

Genomic analyses reveal poaching hotspots and illegal trade in pangolins from Africa to Asia

Xu Jiaqi

26/05/22

Large-scale pangolin scale seizures in Hong Kong



2018.07.20

Hong Kong SAR Customs

- 7.1 tons of pangolin scales;
- The largest trafficking case up to that year;



2019.01.16

Customs of Hong Kong and Mainland

- 8.3 tons of pangolin scales;
- 2.1 tons of African ivory;
- Broke the record;



Between 2012 and 2018 alone, Hong Kong Customs seized 32 shipments of pangolin scales.

Limitations of traditional trafficking investigations



Long-term joint law enforcement efforts with Nigeria have been carried out, yet illegal activities have not been effectively curbed.

Traditional customs investigations can only identify transit countries and cannot pinpoint the true source of illegally traded pangolins.

Can genomic techniques help trace the true origin of trafficked pangolins?

Collaborating research groups



Timothy Bonebrake
HKU



Thomas Smith
UCLA

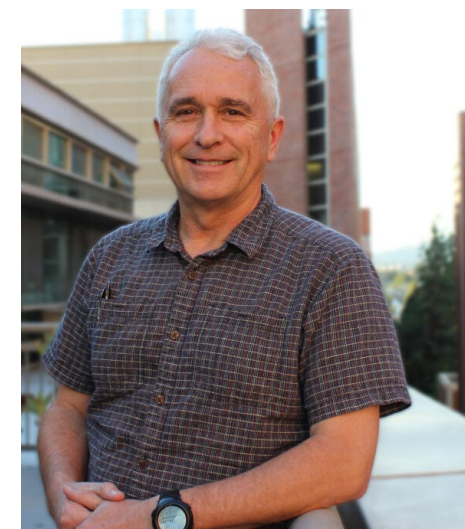
CONSERVATION

Genomic analyses reveal poaching hotspots and illegal trade in pangolins from Africa to Asia

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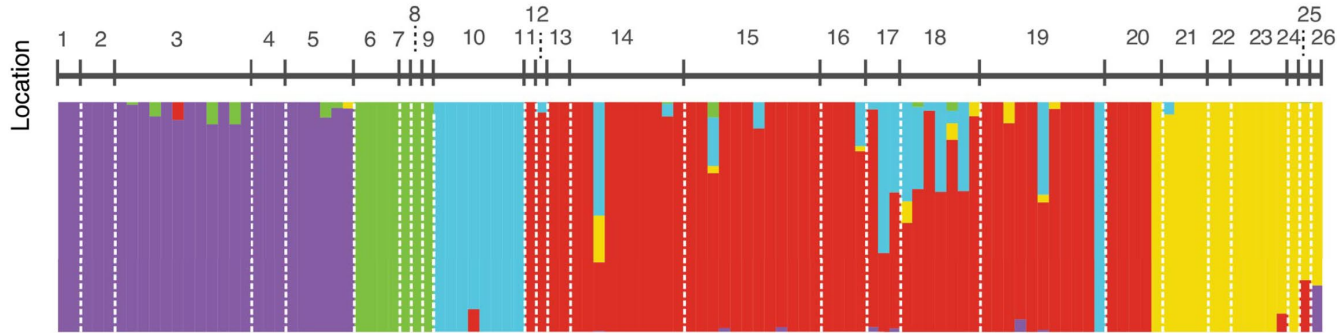
Timothy Bonebrake
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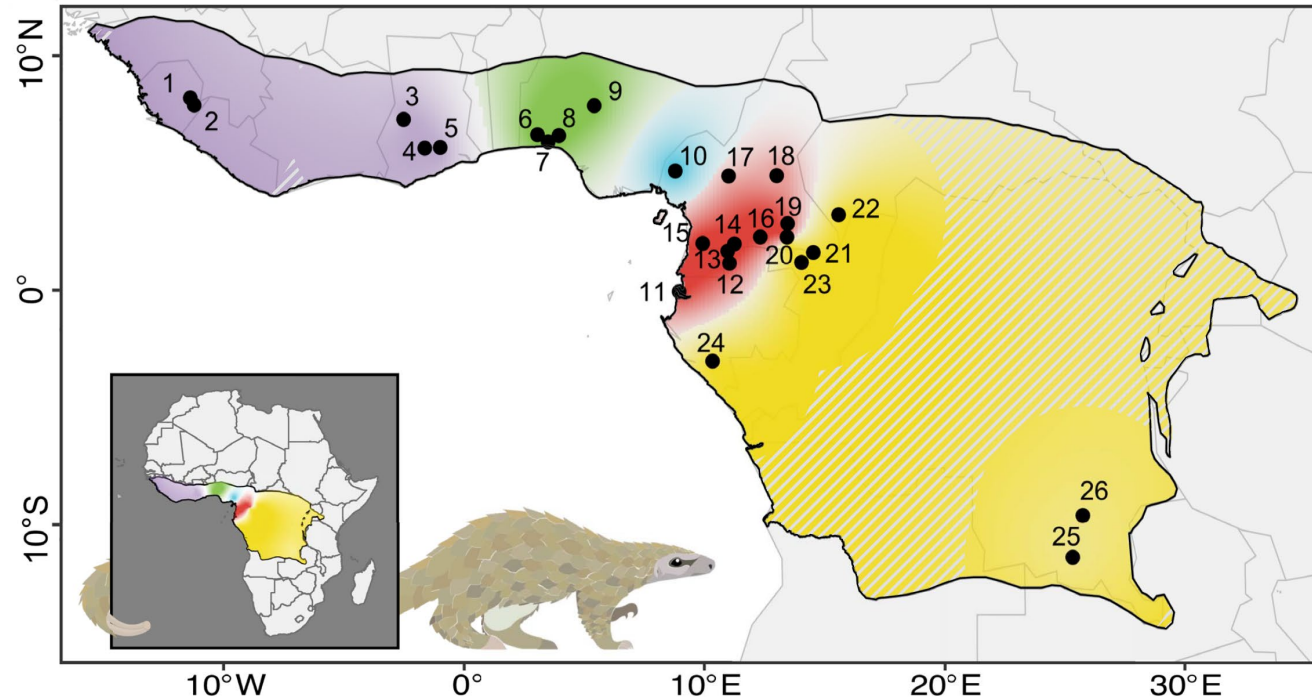
Thomas Smith
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Genomic population structure of white-bellied pangolins

- > 4 million genome-wide SNPs from 111 GPS-located samples



Five genetic clusters



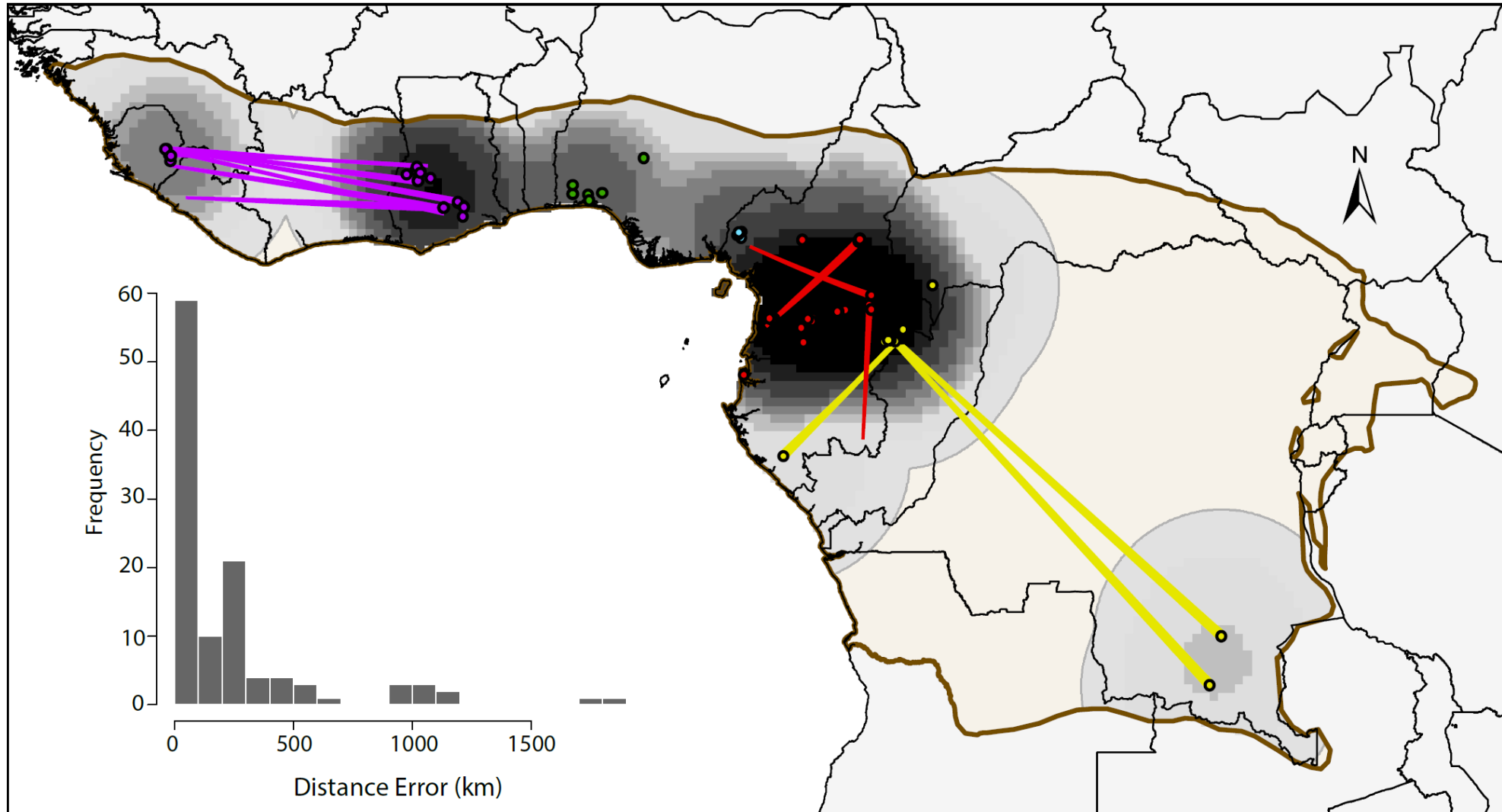
Reference map for tracing seized scales;

Predict confiscated scale origin using Rubias & OriGen with 96 diagnostic SNPs

- **Can this model accurately trace the geographic origins of poached white-bellied pangolins?**
- **What is the true structure of the illegal trade network from African poaching hotspots to Asian end markets?**

- **Can we accurately trace the geographic origins of poached white-bellied pangolins using genomic data?**
- What is the true structure of the illegal trade network from African poaching hotspots to Asian end markets?

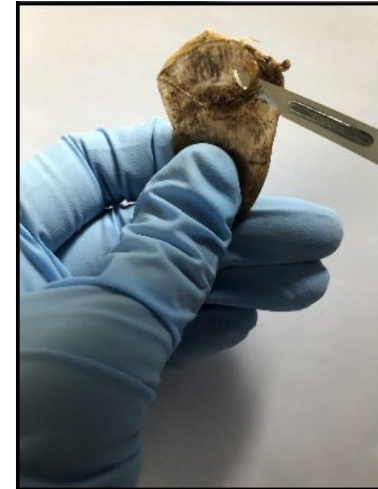
Validation of SNP-based geographic assignment



- **Most known-origin samples were assigned close to their true locations, with 87.4% within 500 km;**
- **Accuracy is lower in broad or poorly sampled genetic clusters (colored lines);**

- Can we accurately trace the geographic origins of poached white-bellied pangolins using genomic data?
- **What is the true structure of the illegal trade network from African poaching hotspots to Asian end markets?**

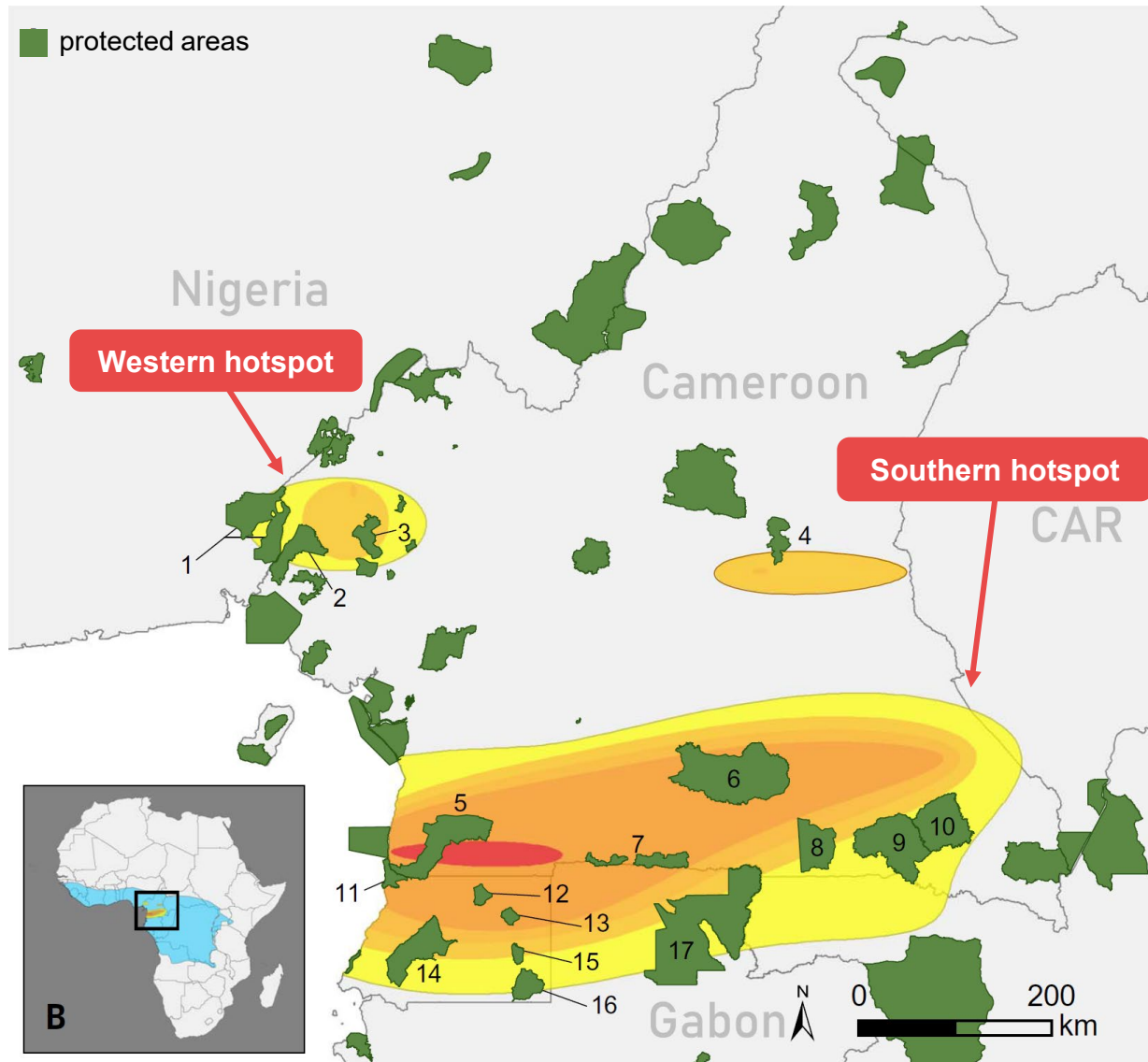
Seized white-bellied pangolin scales



Remnant skin on the scales was collected and cut for DNA extraction.

Confiscated white-bellied pangolin scales used for DNA extraction and downstream origin assignment.

Where are the likely poaching hotspots for white-bellied pangolins?

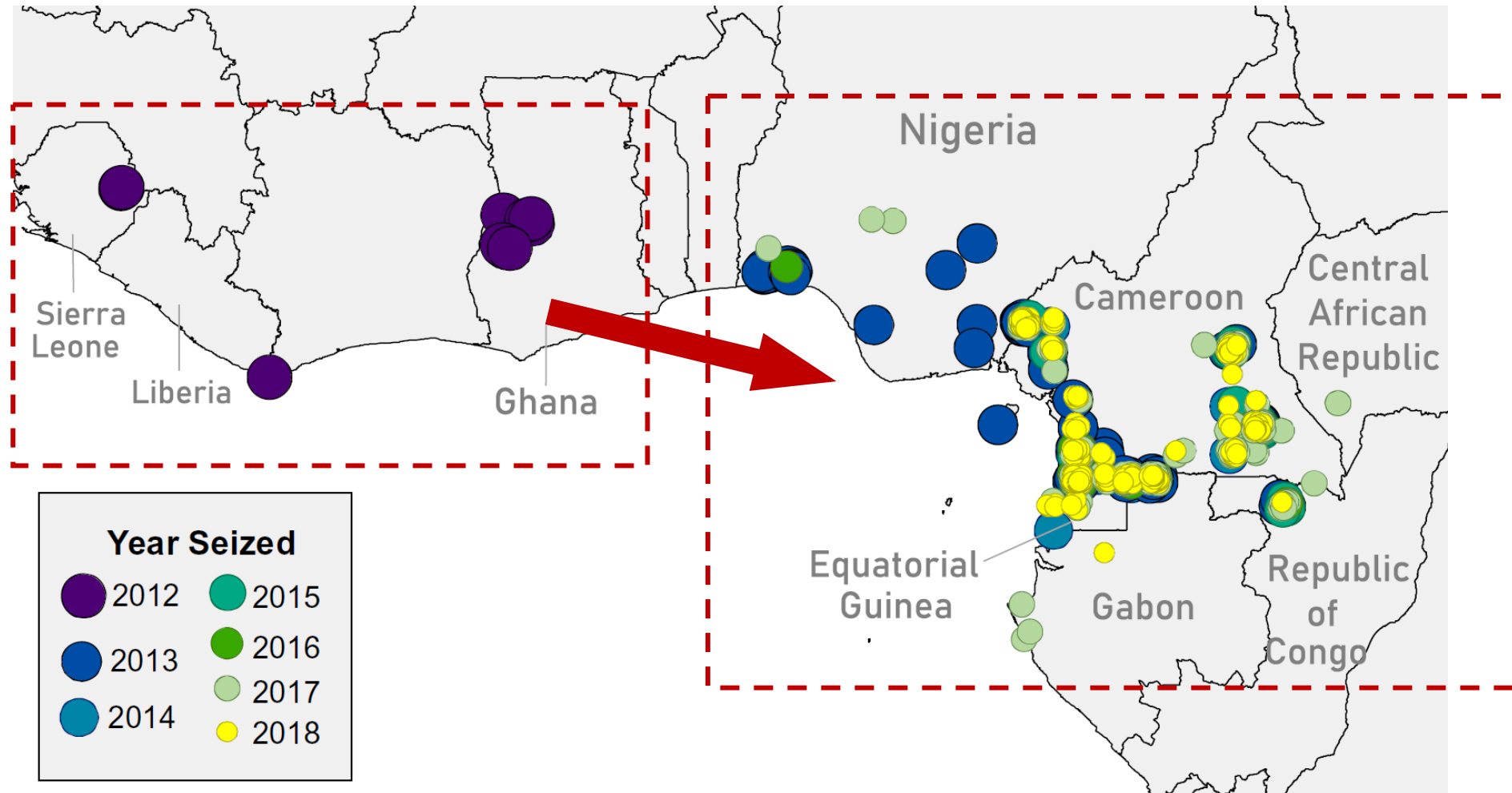


Two major hotspots

- Western hotspot: Cameroon-Nigeria border (Cross River NP, Korup NP);
- Southern hotspot: S. Cameroon – Eq. Guinea – Gabon (Congo basin)

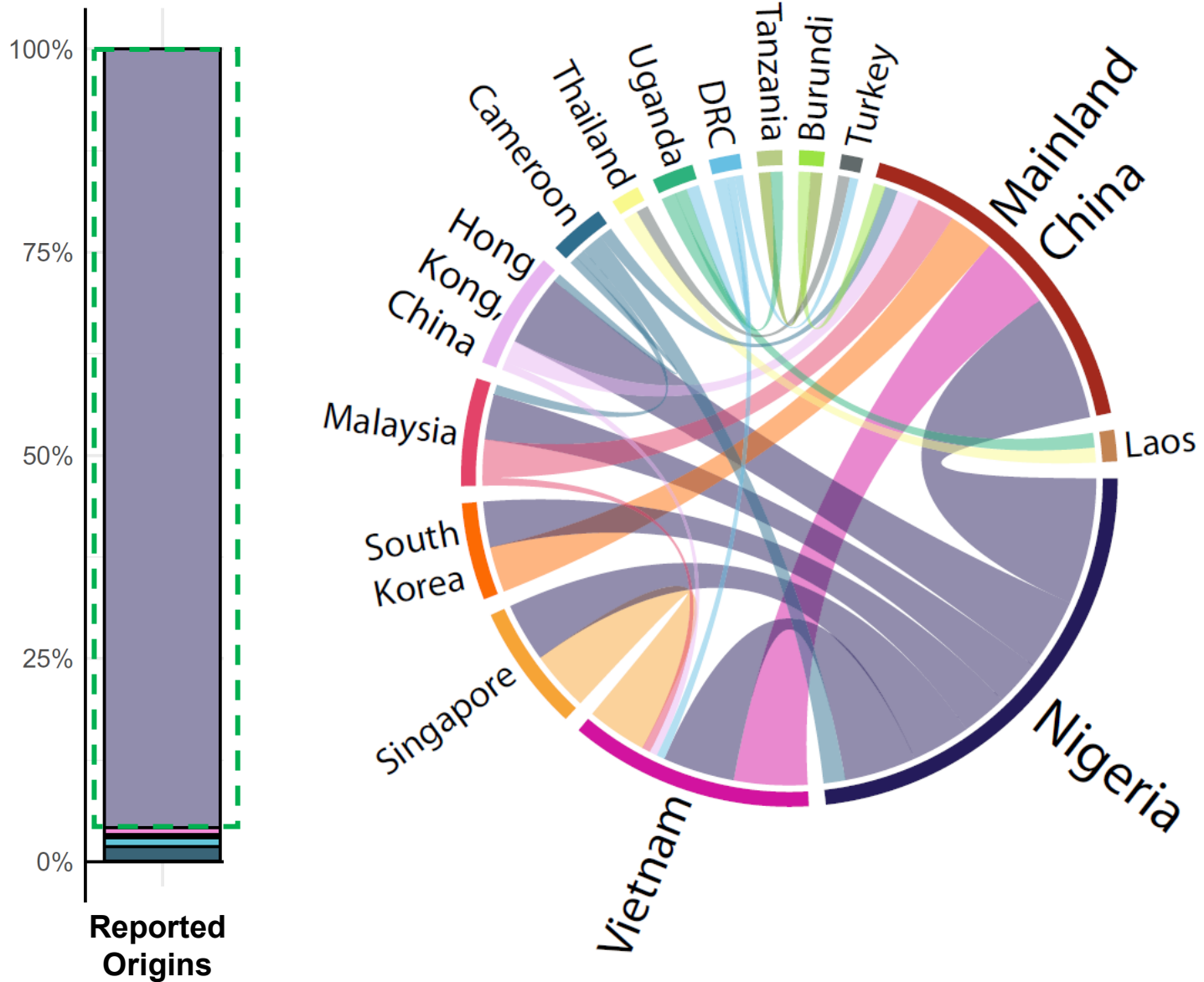
Hotspots **OVERLAP** with protected areas;
Boundaries alone are insufficient;

Changes in pangolin poaching over time



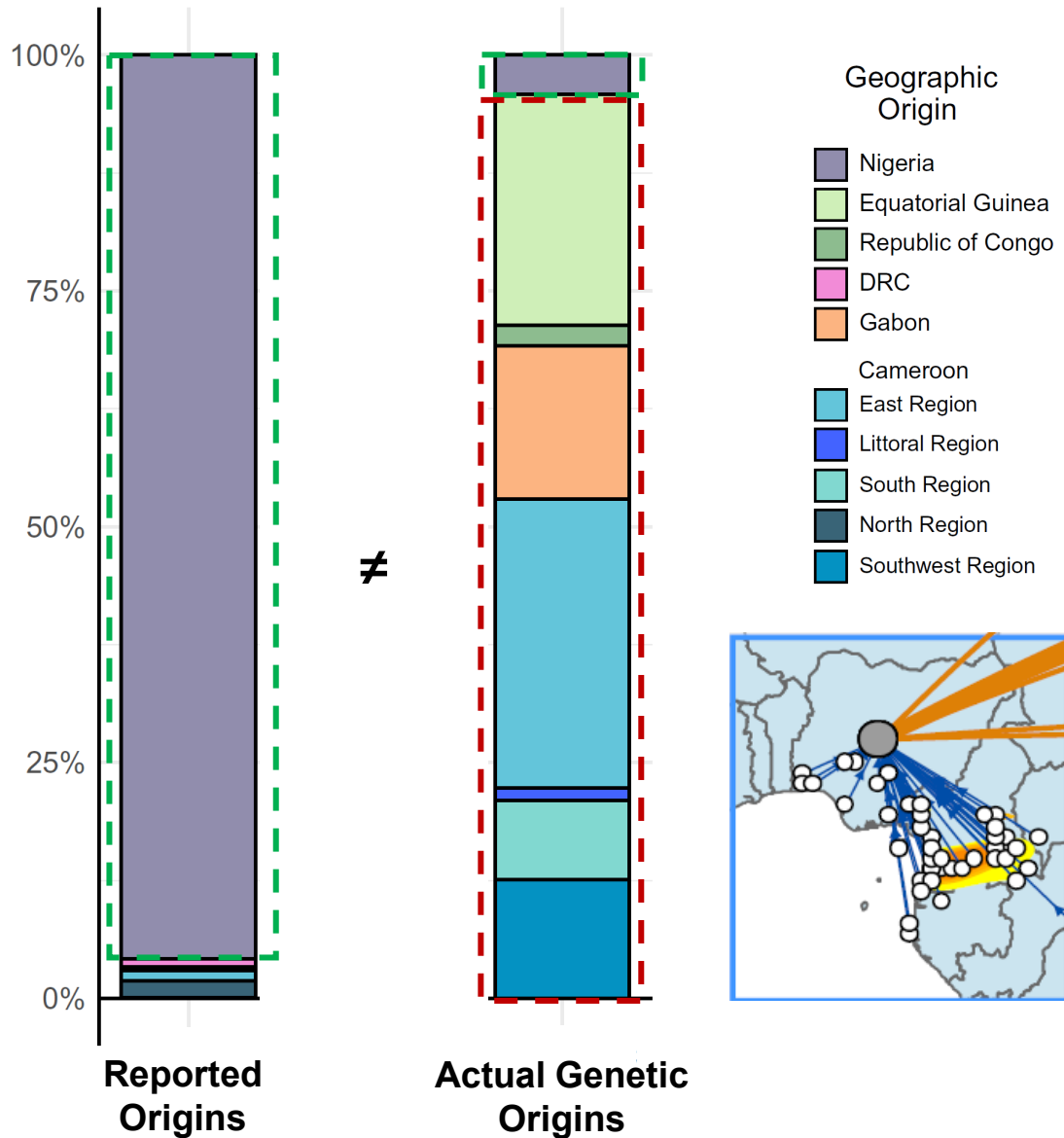
- **2012: Mainly in Sierra Leone, Liberia, and Ghana;**
- **2013-2014: Shifted eastward, mainly in Nigeria-Cameroon border (Western hotspots);**
- **2015-2018: Concentrated in Congo basin (S. Cameroon, Equatorial Guinea, Gabon);**

Nigeria is a Trafficking Hub, Not the Origin



- **Customs data show that over the past 40 years, the pangolins smuggled from Africa to Asia have mainly come from Nigeria;**

Nigeria is a Trafficking Hub, Not the Origin



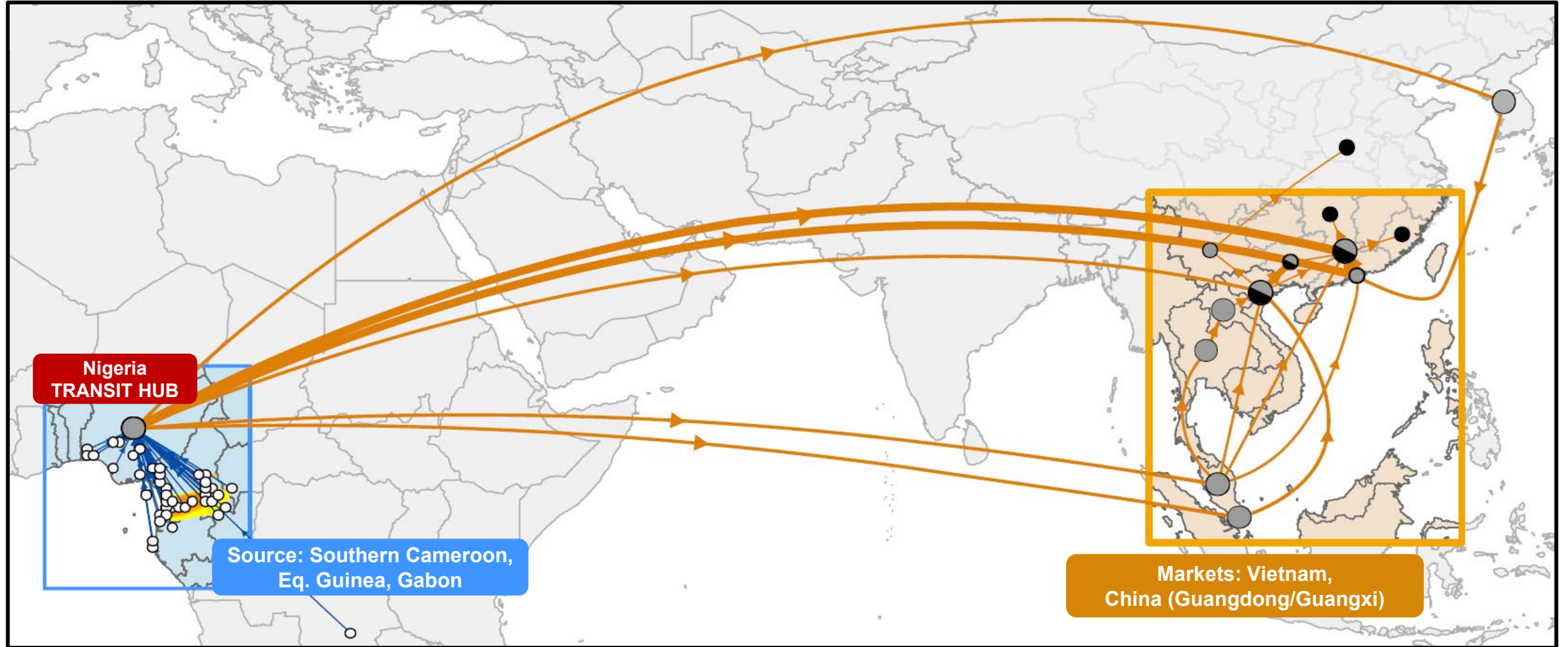
- **Bulk of the trafficked pangolins originate from the Congo Basin (Cameroon, Equatorial Guinea, Gabon).**

Seizure data indicates Nigeria (95.1%) as the primary source;

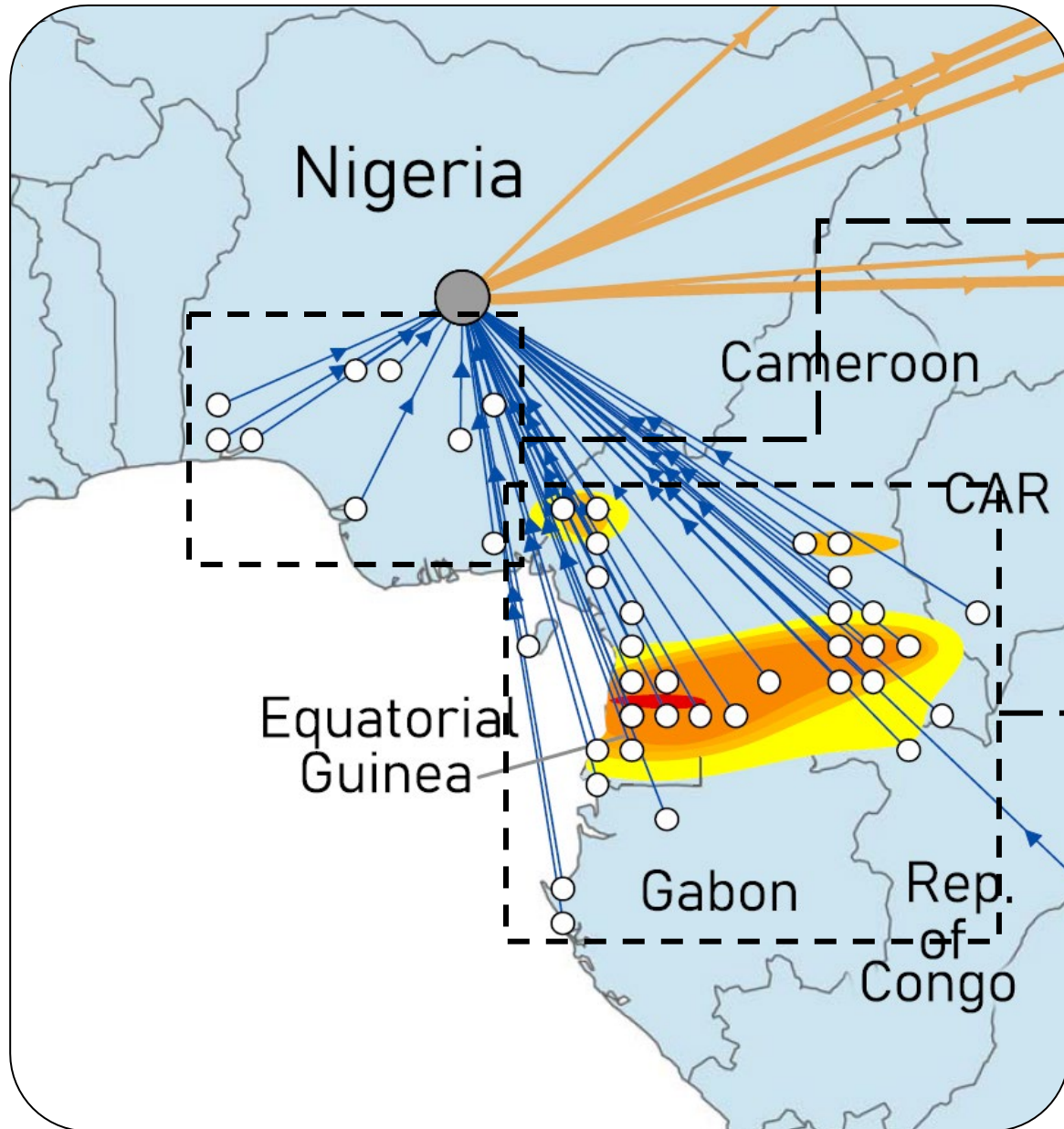
Genomic evidence reveals Nigeria only accounts for 4.2%.

A transit hub, rather than a poaching source

An origin-to-destination map of pangolin trafficking



Zoomed-in look at source localities for African pangolins transited through Nigeria



Domestic Sources (Only 4.2%)

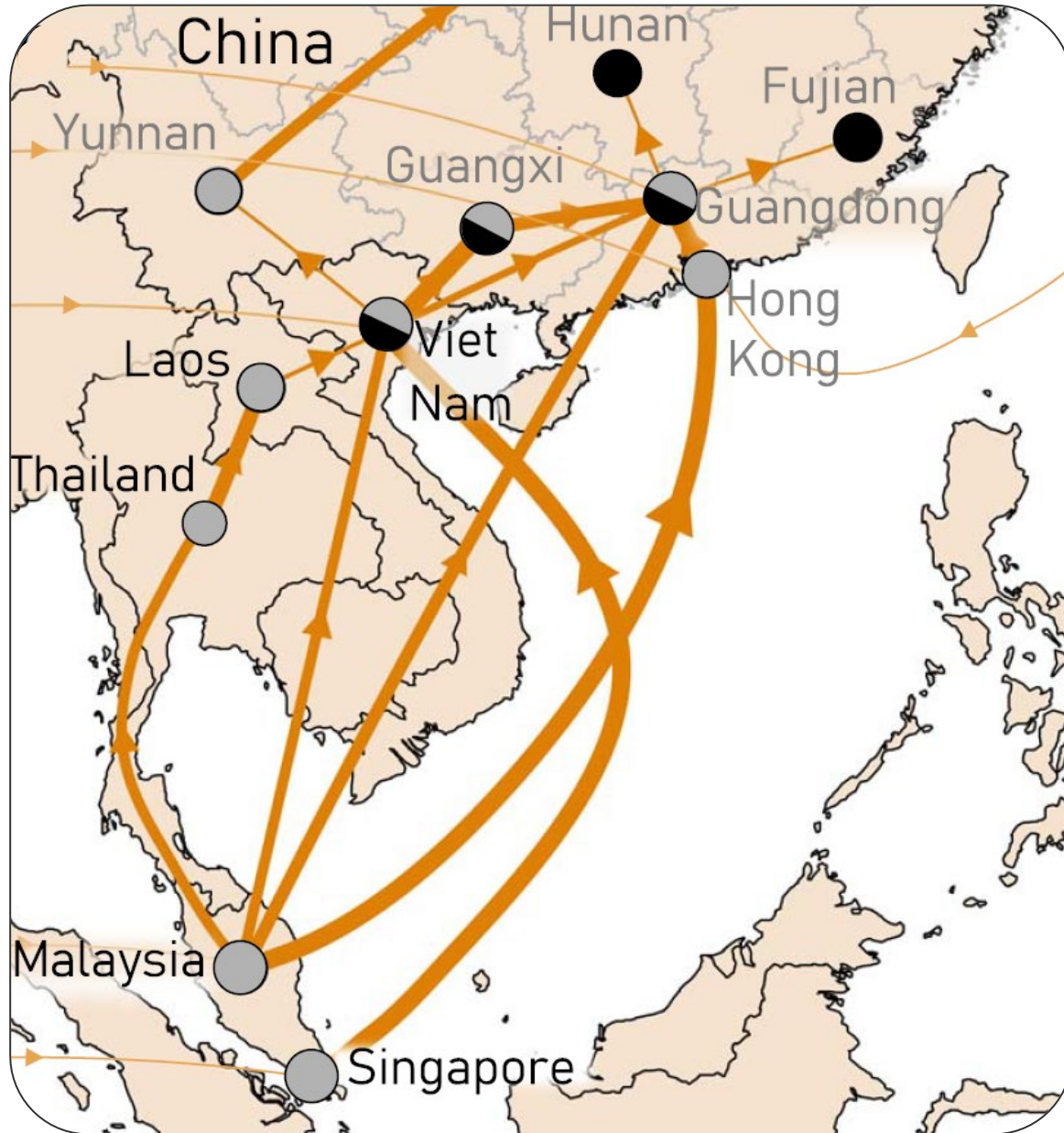
Originated from domestic Nigerian populations

Transboundary Sources (Majority)

Most originated from Central African populations (Southern Cameroon, Equatorial Guinea, and Gabon)

Nigeria acts as a trafficking hub

Routes taken by African pangolins once they arrive in Southeast Asia



○ Route Characteristics

From 3097 global seizure incidents (1981–2022)

Poaching sources

Poaching from central Africa, and transferring to Nigeria



Major transshipment hubs

Singapore, Malaysia, Thailand, Viet Nam, and Hong Kong



Destinations

Guangdong, Guangxi, and Yunnan Province

This study uses pangolin genomic data to reconstruct the trafficking route from poaching sources to final markets, revealing hidden details of the illegal trade network that traditional investigations had missed.

1 Methods

- **Built a genomic assignment model using reference samples from known locations.**
- **Enabled source tracing for unknown and degraded seized scales.**

2 Main findings

- **Identified major poaching hotspots in the Congo Basin.**
- **Revealed a temporal shift in poaching pressure from West Africa to Central Africa.**
- **Showed that Nigeria is mainly a transit hub, not the true origin.**

3. Significance

- **Reconstructed the full pangolin trafficking network from source to destination.**
- **Demonstrated the value of genomics in improving wildlife trafficking investigations.**

Thanks for your attention!

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