

2. DNA Mapping Identifies Pangolin Trafficking Routes Across Asia and Africa – Environment

1. Why in News

1. Scientists developed advanced "DNA maps" identifying pangolin trafficking routes and poaching hubs across Asia and Africa
2. Using population genomics targeting 671 key genome locations
3. Identified major trafficking hotspots in southwestern Cameroon, southwestern Borneo, around Myanmar
4. Evidence of trafficking networks from Arunachal Pradesh, Assam, possibly Bhutan through Yunnan, China
5. Strengthens wildlife-crime investigations and enforcement

2. DNA Mapping and Pangolin Trafficking

Genetic Mapping Technique

1. Researchers used advanced population genomics
2. Targeted 671 key genome locations (genetic markers)
3. Trace geographic origin of trafficked pangolins
4. Single nucleotide polymorphisms (SNPs) analysis
5. Geographic-specific genetic signatures

Objective

1. Identify trafficking hubs (source and transit points)
2. Understand links between domestic and international pangolin trade networks
3. Connect seizures to poaching locations
4. Map trade routes and criminal networks

Key Findings

Major trafficking hotspots identified -

1. **Southwestern Cameroon** - African pangolin species (white-bellied, giant pangolins)
2. **Southwestern Borneo** - Sunda pangolin (Southeast Asian species)
3. **Around Myanmar** - Chinese and Sunda pangolins
4. Geographic clustering of seized samples revealing trade patterns
5. Cross-border trafficking routes mapped

India Linkages

Evidence suggested trafficking networks from -

1. **Arunachal Pradesh** - Northeast border state, biodiversity hotspot
2. **Assam** - Gateway to international markets
3. **Possibly Bhutan** - Trans-Himalayan route
4. Supplying pangolin scales through **Yunnan province in China**
5. Yunnan - Major transit hub for Southeast Asian wildlife trafficking
6. Scales destined for traditional medicine markets (China, Vietnam)
7. Indian pangolin (*Manis crassicaudata*) and Chinese pangolin (*Manis pentadactyla*) both targeted

Importance of DNA Databases

1. **Geo-referenced genetic databases** - Link genetic profiles to specific geographic locations

Help enforcement agencies -

2. Identify poaching sources accurately
3. Track trafficking routes
4. Connect seizures across borders
5. Strengthen prosecution cases
6. Wildlife-crime investigations enhanced through scientific evidence

7. Similar to human forensic databases (CODIS in USA)

3. About DNA Mapping

Definition

1. Scientific technique identifying arrangement and specific locations of genes or genetic markers on chromosome or genome
2. Creating genetic "fingerprints" and population-level genetic maps
3. Whole-genome sequencing or targeted genotyping

Applications

Wildlife Conservation -

1. DNA mapping helps trace poaching hotspots
2. Identify trafficked species (forensic species identification)
3. Monitor genetic diversity in endangered animals (pangolins, tigers, rhinos, elephants)
4. Assess population health and inbreeding risks
5. Track illegal wildlife products (ivory, scales, skins)

Medical Research -

1. Detect genetic disorders (sickle cell anaemia, cystic fibrosis, Huntington's disease)
2. Study inherited diseases and genetic predispositions
3. Support development of personalized medicine (pharmacogenomics tailoring treatments to individual genetics)
4. Cancer genomics identifying mutations
5. Gene therapy research

Forensic Science -

1. Criminal investigations (matching suspects to crime scenes)
2. Victim identification (mass disasters, decomposed remains)
3. Biological evidence analysis (blood, saliva, hair, semen)
4. Paternity testing
5. Solving cold cases

Agriculture and Biotechnology -

1. Development of disease-resistant crop varieties (blight-resistant wheat, virus-resistant papaya)
2. High-yield crop varieties through genetic improvement programs
3. Marker-assisted selection in breeding
4. Genetically modified organisms (GMOs)
5. Livestock improvement

Evolutionary and Population Studies -

1. Study species evolution and phylogenetics
2. Migration patterns (human migration out of Africa, animal dispersal routes)
3. Population relationships across regions
4. Genetic divergence and speciation
5. Conservation genetics (genetic rescue, translocation planning)

4. About Indian Pangolin

Basic Characteristics

1. Nocturnal, scale-covered mammal
2. Found in Indian subcontinent
3. Among world's most trafficked mammals (all 8 pangolin species critically endangered or endangered)
4. Scientific name - *Manis crassicaudata*
5. Also called "thick-tailed pangolin" or "scaly anteater"

Habitat

1. Inhabits tropical forests, grasslands, scrublands
2. Agricultural fields and dry regions
3. Requires loose soil suitable for burrowing
4. Altitude range - Sea level to ~2000 meters
5. Adapts to human-modified landscapes but prefers natural habitats

Distribution

1. Distributed across India (most states except extreme northeast where Chinese pangolin found), Sri Lanka, Nepal, parts of Pakistan and Bangladesh
2. India - Central, southern, western regions primarily
3. Overlapping range with Chinese pangolin in eastern India, northeastern states

5. Key Features of Indian Pangolin

Protective Scales

1. Body covered with hard keratin scales (same protein as human nails and hair)
2. Scales act as Armor against predators
3. When threatened, rolls into tight ball with scales protecting vulnerable underside
4. Scales overlap like roof tiles
5. Constitute ~20% of body weight

Specialized Diet

1. Primarily feed on ants and termites (myrmecophagous)
2. Using long sticky tongue (up to 40 cm; one of longest tongues relative to body size)
3. Strong claws for digging into anthills and termite mounds
4. Toothless; swallow prey whole
5. Stomach has keratinous spines and ingested stones grinding food
6. Consume ~70 million insects annually per individual

Solitary Behaviour

1. Prefers solitary living except during breeding periods
2. Territorial but non-aggressive
3. Nocturnal activity pattern avoiding daytime heat and predators
4. Poor eyesight compensated by excellent smell

Burrowing Ability

1. Creates deep burrows for shelter and protection (3-6 meters deep)
2. Burrows have multiple chambers
3. Contributing to soil aeration and ecosystem balance
4. Abandoned burrows used by other species (monitor lizards, snakes, small mammals)
5. Ecosystem engineers modifying habitat

Other Features

1. Size - 75-90 cm body length; tail ~40-45 cm; weight 10-18 kg
2. Single offspring per birth (occasionally twins); 1-2-year intervals
3. Gestation ~120 days; offspring carried on mother's back/tail
4. Lifespan ~13 years in wild

6. Conservation Status of Indian Pangolin

Wildlife (Protection) Act, 1972 - Schedule I

1. Highest legal protection in India
2. Hunting, poaching, trading prohibited
3. Severe penalties - Imprisonment up to 7 years and/or fine up to ₹25,000
4. Enhanced penalties under 2022 amendments

IUCN Red List - Endangered

1. High risk of extinction in wild
2. Population declining due to trafficking and habitat loss
3. Assessment based on population trends, threats, range

CITES Protection - Appendix I

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora
2. Appendix I - Species threatened with extinction; commercial international trade prohibited
3. All 8 pangolin species in Appendix I since 2017 (upgraded from Appendix II)
4. Zero export quota for wild-caught specimens

7. Causes of Pangolin Trafficking

Illegal Wildlife Trade

1. **Pangolin scales** - Trafficked for traditional medicine (Chinese, Vietnamese traditional medicine believing scales treat various ailments despite no scientific evidence; scales are keratin-like fingernails)
2. **Meat** - Luxury food consumption in China, Vietnam (status symbol; pangolin meat expensive delicacy)
3. **Superstitious beliefs** - Blood, fetuses used in traditional remedies
4. Scales also used in leather goods, jewellery
5. Estimated 200,000+ pangolins trafficked annually globally (all species combined)
6. Most trafficked mammal by number of individuals

Habitat Loss

1. Deforestation for agriculture, timber, urban expansion
2. Mining activities destroying habitats (open-cast mining especially damaging)
3. Infrastructure expansion (roads, dams, industrial projects) fragmenting habitats
4. Reducing natural habitats and increasing human-wildlife conflict
5. Agricultural intensification eliminating scrublands, grasslands
6. Climate change altering suitable habitat ranges

Weak Enforcement Networks

1. Cross-border smuggling routes well-established (Northeast India-Myanmar-China; India-Nepal-Tibet)
2. Organized wildlife-crime syndicates operating internationally
3. Corruption facilitating trafficking
4. Limited enforcement capacity in remote areas
5. Inadequate penalties deterring poachers insufficiently
6. Porous borders difficult to monitor
7. Lack of coordination among enforcement agencies (customs, forest departments, police)
8. Poverty and lack of alternative livelihoods driving local communities to poaching

Other Factors

1. Accidental capture in snares/traps set for other animals
2. Roadkill increasing with road network expansion
3. Electrocution from electric fences around agricultural fields
4. Dog attacks (stray and domestic dogs)
5. Pesticide use reducing ant/termite prey availability

8. Significance of DNA-Based Wildlife Forensics

Strengthening Law Enforcement

1. DNA mapping improves prosecution by scientifically linking seized wildlife products to poaching hotspots
2. Provides irrefutable scientific evidence in courts

3. Connecting multiple seizures to same source/network
4. Identifying species (distinguishing Indian from Chinese pangolin scales)
5. Overcoming challenges of visual identification (processed products)
6. Higher conviction rates with scientific evidence

International Cooperation

1. Technology supports transnational coordination against illegal wildlife trade networks
2. Sharing genetic databases across countries (INTERPOL, UNODC initiatives)
3. Harmonizing forensic protocols
4. Joint investigations tracking cross-border trafficking
5. Mutual legal assistance in prosecutions
6. Regional cooperation frameworks (ASEAN-WEN, SAWEN)

Biodiversity Conservation

1. Scientific tracking tools help protect endangered species
2. Preserve ecological balance (pangolins control ant/termite populations preventing agricultural damage)
3. Identify priority conservation areas based on genetic diversity
4. Monitor population trends and health
5. Genetic rescue programs for fragmented populations
6. Translocation and reintroduction programs informed by genetics

Policy and Monitoring Support

1. Genomic databases enable targeted conservation planning
2. Improved wildlife-surveillance mechanisms
3. Informing CITES implementation and enforcement
4. Allocation of resources to high-trafficking areas
5. Assessing effectiveness of anti-poaching measures
6. Early warning systems for emerging trafficking routes
7. Adaptive management based on trafficking trends

Additional Benefits

1. Public awareness through scientific findings publicized
2. Deterrent effect on traffickers knowing advanced forensics used
3. Capacity building in forensic labs and wildlife departments
4. Technology transfer to developing countries
5. Research advancing conservation genetics field

9. Way Forward

Expand DNA Databases

1. Comprehensive geo-referenced genetic databases for all pangolin populations across range countries
2. Include other trafficked species (tigers, elephants, rhinos, turtles)
3. Standardized protocols for sample collection, storage, analysis
4. Open-access databases (with safeguards) for international enforcement

Strengthen Enforcement

1. Equip customs, forest departments with portable DNA testing kits
2. Training programs for enforcement officers on wildlife forensics
3. Inter-agency coordination (forest, customs, police, judiciary)
4. Stringent penalties and fast-track courts for wildlife crimes
5. Combat corruption in enforcement chain

Reduce Demand

1. Awareness campaigns in consumer countries (China, Vietnam) debunking medicinal myths

2. Engage traditional medicine practitioners promoting alternatives
3. Celebrities and influencers advocating against pangolin consumption
4. Strict penalties for buyers and consumers (not just traffickers)

Habitat Protection

1. Expand protected area network covering pangolin habitats
2. Wildlife corridors connecting fragmented populations
3. Community-based conservation involving local communities
4. Alternative livelihood programs reducing poaching pressure
5. Sustainable land-use planning minimizing habitat conversion

International Collaboration

1. CITES enforcement strengthening
2. Bilateral agreements on wildlife crime (India-China, India-Myanmar)
3. INTERPOL and UNODC support for transnational investigations
4. Regional cooperation platforms active engagement
5. Technology and capacity sharing

Research Priorities

1. Population surveys and monitoring
2. Ecological studies understanding habitat requirements
3. Breeding programs (ex-situ conservation as backup)
4. Reintroduction feasibility studies
5. Climate change impact assessments

10. Conclusion

DNA mapping identifying pangolin trafficking routes from Arunachal Pradesh-Assam-Bhutan through Yunnan, China with hotspots in southwestern Cameroon-Borneo-Myanmar strengthens wildlife-crime investigations. Indian pangolin (Endangered, IUCN; Schedule I, WPA; Appendix I, CITES) faces threats from illegal trade (scales for traditional medicine, meat as delicacy), habitat loss, and weak enforcement. DNA-based wildlife forensics strengthens prosecution, enables international cooperation, supports biodiversity conservation, and informs policy. Way forward requires expanding DNA databases, strengthening enforcement, reducing demand through awareness, protecting habitats, and enhancing international collaboration ensuring pangolin survival.

Source - <https://www.thehindu.com/sci-tech/energy-and-environment/how-scientists-are-using-dna-maps-to-expose-pangolin-trafficking-hubs/article70988109.ece>