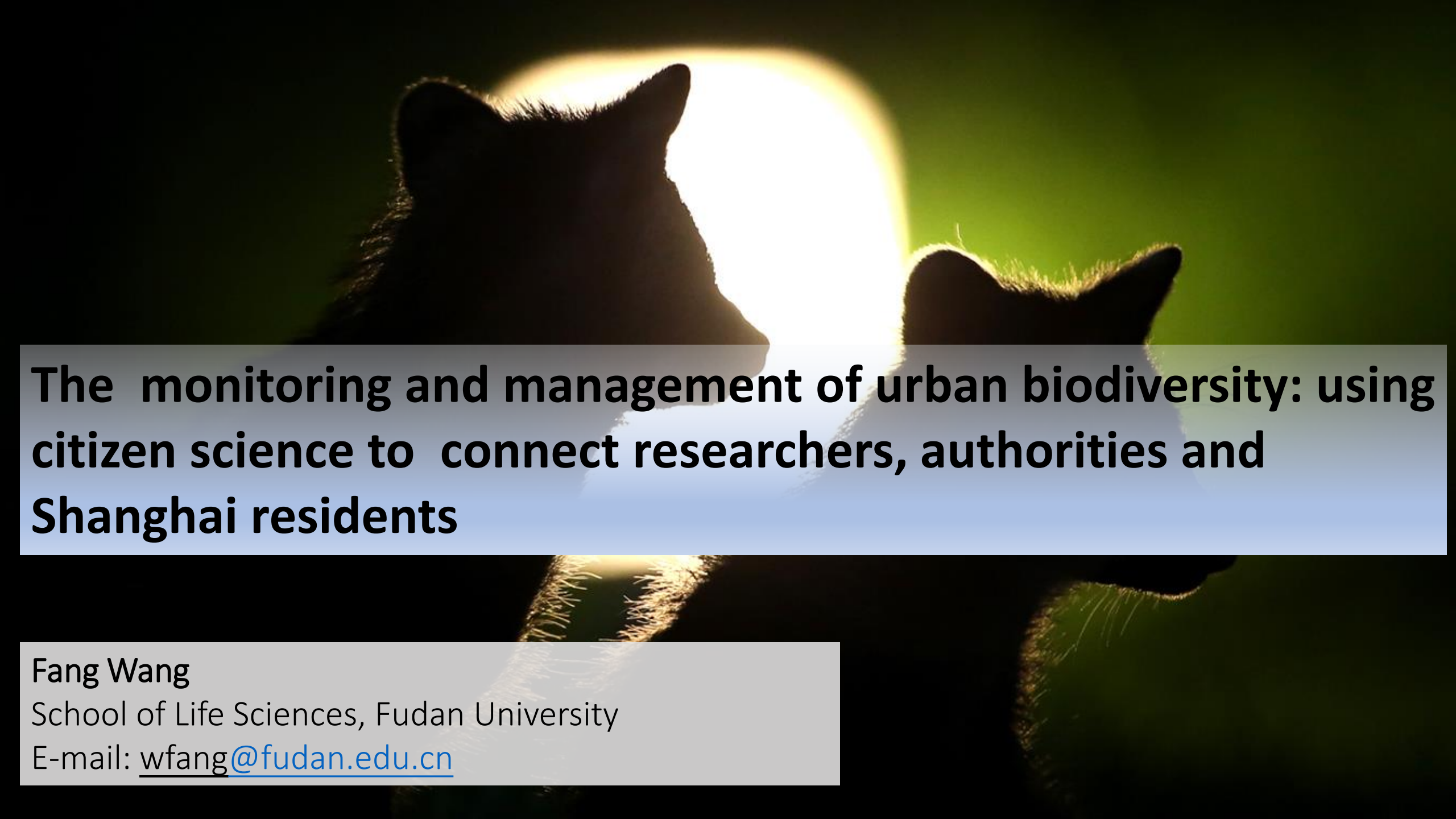


The monitoring and management of urban biodiversity: using citizen science to connect researchers, authorities and Shanghai residents

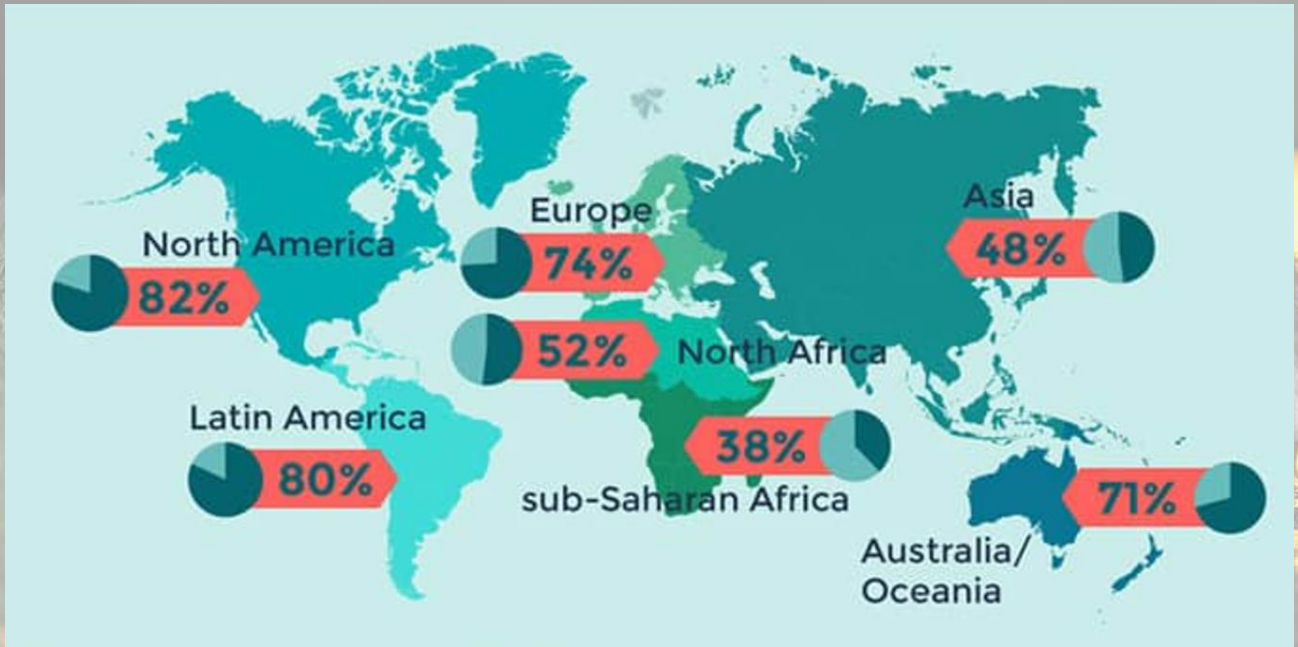
Fang Wang
School of Life Sciences, Fudan University
E-mail: wfang@fudan.edu.cn

The monitoring and management of urban biodiversity: using citizen science to connect researchers, authorities and Shanghai residents

Fang Wang[1], Zirong Li[2], Yuhan Li[3], Yidi Feng[3], Yihan Wang[1], Qianqian Zhao[1],
Lishan Tang[1], Xi Zhao[1], Yixin Diao[1], Yue Weng[1], Lei Ji[2], Yunxiang Zheng[2], Yongrui Chen[3]
1. Fudan University 复旦大学
2. Shanghai Forestry Bureau 上海市林业总站
3. Shanshui Conservation Center 山水自然保护中心

Urban biodiveristy: importance and resistance

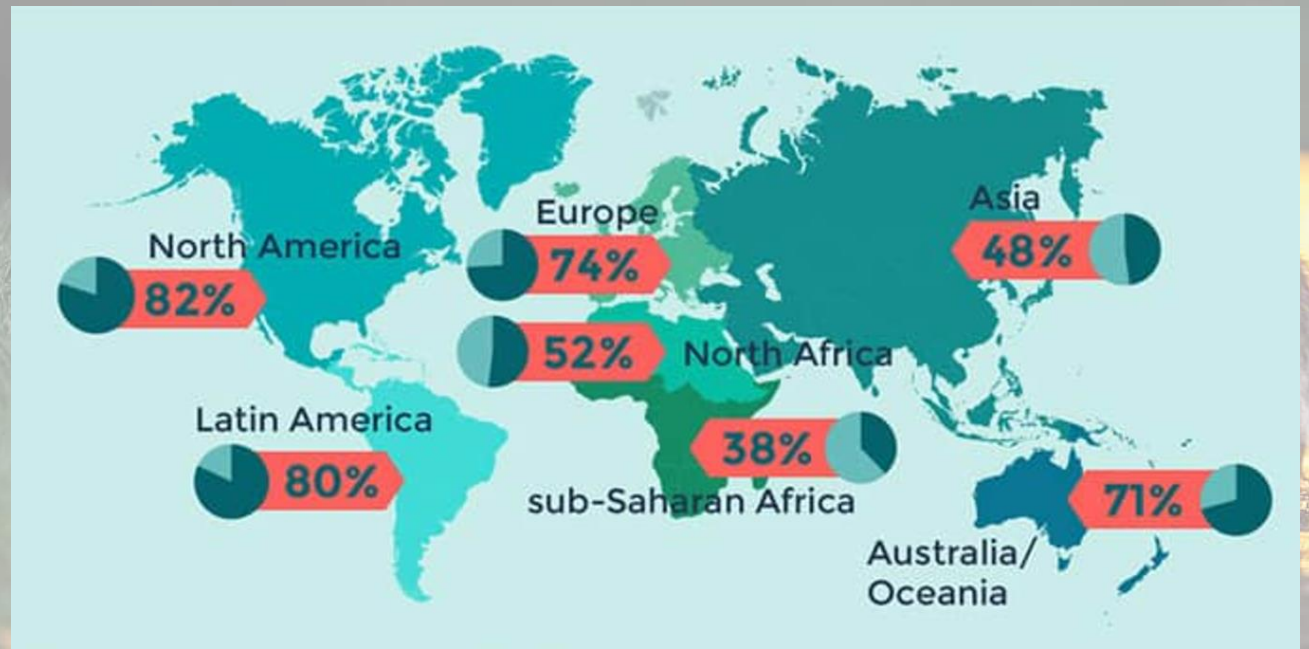
- **Urban biodiversity**: The sum of species and ecosystem diversity, genetic and habitat diversity in urban areas
- Global urban population: 4.5 billion (58%) , **increasing interaction** between urban biodiversity and humans.



Dearborn and Kark 2010; Zari 2018

Urban biodiveristy: importance and resistance

- **Urban biodiversity**: The sum of species and ecosystem diversity, genetic and habitat diversity in urban areas
- Global urban population: 4.5 billion (58%) , **increasing interaction** between urban biodiversity and humans.
- A vital role in development and human life, **key ecological services and functions**.



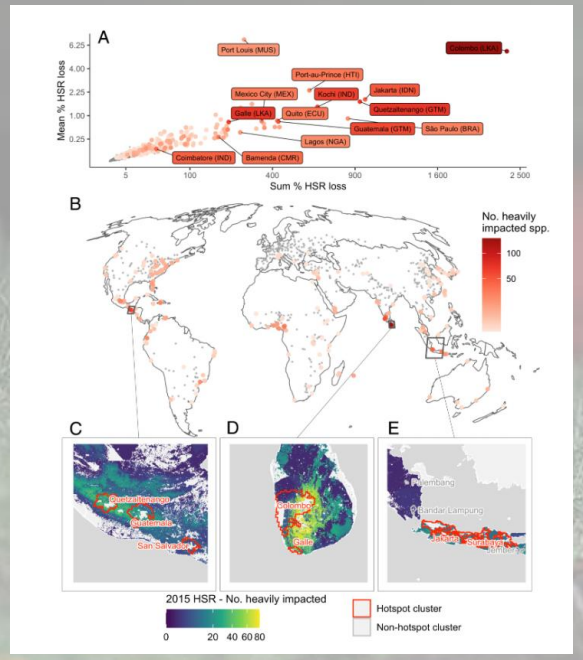
Major Motivations for Urban Biodiversity Conservation

Benefits to nature	Preserve local biodiversity in an urbanizing environment and protect important populations or rare species
	Create stepping stones or corridors for natural populations
	Understand and facilitate responses to environmental changes
	Connect people with nature and provide environmental education
	Provide ecosystem services
	Fulfill ethical responsibilities
Benefits to humans	Improve human well-being

Dearborn and Kark 2010; Zari 2018

Urban biodiveristy: importance and resistance

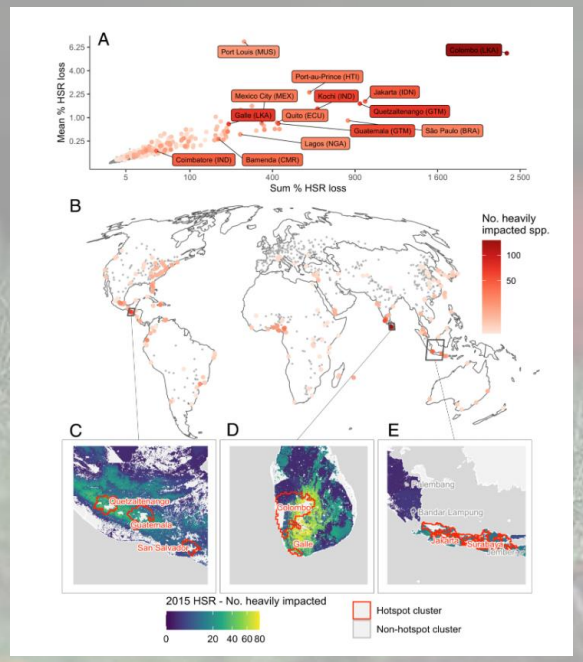
- Coexistence of loss and resilience
  - Most research focus on **the decline in biodiversity caused by urbanization**
  - Overlooks that **humans and wildlife coexisted in urban areas** since recorded history

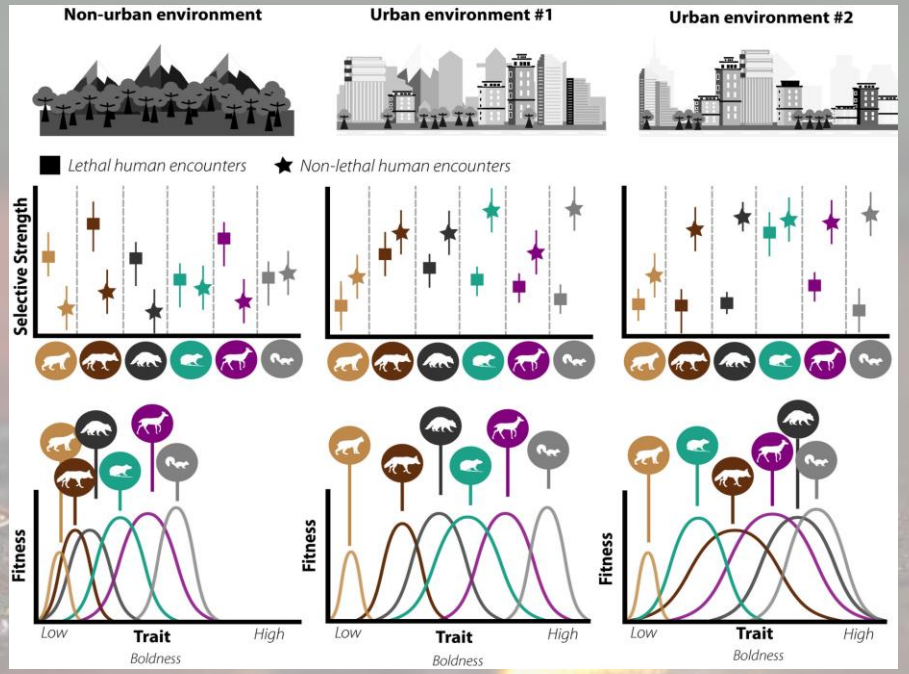


Schell 2020; Simkin et al. 2022;

Urban biodiveristy: importance and resistance

- Coexistence of loss and resilience
  - Most research focus on **the decline in biodiversity caused by urbanization**
  - Overlooks that **humans and wildlife coexisted in urban areas** since recorded history
  - Urban species exhibit high behavioral plasticity, increasing in number and spreading distribution, **adapting to urban environments**.

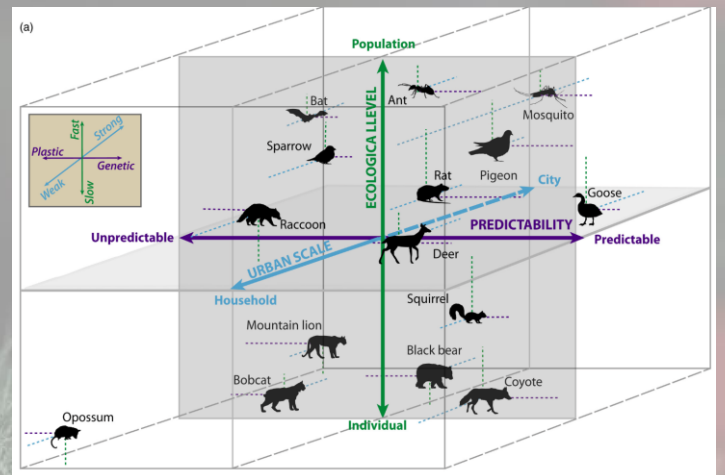




Schell 2020; Simkin et al. 2022;

Monitoring Gaps and Human-Wildlife Conflicts

- Changes in urban biodiversity and human-wildlife conflicts
  - **Rapid changes** in genetics, morphology, personality, behavior, population, distribution…



(b)

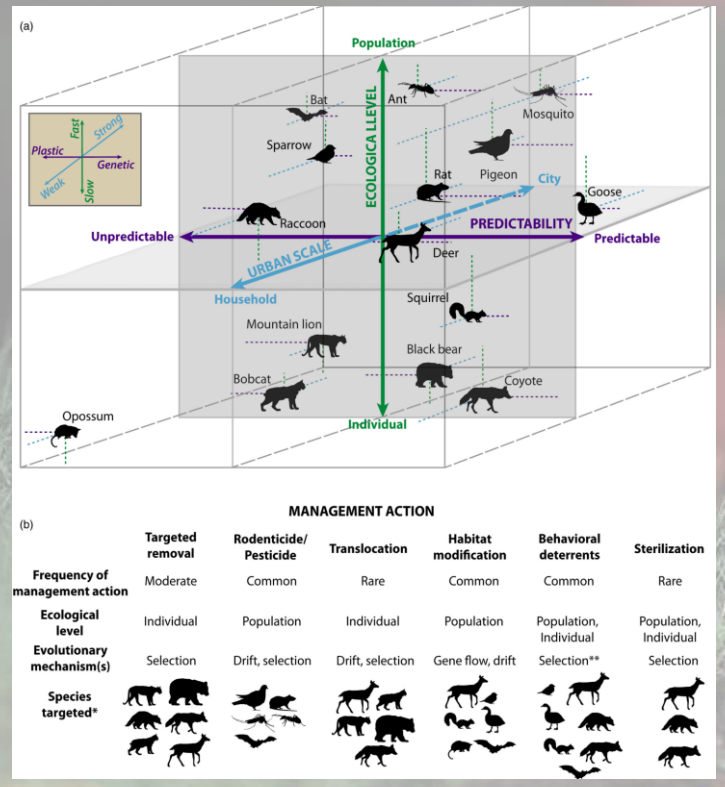
MANAGEMENT ACTION

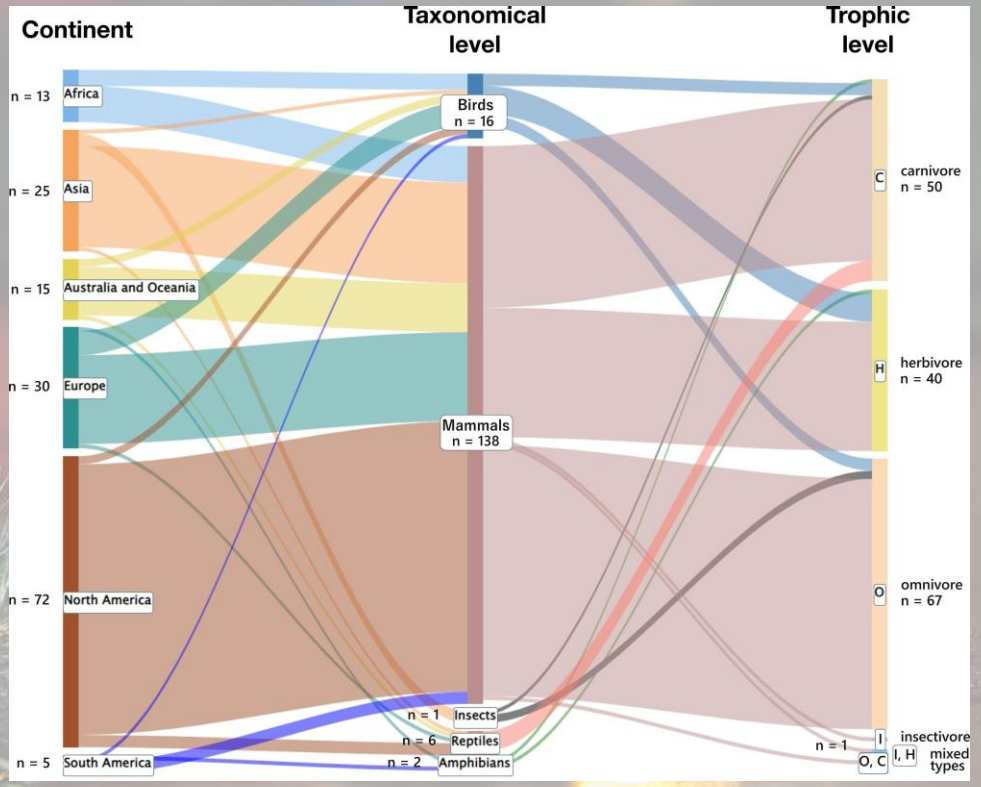
	Targeted removal	Rodenticide/ Pesticide	Translocation	Habitat modification	Behavioral deterrents	Sterilization
Frequency of management action	Moderate	Common	Rare	Common	Common	Rare
Ecological level	Individual	Population	Individual	Population	Population, Individual	Population, Individual
Evolutionary mechanism(s)	Selection	Drift, selection	Drift, selection	Gene flow, drift	Selection**	Selection
Species targeted*						

Basak et al. 2023; Schell et al. 2020

Monitoring Gaps and Human-Wildlife Conflicts

- Changes in urban biodiversity and human-wildlife conflicts
  - **Rapid changes** in genetics, morphology, personality, behavior, population, distribution…
  - **All taxonomic groups are involved**, mammals the highest proportion





Basak et al. 2023; Schell et al. 2020

Monitoring Gaps and Human-Wildlife Conflicts

- Human-Wildlife Conflicts in cities
  - Direct conflicts: attacks, harassment, traffic accidents, etc.
  - Indirect conflicts: parasites, zoonotic diseases, noise, environmental pollution, etc.
  - **Monitoring gaps, conservation challenge, and human-wildlife conflicts are universally present globally.**

Coyote in Los Angeles

Red fox in London

Wild boar in Nanjing, Hangzhou, Shenzhen

Raccoon dogs *(Nyctereutes procyonoides)*

Raccoon dogs *(Nyctereutes procyonoides)*

- Noctornal activity pattern
- Solitary species
- Live in **mountainous areas**
- Omnivore foraging strategy

Raccoon dogs *(Nyctereutes procyonoides)*

- Historical distribution **throughout eastern China**
- **Population disapeared** in most urban/ suburban areas

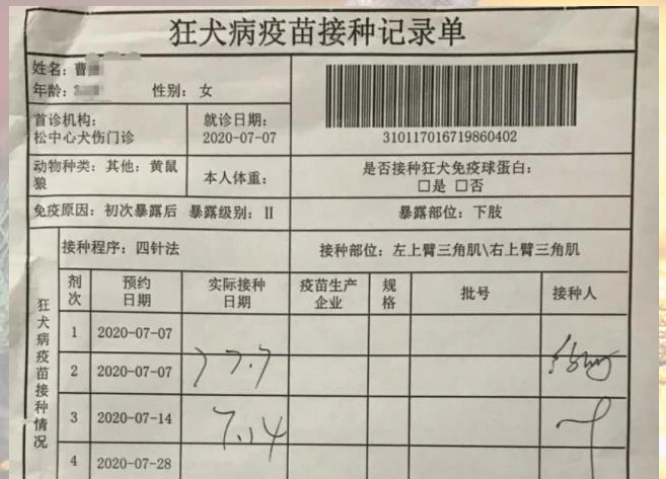
2020:
70+ individuals in one community

2020:
Found in 30 residential districts

2021: 170 residential districts
2024: 300+ residential districts

Surge in Human-Raccoon Dog Conflicts in Shanghai

- Surge in Conflicts
  - Over 300 residential areas
  - Distributed in all districts and counties
  - **Conflicts/ complaints: 0 to 300+**
  - **3 Direct attack**
  - **Tens of illegal poaching**


狂犬病疫苗接种记录单

姓名：曹
年龄：　性别：女
首诊机构：松中心犬伤门诊
就诊日期：2020-07-07
动物种类：其他：黄鼠狼
本人体重：
是否接种狂犬免疫球蛋白：□是 □否
免疫原因：初次暴露后　暴露级别：II
暴露部位：下肢
接种程序：四针法
接种部位：左上臂三角肌\右上臂三角肌

狂犬病疫苗接种情况	剂次	预约日期	实际接种日期	疫苗生产企业	规格	批号	接种人
	1	2020-07-07					
	2	2020-07-07	7.7				
	3	2020-07-14	7.14				
	4	2020-07-28					

百度为您找到相关结果约21,200个

上海一小区野生貉泛滥:是什么让胆小的它们攻击人
2020年8月8日 - 7月下旬,据上海本地媒体报道,上海市松江区
在60只到80只之间,密度超正常小区数倍。 网络上流传的视频
www.esaga.com/share_artic...ph... - 百度快照

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腾讯网 - 百度快照

松江米兰诺贵都的貉 老干部闲聊 篱笆网 - 年轻家
29条回复 - 发帖时间: 2020年7月22日
2020年7月22日 - 不过那是去年的事了 然后今晚 我去地库停
说看到只小浣熊 我说怎么可能 刚看到你们说貉 才想起来去年
www.libaclub.com/t_13_10604600... - 百度快照

上海一小区野生貉泛滥:是什么让胆小的它们攻击人
2020年8月7日 - 幼貉与流浪猫 7月下
松江区米兰诺贵都小区野生貉数量激
常小区数倍。
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松江一小区惊现野生貉"邻居",看似萌萌也会咬人!专
2020年7月15日 - 小区管理优美生态好,凉亭后面就有貉的土洞
中央人车分流,绿化灌木密,品种多,当了15年物业经理的马晓华
腾讯网 - 百度快照

微广场:"上海一小区野生貉泛滥:是什么让胆小的它
2020年8月8日 - 7月下旬,据上海本地媒体报道,上海市松江区
在60只到80只之间,密度超正常小区数倍。 网络上流传的视频

Research and conservation goals

- **Species perspective**
  - Is the species **adapted to human environment?**
  - What is the population **trend in near future?**

- **Human perspective**
  - How to alleviate human-raccoon dog conflict?
  - What method can be used to promote coexistence?

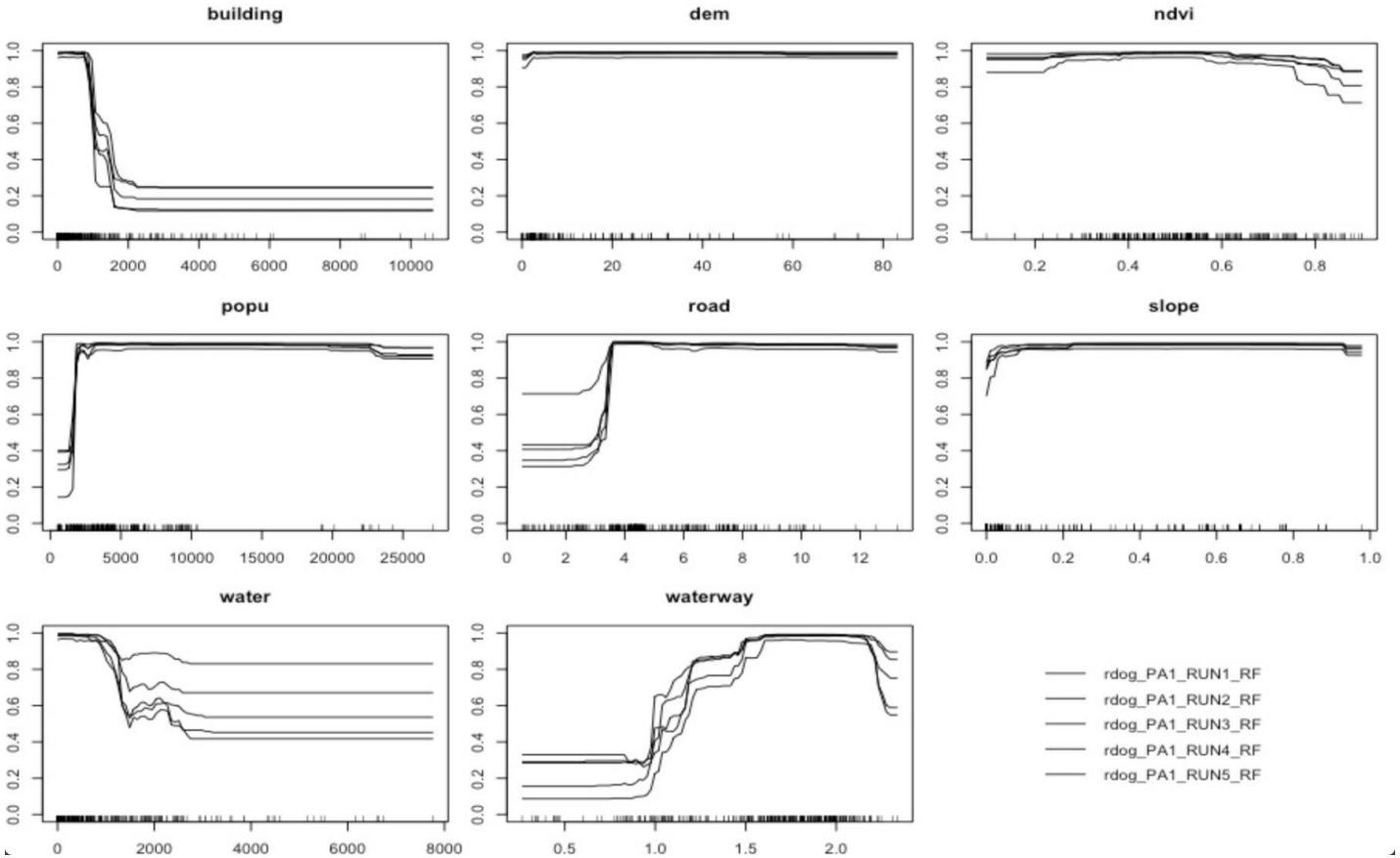
Habitat modeling：
Revealing species' positive association with human

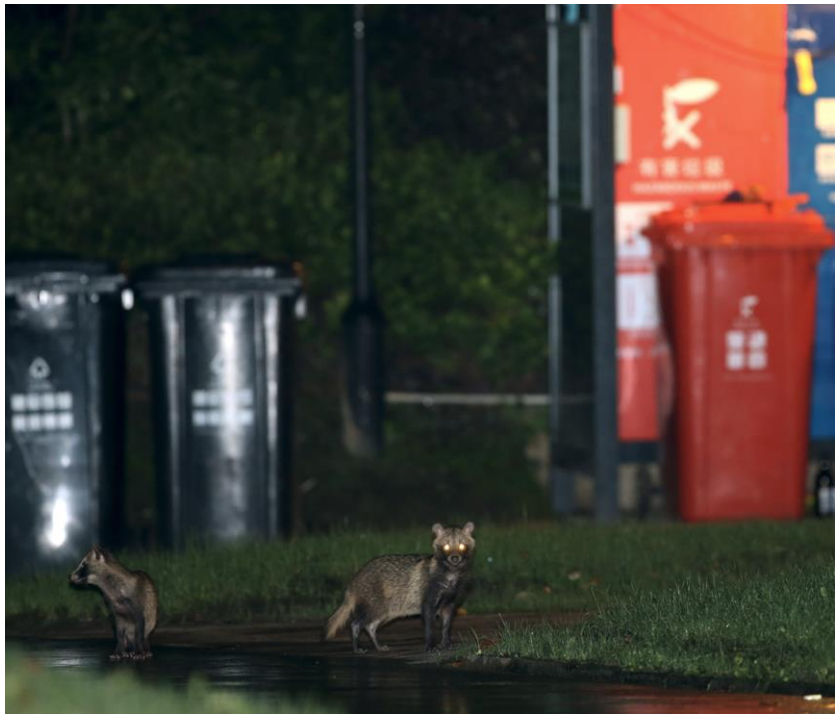
- Field techniques
  - Camera trapping
  - Sign transect
  - GPS tracking

- Ensembling modeling approach
  - Occupancy modeling
  - Random forest

Species positively associated to human factors

- Positive association:
  - **Road density**, **night light**, **human density**
- Negative association:
  - Large lake, farmlands



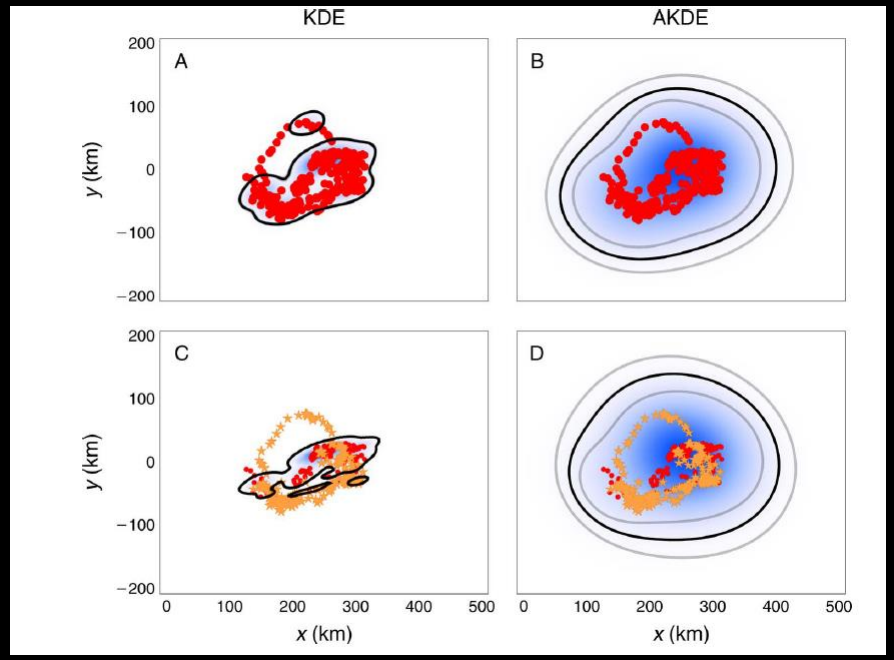


***Landscape and Urban Planning* (2021)**

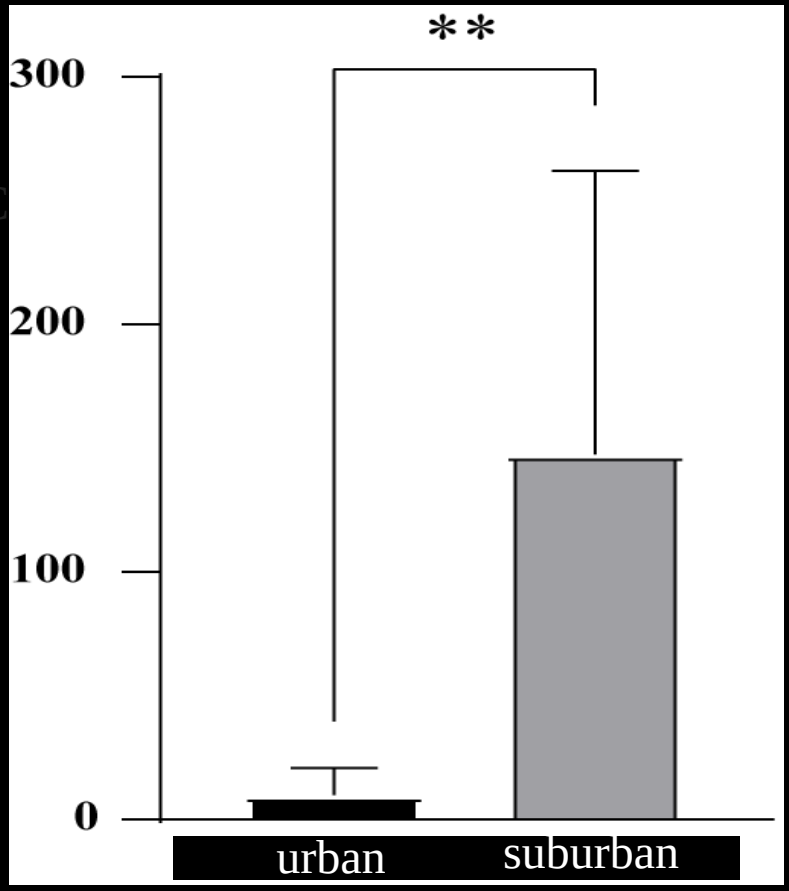
Home range analysis: indication behavioral plasticity

10% home range size

urban individuals compared to suburban ones



Environment	Mean	Standard deviation	P value
urban	**10.4**	10.1	0.000**
suburban	**165.95**	128.18	



***Environmental Research Letters* (2021)**

Thorough behavior change

Higher boldness level in 0.1km^2
Demonstrated **higher daytime activity**
Solitary animal demonstrated **social behavior** (e.g. allomaternal care)

Diet analysis:

Overabundant:

wet-waste and cat food feeding

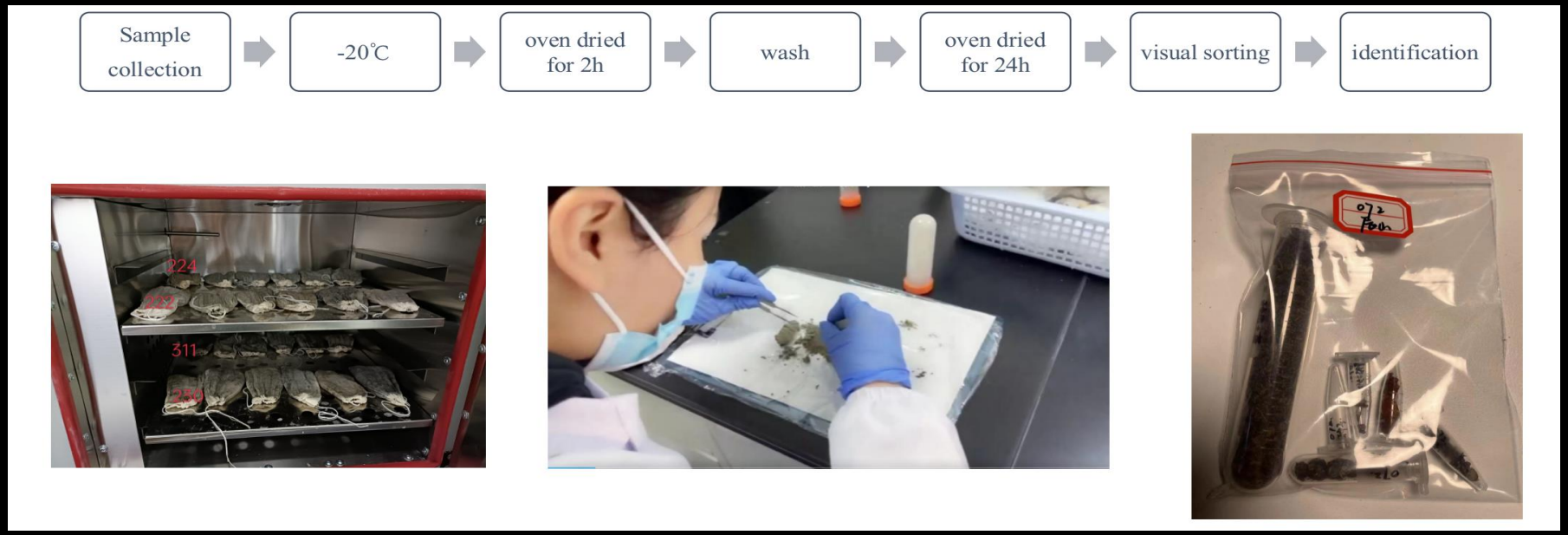
Loss of natural foraging behavior

Site	Anthropogenic items	Bird	Mammal	Plant	Invertebrate
F-U1	0.630	0.065	0.370	1.000	0.478
F-U2	0.636	0.182	0.273	0.818	0.455
F-U3	0.833	0.000	0.444	1.000	0.333
F-S1	0.455	0.045	0.318	0.955	0.409
F-S2	0.588	0.118	0.176	1.000	0.529

Cross tabs with Chi-square of environment x anthropogenic items

Environment		anthropogenic items		Total
		F	T	
suburban	O	20	19	39
	E	15.1	23.9	39.0
urban	O	24	51	75
	E	28.9	46.1	75.0
Total		44	70	114

$\chi^2 = 4.025$, $P = 0.045$



Research and conservation goals

- Species perspective
  - **Species adapting to human environment**
    - Population modeling
    - Movement tracking
    - Behavioral experiment
    - Diet analysis
  - What is the population trend in near future?

- Human perspective
  - How to alleviate human-raccoon dog conflict?
  - What method can be used to promote coexistence?

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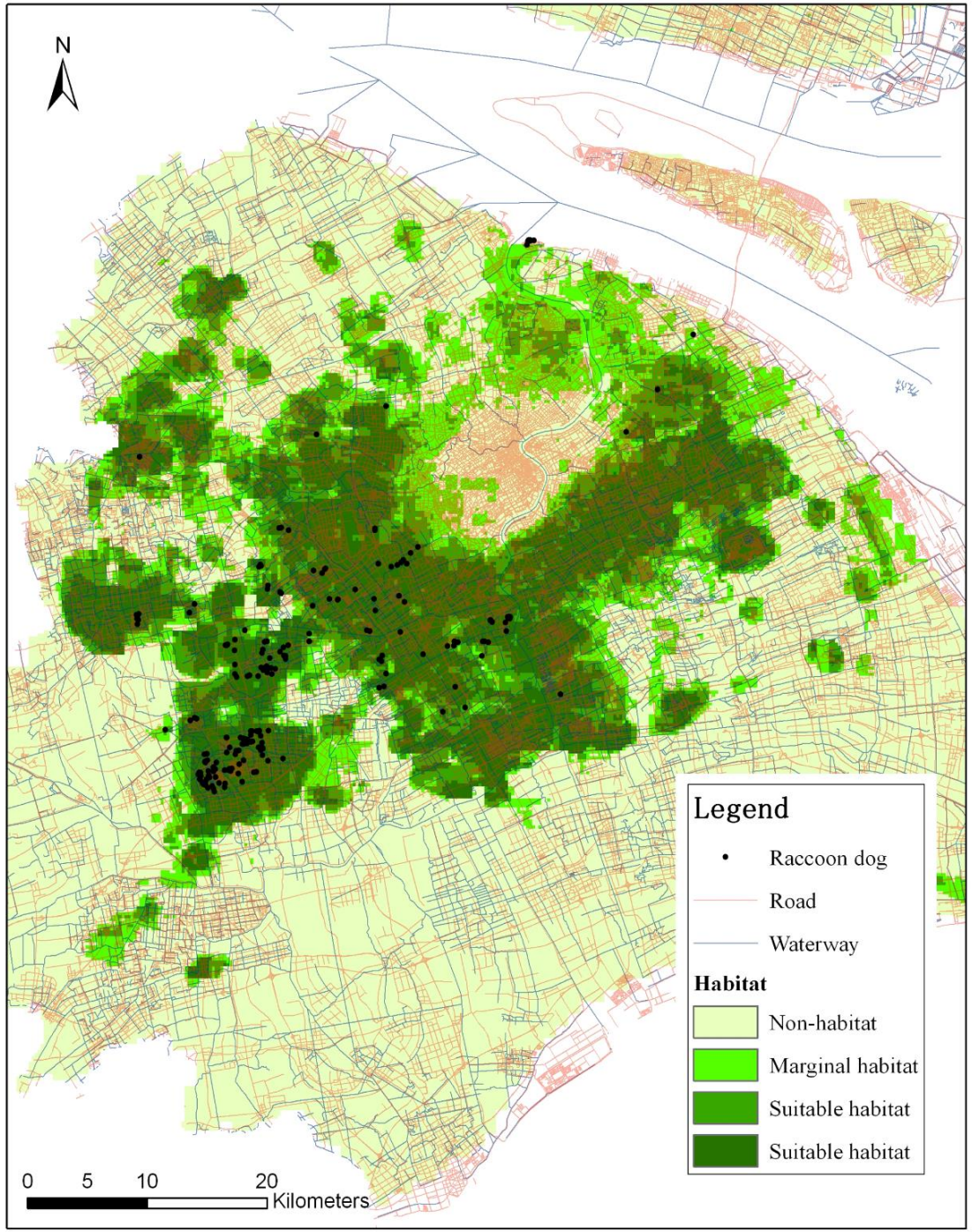
Habitat Prediction: more drastic changes to come

- Habitat prediction
  - **Only occupied 10% suitable habitat**
  - Large habitat patches in eastern and northern Shanghai

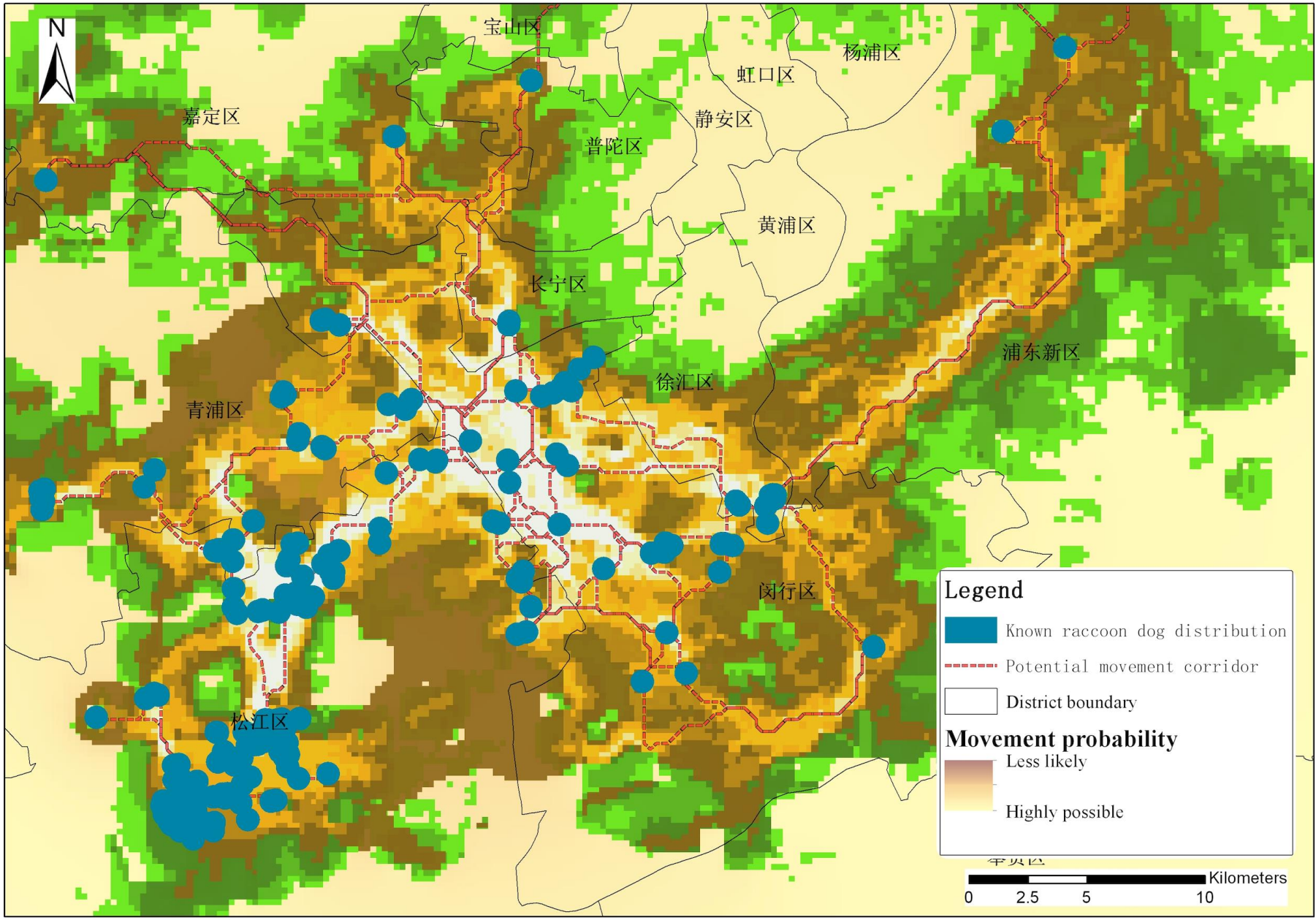
Environmental Research Letters (2022)



Dispersal corridor:

- Seven major routs
- 42 minor routs

- Major routs confirmed heated conflict areas



Environmental Research Letters (2022)

Research and conservation goals

- Species perspective
  - The species is adapting to human environment.
  - The population will keep increasing.
    - Habitat modeling
    - Movement corridor modeling
- Human perspective
  - How to alleviate human-raccoon dog conflict?
  - What method can be used to promote coexistence?

Research and conservation goals

- Species perspective
  - The species is adapting to human environment.
  - The population will keep increasing.

- Human perspective
  - How to alleviate human-raccoon dog conflict?
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城市生物多样性研究和保护：
填补研究空缺、支持保护实践、增加公众参与

The involvement of the public in scientific research – whether community-driven research or global investigations.

Phase 1:

Exploring Potential Enthusiasm of Participants

July 2019 - Pilot study

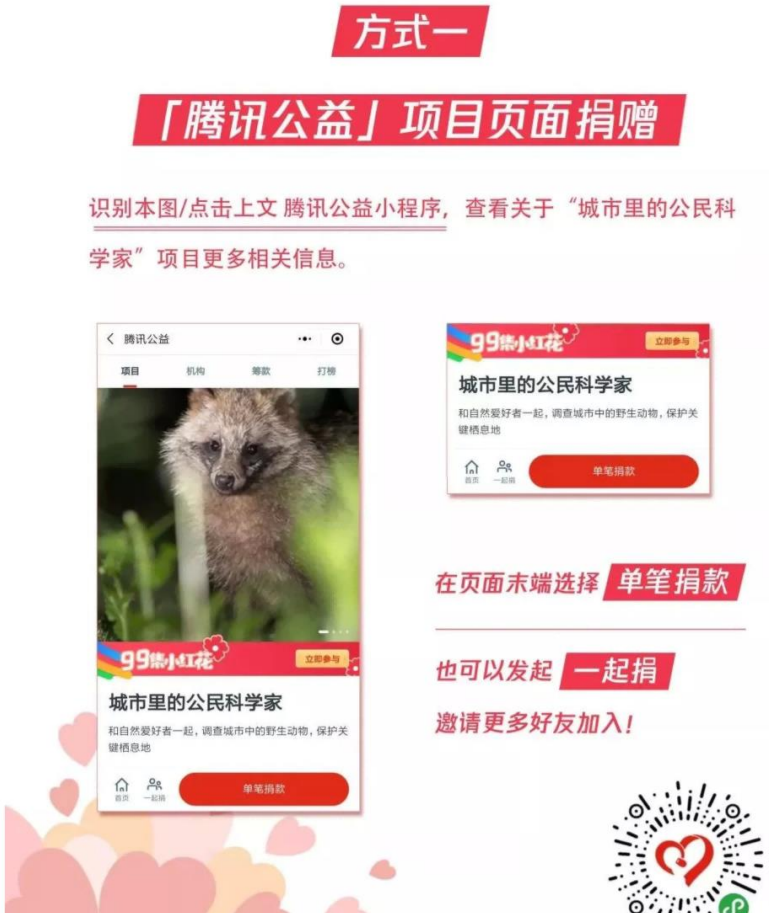
August - Popular science articles

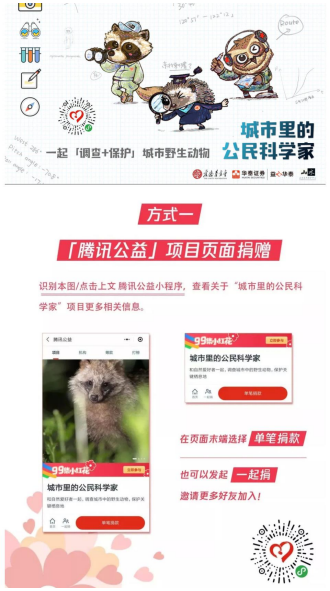
July 2019 - Exploratory communication

August - Popular science articles

September-kickstart

Phase 2:
Kickstart





July 2019 - Exploratory communication

August - Popular science articles

September-kickstart

Phase 2:

Kickstart, 4000 donnors,

￥170,000 Start-up Funds

Citizen Scientist

公民科学家

Open database

数据平台

Participants

机构

Entertaining

娱乐接入

Academical

学术接入

Government departments
Authorities
Universities
High shool
Environmental NGOs
Residential communities
Filming companies
Illustrators
Landscape designers
and etc.
...

Research 科研

Species adaptation
城市兽类的适应性

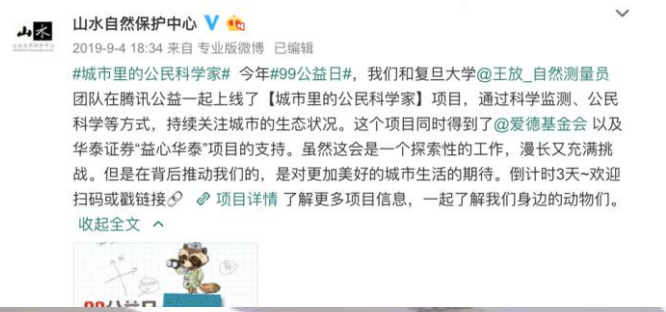
Education 教育

Training and course
绘本、课程

Management 管理

On-ground restoration
城市野地恢复

Phase3： designing a citizen science project



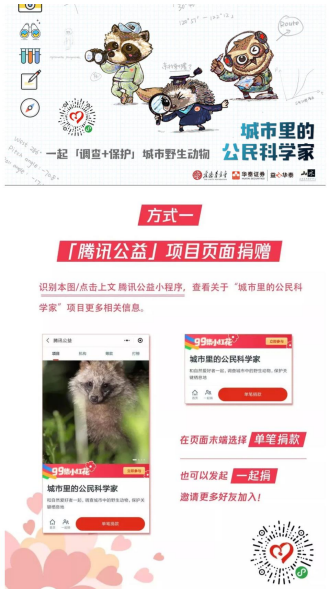
July

November - Volunteer group

December - Support from authorities

Phase 4:

Joint effort



July 2019 - Exploratory communication

September-kickstart

November - Volunteer group

August - Popular science articles

November - face-to-face brain storm

December - Support from authorities

Phase 4:

Joint effort:

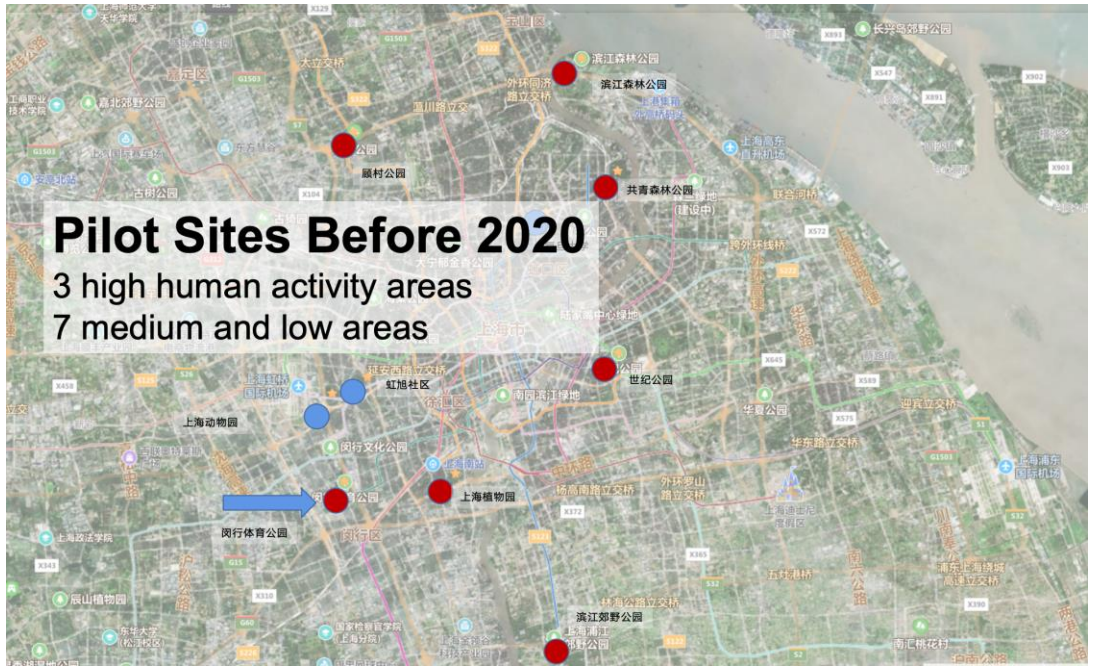
Residents, researchers, NGOs, Authorities

Volunteers provide wildlife records

200+ volunteers participated in camera trap survey

Establishment of Monitoring Sites across Shanghai

- A city-wide monitoring network
- Long-term monitoring
- Covering areas with different levels of urbanization



Before 2020

2020-2022

2020年7月，重新发现国家一级保护动物小灵猫

Rediscovered “local exitincted” small Indian civet in July 2020

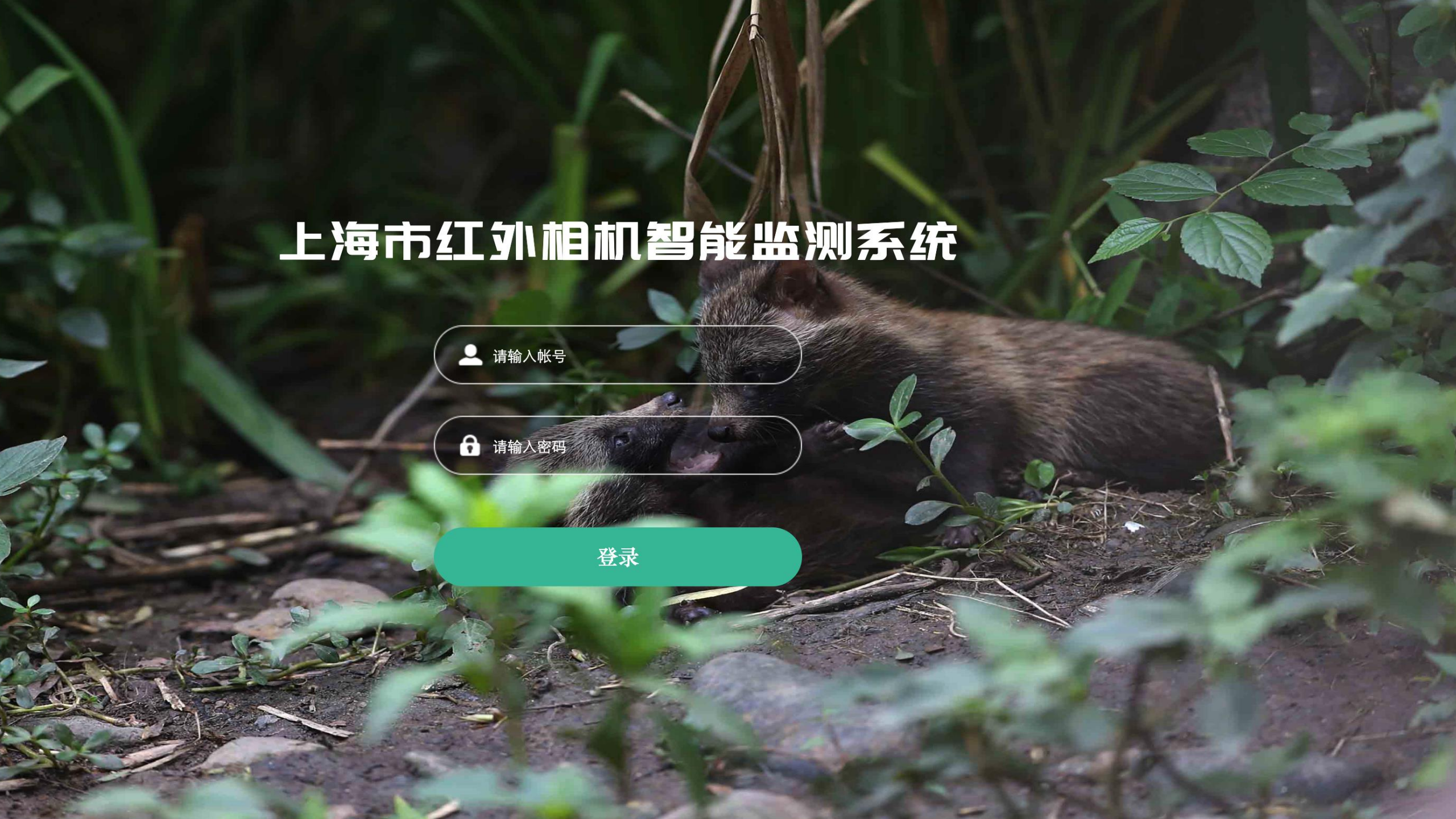
National First Level Protected Species

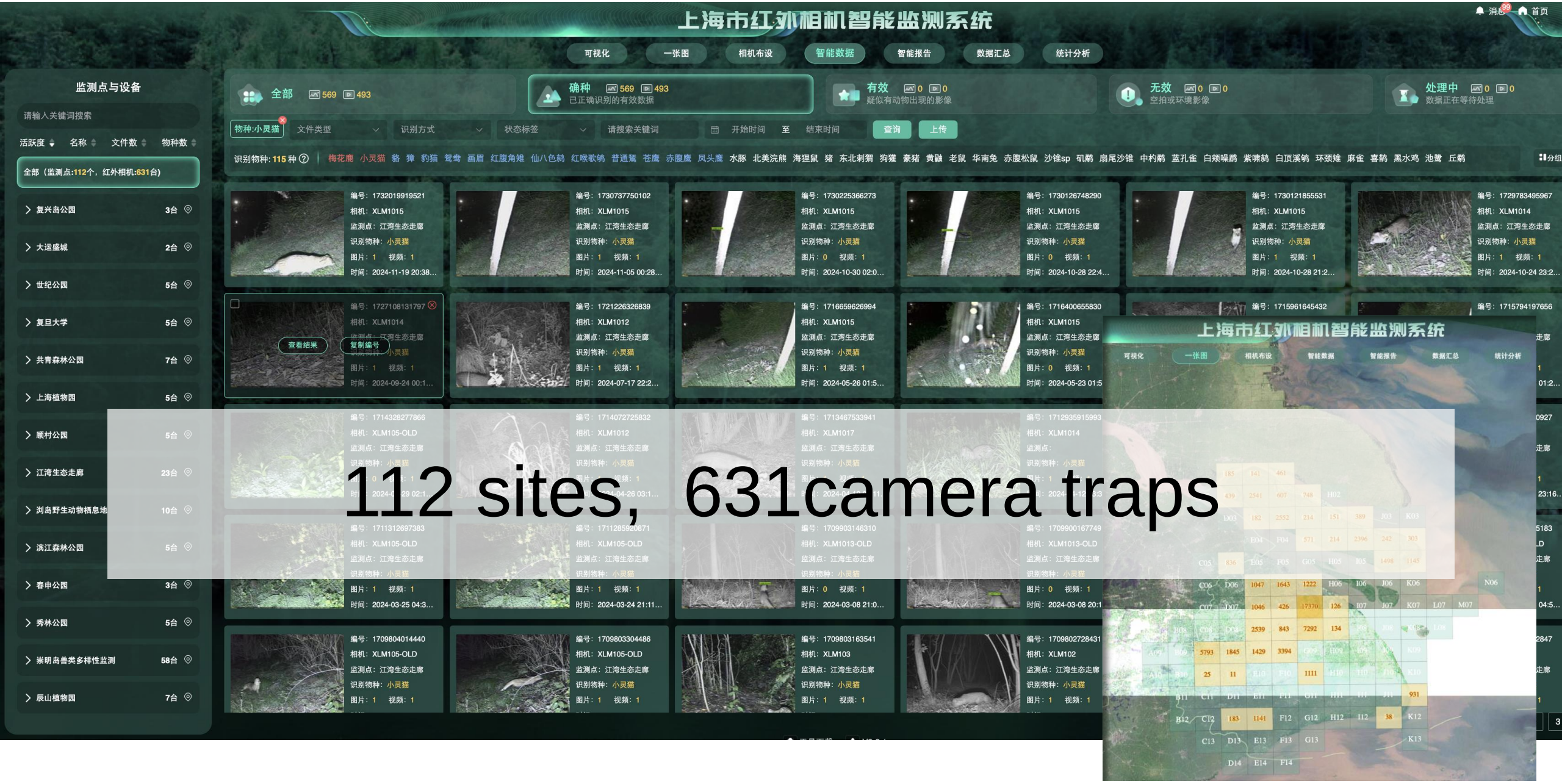
2022年8月，重新发现国家二级保护动物小灵猫

Rediscovered “local exitincted” leopard cat in August 2022

National Second Level Protected Species

2023-2024, re-estimated badger distribution


上海市红外相机智能监测系统
请输入帐号
请输入密码
登录

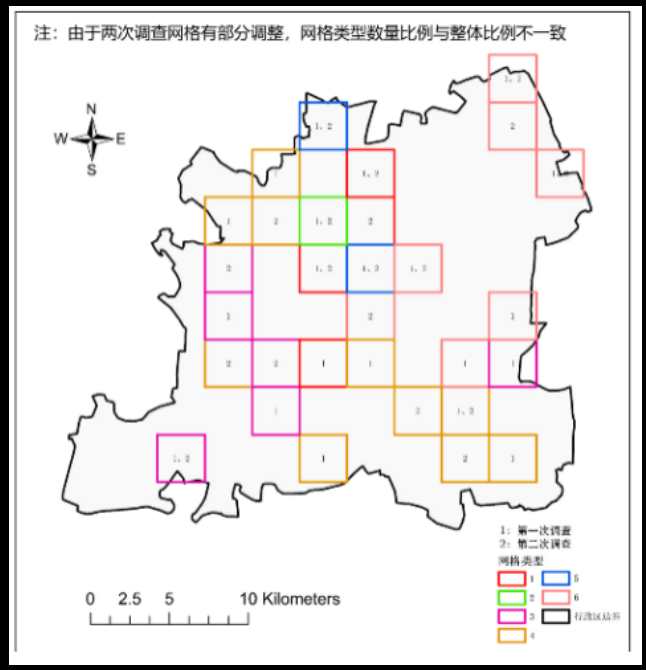

上海市红外相机智能监测系统
消息 99
首页
可视化
一张图
相机布设
智能数据
智能报告
数据汇总
统计分析
监测点与设备
请输入关键词搜索
活跃度
名称
文件数
物种数
全部（监测点:112个，红外相机:631台）
复兴岛公园 3台
大运盛城 2台
世纪公园 5台
复旦大学 5台
共青森林公园 7台
上海植物园 5台
顾村公园 5台
江湾生态走廊 23台
浏岛野生动物栖息地 10台
滨江森林公园 5台
春申公园 3台
秀林公园 5台
崇明岛兽类多样性监测 58台
辰山植物园 7台
全部 569 493
确种 569 493
已正确识别的有效数据
有效 0 0
疑似有动物出现的影像
无效 0 0
空拍或环境影像
处理中 0 0
数据正在等待处理
物种:小灵猫
文件类型
识别方式
状态标签
请搜索关键词
开始时间
至
结束时间
查询
上传
识别物种: 115 种
梅花鹿 小灵猫 貉 獐 豹猫 鸳鸯 画眉 红腹角雉 仙八色鸫 红喉歌鸲 普通鵟 苍鹰 赤腹鹰 凤头鹰 水豚 北美浣熊 海狸鼠 猪 东北刺猬 狗獾 豪猪 黄鼬 老鼠 华南兔 赤腹松鼠 沙锥sp 矶鹬 扇尾沙锥 中杓鹬 蓝孔雀 白颊噪鹛 紫啸鸫 白顶溪鸲 环颈雉 麻雀 喜鹊 黑水鸡 池鹭 丘鹬
查看结果
复制编号
112 sites, 631camera traps

貉口普查2022-2024

Raccoon dog census

2024 census

- **700 participates**
- 279 valid transects
- **Transects lenghth 500km**
- 93% exactly followed protocol



① 单次调查中的目击貉数量： $WN_i=\sum(wn_{1(i)}+wn_{2(i)}+\cdots+wn_{n(i)})$
② 目击貉数量： $WN=\max(WN_1,WN_2)$
③ 访谈貉数量： $IN=\max(IN_1,IN_2,\cdots,IN_n)$
④ 小区貉数量： $N=\max(WN,IN)$
⑤ 小区貉密度： $AN=N/S$

式中： WN_i——第 i 次调查中的目击貉数量
$wn_{n(i)}$——第 i 次调查中第 n 次目击的貉数量
WN——该小区目击貉数量
IN_n——该小区第 n 次访谈得到的单次目击最高貉数量
IN——该小区访谈得到的单次目击最高貉数量
N——该小区 2022 年貉数量
AN——该小区 2022 年每公顷貉数量
S——该小区面积(ha)

$$Moran's I = \frac{N}{\sum_{ij} w_{ij}} \frac{\sum_i \sum_j w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{\sum_i (x_i-\bar{x})^2}$$

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_{p-1} x_{p-1} + \epsilon$$

逐渐填补科研空白

Filling research gaps in China

保护生物学政策法规
Legislations and regulations
SCI(Q1)

城市流浪动物管理
Stray animals
SCI(Q1)

貉生态学研究论文
Population ecology
SCI(Q1)

居民对兽类容忍度研究
Residents’ tolerence
SCI(Q1)

冲突预警研究
Human-wildlife conflict
SCI(Q1)

容忍度研究
Residents’ tolerence
SCI(Q1)

First urban raccoon dog documentary in China
第一部和第二部中国城市貉纪录片

First urban raccoon dog illustrator book in China
第一本中国貉绘本

两个月后，洞里多了6只胖乎乎的貉宝宝——那是小卷毛和它的哥哥姐姐们。

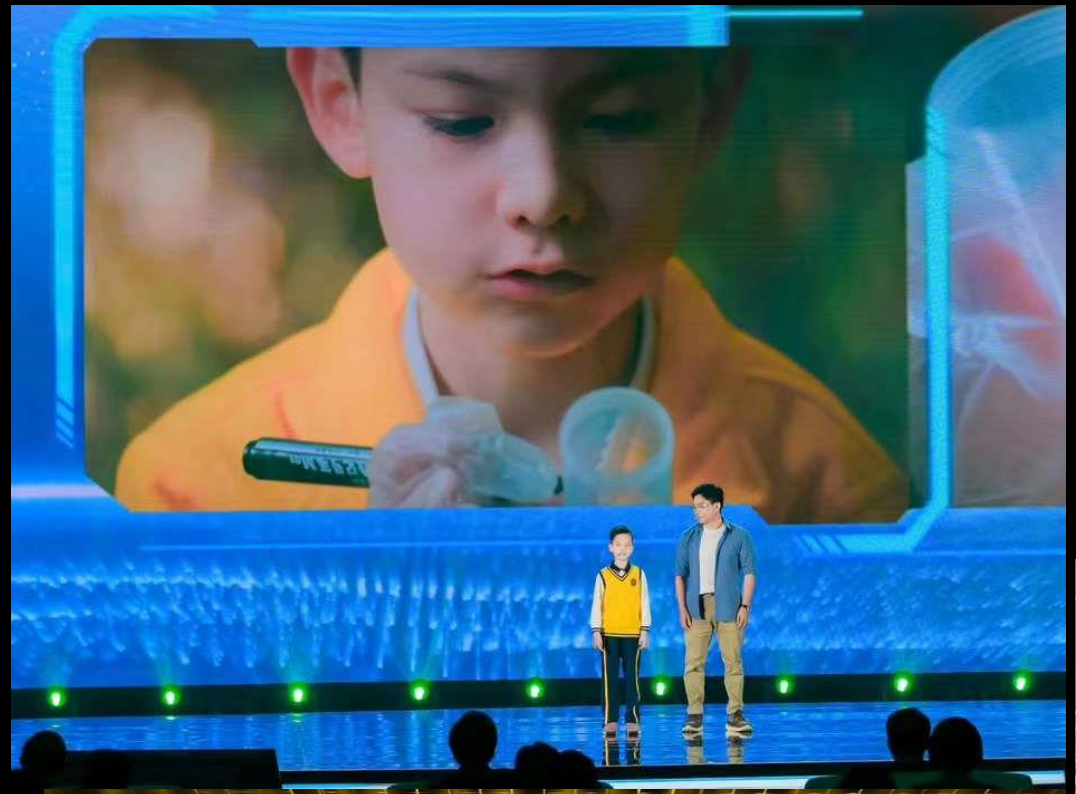
小卷毛偶尔会趴在洞口好奇地张望。但爸爸妈妈告诉它，外面到处都是危险，要长大了才能出去。

为了保护宝宝们，爸爸每天都外出巡视领地。妈妈呢，则花更多的时间来照顾宝宝们。

First and second urban raccoon dog illustrator book in China
第一本和第二本中国貉绘本

More and more school courses
越来越多的中小学课程和课题

Urban biodiversity in urban life
越来越随处可见的野生动物宣传



2024
SHANG
HAI
上海科技节

城市科考之路
红外捕手
王琳珍
白领
2024
SHANG
HAI
上海科技节

CCTV 1
综合
腾讯视频
每一块石头
开学第一课

国家林业和草原局
国家公园管理局

林业工作站管理总站

林业工作站管理总站 > 基层动态

2023"貉口普查"第一次工作

国家林业和草原局政府网 http://www

【字体：大

为科学谋划2023年"貉口普查"项目工作计划，近日
市林业总站主持，项目发起单位和相关工作人员参会。

会上，与会工作人员围绕调查区域、时间、频次、
格完善等方面进行了深入研讨，初步形成了项目工作计
入探讨。

上海首份"貉口普查"调查报告来了！这些地方

2022-11-26 15:25

上海曾有"貉出没"的点位已达260多个，松江50个小
天，上海首份"貉口普查"调查报告公布。值得关注的是，
一次通过"公民科学"的方式，对城市野生哺乳动物进行同
学研究的新形式，在科普甚至促进政府管理和决策方面，
用。

视频丨首份"貉口普查"报告：人类这些行为可能导致貉密度翻番

播报文章

国家林业和草原局
国家公园管理局

国家林业和草原局政府网 > 资讯 > 林草新闻 > 动植物保护 > 物种保护

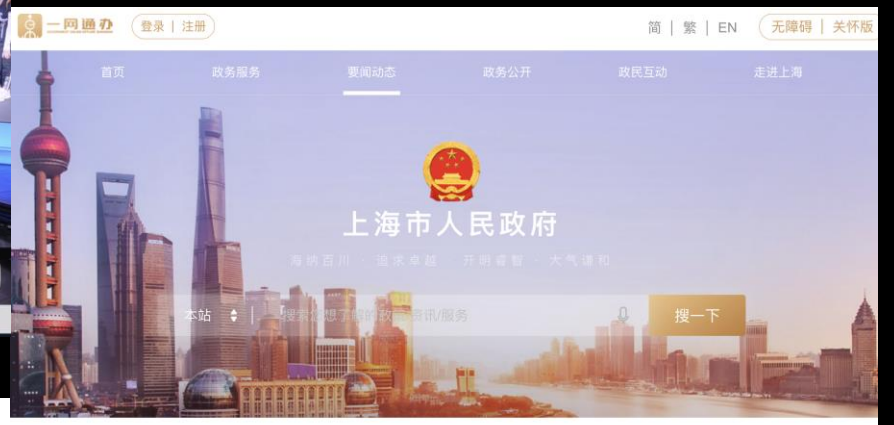
上海发起"貉口普查"公民科学项目

国家林业和草原局政府网 http://www.forestry.gov.cn　2022-07-20　来源：上海市林业局

【字体：大 中 小】　打印本页

粮和湿垃圾管理不当将导致貉密度增

9:18



首页 / 要闻动态 / 行业信息

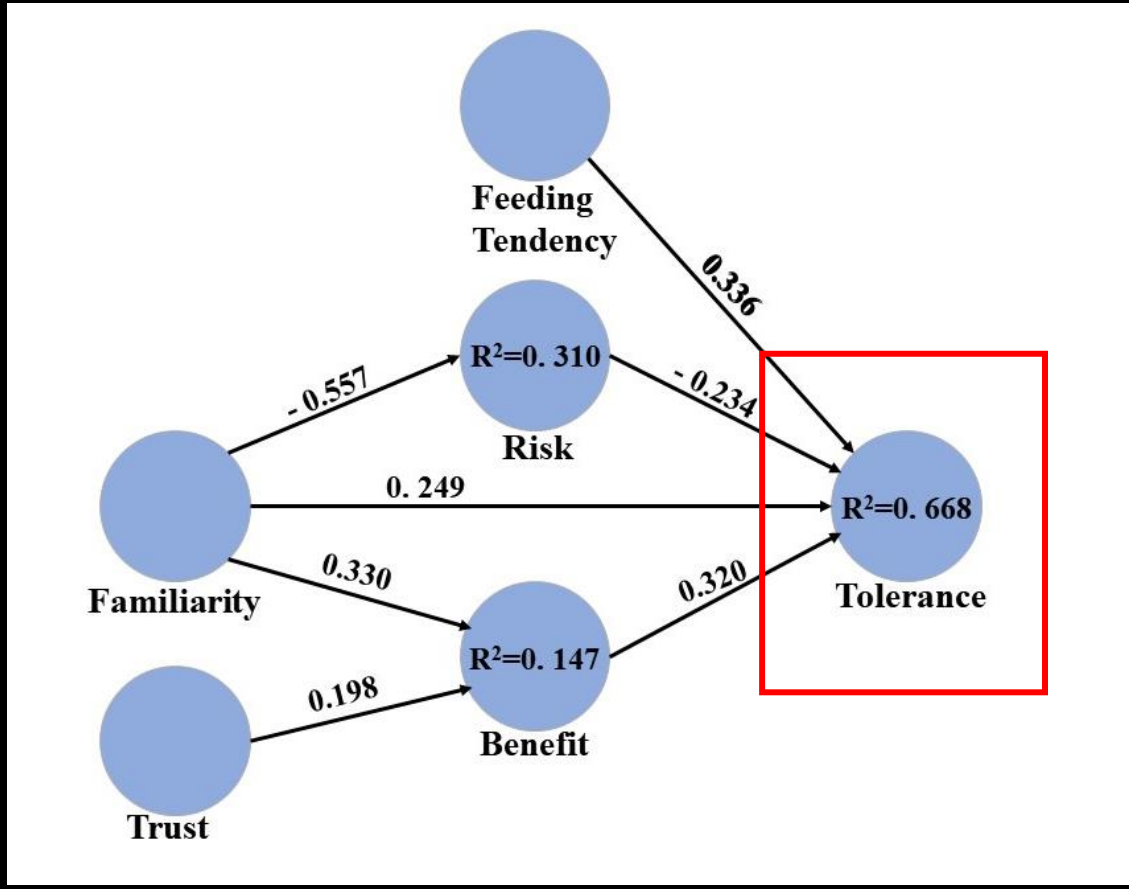
"貉口普查"公民科学项目（上海） 正式启动

2022-07-19　来源：市绿化市容局

字号：大 中

Mapping human mind: determining factors of attitude?

Increased familiarity improved people's tolerance



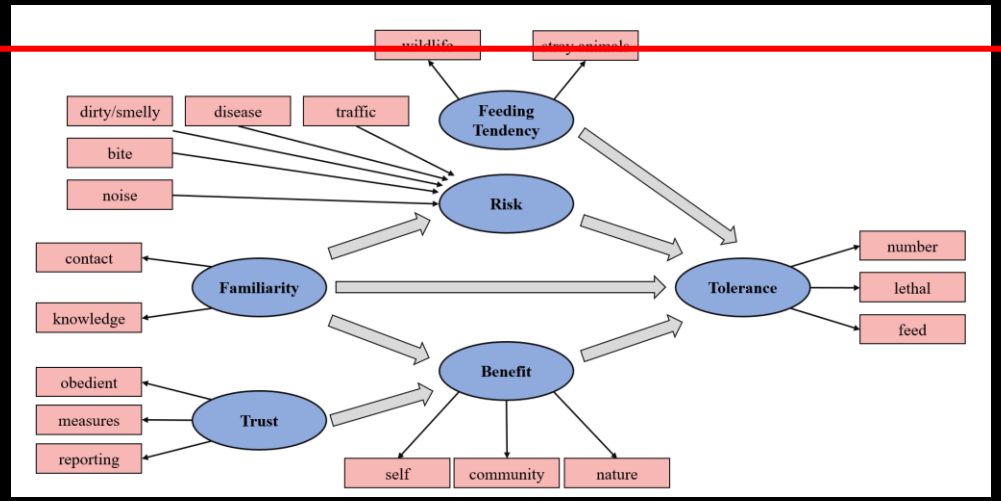
People and Nature (2024)

Mapping human mind: determining factors of attitude?

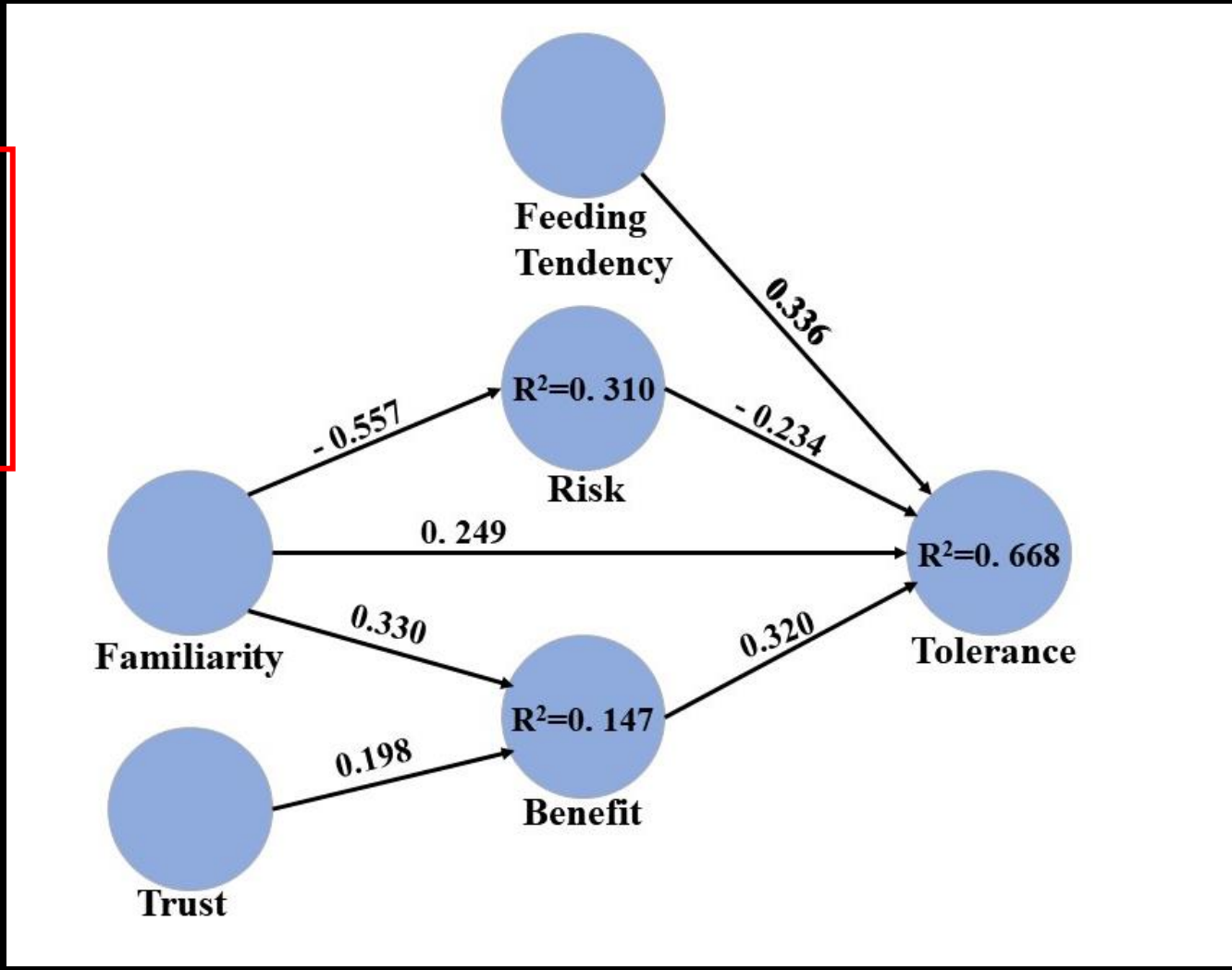
Increased familiarity increased tolerance

Improved attitudes (e.g. stopped feeding, better wet-waste control) resulted in lowered more sustainable raccoon dog density

Conflict report decreased 300+ to 20



People and Nature (2024)



《野生动物保护条例》2023年10月1日生效

Major suggestions be incorporated in ***Shanghai Wildlife Protection Law***

“public participation”, “community-based management”, “educational efforts”

The monitoring and management of urban biodiversity: using citizen science to connect Shanghai residents, researchers and authorities

- Citizen Science Recruitment: **1,000+ citizen volunteers**
- Research Outputs:**7 SCI publications**, 3 dissertations
- Popular Science: **2 documentaries**, 2 illustrated books
- Policy Outputs: **1 municipal conservation regulations**

• Acknowledgement

Shanghai Forestry Bureau
Shanshui Conservation Center

• Acknowledgement

Shanghai Forestry Bureau
Shanshui Conservation Center
WWF and One Planet Foundation
One-Yangtze Project of Huatai Foundation
Shanghai Natural History Museum
Forest City Studio
Shanghai Ocean University

Citizen Scientists

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Shanghai Ocean University

Citizen Scientists

Thank you!