

Global Warming and Sex Reversal in Frogs

Prelims: Current events of national and international importance | Environment

Why in News?

Recently, a study revealed that climate-change-induced sex reversal in wild Agile Frogs (*Rana dalmatina*) where extreme heat overrides genetic chromosomes to turn female tadpoles into physical males.

- **Phenomenon** - Sex reversal occurs when an organism develops anatomical and physiological reproductive traits that differ from its genetically determined sex.
- **The Heat Effect**- In agile frogs, chromosomal sex determination typically yields females (XX) and males (XY).
- However, heatwaves during early tadpole development interfere with hormonal signals and gene expression, causing genetically female (XX) tadpoles to develop into fertile physical males.

Key Scientific Findings

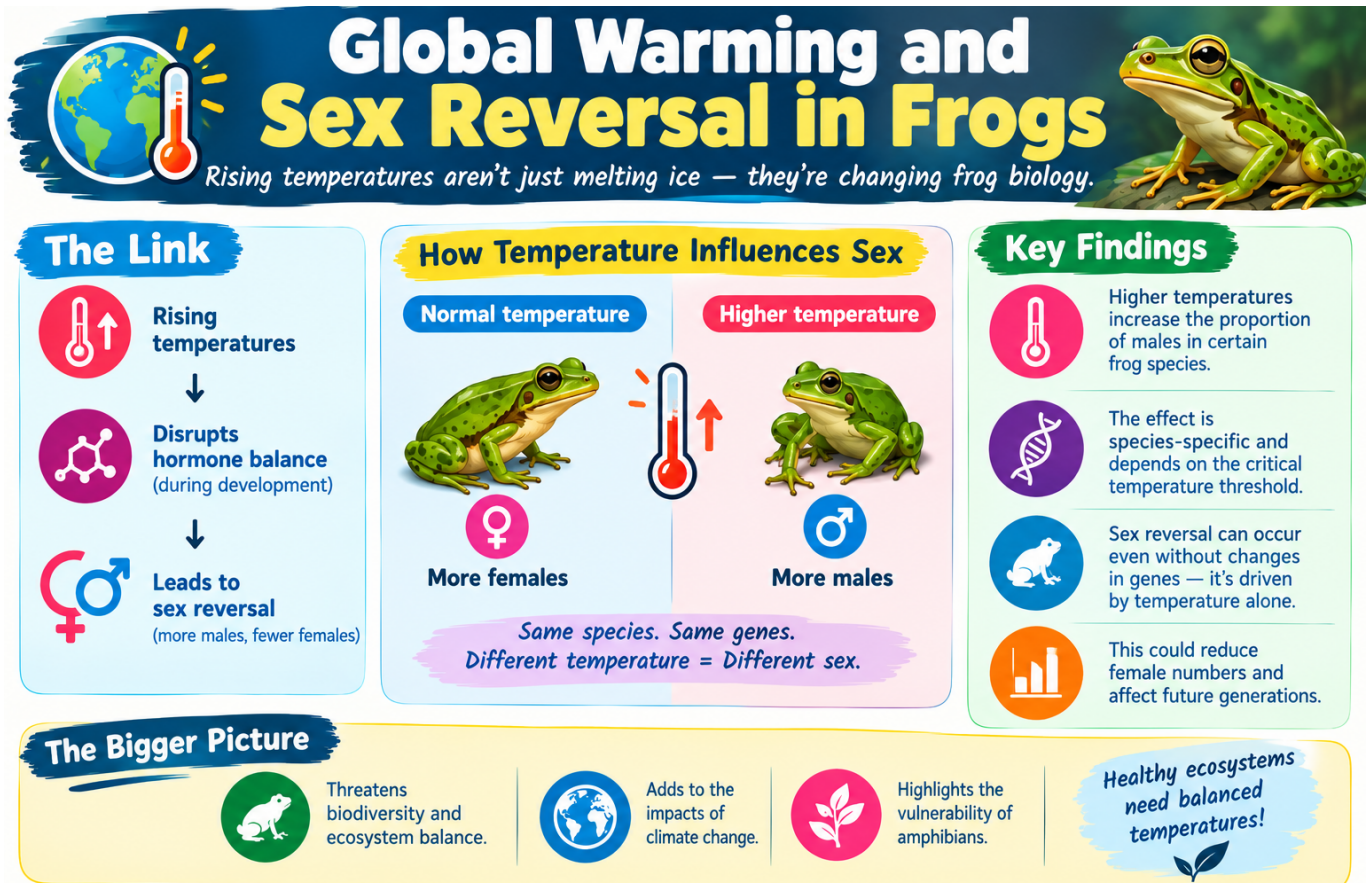
- **Reproductive Failure**
 - Although sex-reversed (XX) males are fertile, wild females exhibit a lower mating response toward them.
 - Field observations across 16 populations revealed that while sex-reversed males constituted **20% of the wild male population**, they fathered **only 4% of total egg clutches**.
- **Inherited Vulnerability in Offspring**
 - Offspring fathered by sex-reversed males demonstrated higher susceptibility to heat-induced sex reversal.
 - Under heat stress, **61% of offspring** from sex-reversed fathers developed as males despite carrying XX chromosomes, compared to only **17%** from normal XY males.
- **Synergy with Lethal Pathogens**
 - Laboratory heatwave experiments showed that tadpoles fathered by sex-reversed males carried significantly higher viral loads when exposed to **Ranavirus**.
- **Accelerated Extinction Timelines**
 - Computer modeling indicates that small, isolated frog populations subjected to skewed male-biased sex ratios could face collapse within 60 to 70 years.
 - When Ranavirus-induced mortality among offspring of sex-reversed males was factored in, population collapse occurred ~10 years earlier, and total extinction arrived 9.5 years sooner.

Significance

- **Hidden Driver in Threatened Amphibians**- Amphibians are already the most threatened

vertebrate class globally, with ~40% of species facing extinction according to IUCN estimates.

- Undetected sex reversal means field surveys relying purely on physical traits overestimate effective female breeding populations.
- **Implications for Indian Biodiversity** - In India's Western Ghats, a global hotspot for endemic frogs rising temperatures combined with deadly pathogens like *Chytrid fungus* (*Batrachochytrium dendrobatidis*) and *Ranavirus* present a dual threat.
- **Policy Imperative** - Highlights the necessity of incorporating genetic sex-monitoring, micro-habitat shading, and thermal buffer management into species action plans under the **Wild Life (Protection) Act, 1972**.



Reference

[The Hindu | Frogs' sex reversal into an extinction risk](#)