL

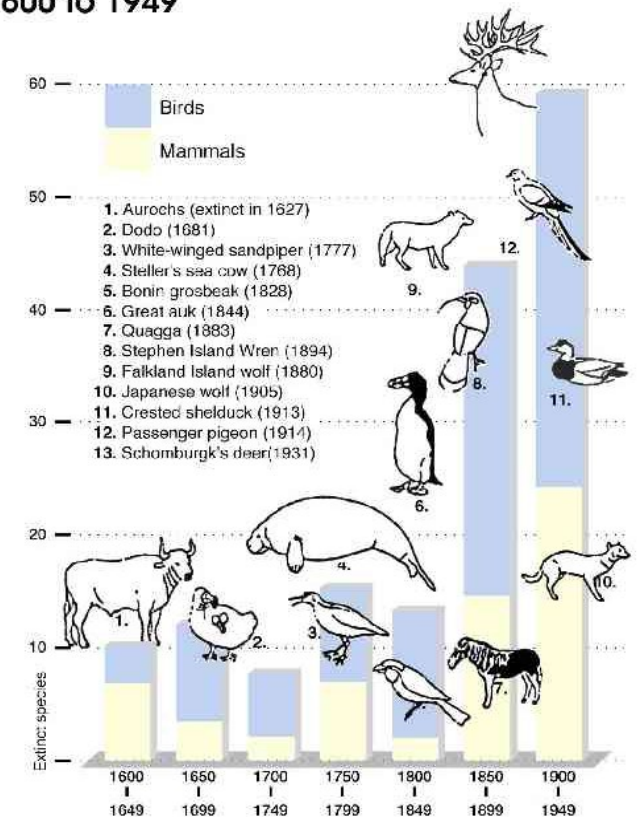
- **Extinctions can occur naturally.**
 - Nearly all of the species that have existed on earth have gone extinct.
- There have been 5 major mass extinctions in geological history.
 - Recovery from these events took millions of years.



WHEN DO EXTINCTIONS OCCUR?

- **Extinctions occur when the environment of a species changes faster than the species can adapt.**
 - In other words, a species' adaptations are no longer sufficient in allowing that species to acquire and compete for resources.
- **Extinctions can be local, widespread, or global.**
 - For example, the **Cheetah** in India but not in Africa
 - Wild elk and woodland caribou are now extinct in Wisconsin but are prevalent in other parts of North America.

Birds and mammals that became extinct from 1600 to 1949

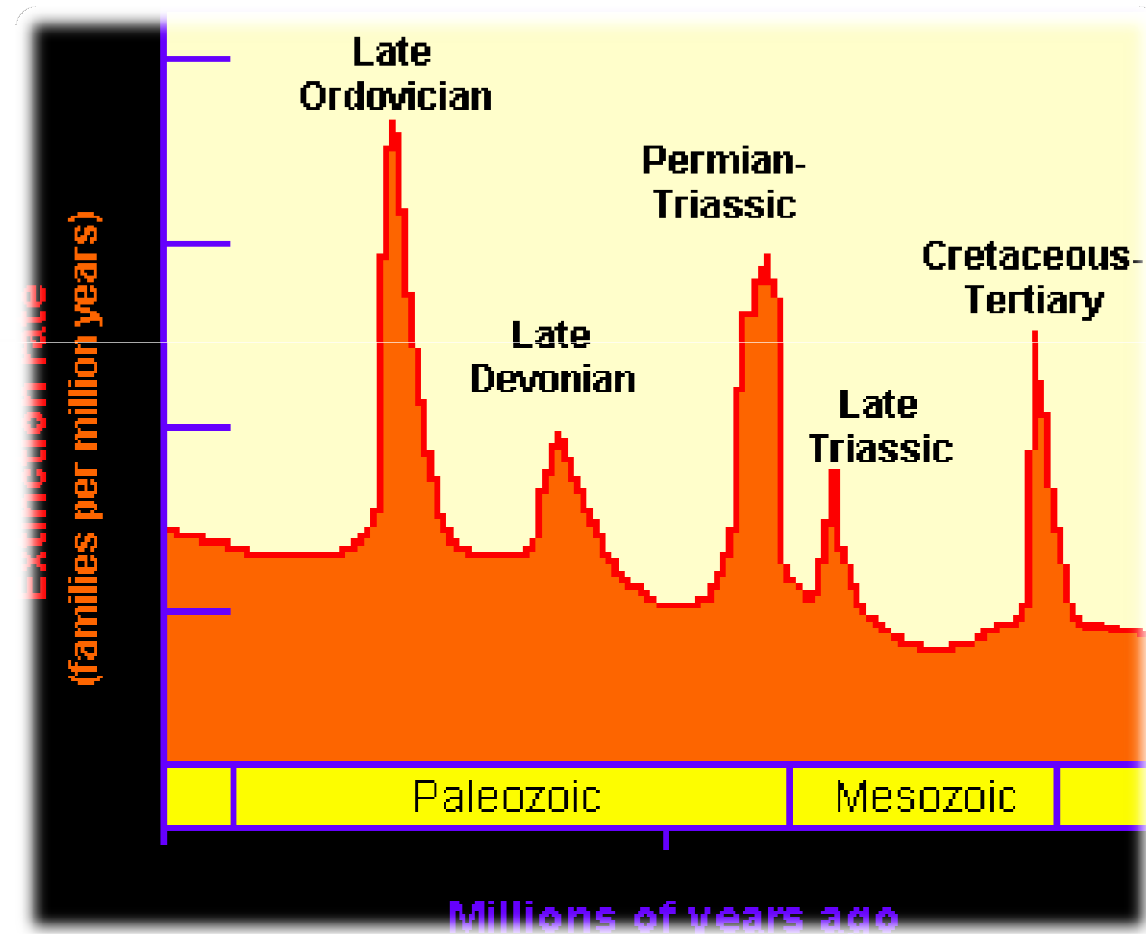


Source: *Keeping Options Alive: The Scientific Basis for Conserving Biodiversity* by Walter V. Reid and Kenton R. Miller, published by Diamond, Inc.

THE 5 (NOW 6) MASS EXTINCTIONS

1. *Ordovician-Silurian* Extinction (440 *mya*).
2. *Late Devonian* Extinction (364 *mya*).
3. *Permian Triassic* Extinction (250 *mya*).
4. *End Triassic* Extinction (200 *mya*).
5. *Cretaceous-Tertiary* Extinction (65 *mya*).
6. *Holocene* Extinction (0 *mya*)

(# = millions of years ago)



Background Extinction and Extinction Events

- ❑ The extinction rate that is normal in the fossil record is known as background extinction.
- ❑ Extinction events are relatively short (in terms of geological time) periods with greatly increased extinction rates.
- ❑ A mass extinction event must eliminate $>60\%$ of species in a relatively short period of geological time with widespread geographical and taxonomical impacts.
- ❑ Mass extinction events are important because of the disruptive effect they have on the way biodiversity develops.
- ❑ Mass extinction events may occur periodically.

1ST: THE ORDOVICIAN MASS EXTINCTION

- ❑ The earliest of the five mass extinctions.
- ❑ Happened about 439 million years ago.
- ❑ Impacts on life forms:
 - ❑ Plants, insects and tetrapods had not yet developed so they were not affected.
 - ❑ **Marine organisms: brachiopods, cephalopods, echinoderms, graptolites, solitary corals and trilobites.**
- ❑ Suggested causes include:
 - ❑ **Climate change,**
 - ❑ A drop in sea level,
 - ❑ Asteroid or comet impacts,
 - ❑ A gamma ray burst.



IIND: THE LATE DEVONIAN MASS EXTINCTION

- ❑ The second of the five mass extinctions.
- ❑ Happened about 365 million years ago.
- ❑ Impacts on life forms:
 - ❑ Insects and tetrapods had not yet developed so they were not affected.
 - ❑ **Plants: the rhyniophytes decreased.**
 - ❑ **Marine organisms affected: ammonoids, brachiopods, corals, agnathan fish, placoderm fish, ostracods and trilobites.**
- ❑ Suggested causes include:
 - ❑ Climate change,
 - ❑ Multiple asteroid impacts.



IIIRD: THE END PERMIAN MASS EXTINCTION

- ❑ The **biggest** of the five mass extinctions happened about **245 million years ago**.
- ❑ Impacts on life forms:
 - ❑ **Plants:** the previously dominant *Ottokariales* (glossopterids) became extinct.
 - ❑ **Insects:** about two thirds of the insect families became extinct and six insect orders disappeared.
 - ❑ **Tetrapods:** amphibians and mammal-like reptiles
 - ❑ **Marine organisms:** benthic foraminifera, brachiopods, bryozoans, echinoderms, 44% of fish families, all graptolites, solitary corals and all trilobites.
- ❑ Suggested causes include:
 - ❑ **Climate change,**
 - ❑ Drop in sea level,
 - ❑ Massive carbon dioxide (CO₂) poisoning,
 - ❑ Oceanic anoxia, asteroid or comet impacts, plate tectonics during the formation of Pangea and high volcanic activity.



IVTH: THE END TRIASSIC MASS EXTINCTION

- ❑ The fourth of the five mass extinctions.
- ❑ Happened about 210 million years ago.
- ❑ Impacts on life forms:
 - ❑ **Plants:** several orders of gymnosperms were lost.
 - ❑ Insects: not severely affected.
 - ❑ **Tetrapods:** some reptile lineages the mammal-like reptiles (therapsids) especially.
 - ❑ **Marine organisms:** ammonites, ammonoids, bivalves (Molluscs), brachiopods, corals, gastropods and sponges.
- ❑ Suggested causes include:
 - ❑ One or more asteroid/comet impacts,
 - ❑ **Climate change** and volcanic activity.



VTH: THE CRETACEOUS MASS EXTINCTION

- ❑ The final and **best known of the five mass extinctions**.
- ❑ Happened about **65 million years ago**.
- ❑ **Impacts on life forms:**
 - ❑ **Plants**: debatably up to 75% of species.
 - ❑ Insects: not severely affected.
 - ❑ **Tetrapods affected**: 36 families from 3 groups dinosaurs (all non-avian), plesiosaurs and pterosaurs.
 - ❑ **Marine organisms affected**: ammonites, ammonoids, cephalopods, bivalves, foraminifera, ichthyosaurs, mosasaurs, plackton and rudists.
- ❑ **Suggested causes include:**
 - ❑ Asteroid/comet impact,
 - ❑ **Climate change** and volcanic activity.
- ❑ The occurrence of an impact event has been verified.



THE HOLOCENE EXTINCTION

- Today's massive loss of species has been dubbed the “Holocene Extinction” (**we are currently in the Holocene epoch**)
- Catastrophic extinctions, as was the case when an **asteroid-strike wiped out the dinosaurs**, actually took many thousands of years to occur.
 - What took thousands of years for the dinosaurs is taking decades for us today.
- The current extinction rate appears significantly greater than that of the dinosaurs.
 - ❑ **Human-activity is killing off species faster than an asteroid could 65 million years ago.**



MODERN CAUSES OF EXTINCTIONS

- **Habitat Loss:** fragmentation, degradation, and outright destruction of ecosystems (leading cause).
- **Invasive Species:** (second leading cause).
- **Over-harvesting:** the removal of species at rates that exceed reproduction.
- **Pollution:** harmful agents that reduce the effectiveness of a species adaptations.
- **Climate Change:** changing climatic isotherm making species survival difficult



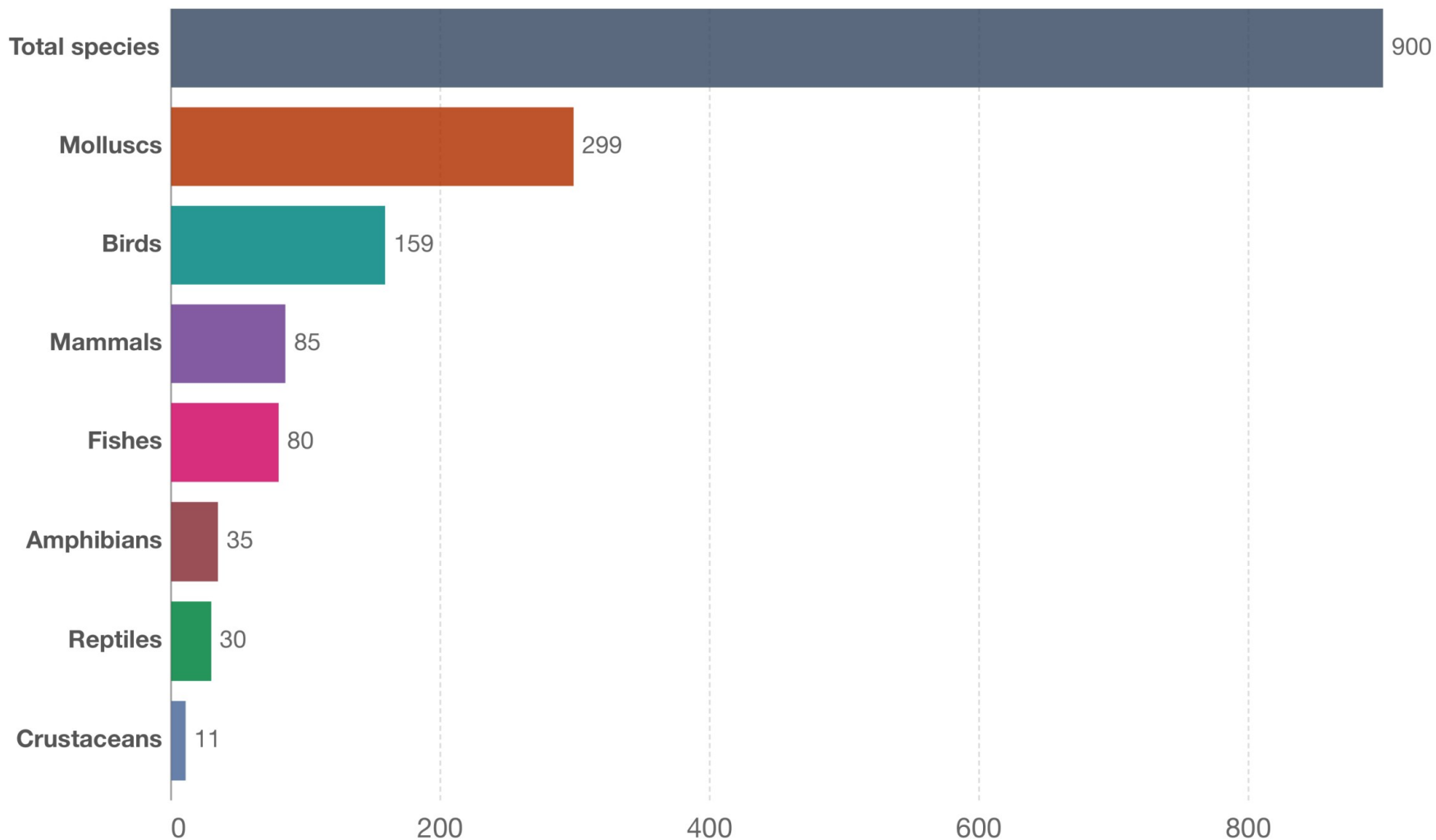
CURRENT STATS

- ❑ Extinctions are a natural part of the evolutionary history. As 99% of the four billion species that have evolved on Earth are now gone (Barnosky, et al. 2011). Species go extinct, while new ones are formed.
- ❑ The current rate of extinction is greater than the normal. If it took us 500 years to lose 1% of species, it would take us 37,500 years to lose 75% (Barnosky et al. 2011). Again, 100 to 1000 times higher than the background rate.
- ❑ Every day, up to 150 species are lost. Every year, between 18,000 and 55,000 species become extinct. The cause: human activities. (CBD Secretariat).
- ❑ The world's oceans could be virtually emptied for fish by 2048. A study shows that if nothing changes, we will run out of seafood in 2048.
- ❑ One in eight plant species are in danger of extinction within the next 30 years (ICUN Red List)
- ❑ About 52 species of birds, mammals and amphibians move one category closer to extinction on the IUCN Red List every year (Hoffmann et al. 2010).

How many species have gone extinct?

Number of species that have gone extinct since 1500, 2020

Our World
in Data



Source: IUCN Red List

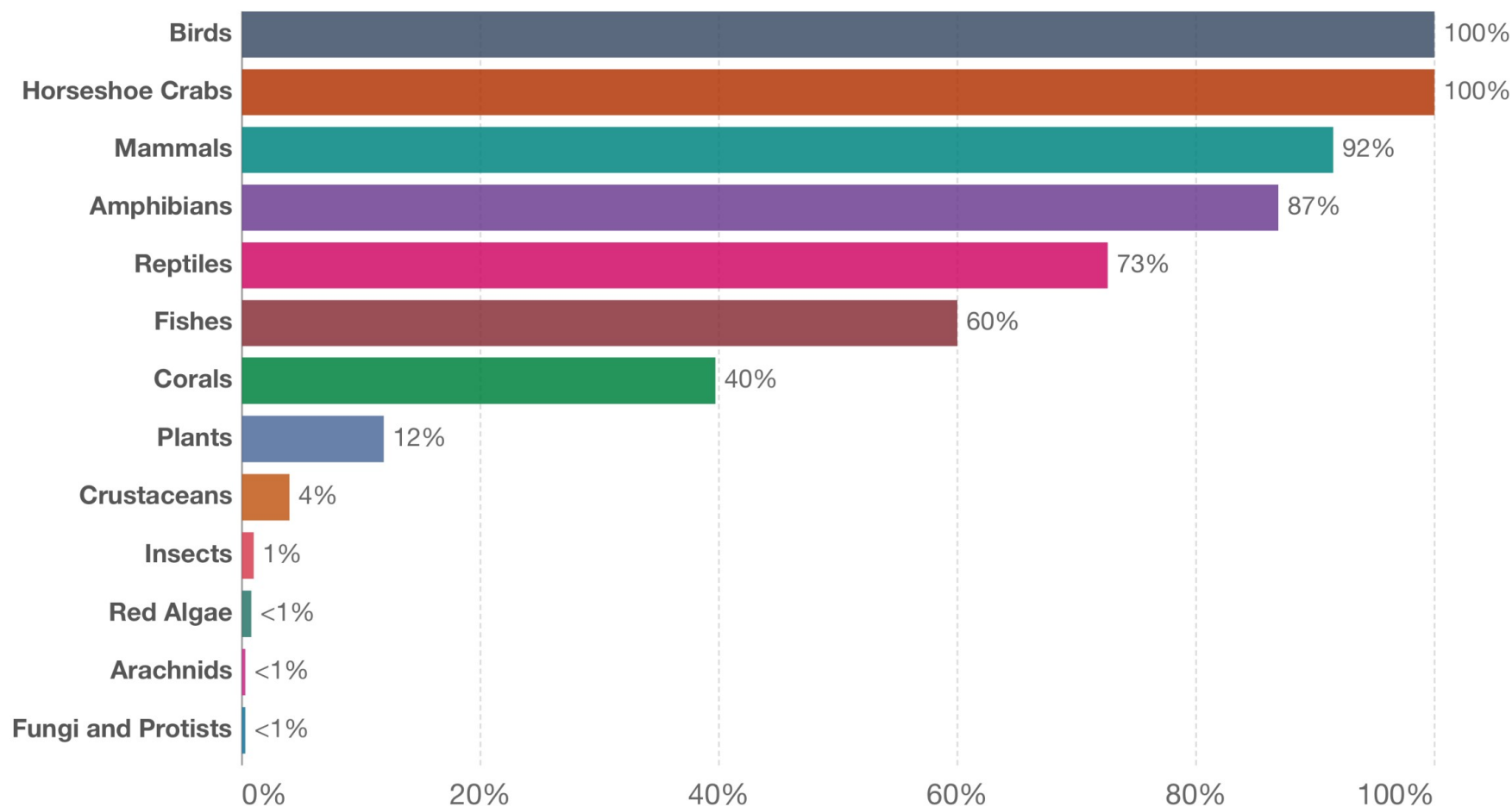
OurWorldInData.org/biodiversity • CC BY

The number of threatened species is an underestimate. Since only 6% of described species have been evaluated. There is inevitably more threatened species within the 94% that have not been evaluated.

Share of described species that have been evaluated for their extinction risk, 2020

Our World
in Data

In many taxonomic groups, very few described species have been evaluated for their extinction risk level. This means the estimated number of species at risk of extinction in these groups is likely to be a significant undercount.



Source: IUCN Red List

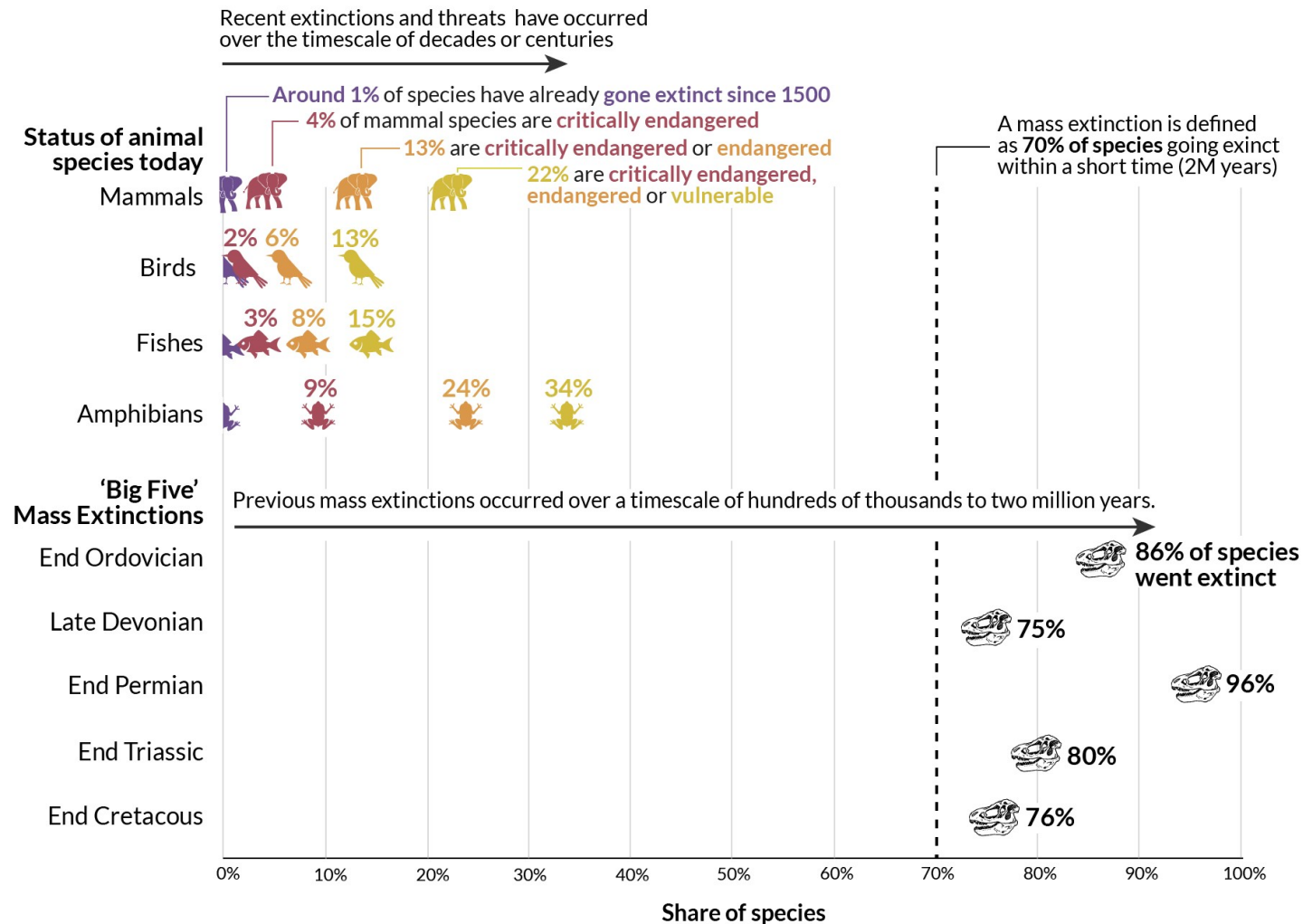
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Currently the species are getting extinct at a much faster rate than the last “Big five” Mass extinction

How far are we from a sixth mass extinction?

Shown is the share of assessed animal species that have gone extinct or are threatened with extinction today, relative to the share of species that went extinct in previous mass extinction events. This is only shown for species in vertebrate groups where more than 80% of known species have been assessed for their extinction risk.

Our World
in Data



Data Sources: Barnosky et al. (2011). Has the Earth's sixth mass extinction already arrived? *Nature*. Threatened species from IUCN Red List (2021). Images sourced from Noun Project. OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the author Hannah Ritchie.

WHAT IS DIFFERENT THIS TIME

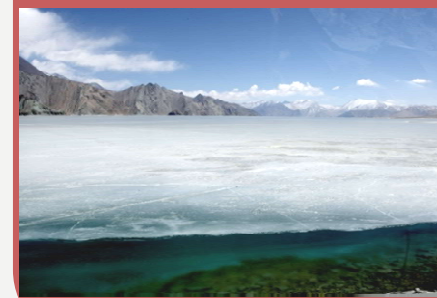
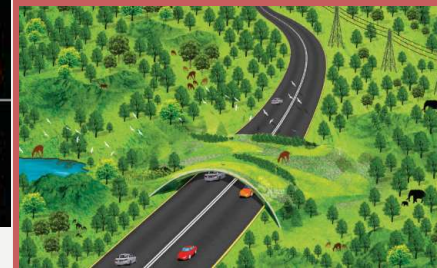
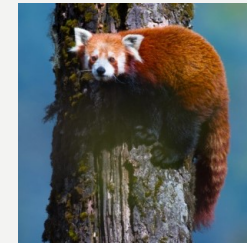
- ❑ The previous “Big Five” were associated with – volcanism, climate change, asteroid or comet impacts, plate tectonics.

The 6th mass extinction is because of us and our activities. The primary driver of these environmental changes: deforestation, climate change, ocean acidification, hunting, and pollution of ecosystems.



WHAT WE CAN DO TO STOP OR SLOW DOWN THE SPEED OF EXTINCTION

1. Protect the biodiversity.
2. Slow and reverse deforestation.
3. Slow down global climate change.
4. Allow natural ecosystems to heal



Planet Index reports a 68% average decline in wildlife populations since 1970; and we continue to lose.

We attempted to achieve CBD 2020 Aichi targets –We didn't meet a single one (Secretariat of the Convention on Biological Diversity (2020). [Global Biodiversity Outlook 5](#). Montreal.)

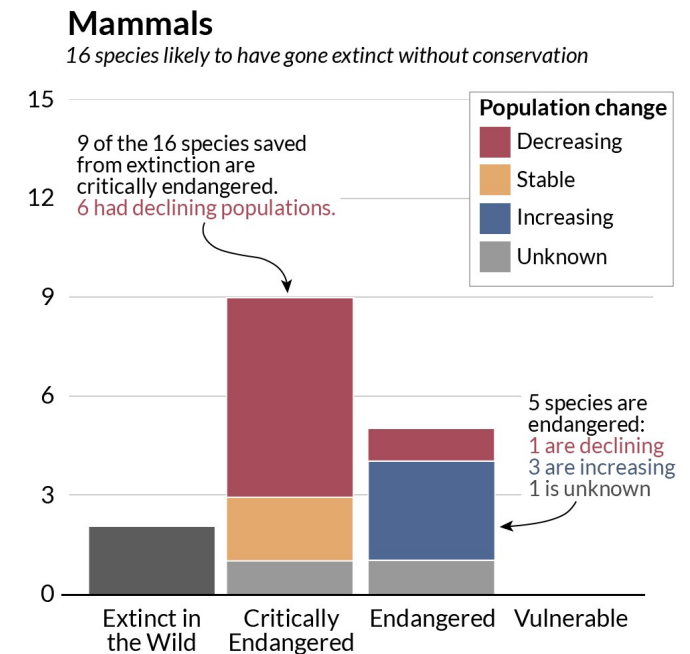
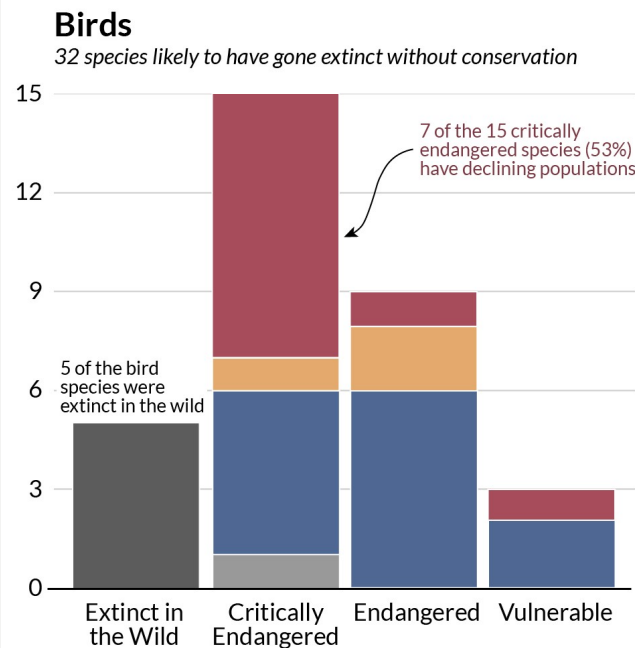
Conservation bring back how many for extinction

21 to 32 bird species, and 7 to 16 mammal species were pulled back from the brink of extinction (ourworldindata.org)

How many species has conservation saved?

An estimated 32 bird and 16 mammal species have been prevented from going extinct due to conservation efforts since 1993. They are shown by their extinction risk category, and status of how their populations were changing on the IUCN Red List in 2019.

Our World
in Data



Source: Friederike Bolam et al. (2020). How many bird and mammal extinctions has recent conservation action prevented? *Conservation Letters*.

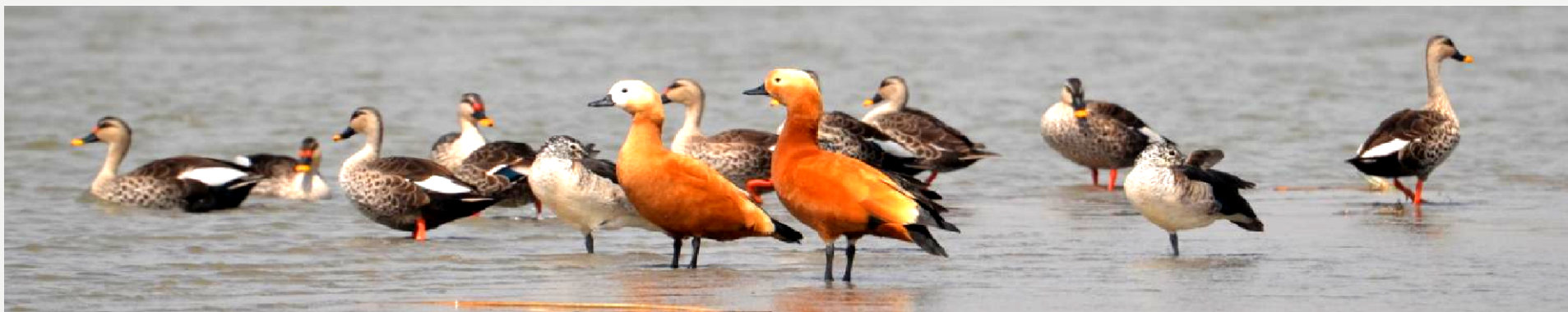
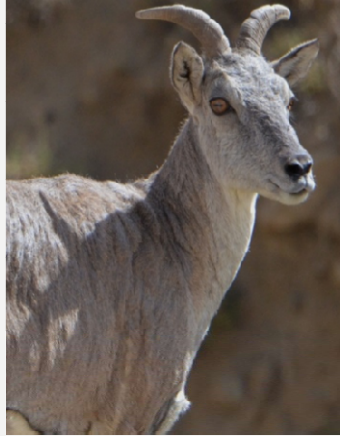
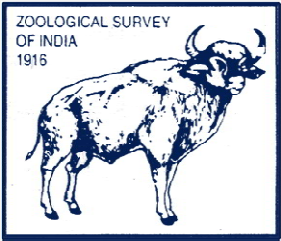
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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WHAT WE ARE DOING IN INDIA TO REVISER THE BIODIVERSITY EXTINCTION

1. Projects on flagship species such as: - Tiger, Elephant, Snow Leopard, Dolphin, Rhino.
2. National Biodiversity Action Plan/ National Biodiversity Authority
3. National Wildlife Action Plan 2017-31
4. India's global partnership (CBD, CMS, CITES, UNCCD, UNFCCC, International Whaling Commission, RAMSAR Convention, IUCN-World Conservation Union, UNESCO World Heritage Program)
5. Creation of Wildlife Crime Control Bureau (WCCB)
6. Integrated Development of Wildlife Habitats-Centrally Sponsored Scheme (IDWH)
7. Species Recovery Programme
8. National Coastal Zone Management Authority
9. NAPCC- National Action plan for Combating Climate Change.
10. NAP- National Afforestation Programme

THE STATE OF BIODIVERSITY INDIA AND THE WORLD



WORLD BIODIVERSITY

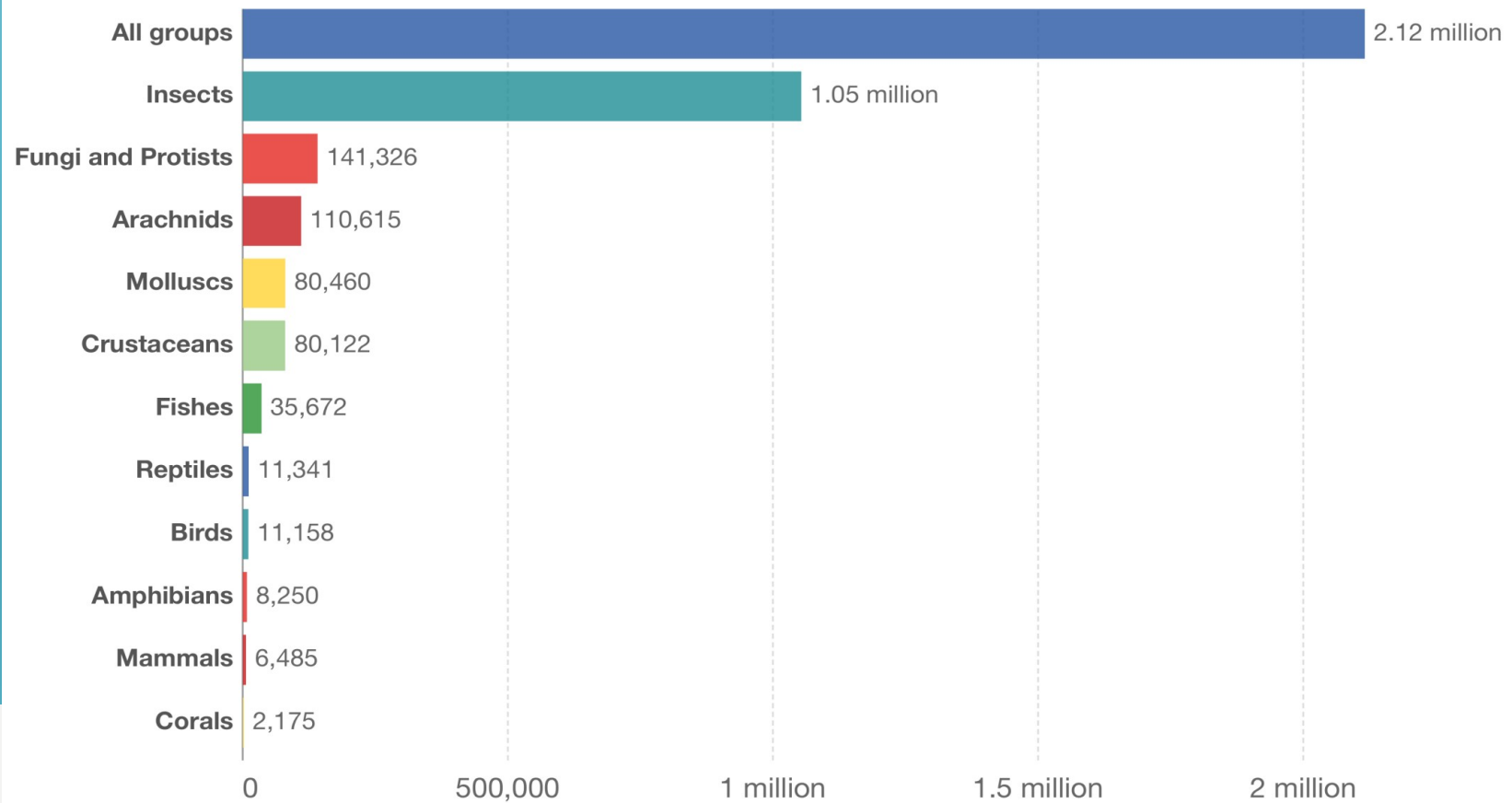
IUCN in 2020 it listed 2.12 million species on the planet.

- 1.05 million insects
- 11,000 birds
- 11,000 reptiles
- 6,000 mammals
- 141328 fungi & protists

Number of described species

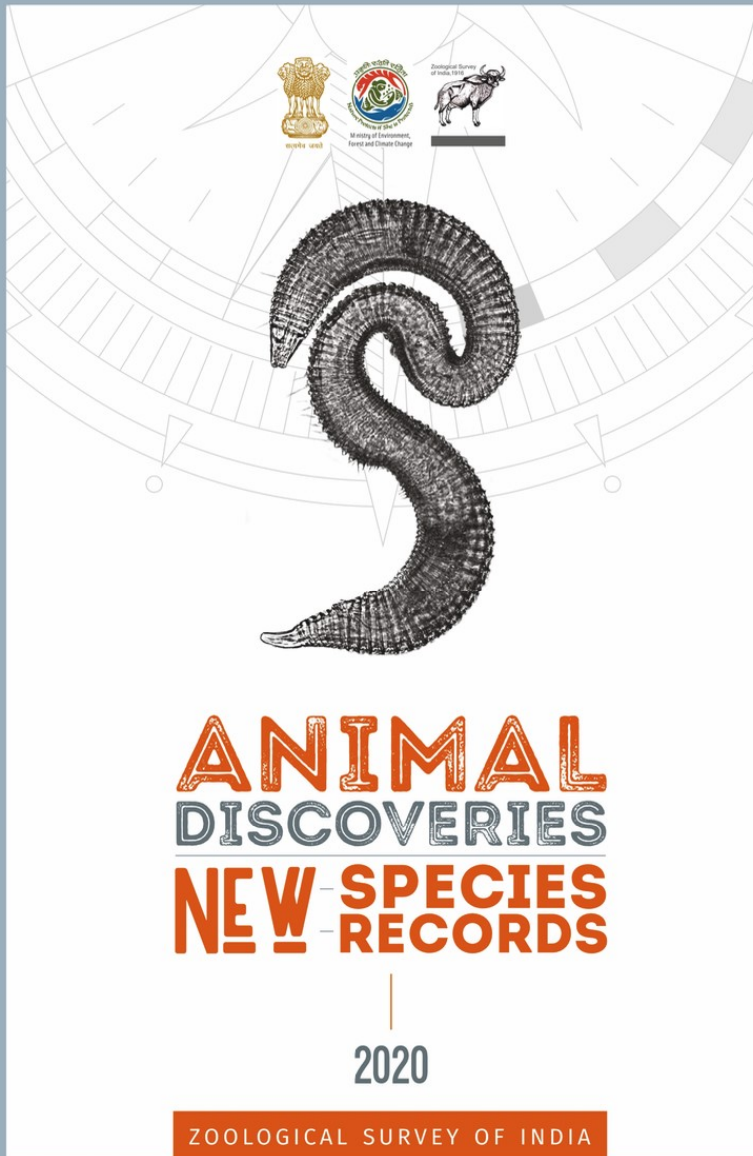
The number of identified and named species, as of 2020. Since many species have not yet been described, this is a large underestimate of the total number of species in the world.

Our World
in Data

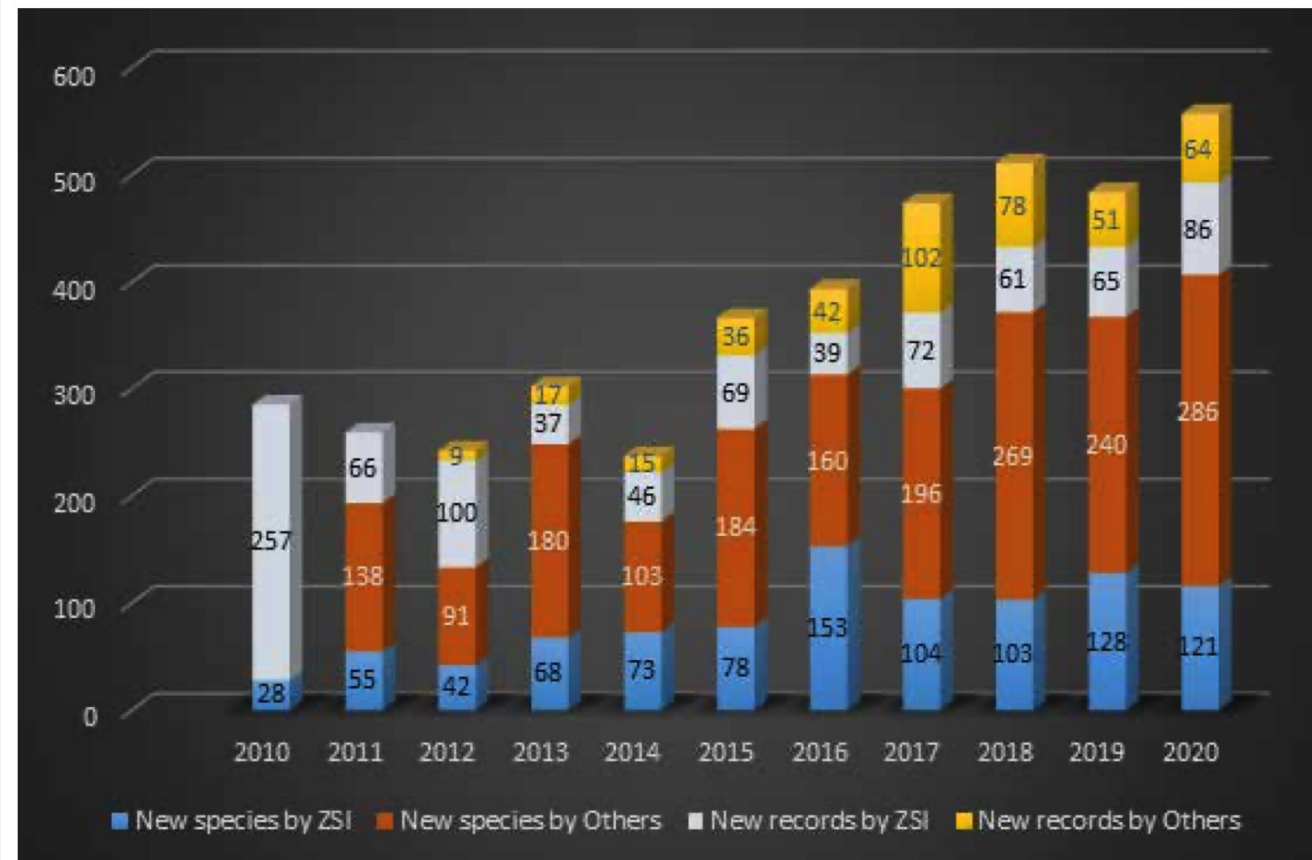


Source: IUCN Red List

OurWorldInData.org/biodiversity • CC BY



About 1,02,718 species are reported from India (Chandra et al. 2020)



Classification of animal groups under different threat categories of IUCN Redlist version 2020-2.

Taxonomic group	EX & EW	CR	EN	VU	NT	LR/CD	LC	DD
Mammalia	0	12	41	47	26	0	269	32
Aves	0	17	21	62	82	0	1085	2
Pieces	0	29	86	121	71	0	1700	239
Reptile	0	10	16	29	11	0	176	68
Amphibia	0	20	33	22	9	0	98	86
Mollusca	0	0	3	4	1	0	255	97
Cnidarian	0	1	4	73	107	0	171	21
Arthropoda	0	2	6	15	4	0	104	91
Insecta	0	1	2	17	15	0	282	159
Annelida	0	0	0	0	0	0	1	0
Echinoderm	0	0	4	5	0	0	23	35
Total	0	92	216	395	326	0	4164	830

Brief History

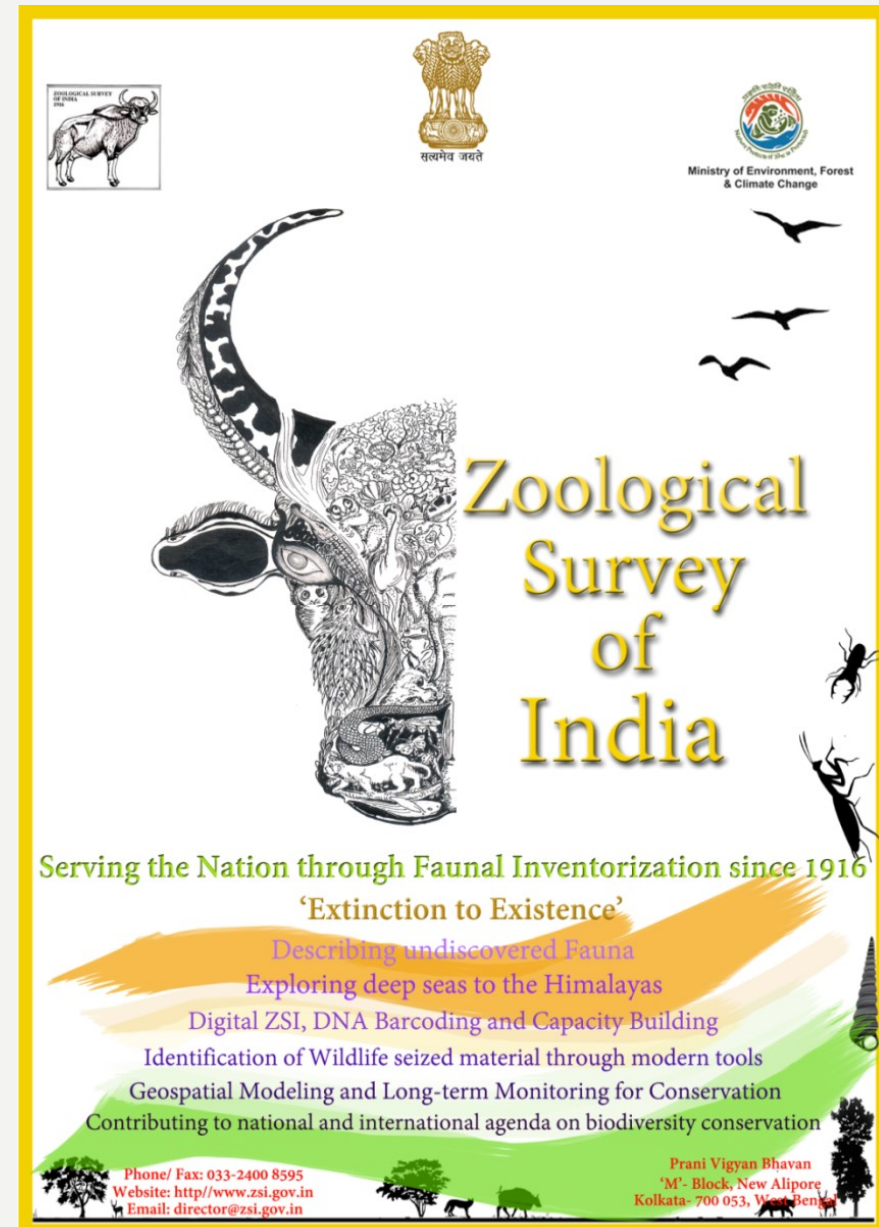
- The Zoological Survey of India (ZSI) was established on 1st July, 1916.
- To promote survey, exploration and research on exceptionally rich faunal diversity of the country.

Vision Statement

- Taxonomy towards conservation and sustaining biodiversity/faunal diversity for future

Mission Statement

- Our Mission is to contribute towards the Monitoring and conservation of the fauna by conducting status survey of Wildlife Protected species, undertaking taxonomic studies and documenting the country's vast diversity.

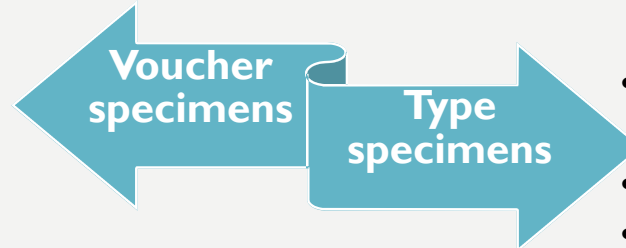


National Zoological Collection's

This slide need to updated

Strategy & Implementation

Zoological Survey
of India
**National
Repository**



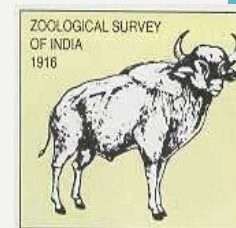
- International & National Institutions
- Universities, Colleges & Schools
- Zoological parks
- NGO's
- Awareness

N o.	Centres	No. of Types of Animals from Protozoa to Mammals
1.	HQ, ZSI, Kolkata	12000
2.	Regional Centre, ZSI	5000
TOTAL		17000

Z.S.I	Named	Unnamed	Total
HQs	24,65,168	6,38,380	31,03,548+ 8,639 slides
RCs	10,08,374	14,80,908 +	24,88,579 +2,609 slides
Total	34,73,542	21,19,288	55,92,127+11,248 slides



75
आज़ादी का
अमृत महोत्सव



भारतीय प्राणि सर्वेक्षण Zoological Survey of India

प्रथम दिवस आवरण FIRST DAY COVER

SABKA PRAYAS SABKA VIKAS....



THANK YOU