生物多样性数据GAP分析
Biodiversity Data Gap Analysis (DGA)

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DGA目的

- 现有分布数据虽然不少，但在类群上和地理上都有缺失（GAP）
- 需要方法和工具来衡量GAP，然后进一步判断数据的适用性
- 为新的生物多样调查，物种采样提供指导

DGA对象

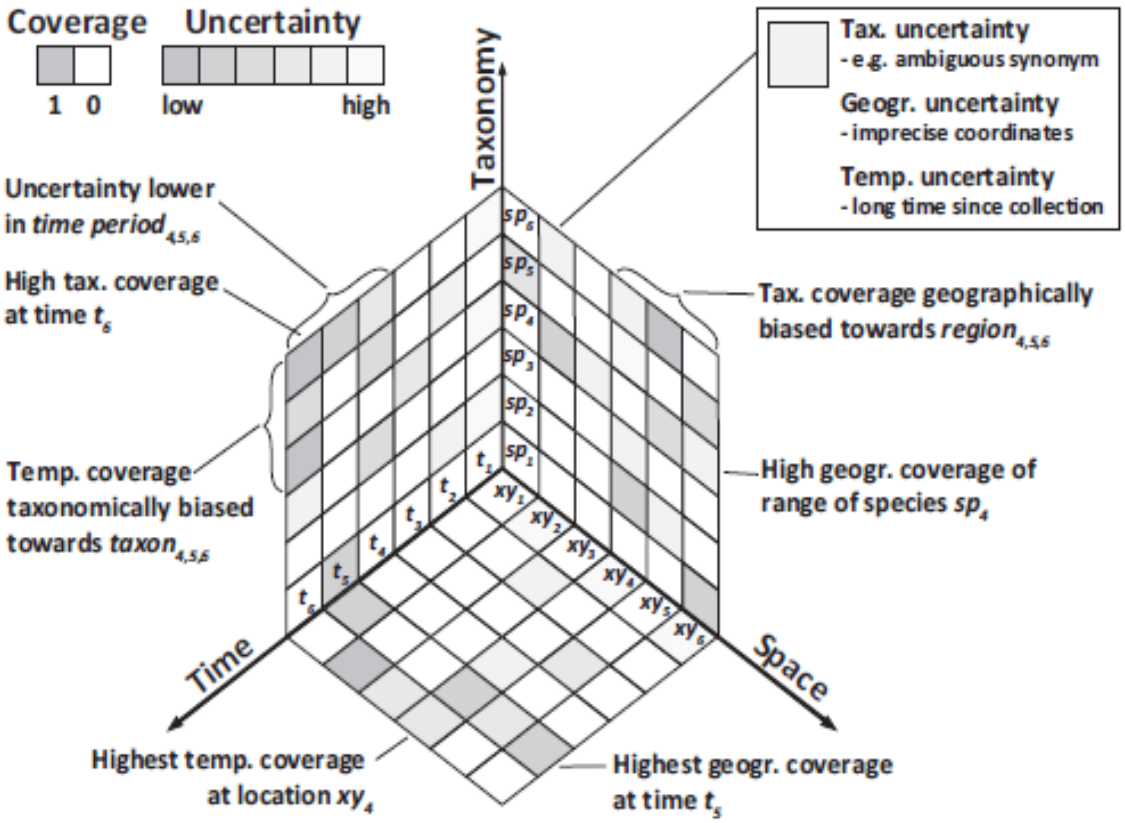
- 分布数据
- 类群 & 物种
- 维度：

  Taxonomic

  Geographic

  Temporal

  Environmental



Meyer et al., 2016

DGA技术与工具

- 数据库技术(Database engines)
- 地理信息系统工具（GIS and mapping tools ）
- 统计工具（Statistical packages or languages (e.g. *R*) ）
- 数据服务接口技术（Web services）
- 可视化工具（Visualization tools ）

DGA scope

taxonomic / geographic / temporal

Data accessibility assessment

1. Data sources inventory
2. Data scope analysis
3. Data amount
4. How to access

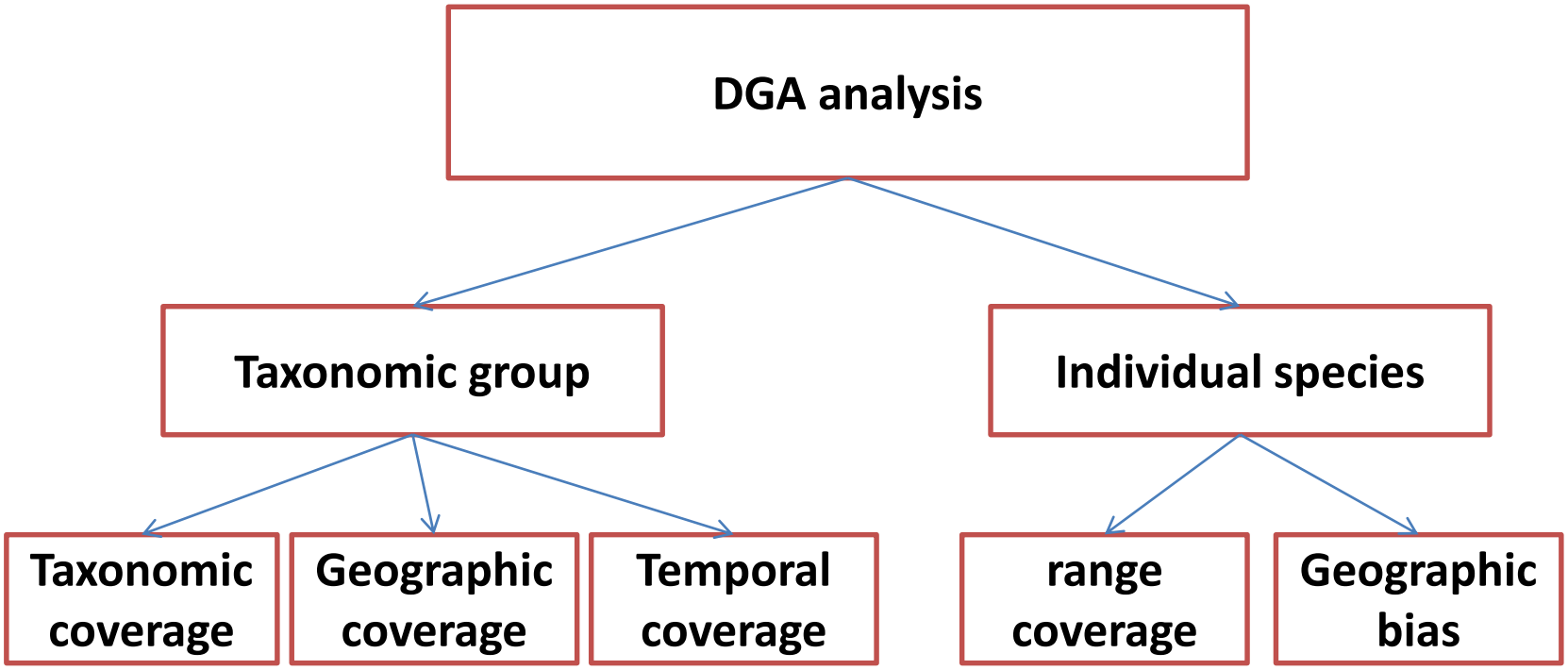
Data harvest

Data clean

1. Clean data without coordination
2. Clean data with wrong coordination
3. Clean data unmatched DGA scope

Data mapping

Mapping data to grid and shape map


DGA analysis
Taxonomic group
Individual species
Taxonomic coverage
Geographic coverage
Temporal coverage
range coverage
Geographic bias

DGA 分析实例

GBIF的中国鸟类分布数据

DGA scope

taxonomic: 鸟类
geographic: 中国
temporal: 全部采样年份

Data accessibility assessment

1. Data sources: GBIF
2. Data amount: **389,456**
3. How to access: Web API

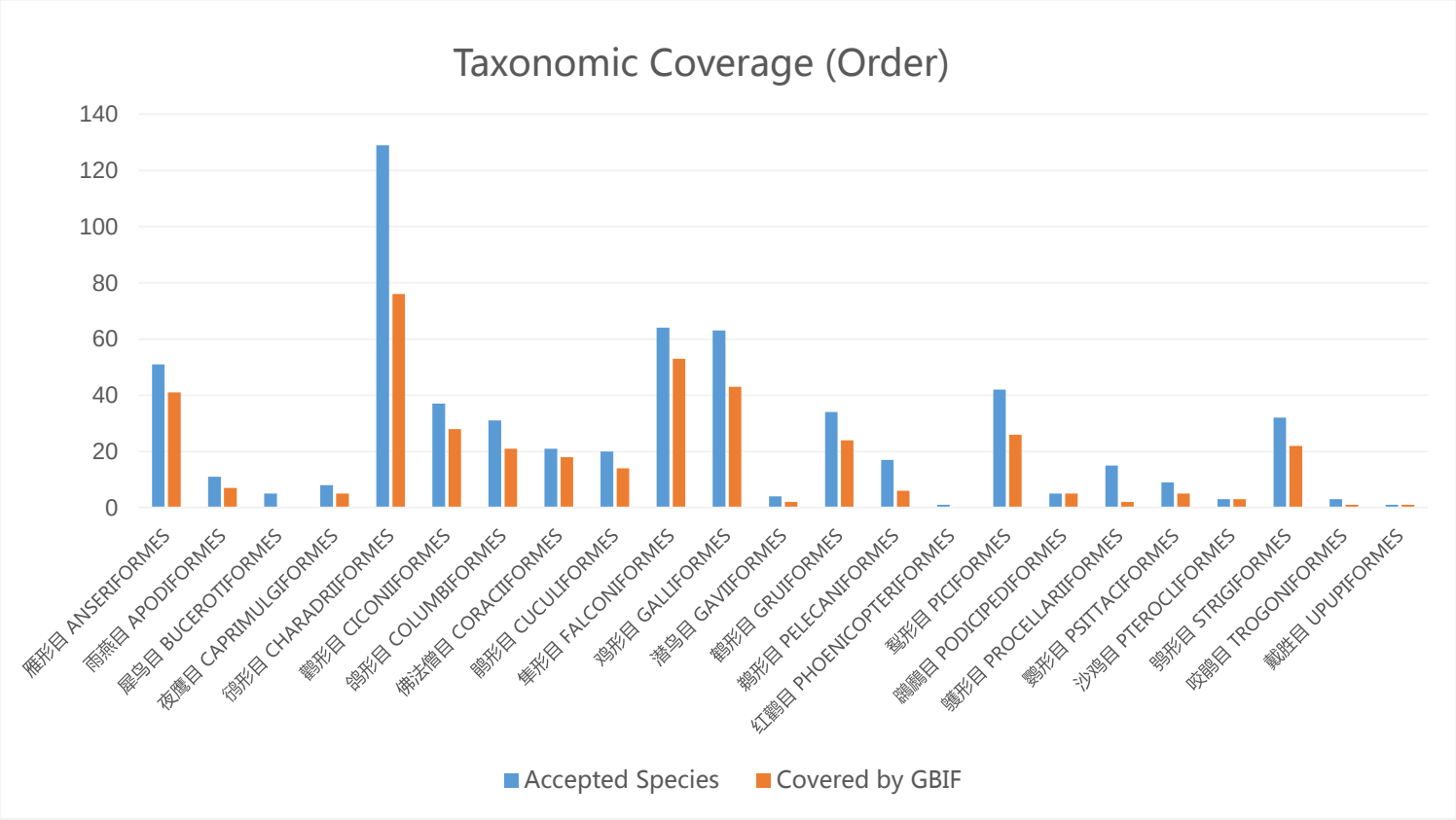
Data harvest

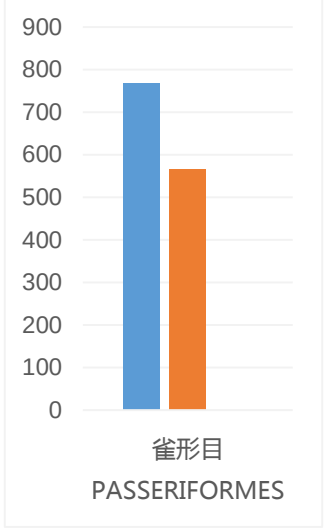
Data clean

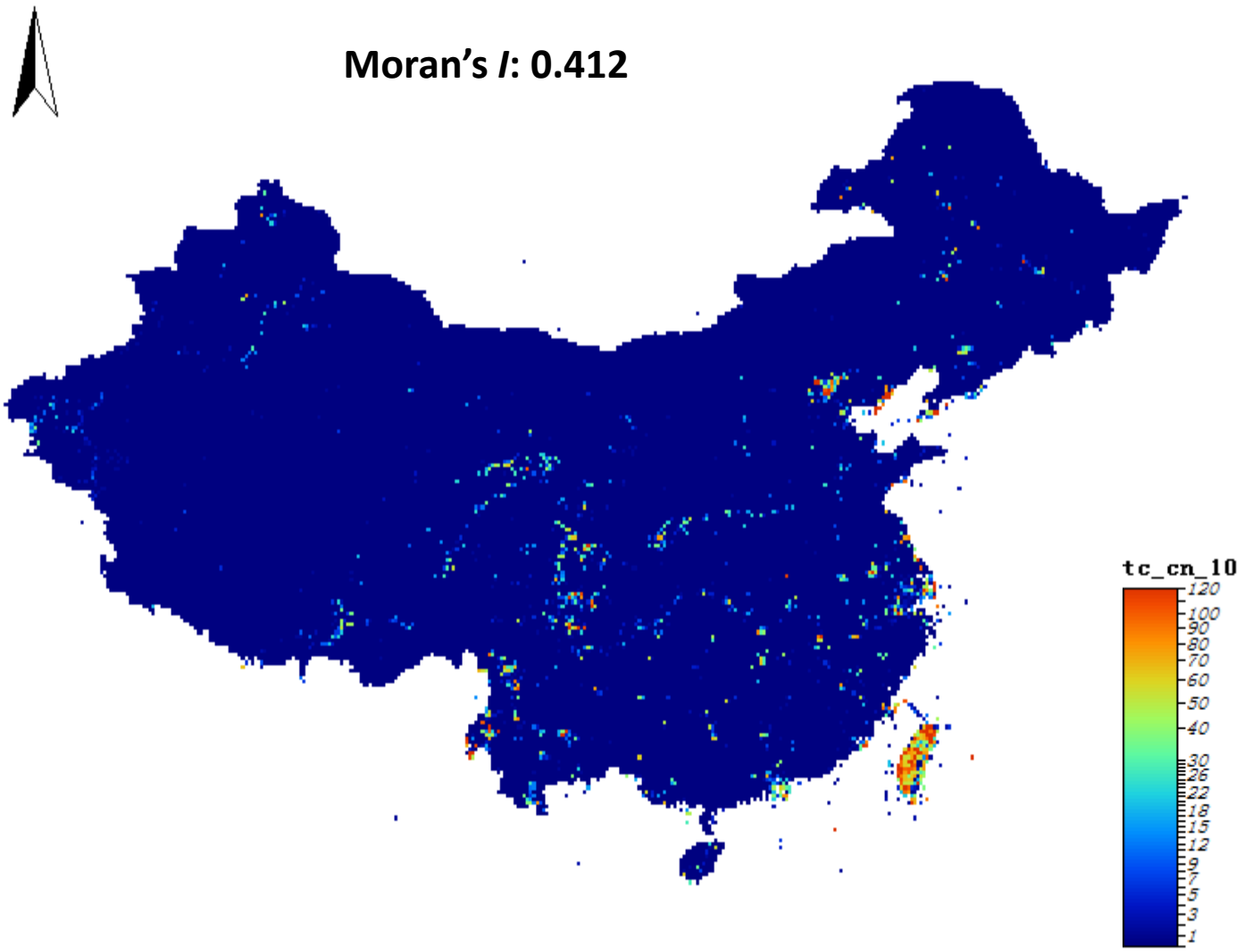
1. without coordination: -78,841
2. unmatched DGA scope: -503

中国鸟类分布记录 (GBIF)

Taxonomic coverage

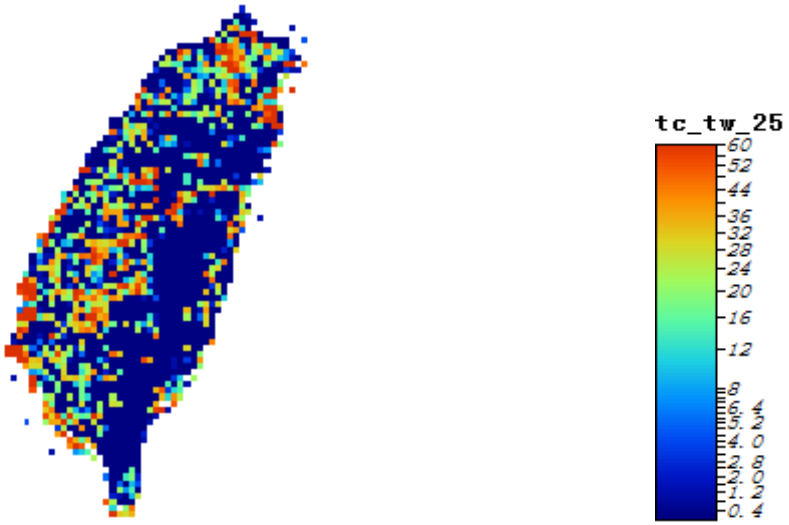






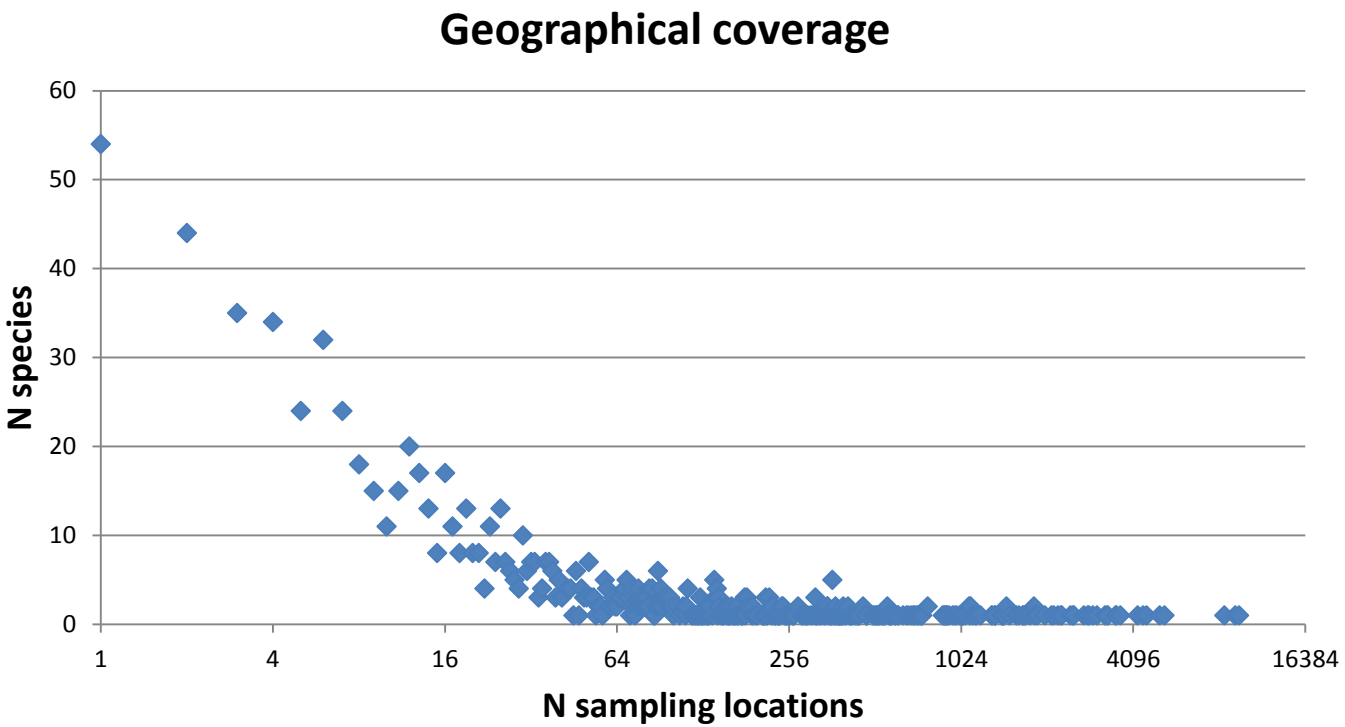
每个栅格被采样的物种数 20km X 20km

Moran's *I*: 0.298

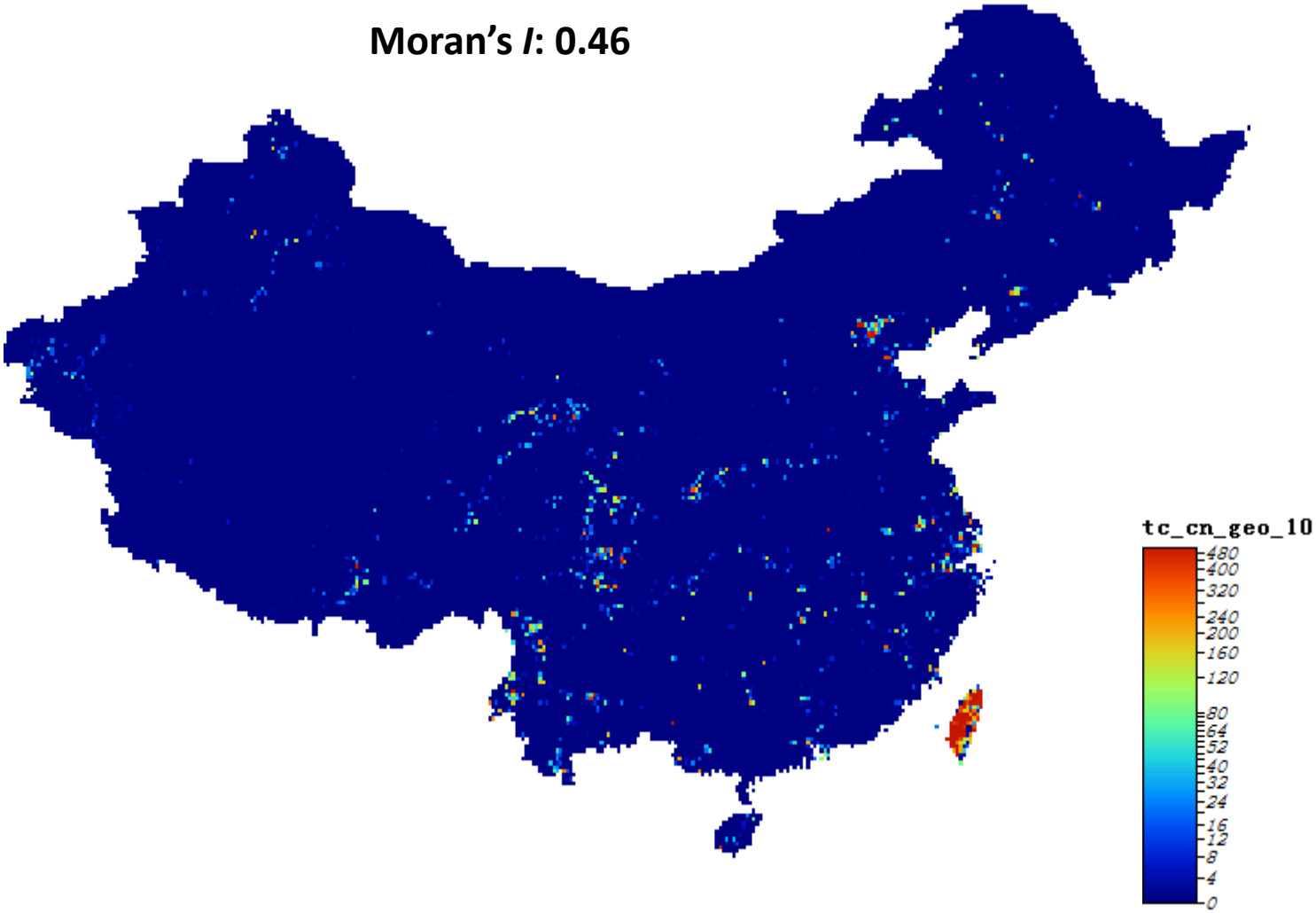


Species coverage in *5km X 5km* grids of Taiwan province

Geographical coverage

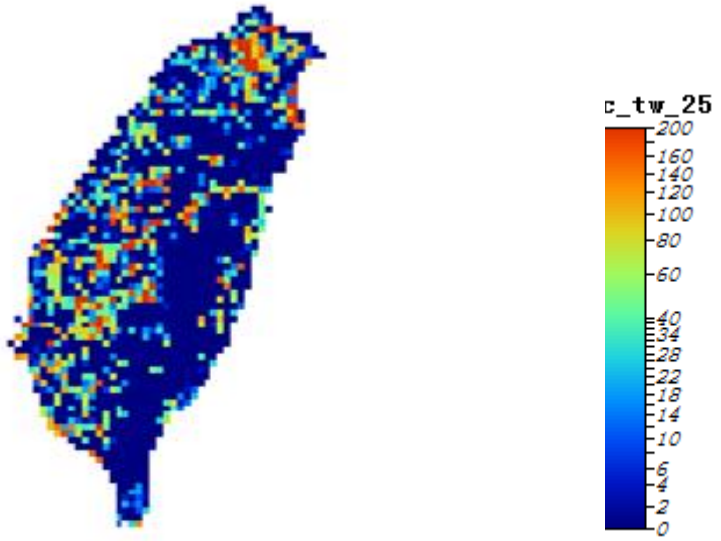


Moran's *I*: 0.46



每个栅格被采样的次数 **20km X 20km**

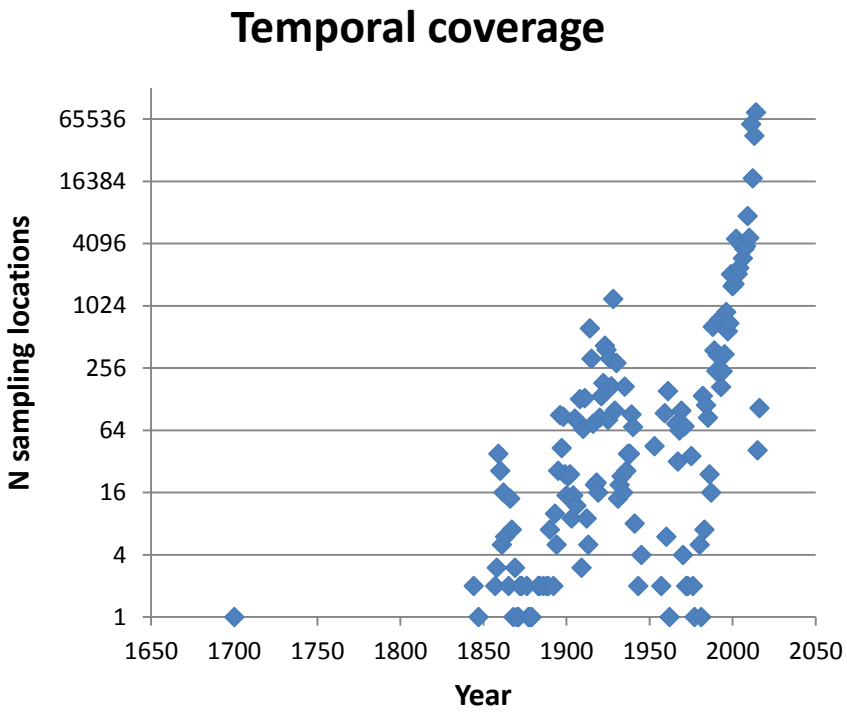
Moran's *I*: 0.234

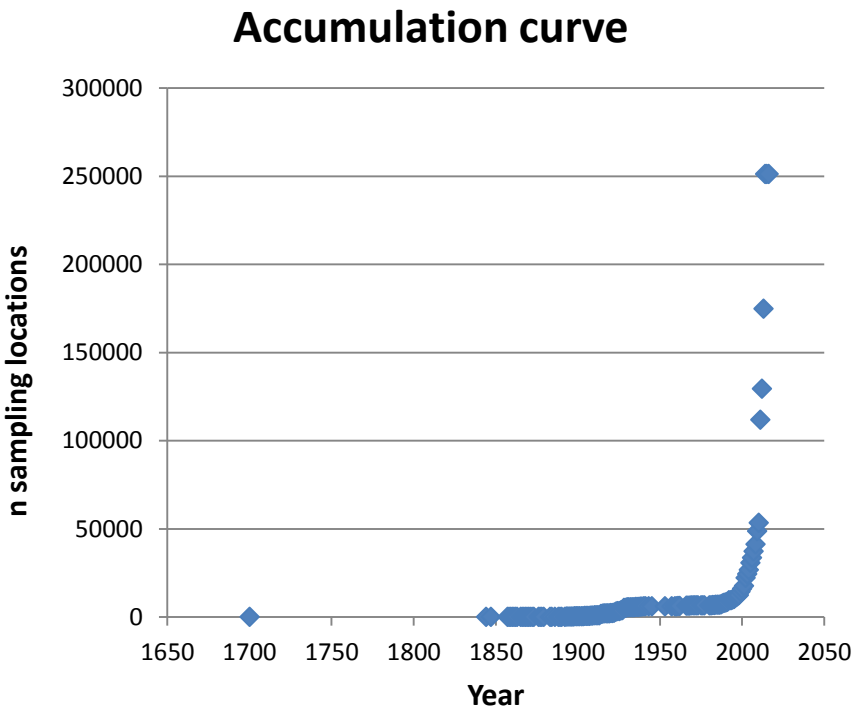


Geo-coverage of Birds sampling location in Taiwan province

5km X 5km

Temporal coverage





台湾画眉（*Garrulax taewanus* (Swinhoe, R.,1859)）分布数据GAP评估

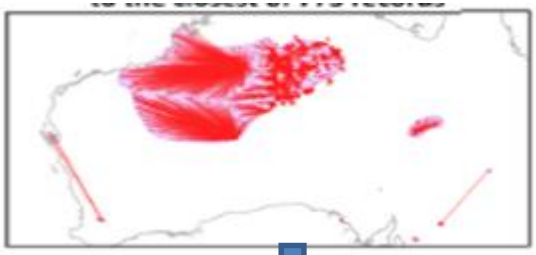
分布范围内随机产生1000个点

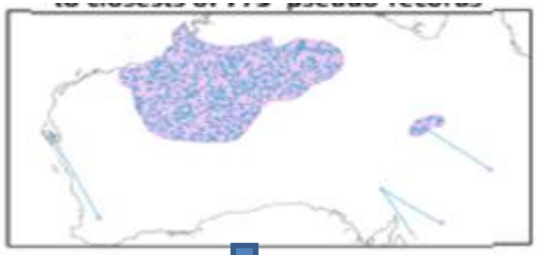
Null model（1000次重复）：
随机产生与实际点数相同的伪样本

实际分布点

计算随机点到实际点的最短距离

计算随机的1000个点到伪样本点的最短距离





Range coverage（RC）：随机点到实际点最小距离的平均值

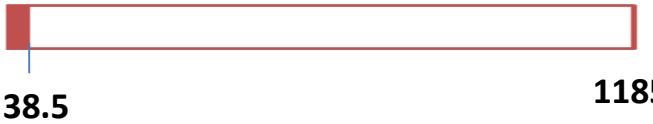
Geographical bias：实际RC 值与原假设模型RC值的差/原假设模型RC的标准差

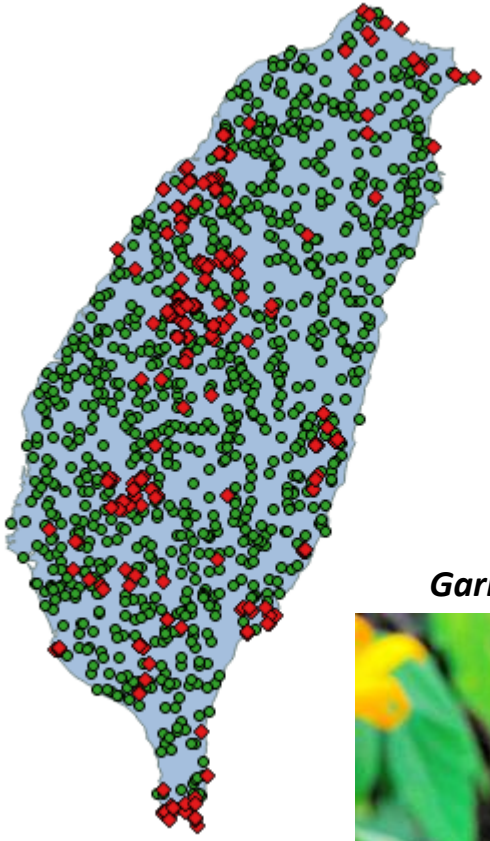
$$range\ coverage = -\mathrm{MMD} = -\frac{1}{1000}\sum_{i=1}^{1000}\mathrm{MinDistRP}_i$$

$$geographical\ bias = \frac{\mathrm{MMD}_{observed} - \mathrm{mean}(\mathrm{MMD}_{null\ model})}{\mathrm{SD}(\mathrm{MMD}_{null\ model})}.$$

Record count: 530
Duplicated: 269
Range area: 36192.8155 km^2
Range coverage： -13.8 km

Geographical bias: 38.5





台湾画眉分布点

1000个随机点

台湾画眉

***Garrulax taewanus* (Swinhoe, R.,1859)**

总结

- GBIF的中国鸟类数据在类群覆盖度方面比较好（>70%）
- 根据Moran's *I* 指数，采样的物种数在地理上相对集中，被采样的地点相对集中
- 多数样本集中在少数几个种
- 重复样本比较多
- 样本记录的时间多在2000年后，不利于时间序列分析

- 台湾省的鸟类数据分布相对均匀，地理覆盖度比较广
- 从覆盖度和地理偏差指标看，台湾画眉的地理分布数据覆盖范围大，偏差较小，补充少量样本就可以用于其分布地预测。
- 地理覆盖度和偏差指数大小对分布地模型预测的影响有待进一步研究。

下一步工作

- 开发新的GAP分析方法
- 评估不同指标对生物多样性评价及物种分布预测的影响
- 完善DGA流程，并上线服务

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