

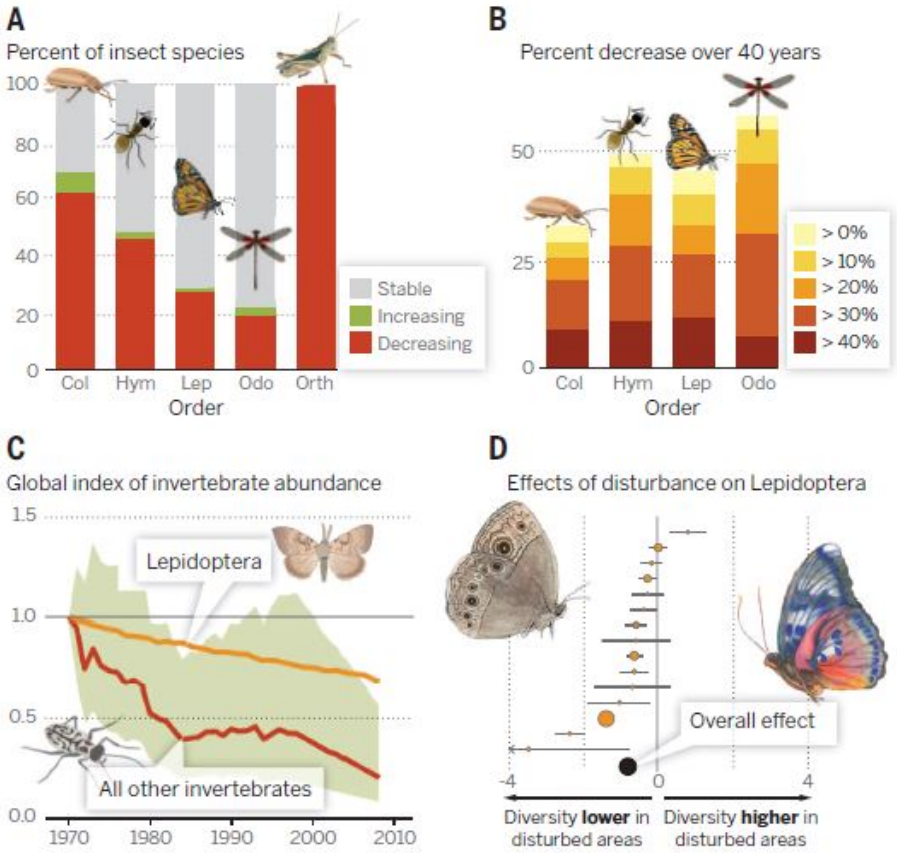
On the front lines of observing change: Biodiversity specimen collectors as the Anthropocene's outlier detectors

Katelin D. Pearson, Shari Ellis, Libby Ellwood, Gil Nelson, Deb Paul, Greg Riccardi, Austin Mast

Integrated Digitized Biocollections

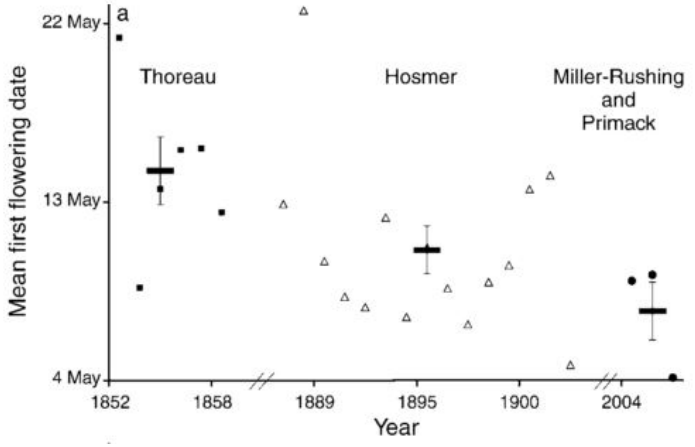
Change in the Anthropocene

Biodiversity loss



Dirzo et al. 2014

Phenological shifts



Miller-Rushing and Primack 2008

Invasive species

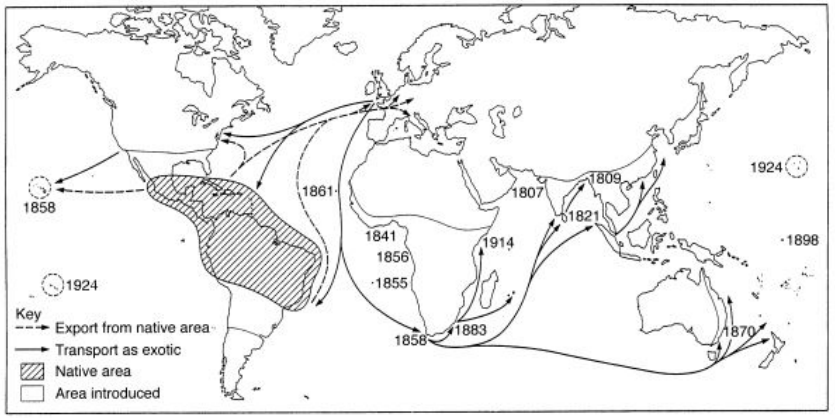


FIG. 1. Some invaders have widely separated new ranges, the products of repeated human dispersal and cultivation. For example, the shrub *Lantana camara* was carried transoceanically throughout the 19th and early 20th century to many subtropical and tropical locales where it has proliferated. Years refer to dates of introduction in widely separated locales (Cronk and Fuller 1995).

Mack et al. 2000

Building networks for critical early detection

I SEE CHANGE
COMMUNITY CLIMATE & WEATHER JOURNAL

USA npn
National Phenology Network

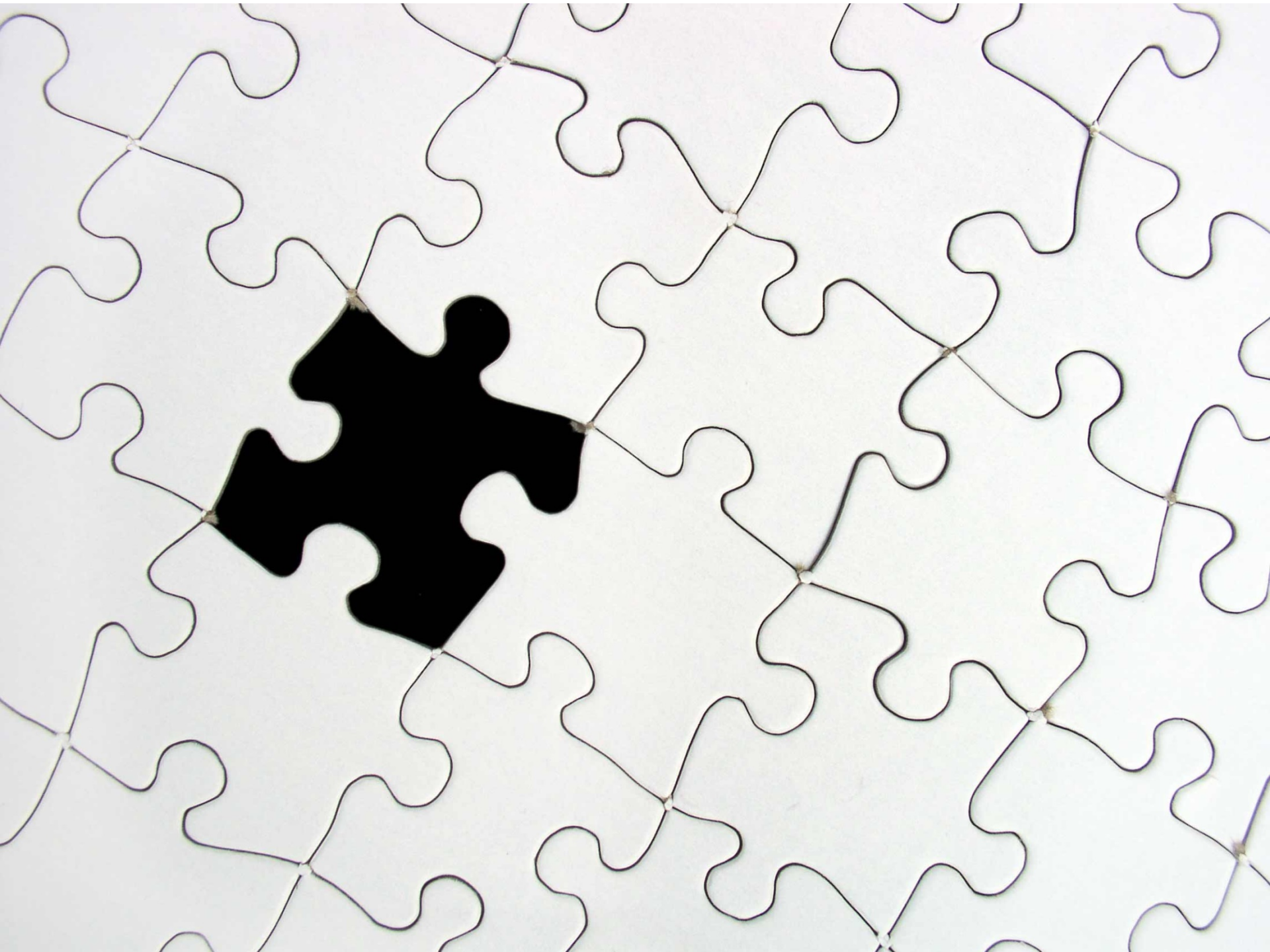
neon™
National Ecological Observatory Network

*i*MapInvasives
Sharing information for strategic management

EDDMapS
Early Detection & Distribution Mapping System

National and International Efforts

Citizen Science



- Biodiversity specimen collectors

Collectors can provide rapid detection

- Collectors are regularly in the field
- Collectors recognize patterns and norms through:
  - Personal experience
  - Examination of reliable resources (e.g., flora)
  - Communication with other experts

Rapid detection using outliers

Types of outliers

- Phenological
- Distributional
- Morphological
- Ecological
- Behavioral
- …

Outliers may be indicators of change

- Hybridization
- Distributional changes
  - Exotic species
  - Native species
- Phenological shifts
- Environmental degradation


https://pixabay.com/en/potato-potato-plant-plant-401388/

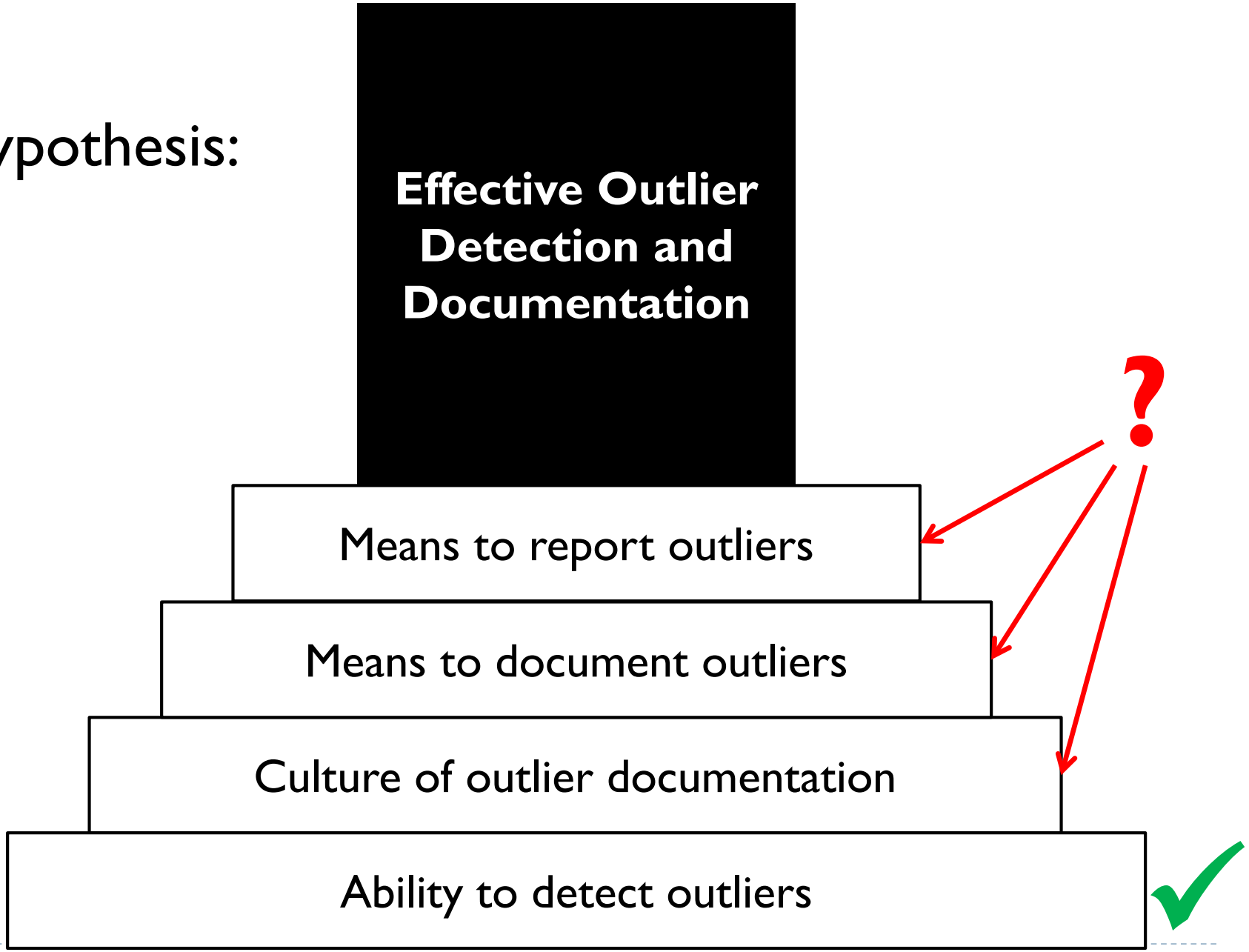

https://www.flickr.com/photos/oregonstateuniversity/5654071383

Collectors can play a critical role in detection and documentation of change.

but

Are they empowered to do so?

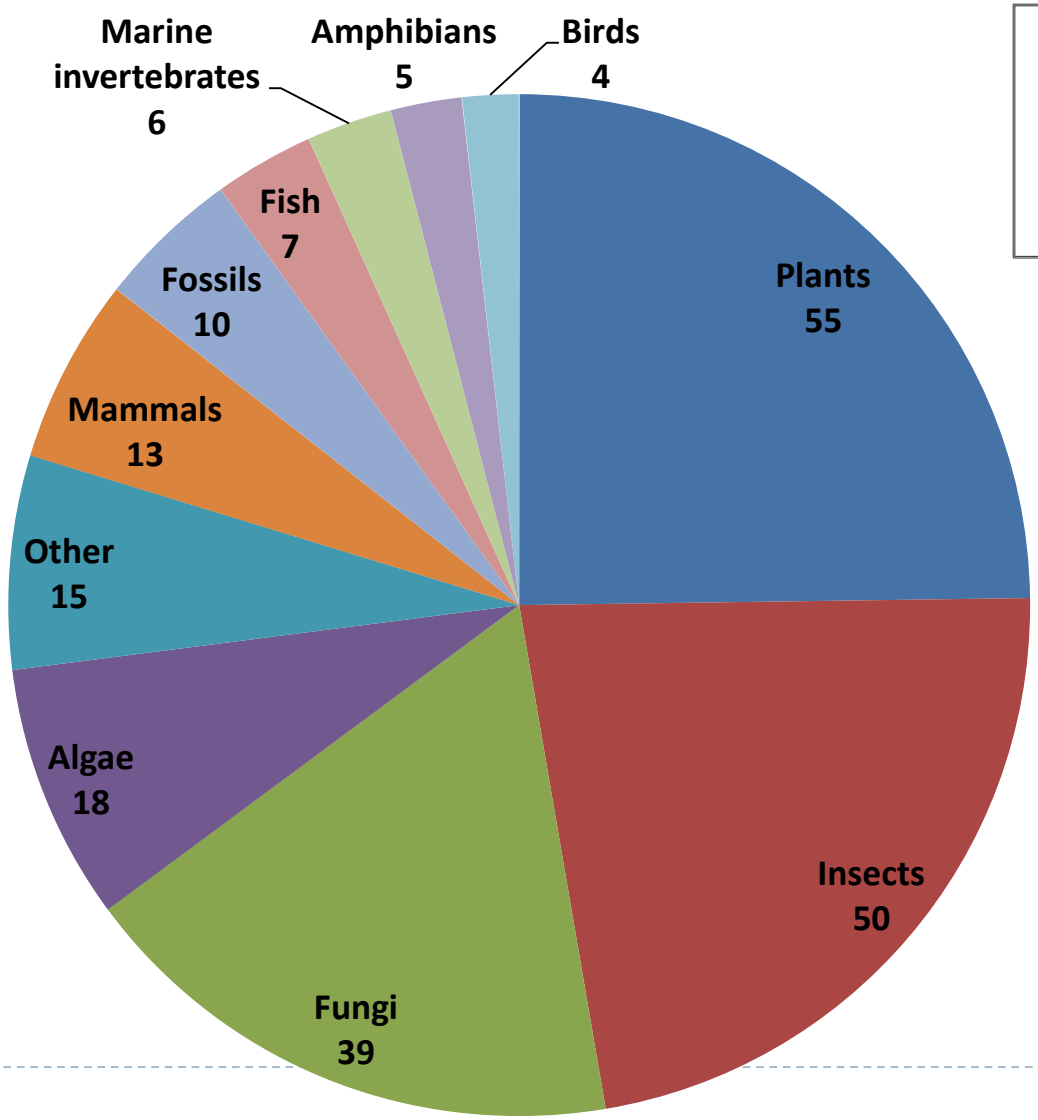
Hypothesis:


Effective Outlier Detection and Documentation
?
Means to report outliers
Means to document outliers
Culture of outlier documentation
Ability to detect outliers

Methods

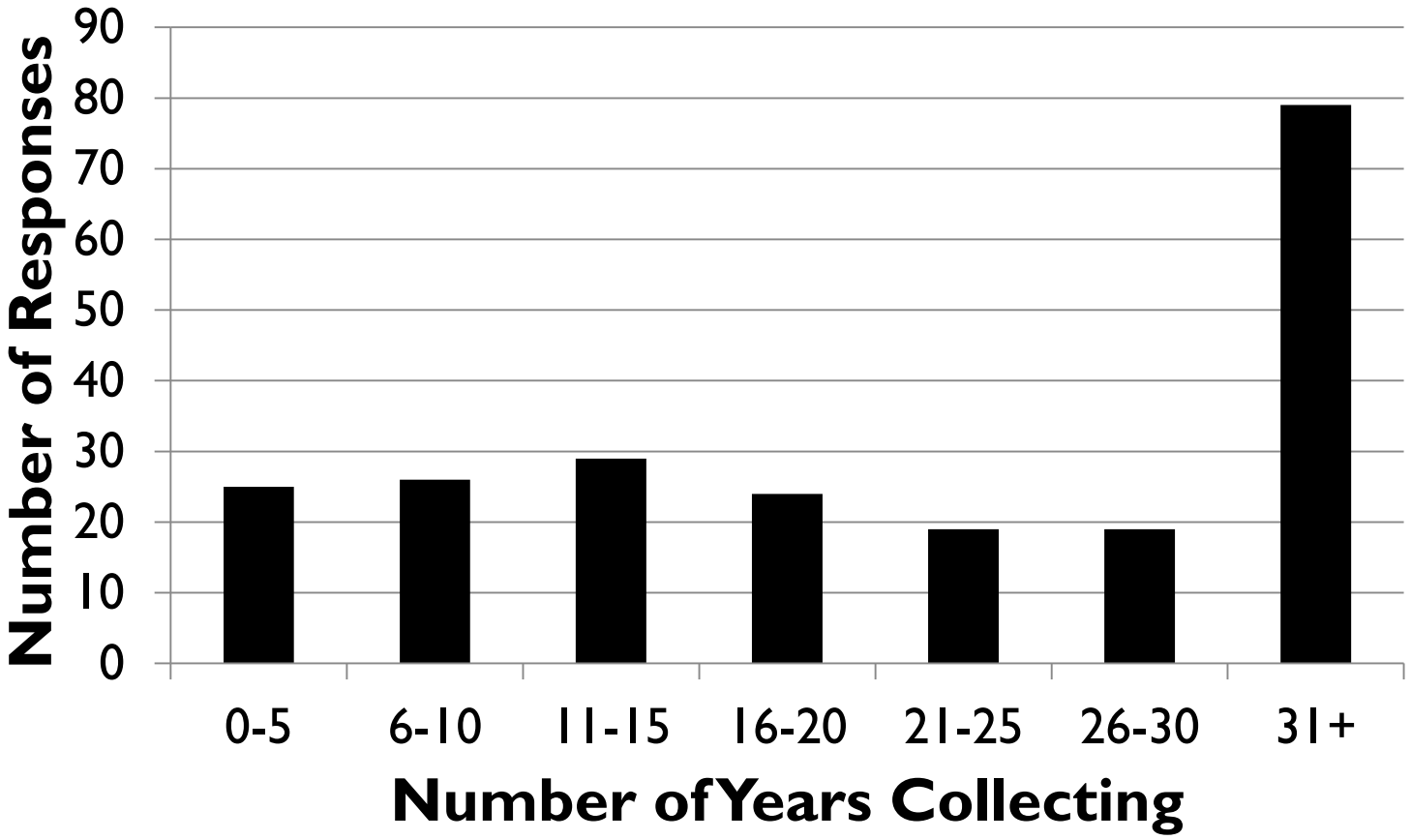
- Distributed an 18-question survey throughout the collecting community
  - Listservs (e.g., NHCOLL-L, HERBARIA, ECN-L)
  - Natural Sciences Collections Alliance groups
  - iDigBio social media

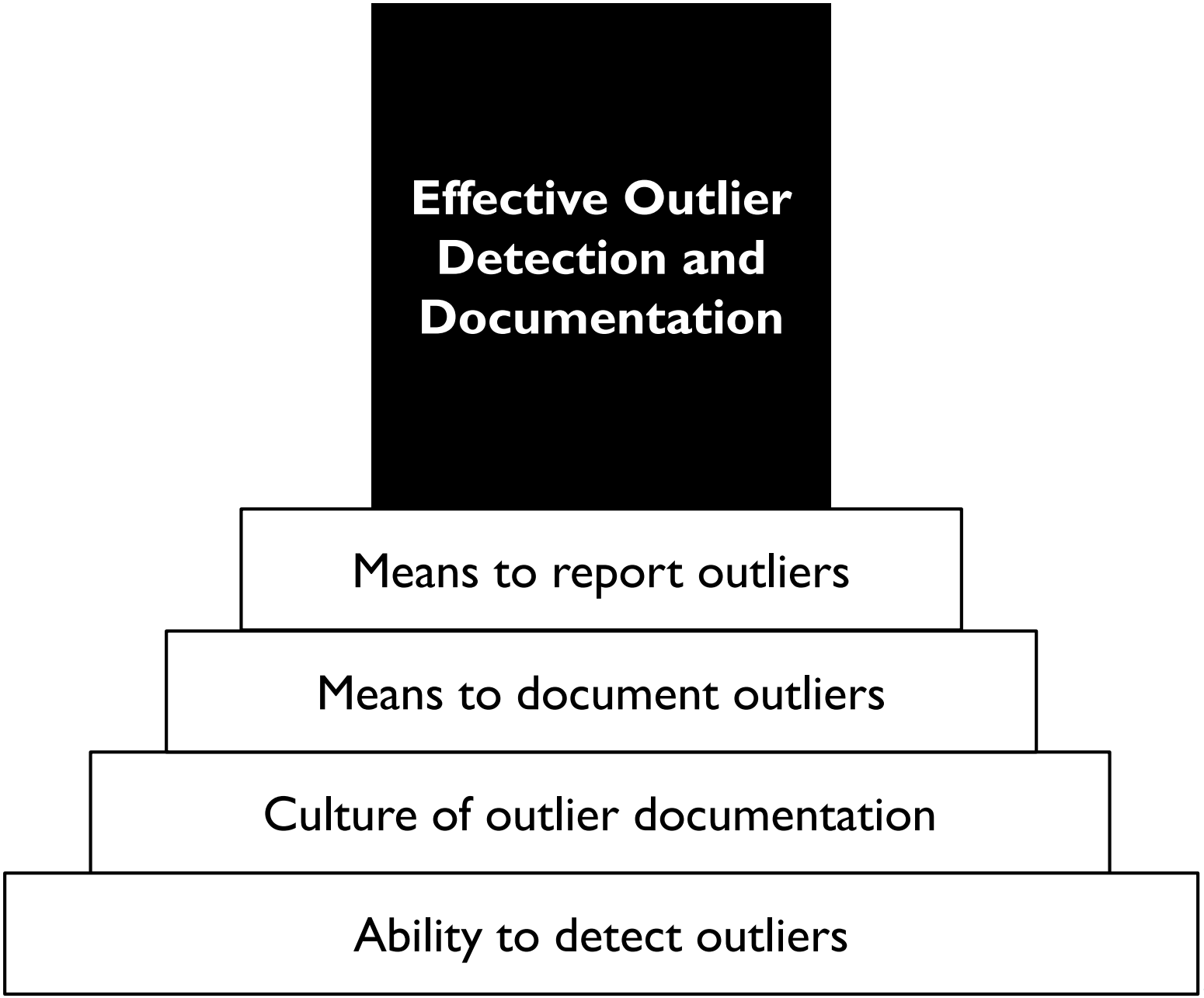
Survey Responses

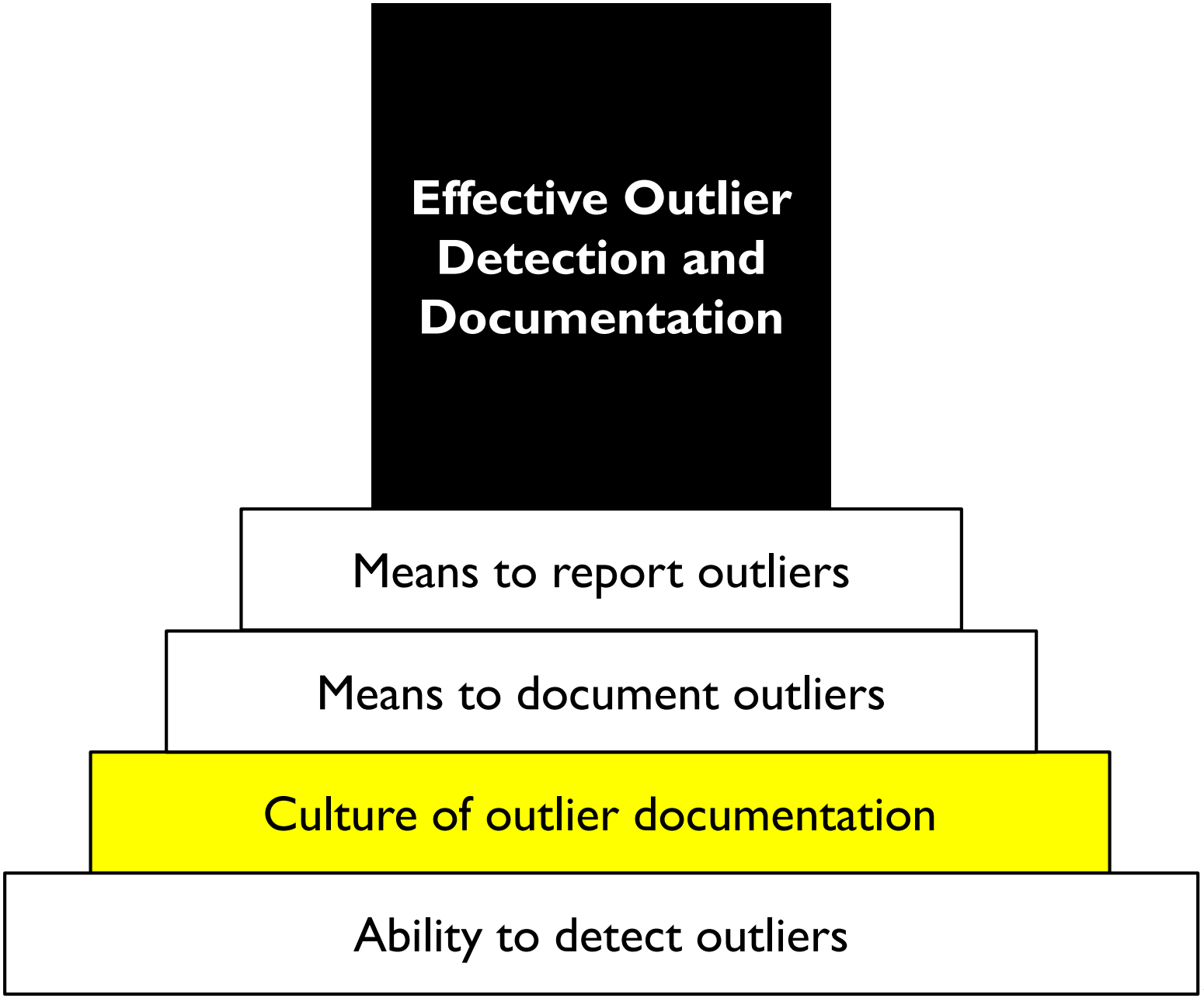


222 total

Survey Responses



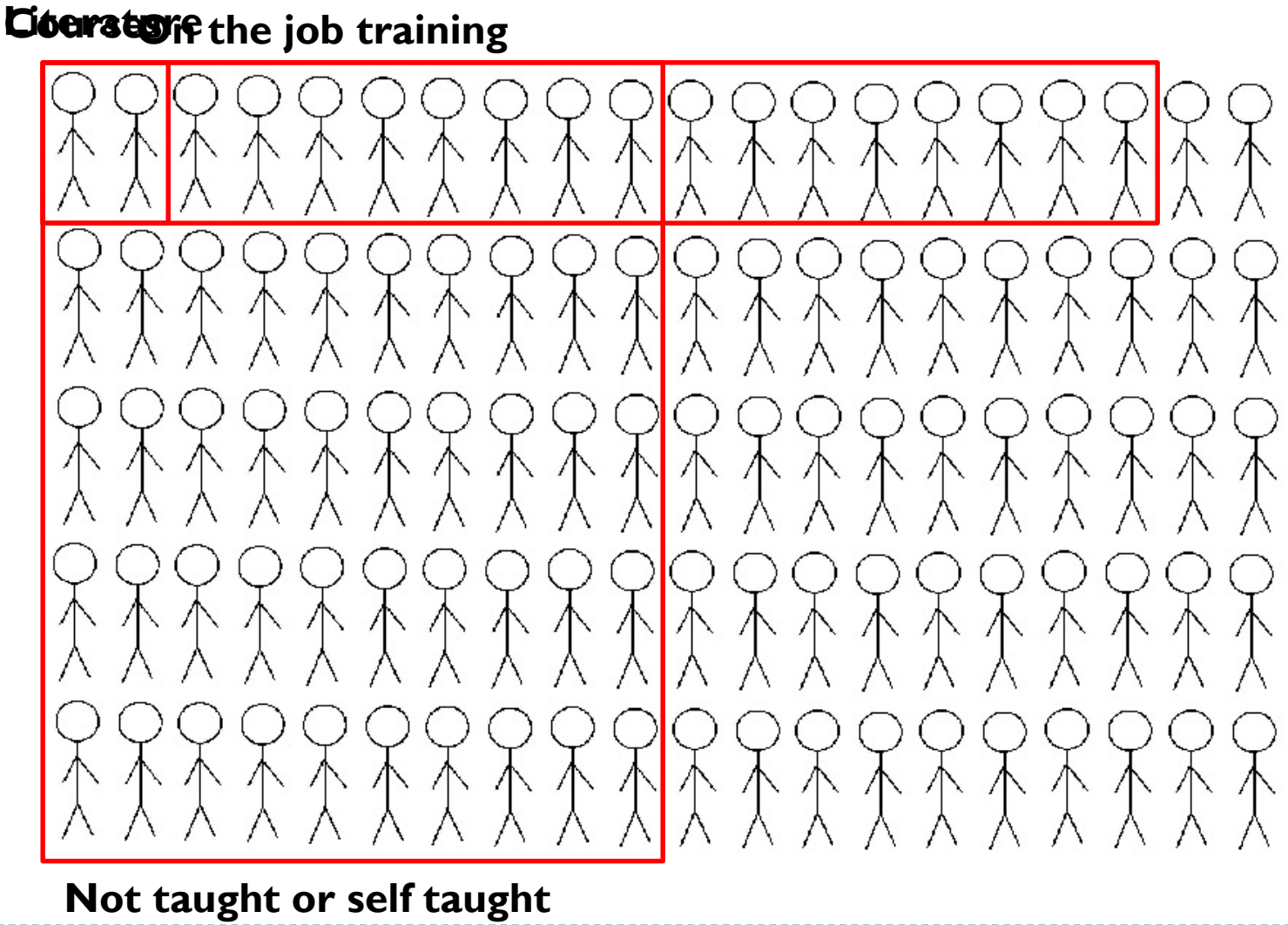

Effective Outlier Detection and Documentation
Means to report outliers
Means to document outliers
Culture of outlier documentation
Ability to detect outliers


Effective Outlier Detection and Documentation
Means to report outliers
Means to document outliers
Culture of outlier documentation
Ability to detect outliers

Awareness

Q: As a collector, do you view yourself as being on the front lines of observing and documenting change in Earth's biota?

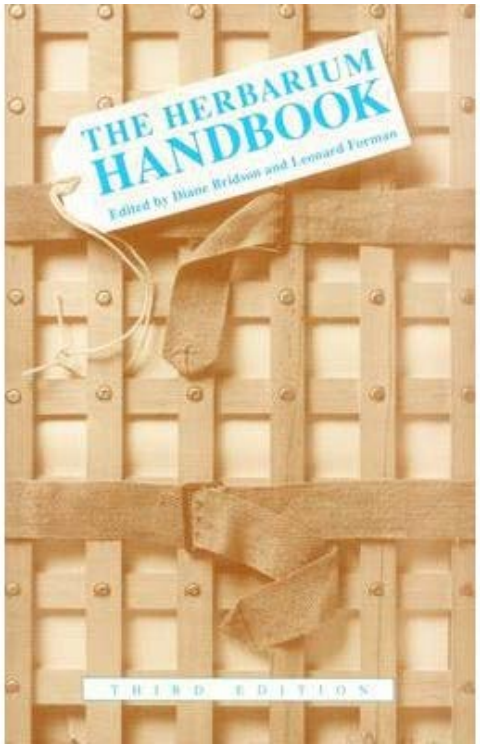
Training

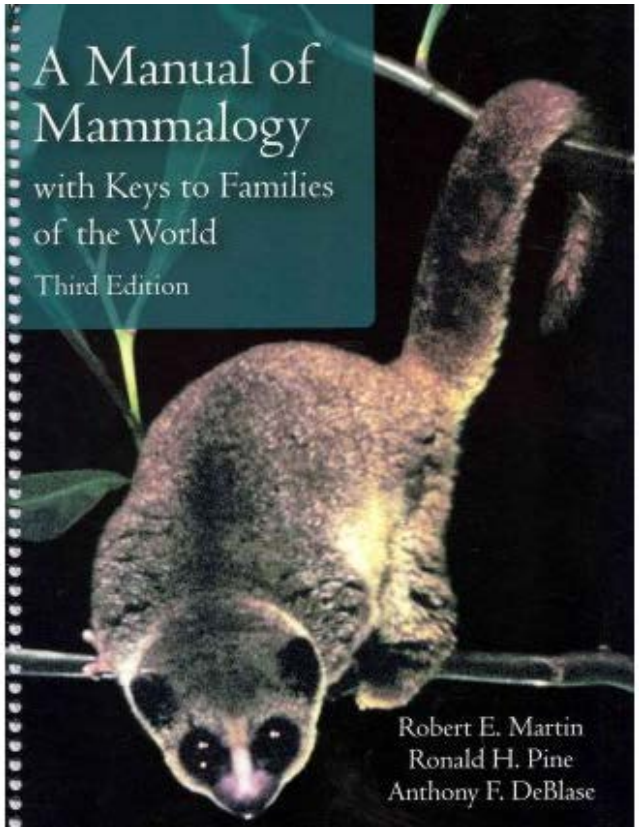


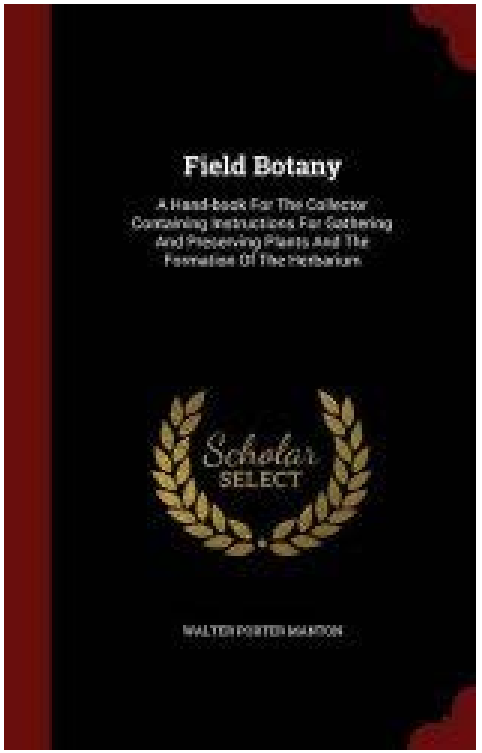
- Culture

Training: Literature Search

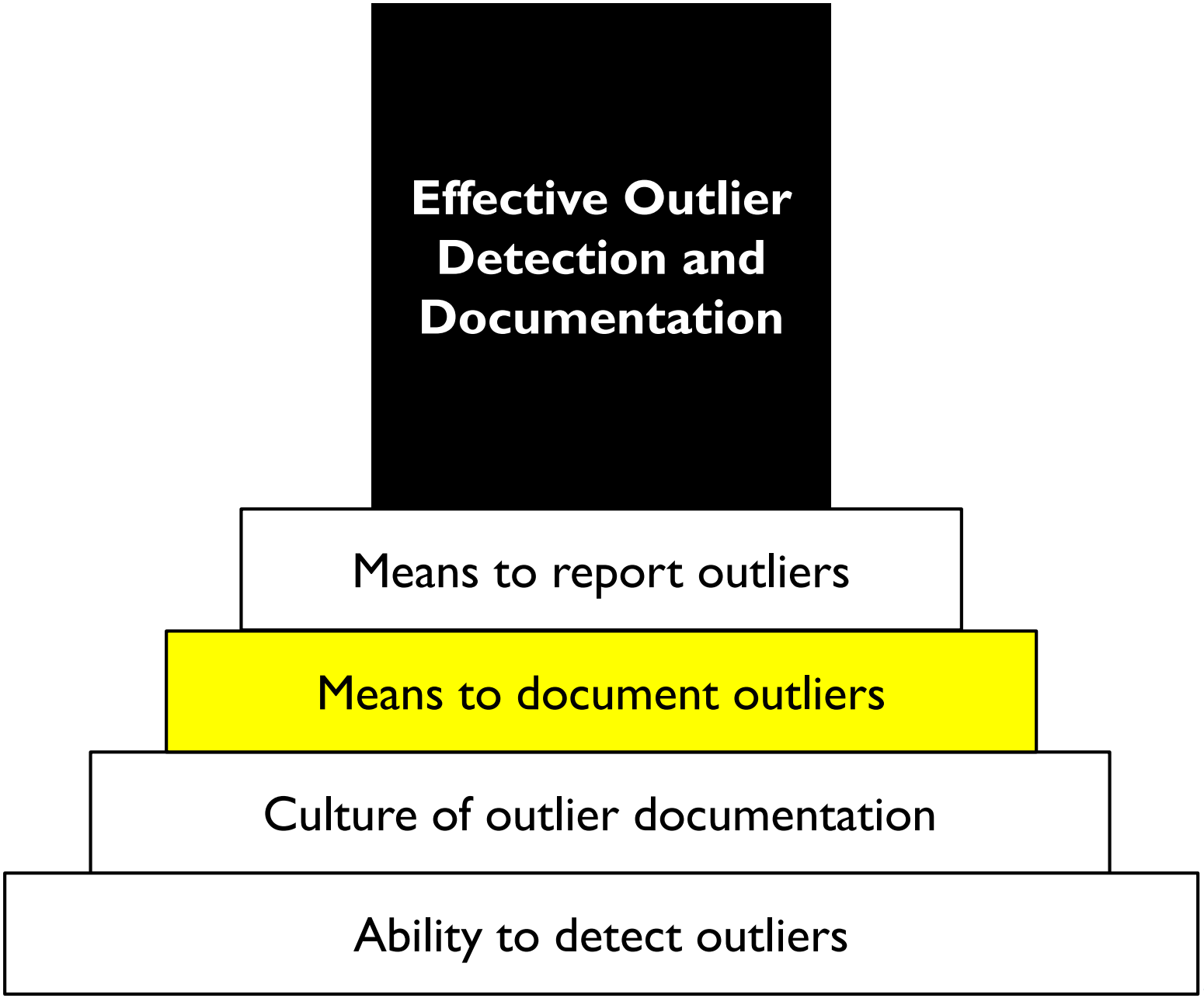
- No mention of outlier detection in the collections manuals and literature that we could find



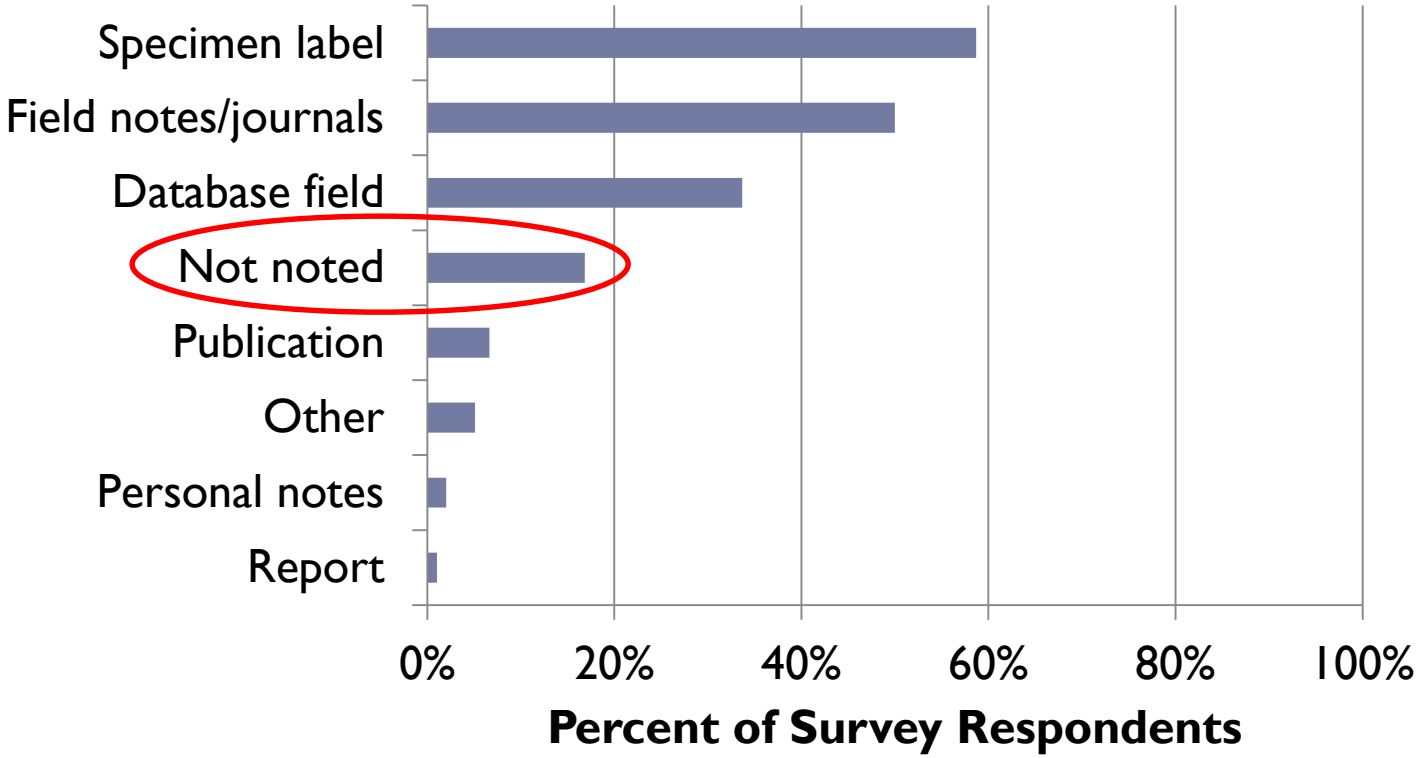




- Culture

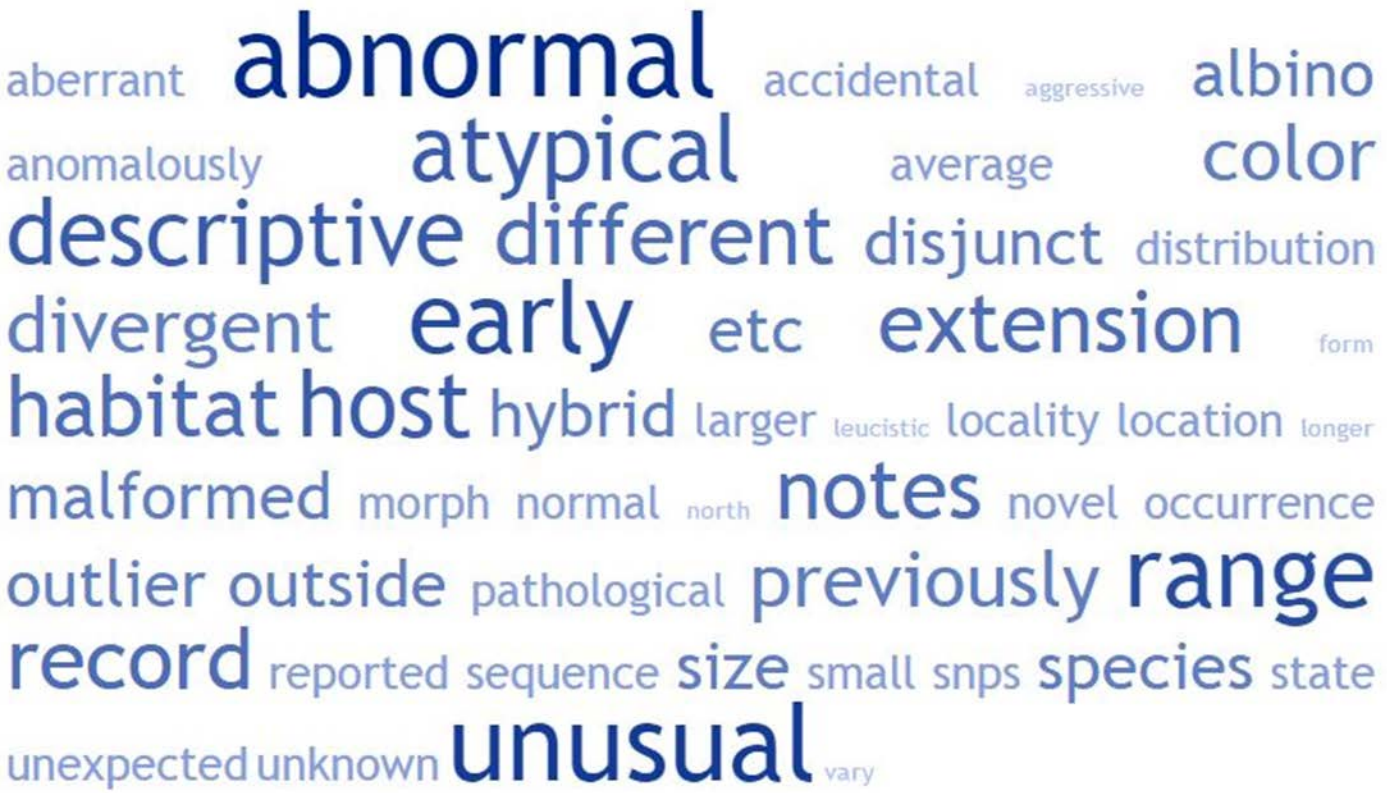

Effective Outlier Detection and Documentation
Means to report outliers
Means to document outliers
Culture of outlier documentation
Ability to detect outliers

Where do collectors document outliers?



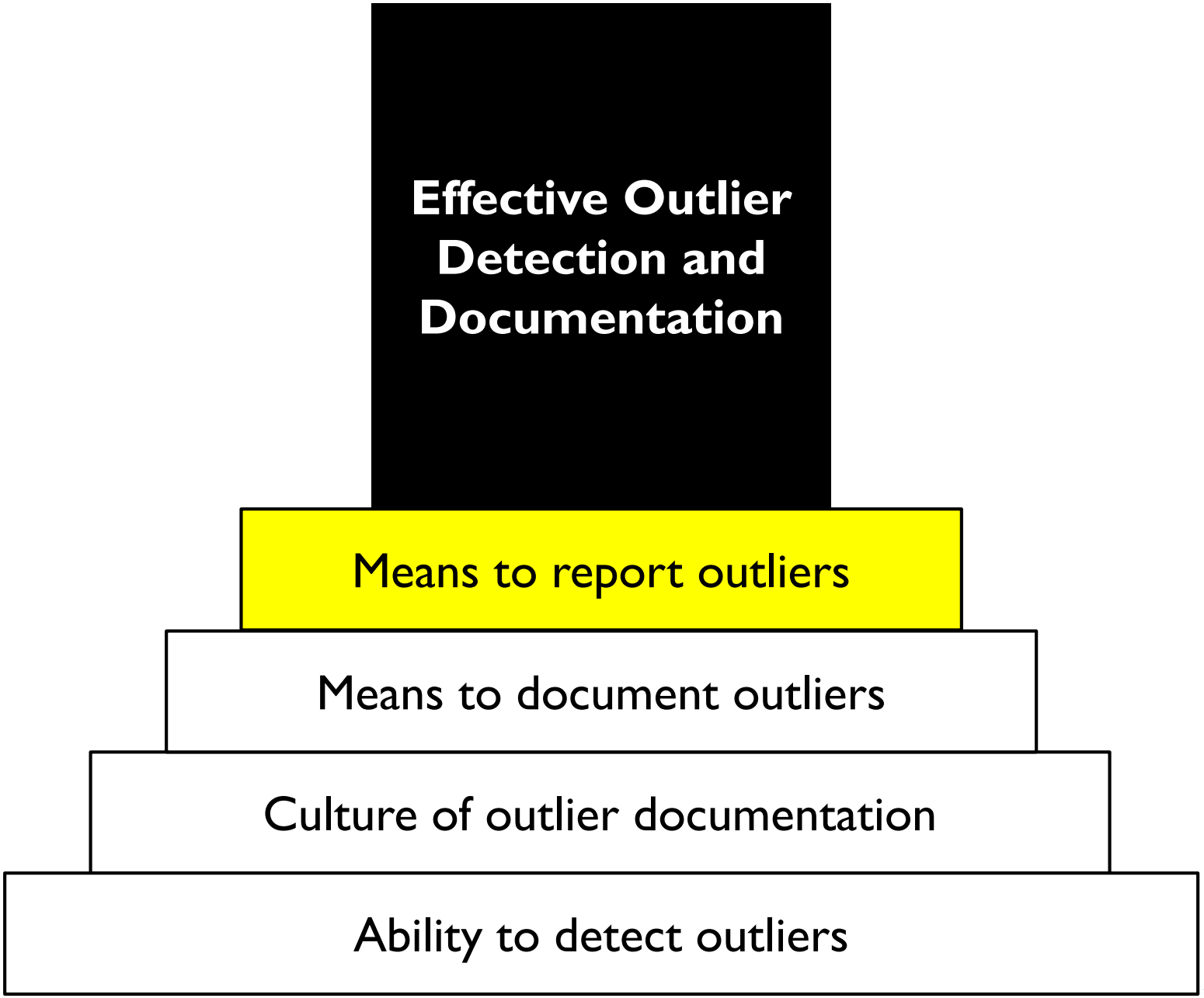
- Documentation

How do collectors document outliers?



- Documentation

Collectors lack the protocol and semantics to document outliers in accessible ways.

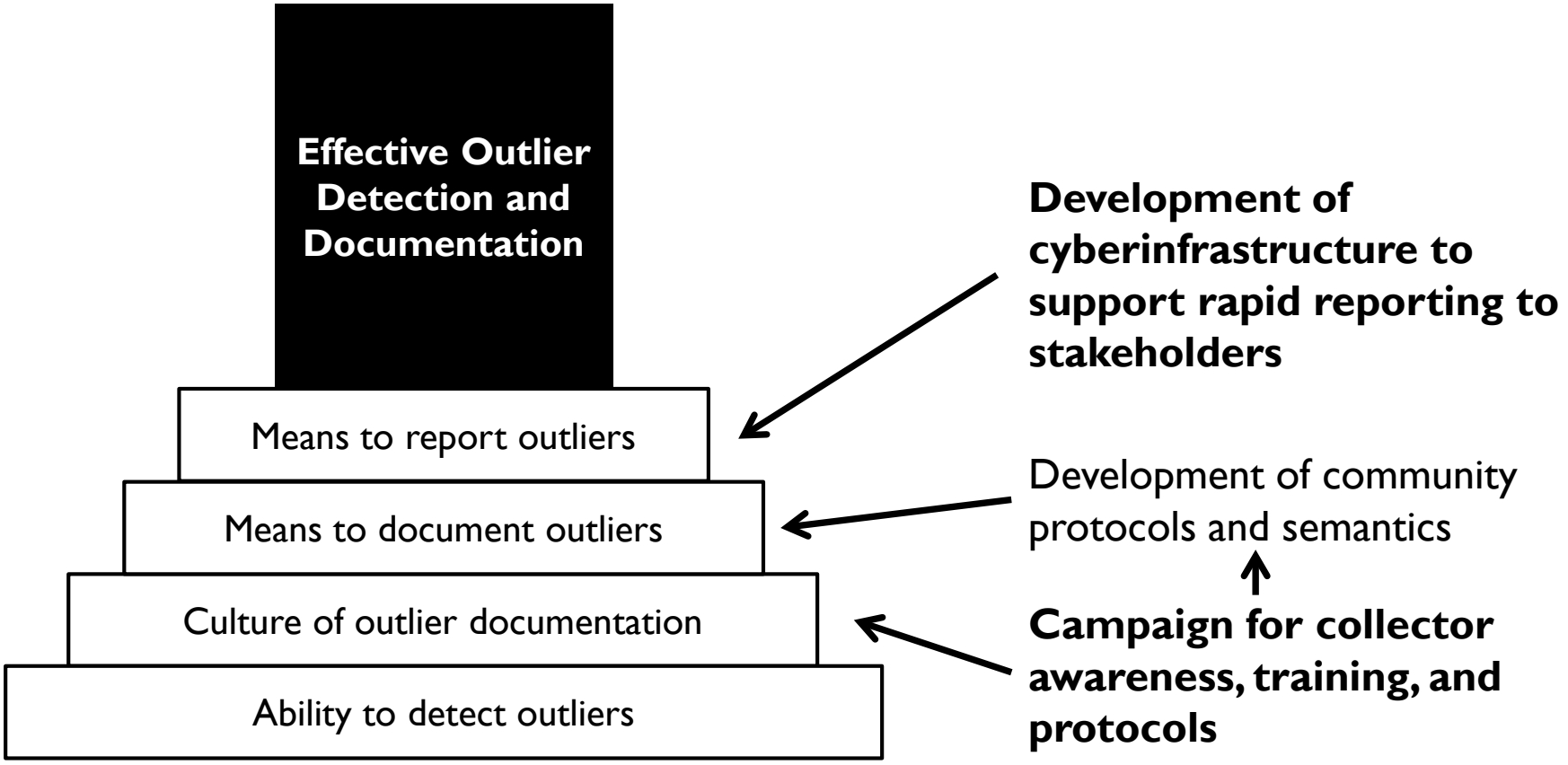

Effective Outlier Detection and Documentation
Means to report outliers
Means to document outliers
Culture of outlier documentation
Ability to detect outliers

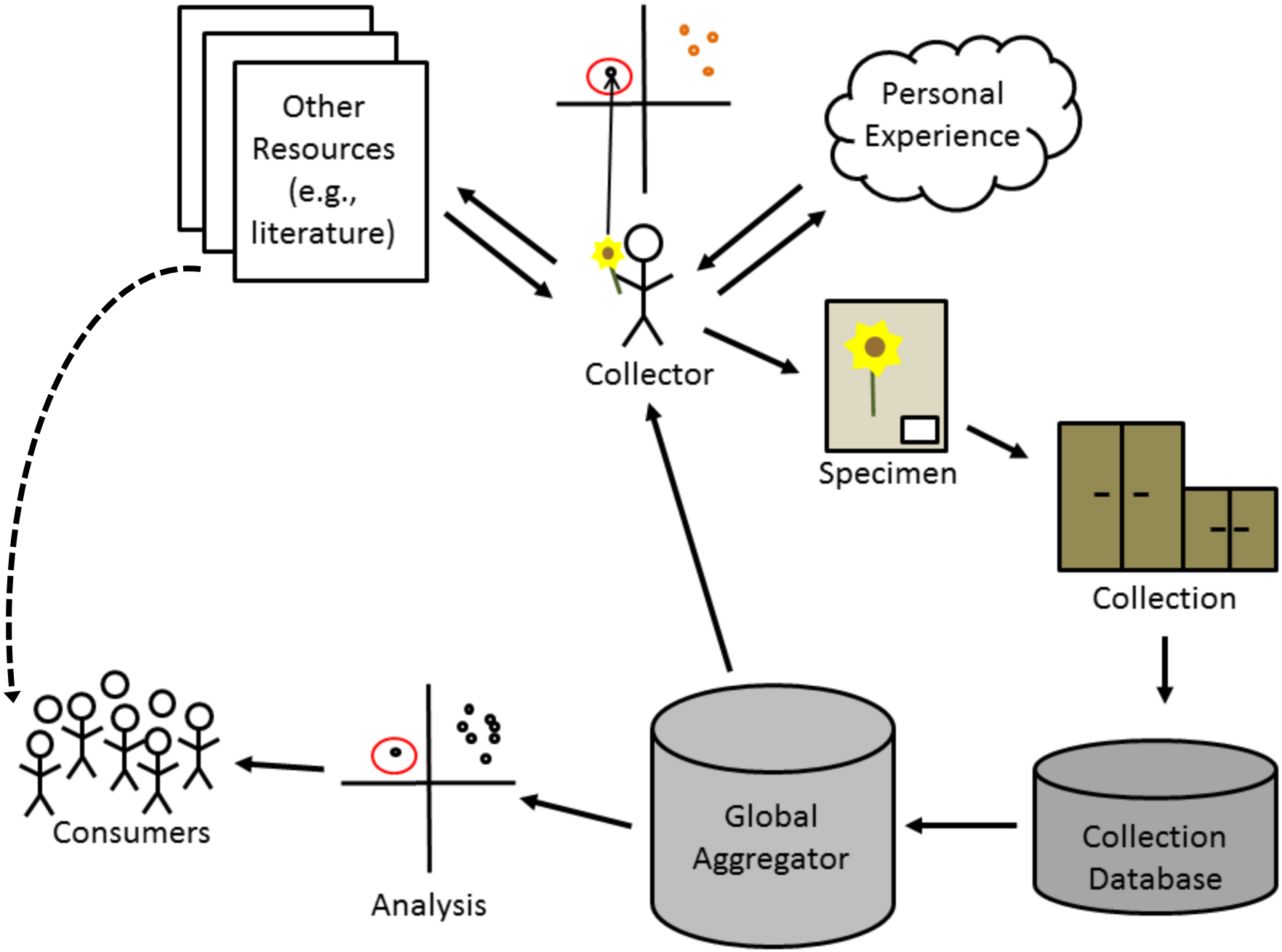
Where do collectors report outliers?

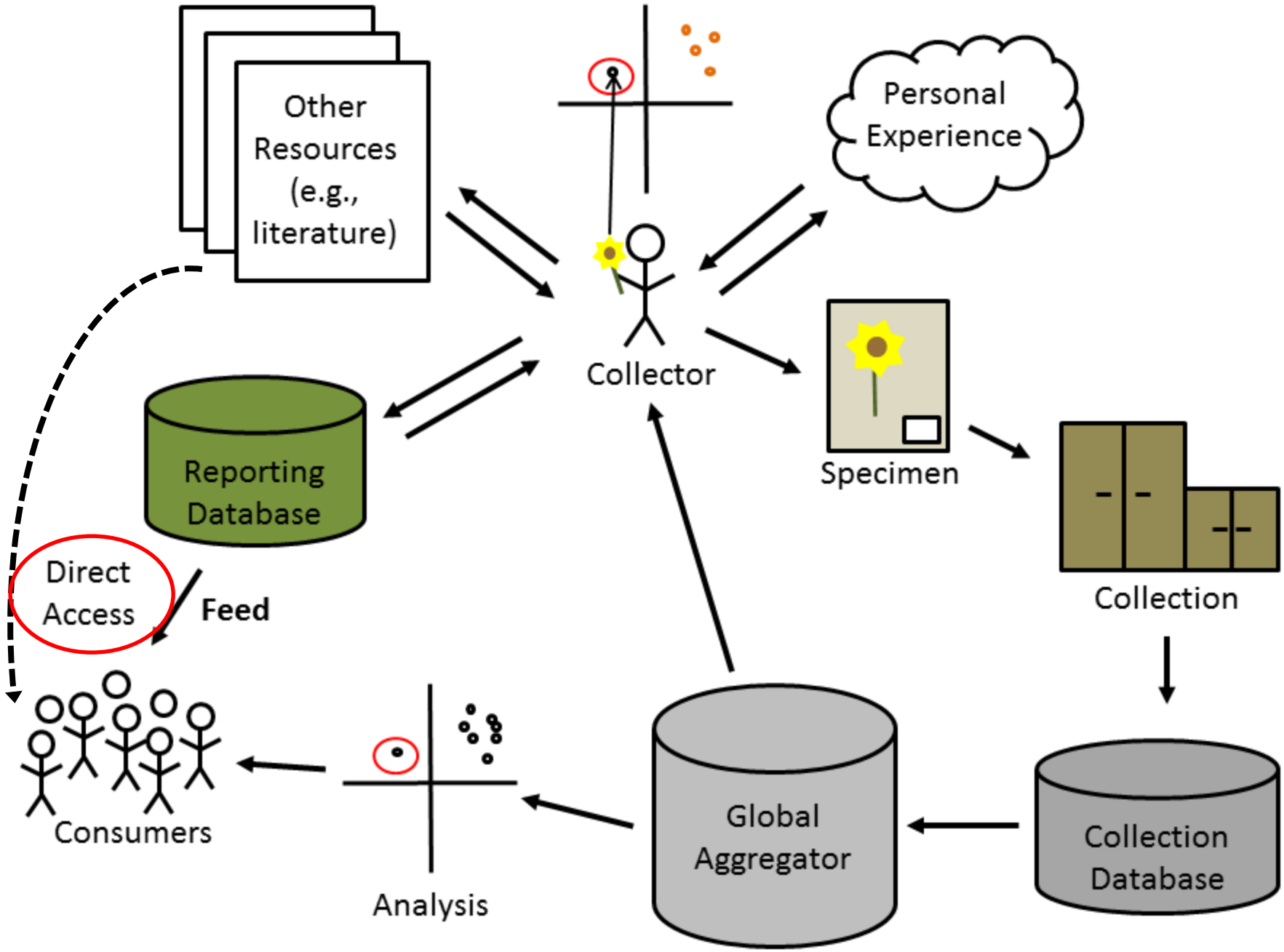
Why don't collectors report outliers?

- Don't consider it important (12%) — Culture
- Lack of standard protocols (30%) — Documentation
- Lack of means for documenting (20%) — Documentation
- Lack of mechanism for reporting (17%) — Reporting
- Lack of time (47%) — Reporting

Recommendations




Other Resources (e.g., literature)
Personal Experience
Collector
Specimen
Collection
Collection Database
Global Aggregator
Analysis
Consumers


Other Resources (e.g., literature)
Personal Experience
Collector
Reporting Database
Specimen
Collection
Direct Access
Feed
Consumers
Analysis
Global Aggregator
Collection Database

Acknowledgements

Special thanks to:

- Co-authors
- Survey participants
- Dr. Austin Mast

iDigBio is funded by a grant from the National Science Foundation's Advancing Digitization of Biodiversity Collections Program (Cooperative Agreement EF-1115210). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Precedent

iDigBio
Integrated Digitized Biocollections

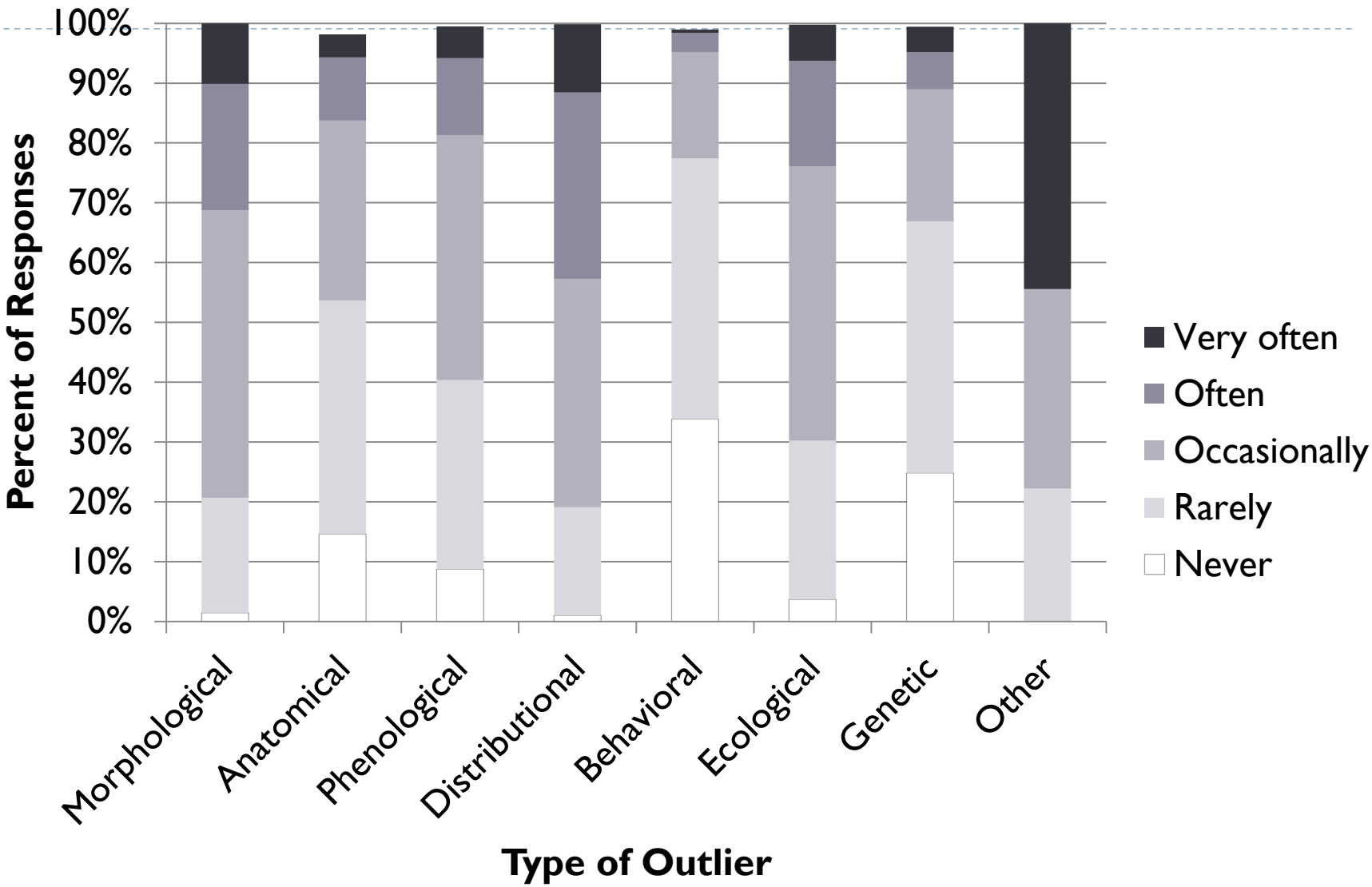
64,015,275 records

687

1,103

2,327

- Culture


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent of Responses
Morphological
Anatomical
Phenological
Distributional
Behavioral
Ecological
Genetic
Other
Type of Outlier
Very often
Often
Occasionally
Rarely
Never