Assessing the Value of Biodiversity Collections in Conservation Research

Henry L. Bart Jr. and Michael V. Cyrana

Tulane University Biodiversity Research Institute

hbartjr@tulane.edu

TUBRI

Hypothesis

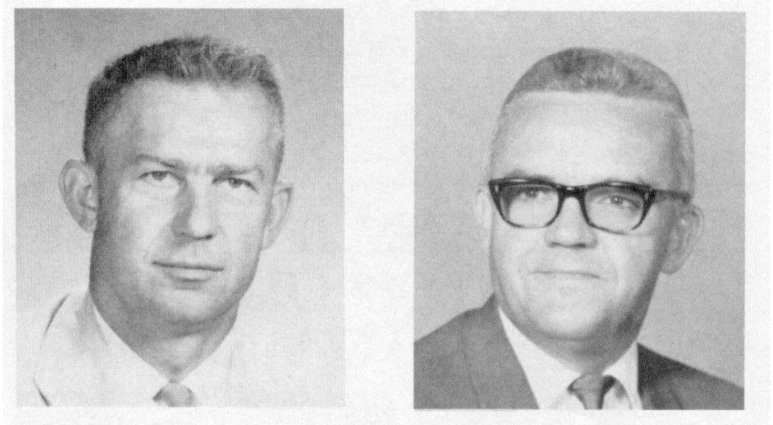
- Biodiversity collection data can't be used in conservation research (assessing how populations and communities of organisms have changed with changing environmental conditions) because of myriad sampling and data issues (H_0).
- H_a: Biodiversity collection data are useful in conservation research.
- To test this, must show that methods used to collect the specimens are systematic and sufficiently standardized to yield samples that adequately represent species present and their relative abundances.

This Study

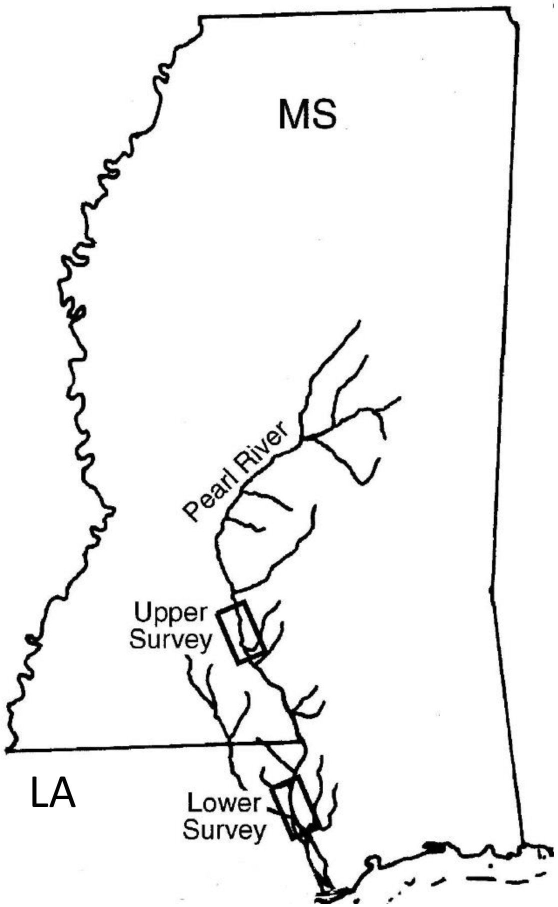
- Attempts to demonstrate that biodiversity collection data *are* useful for conservation research using data mined from Tulane's Royal D. Suttkus Fish Collection.
- Data for the study are seine samples taken quarterly from the same site on different dates from 1963-2005 (long-term monitoring survey).
- Collection records supplemented with ancillary data from Suttkus Field Notes Project (more about this later).

Pearl River Fish Surveys

R. D. Suttkus and G. E. Gunning began quarterly surveys of multiple sites in the Pearl River in 1963 ("Lower Pearl Survey"), which Suttkus continued until 2005.



Royal D. Suttkus | Gerald E. Gunning



"Upper Pearl Survey" began in 1973 and continued until 2005.

2,817 collections and nearly 2 million fish specimens taken from the river.

One of the most comprehensive records of fish community change even amassed.

River Modification

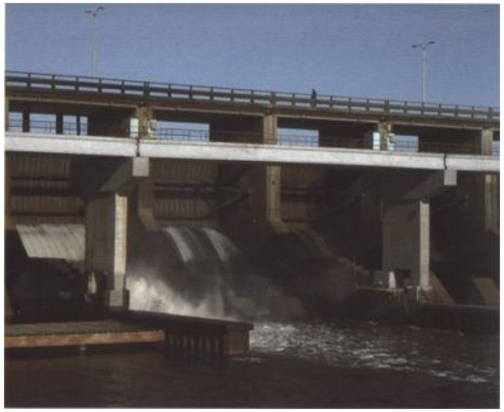
Growth of cities along the Pearl River has resulted in modifications to the river for flood control and navigation; impoundment of the river for water supply and recreation.

Pearl River is presently one of the most modified rivers in Mississippi.

There is evidence that the modifications have destabilized the river and caused accelerated erosion.

River is being polluted by municipal and industrial discharges, strip mining and oil and gas extraction.

All of this is likely taking a toll on the biota.



Ross Barnett Dam, Reservoir 1964

Pearl River Navigation Canal, 1956

Low sill dam at Pools Bluff Sill

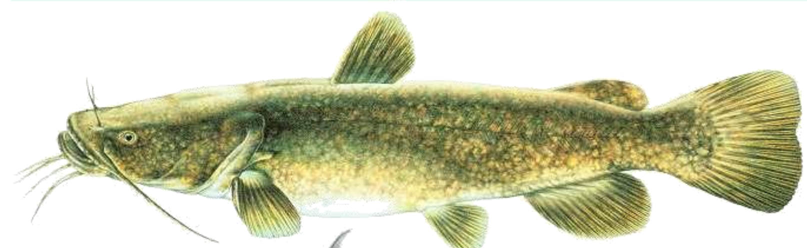
“Seinable” fishes

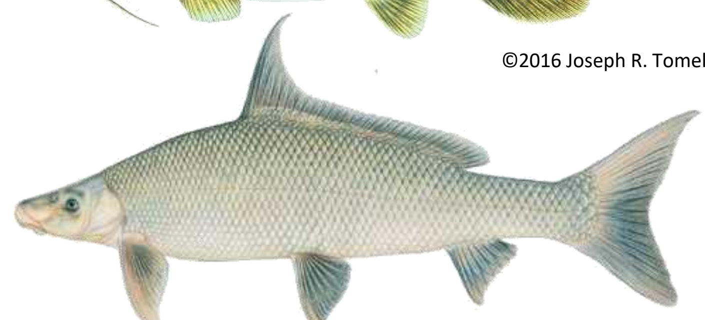
Suttkus usually collected with a 10’ x 6’, 3/16” mesh minnow seine (sometimes by himself but more commonly with others).

Seines mainly catch small shallow-water fish species (minnows, darters, madtoms, small sunfishes).

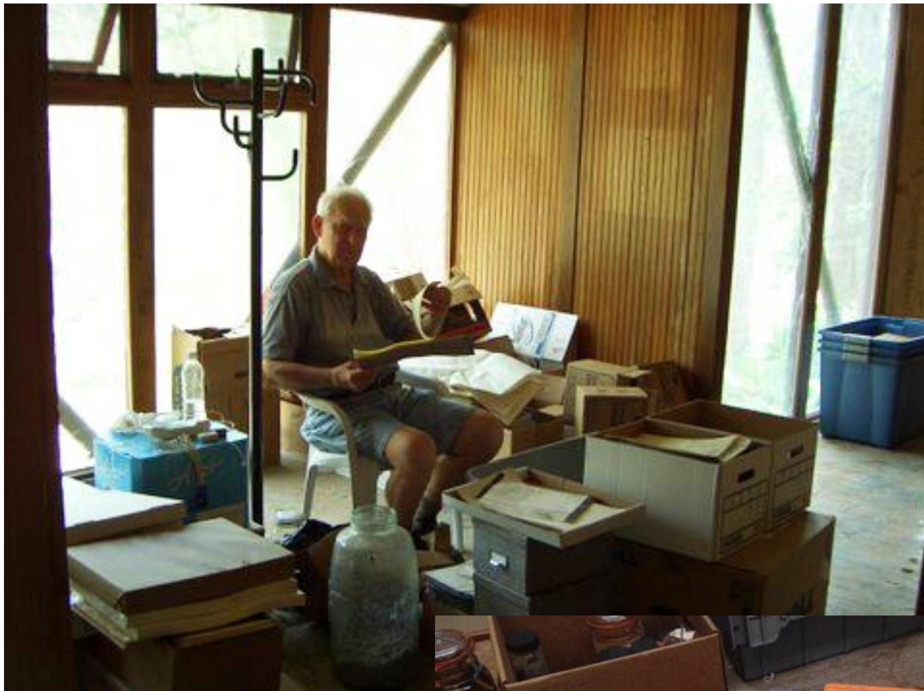
Large fish species are underrepresented in seine samples (unless captured as early life stages).

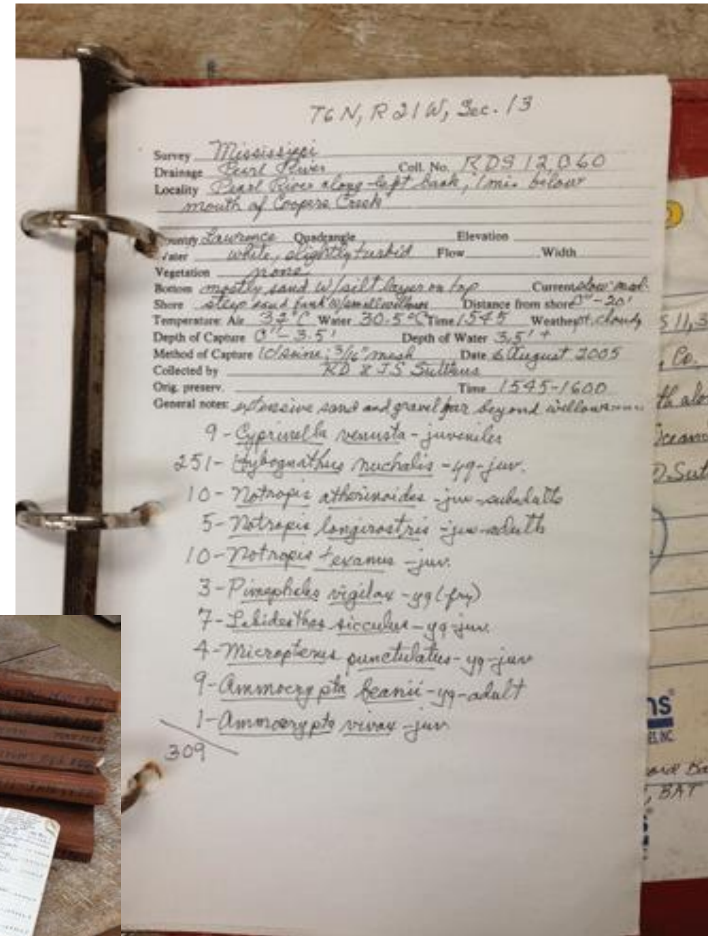
Possible to distinguish gear types used based on species captured.





Hurricane Katrina





Suttkus Field Notes Project

Have recovered 67% of the data associated with Royal Suttkus's lost field notes using information in the notes of people who collected with him.

Below is an alphabetical list of surnames, extracted from our database, of individuals who collected with Royal D. Suttkus. Each surname is listed alone and (in expanded view) in all of the variations that the surname appears in our database (i.e., accompanying initials and punctuation). Click on "Print View" to view a more complete description of the collection event, which should help you to determine if the collector named is indeed you. Once you have identified all of the collections that you assisted with, please either scan or photocopy your notes and send them to us by email (larcie@museum.tulane.edu) or regular mail: Tulane University Museum of Natural History, Attn: RDS Field Notes Project, 3705 Main Street, Belle Chasse, LA 70037. Please help us to spread the word about this project to others whose names you recognize in this list. Many thanks in advance!

- ⊞ Abbey (12) Print View
- ⊞ Adkison (16) Print View
- ⊞ Alegro (5) Print View
- ⊞ Algero (5) Print View
- ⊞ Anderson (82) Print View
- ⊞ Andersson (62) Print View
- ⊞ Ansel (1) Print View
- ⊞ Arata (1) Print View
- ⊞ Archer (2) Print View
- ⊞ Atkinson (2) Print View
- ⊞ Backus (2) Print View
- ⊞ Baker (7) Print View
- ⊞ Barbour (102) Print View
- ⊞ Barclay (6) Print View
- ⊞ Bardon (1) Print View
- ⊞ Barkuloo (103) Print View

Abbey: 12 Collecting Events

RDS 8825; Pease River at US Hwy. 287.; USA; Texas; Wilbarger; 34.17944; -99.32306; R.D. Suttkus, C.J. Jones & M. Abbey; 13 July 1985;

141751 Lepomis cyanellus (13)
141752 Micropterus salmoides (1)
141745 Cyprinella lutrensis (33)
141741 Cyprinus carpio (1)
141742 Hybognathus placitus (841)
141743 Macrhybopsis aestivalis (65)
141744 Notropis bairdi (168)
141746 Pimephales promelas (3)
141748 Cyprinodon rubrofluviatilis (17)
141749 Fundulus zebrinus (51)
141747 Ictalurus punctatus (1)
141750 Gambusia affinis (39)

RDS 8826; Red River at US Hwy. 283; 19.3 mi. N of Vernon.; USA; Texas; Wilbarger; 34.43139; -99.34139; R.D. Suttkus, C.J. Jones & M. Abbey; 13 July 1985;

141754 Carpiodes carpio (7)
141765 Lepomis cyanellus (1)
141766 Lepomis humilis (9)
141767 Lepomis megalotis (1)
141753 Dorosoma cepedianum (8)
141758 Cyprinella lutrensis (259)
141755 Hybognathus placitus (1078)
141756 Macrhybopsis aestivalis (92)
141757 Notropis bairdi (285)
141759 Phenacobius mirabilis (2)
141760 Pimephales promelas (5)
141762 Cyprinodon rubrofluviatilis (22)

Data

- Data for 208 RDS “seine” samples from the Pearl River just below Pools Bluff Sill, ***with sampling start and end times*** and covering the period April 1963 to April 2005, were extracted from the Suttkus Fish Collection database.
- Sampling gear-type available only for 19% of collections, but assemblages support assumption that samples taken with 10’x 6’, 3/16” mesh seines.
- The dataset was trimmed to 99 collections (also 1963-2005) representative of the 63 fish species most commonly encountered at the site.
- Final dataset consisted of catch data (species and abundances) from 69 day and night samples taken between 1969 and 2000.

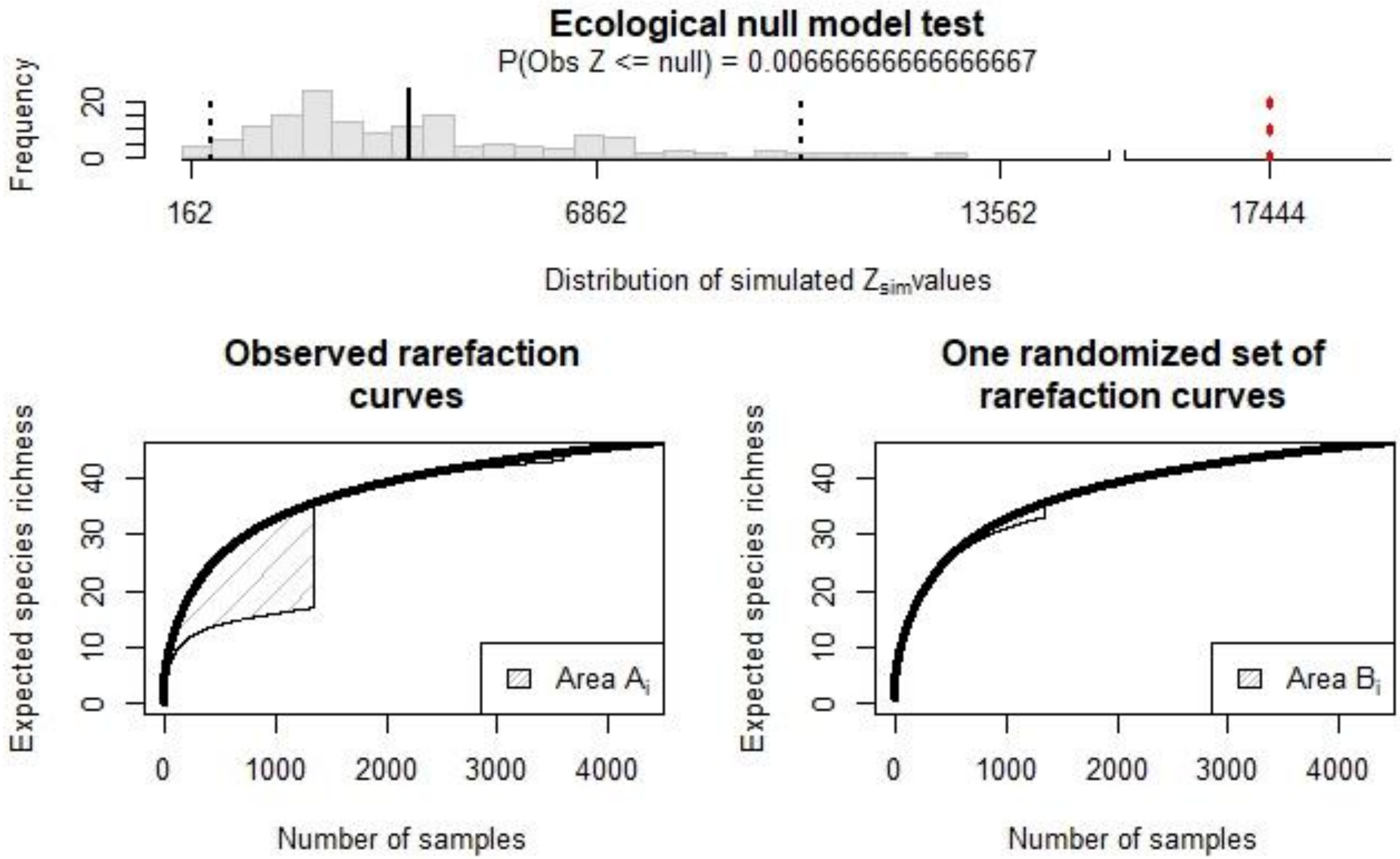
Methods

- Species abundances adjusted based on the amount of time spent sampling (CPUE).
- Compared samples from ***Early*** (1960-70's) and ***Late*** (1980-90's) periods.
- Differences in species CPUE between early and later groups of samples assessed with Kruskal-Wallis tests.
- Nonmetric Multi-Dimensional Scaling (NMDS) used to collapse information from multiple community samples (ranked species CPUE data) into just two dimensions for visualization and interpretation.
- Rarefaction curves computed to model species accumulation with increasing catch.
- Data analyzed in R (Vegan, rareNMtests for Rarefaction)

Rarefaction

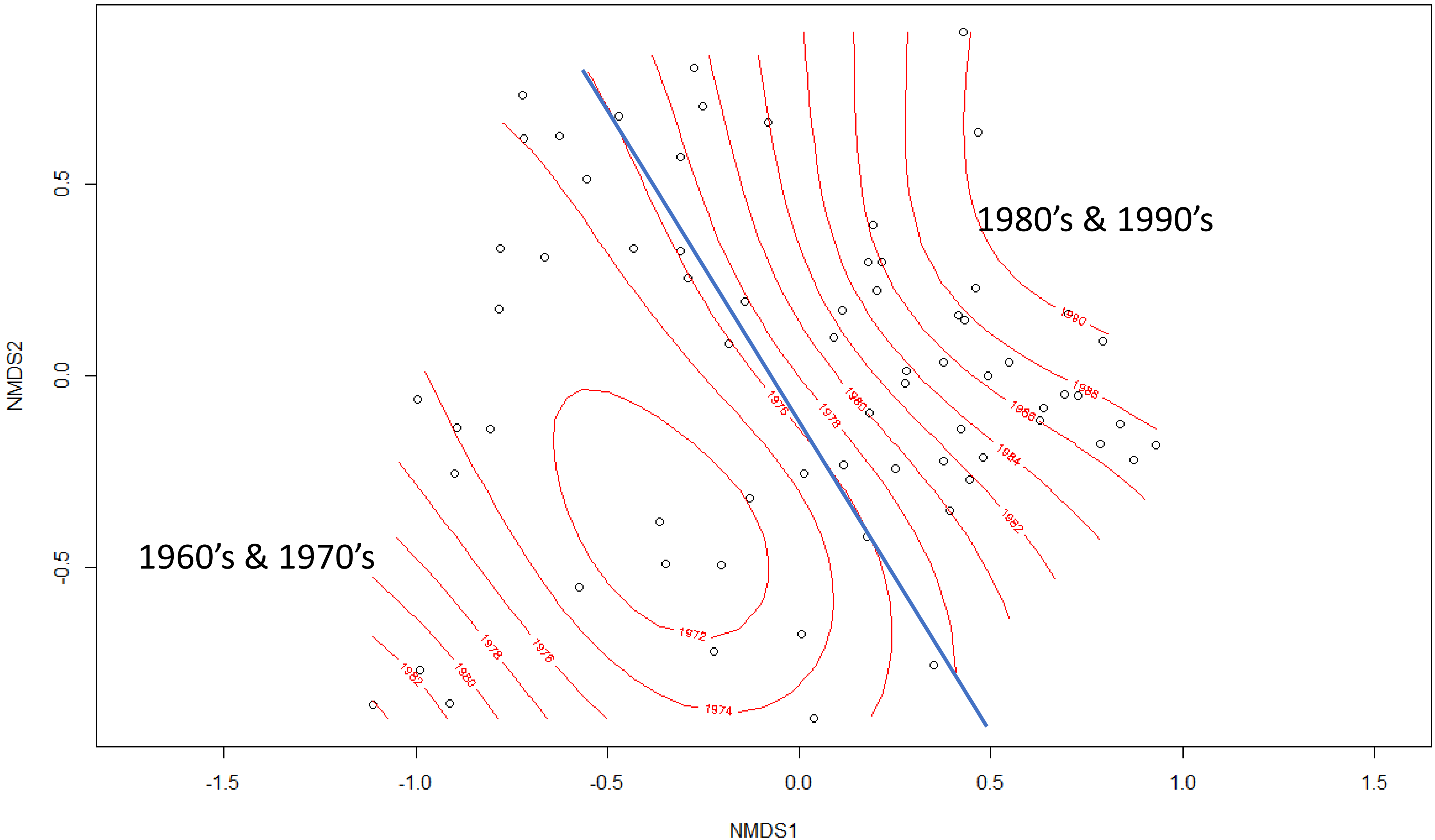
- **Consider two samples** (of the same kind of organisms) that differ in the number of individuals collected; **one** sample **has *N* individuals and *S* species, and the other has *n* individuals and *s* species**.
- **In rarefaction, $n*$ individuals are randomly drawn by subsampling the larger of the two samples without replacement**, where $n*$ equals the number of individuals in the smaller sample.
- Computing **the mean number of species, $s*$, among repeated subsamples of $n*$ individuals estimates** $E(s*|n*)$, **the expected number of species in a random subsample** of $n*$ individuals **from the larger** of the original **sample**s.
- **Variance of $s*$ among random re-orderings of individuals**, **can** also be **estimate**d this way along with a parametric **95% confidence interval**, or the confidence interval can be estimated from the bootstrapped values.

Ecological Null Model Test

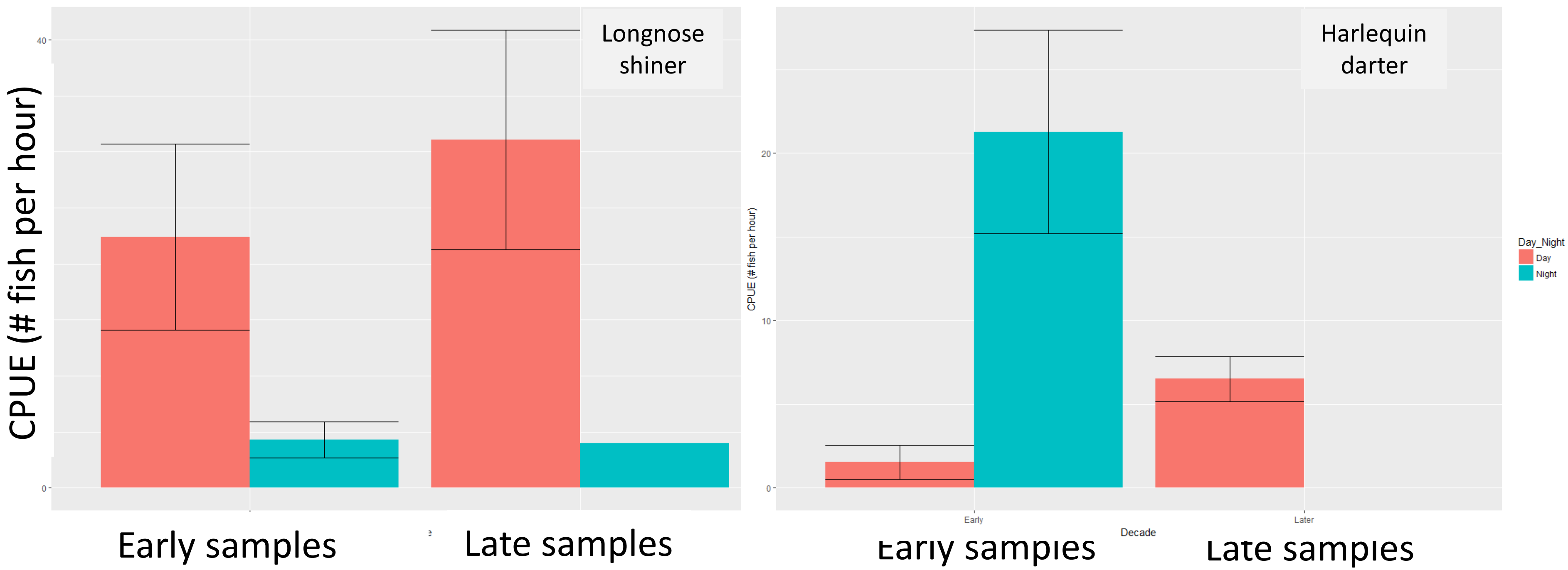


Results

NMDS Results with Year Contours

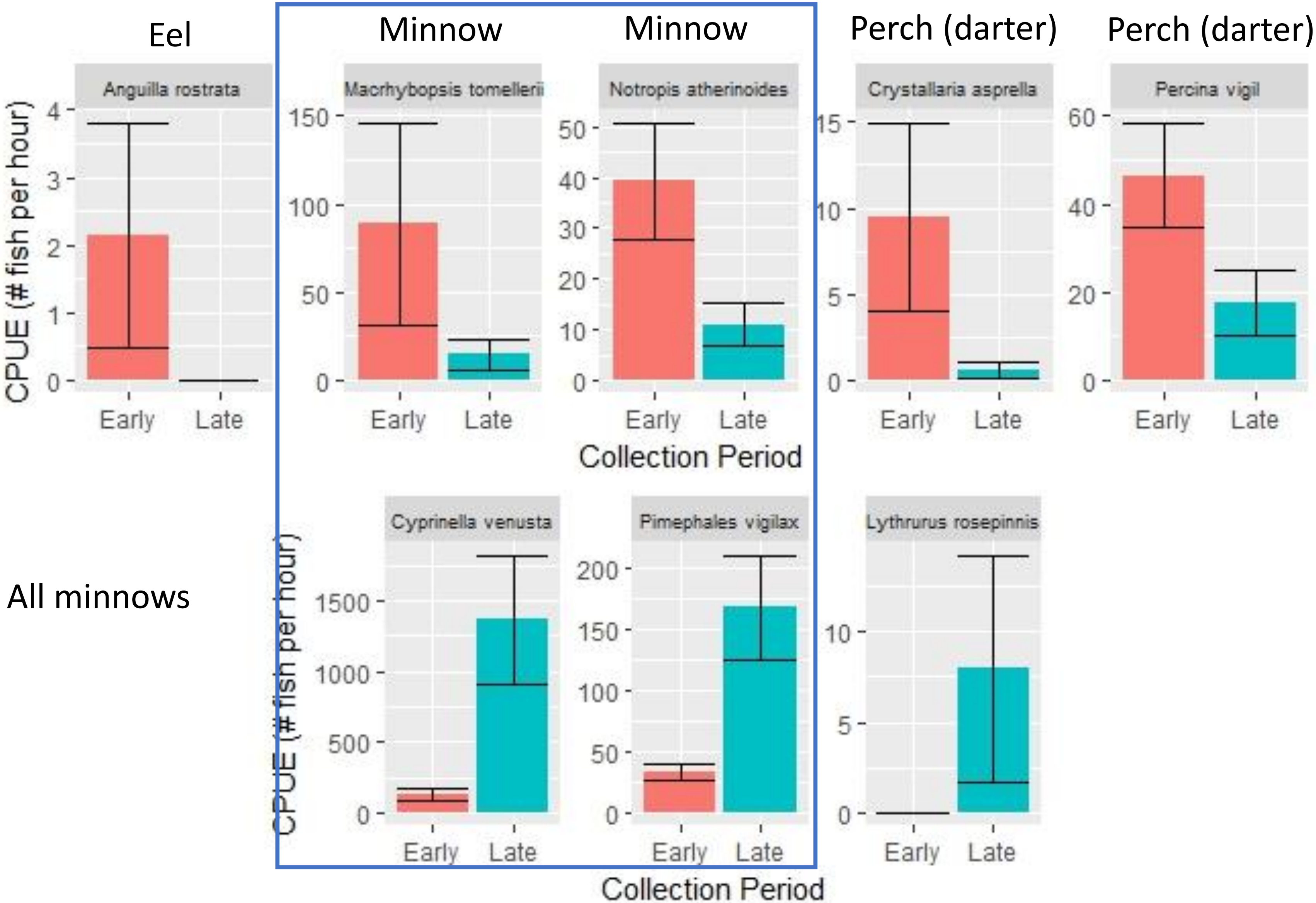


Day vs. Night

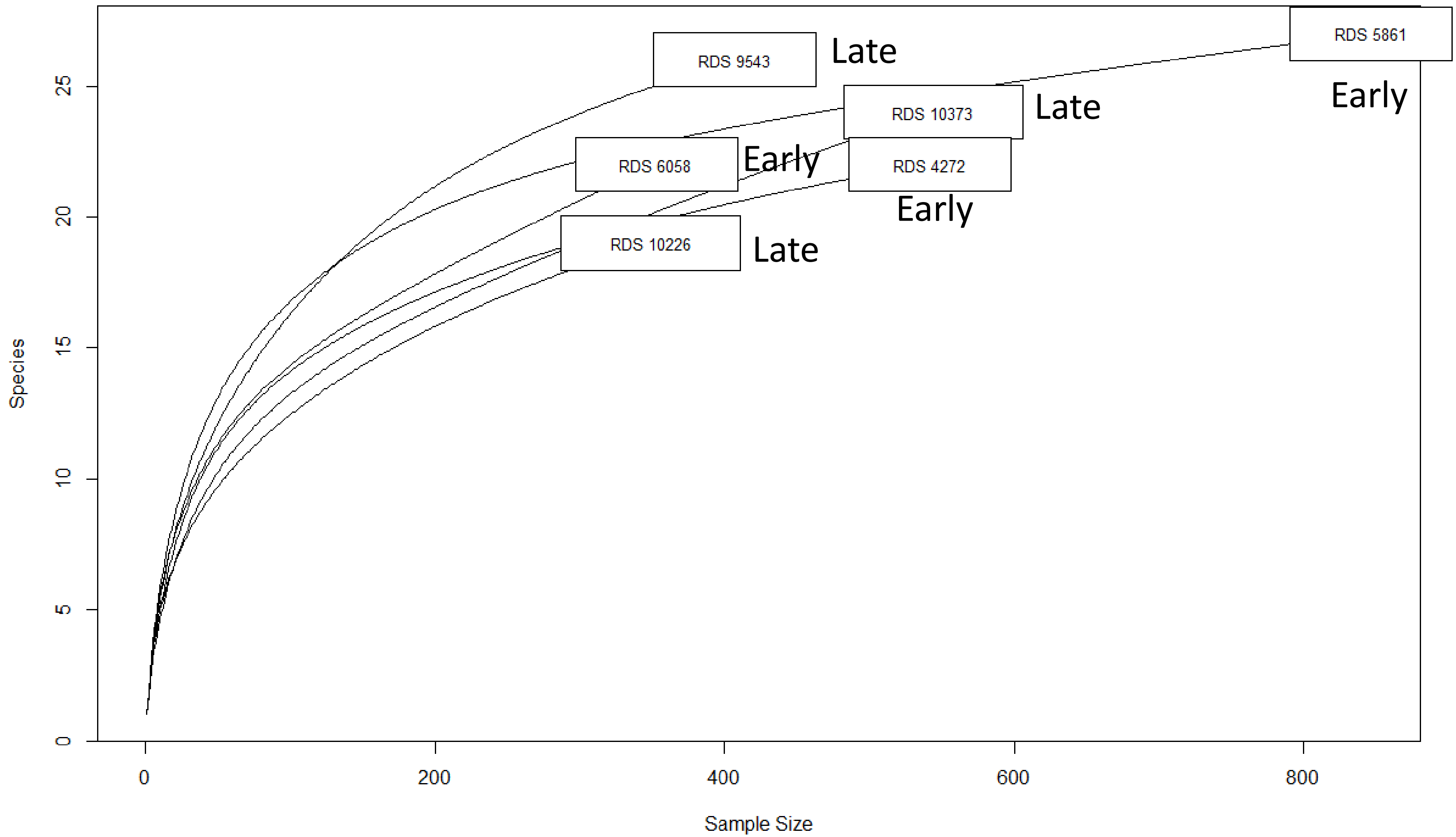


Five of the 63 compared species showed significant differences in CPUE in day vs. night samples.

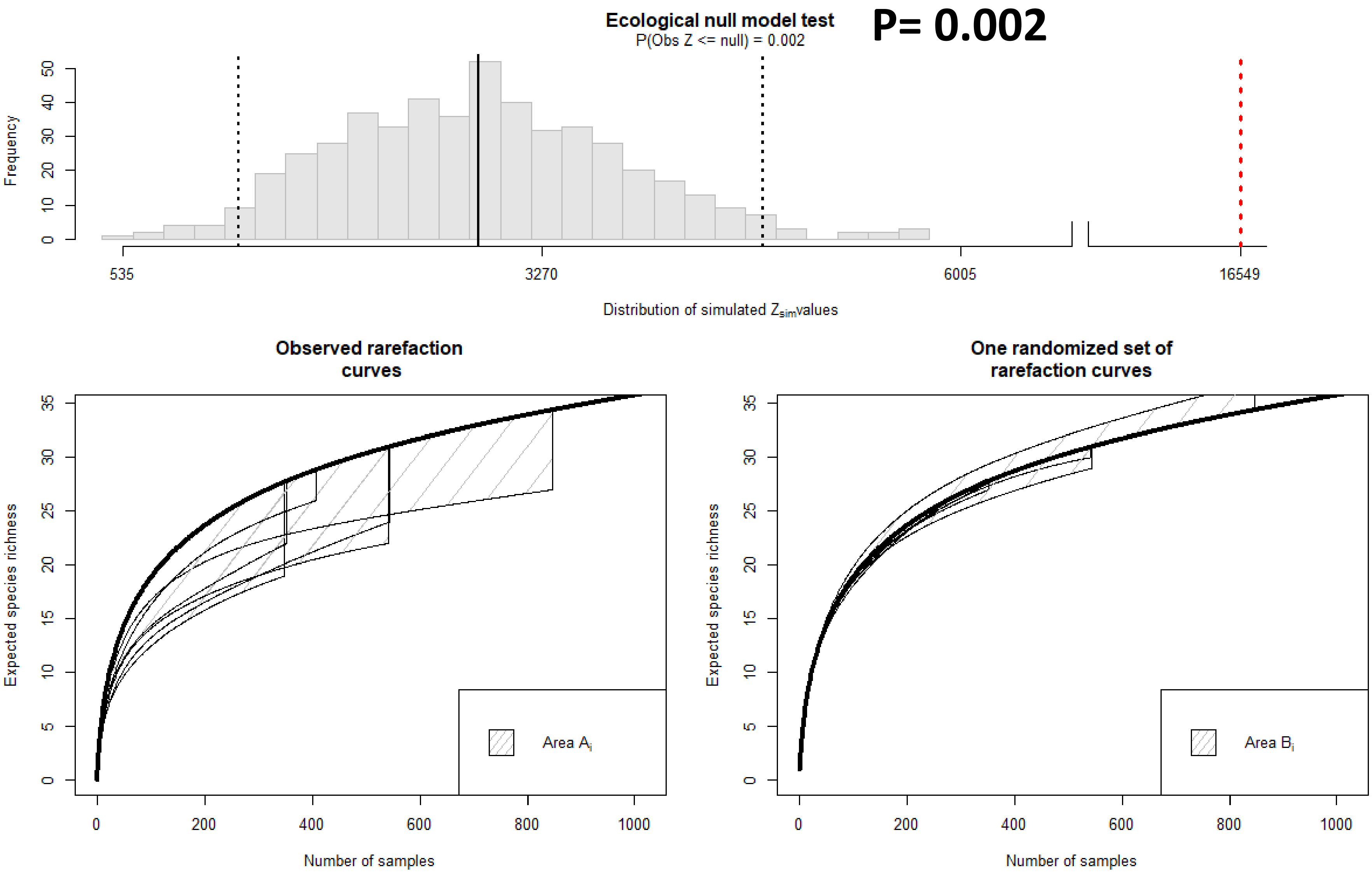
Early-Late Differences in CPUE



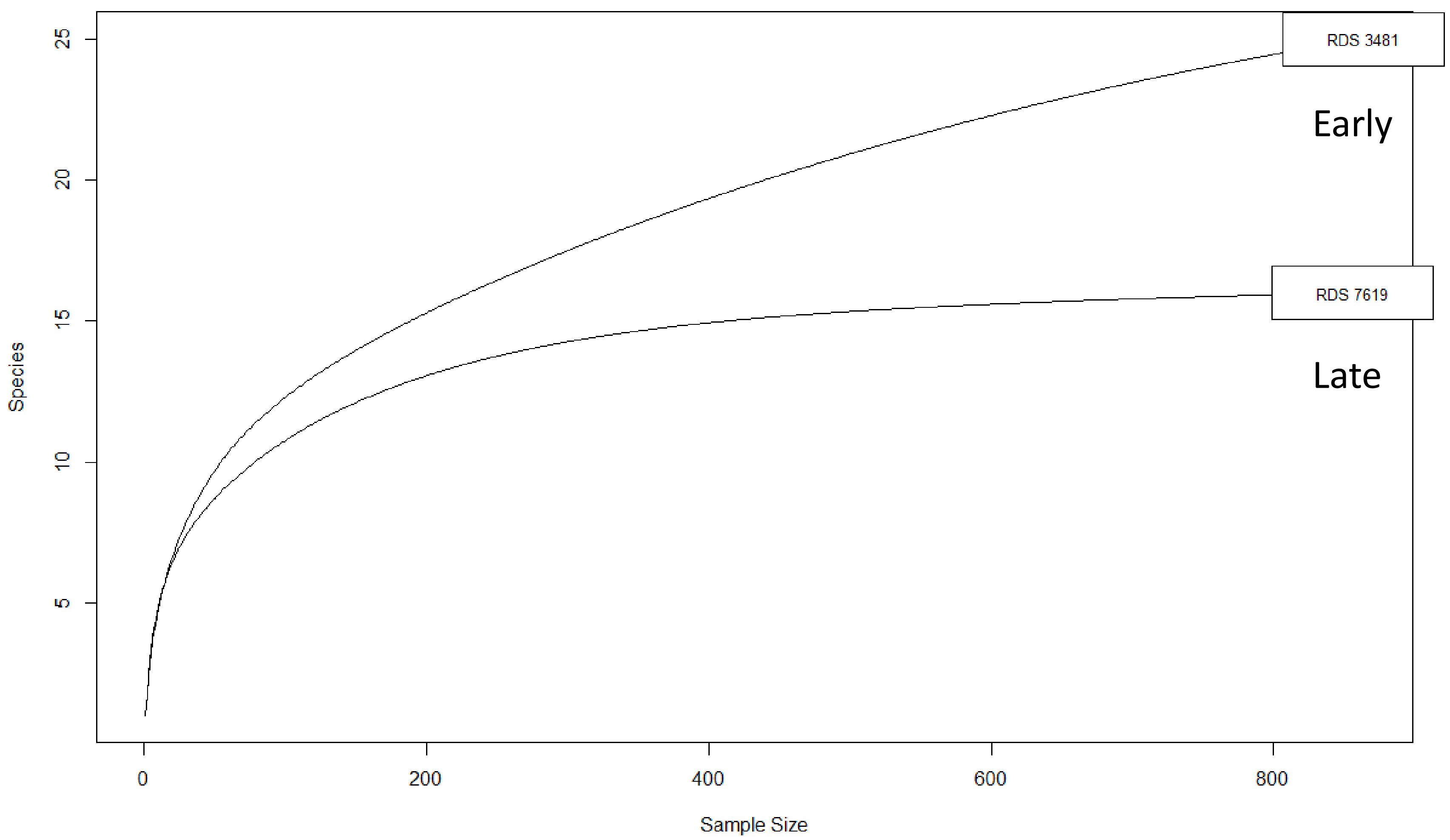
Rarefaction Curves for Six Early and Late Day Samples



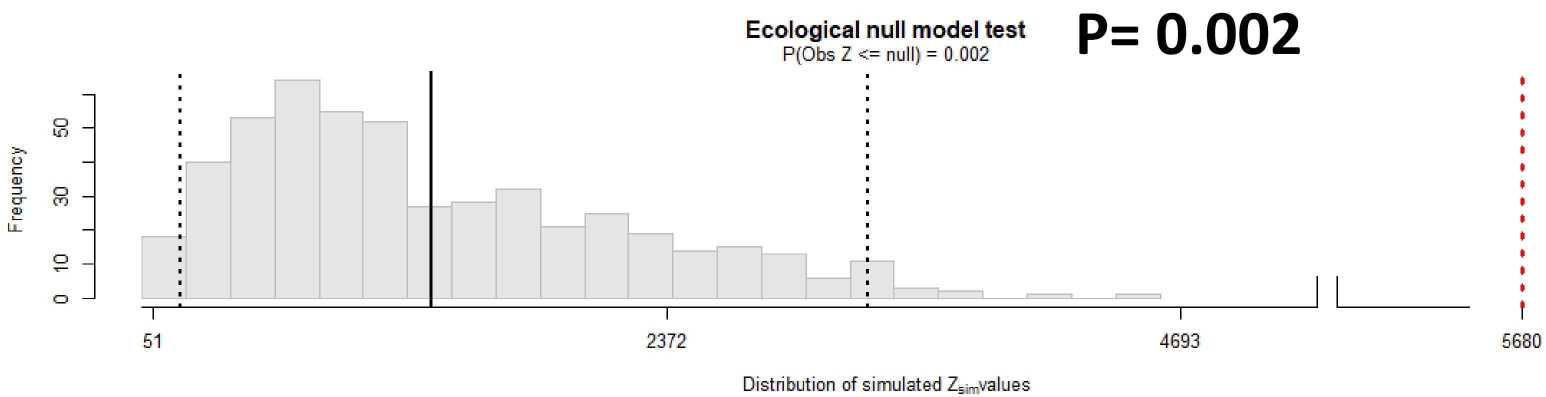
Ecological Null Model Test

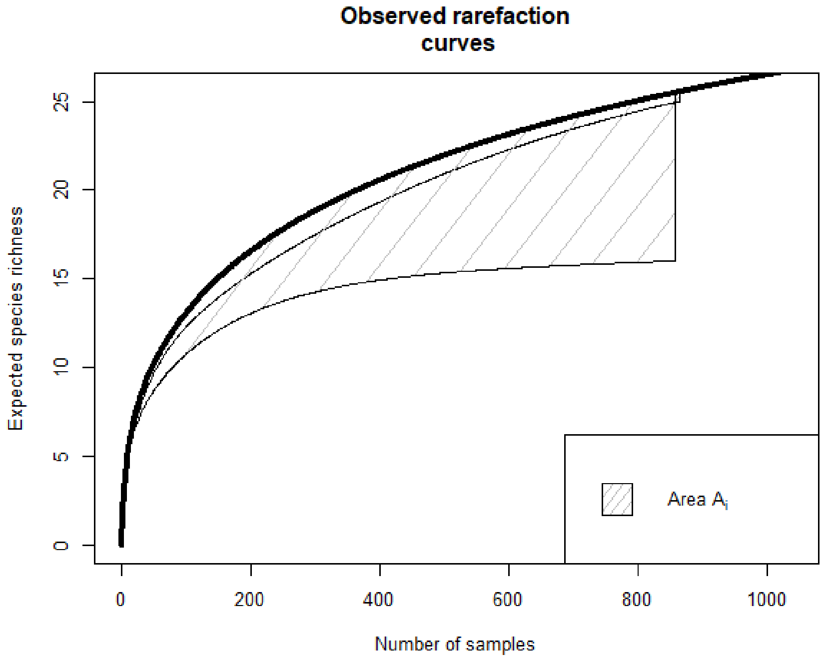


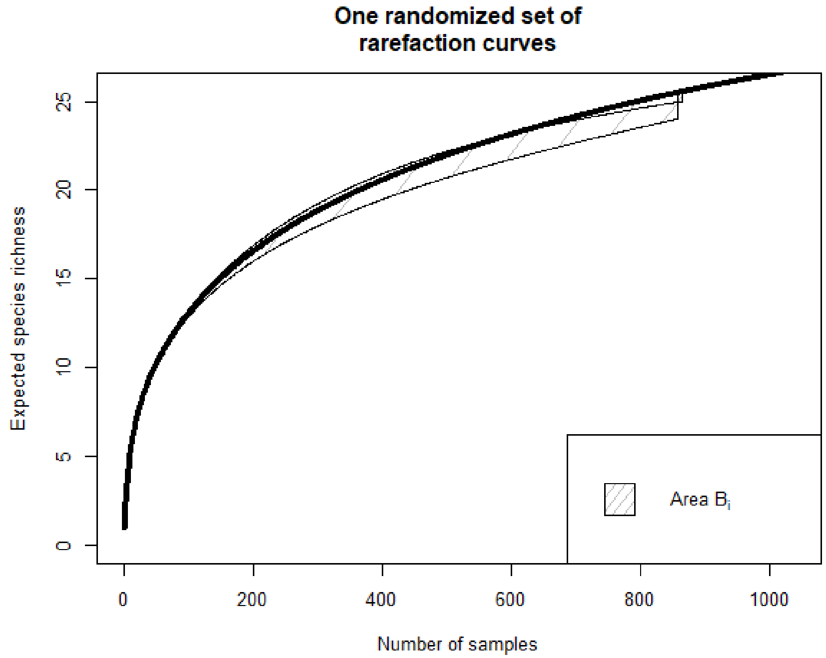
Rarefaction Curves for Early and Late Night Samples



Ecological Null Model Test







Interpretation

- Detected differences in overall fish community composition between Early and Late year blocks (NMDS).
- Early and Late samples come from significantly different assemblages (community has changed over time).
- Significant decreases (5 species) and increases in CPUE (3) between Early and Late periods. Some species increased in dominance at the expense of others.

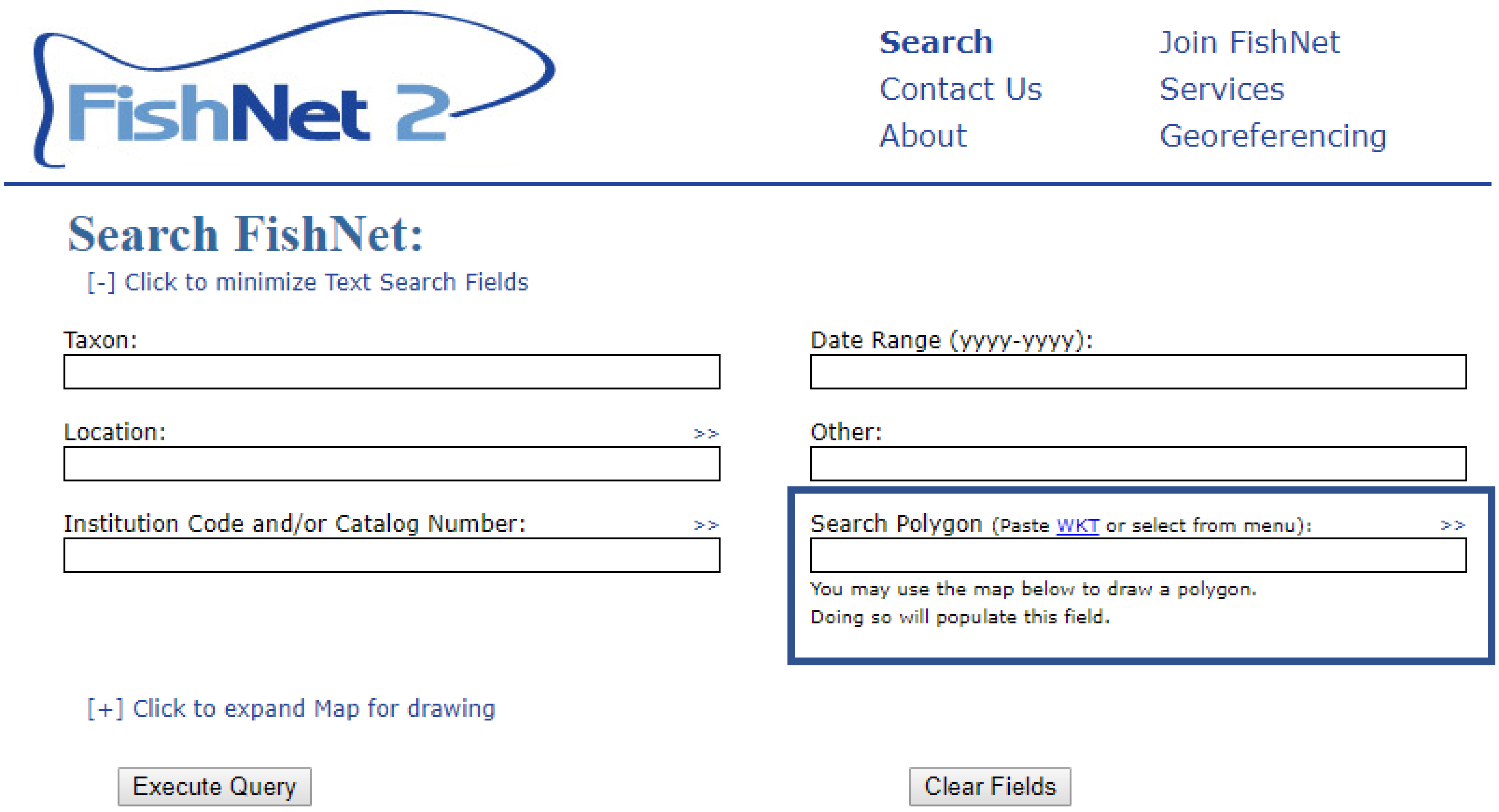
Conclusions

- The fish collection data analyzed here *are* useful for showing how the Pearl River fish community has changed with human alteration of the riverine environment.
- How comparable are samples in Suttkus Fish Collection to samples in other fish collections? (actually, quite comparable…)
- What about other types of taxonomic collections?
- Can we assess this with data from high-level, all-taxa aggregators? (not without testing sampling first)

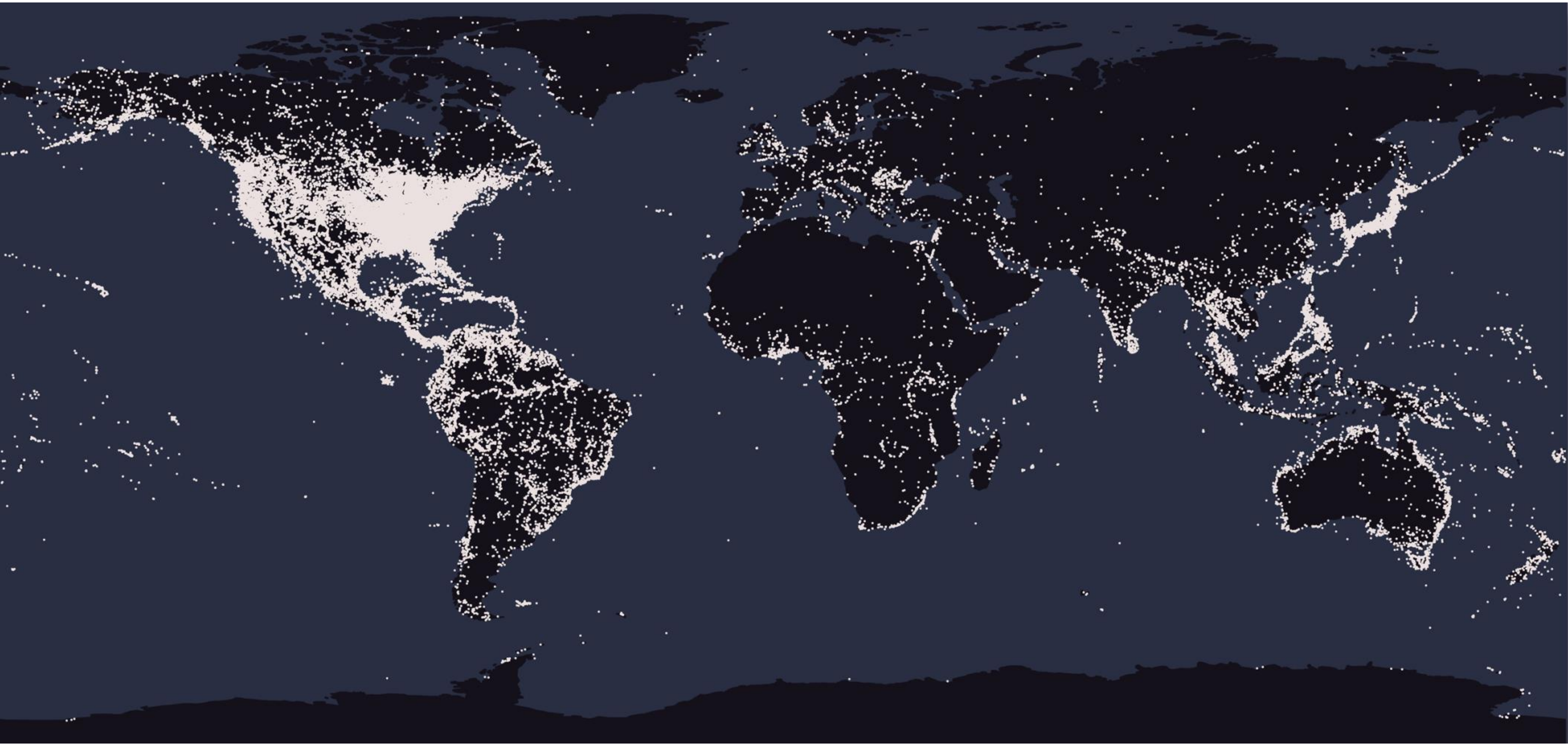
Vision

- Propose to build a platform for accessing data from biodiversity portals, assessing the fitness of the data for conservation use, assessing the adequacy of the sampling (rarefaction tests, etc.), using the data where appropriate to address conservation concerns.
- Propose a taxon-specific approach (standards of sampling, taxonomic expertise and authority resources organized this way).
- Argument for maintaining taxon-based networks (e.g., FishNet 2)…

Prototype of system would be integrated with FishNet 2



Collaborative Georeferencing



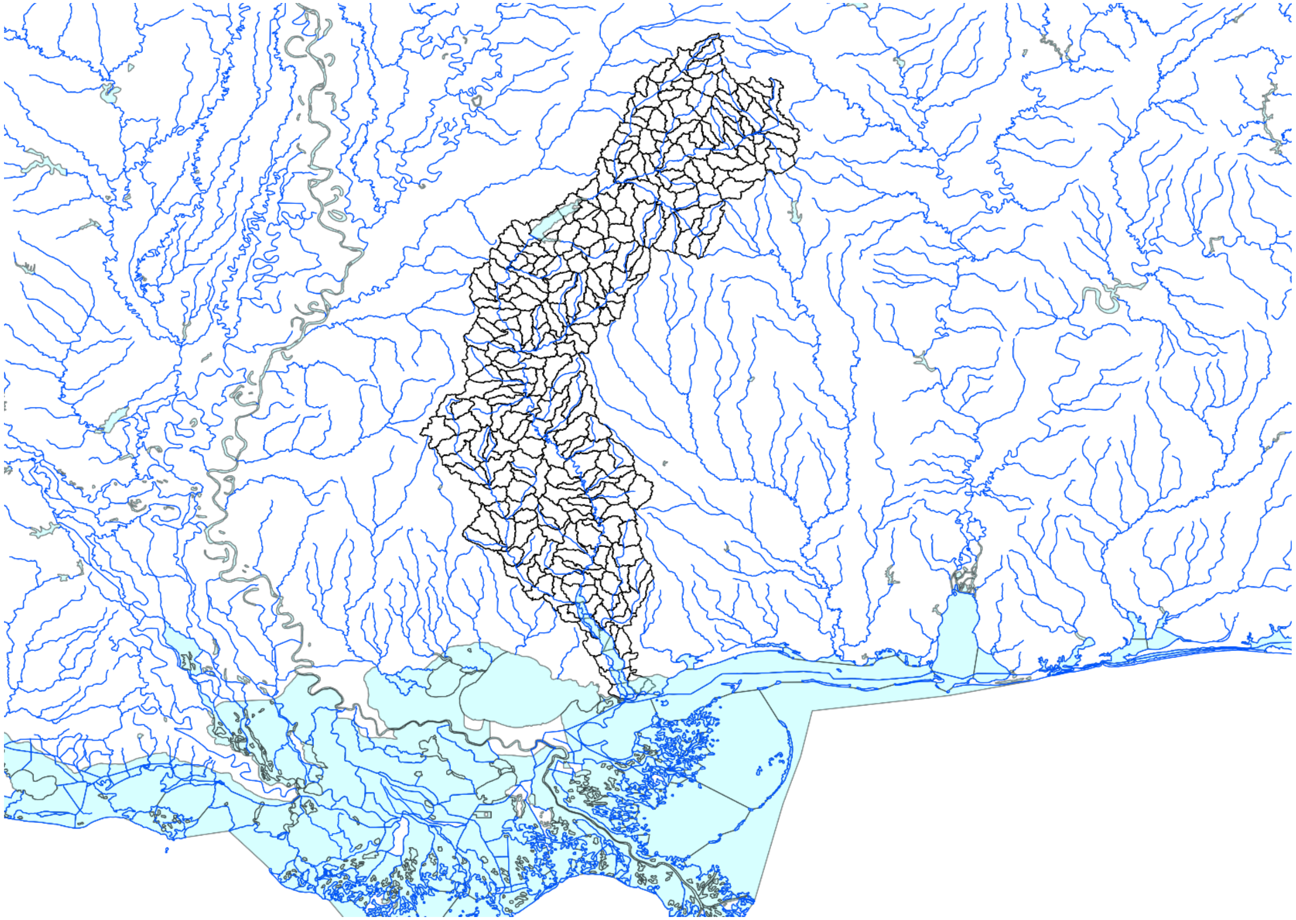
“Corrected”
247,479 localities (88%)
1,172,360 specimen lots

“Skipped”
34,720 localities (12%)
126,881 specimen lots

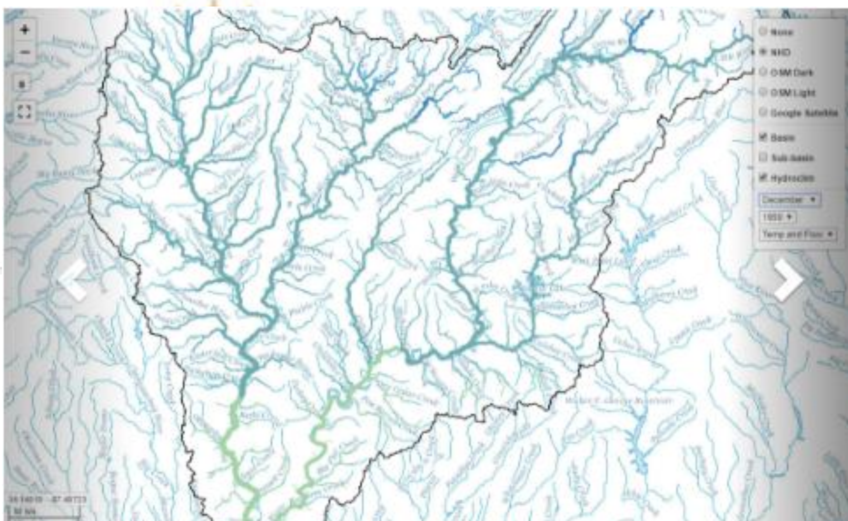
Total Verified
282,199 localities
1,299,241 specimen lots

113% of project goal

Users could extract data using HUC polygons



Institution/collector specific data or data from all FishNet 2 providers.



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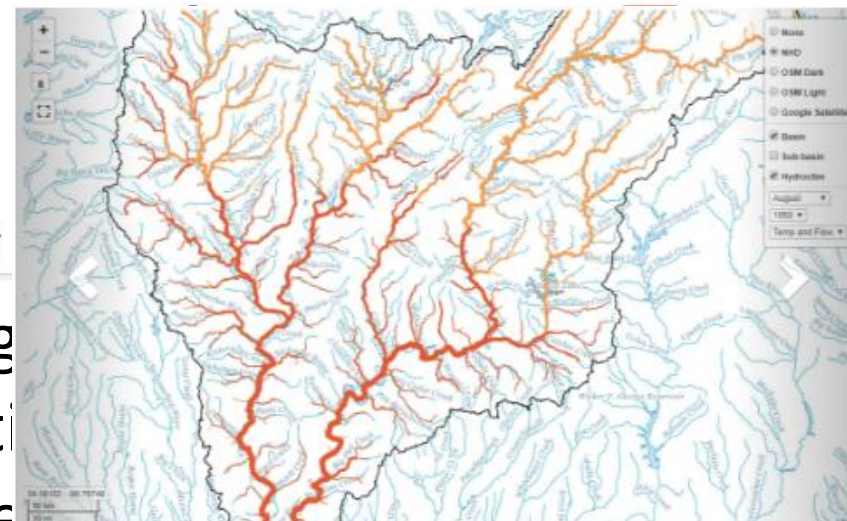

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from 1950-2099 and will be integrated with FishNet 2.

Extending platform to other data and collection types

- Platform could be used for samples of marine fishes (e.g., NOAA fisheries trawl samples)…
- Could integrate environmental data (land use, water quality, oil spills)
- Once prototyped for fishes, platform could be extended to other taxonomic collections (but with expert knowledge or assessment of sampling methods and adequacy).

Acknowledgements

- Justin Mann for assistance with data extraction and figures;

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