Use of RIVPACS-type Multitaxon Distribution Models to Assess Alterations in Regional Biodiversity

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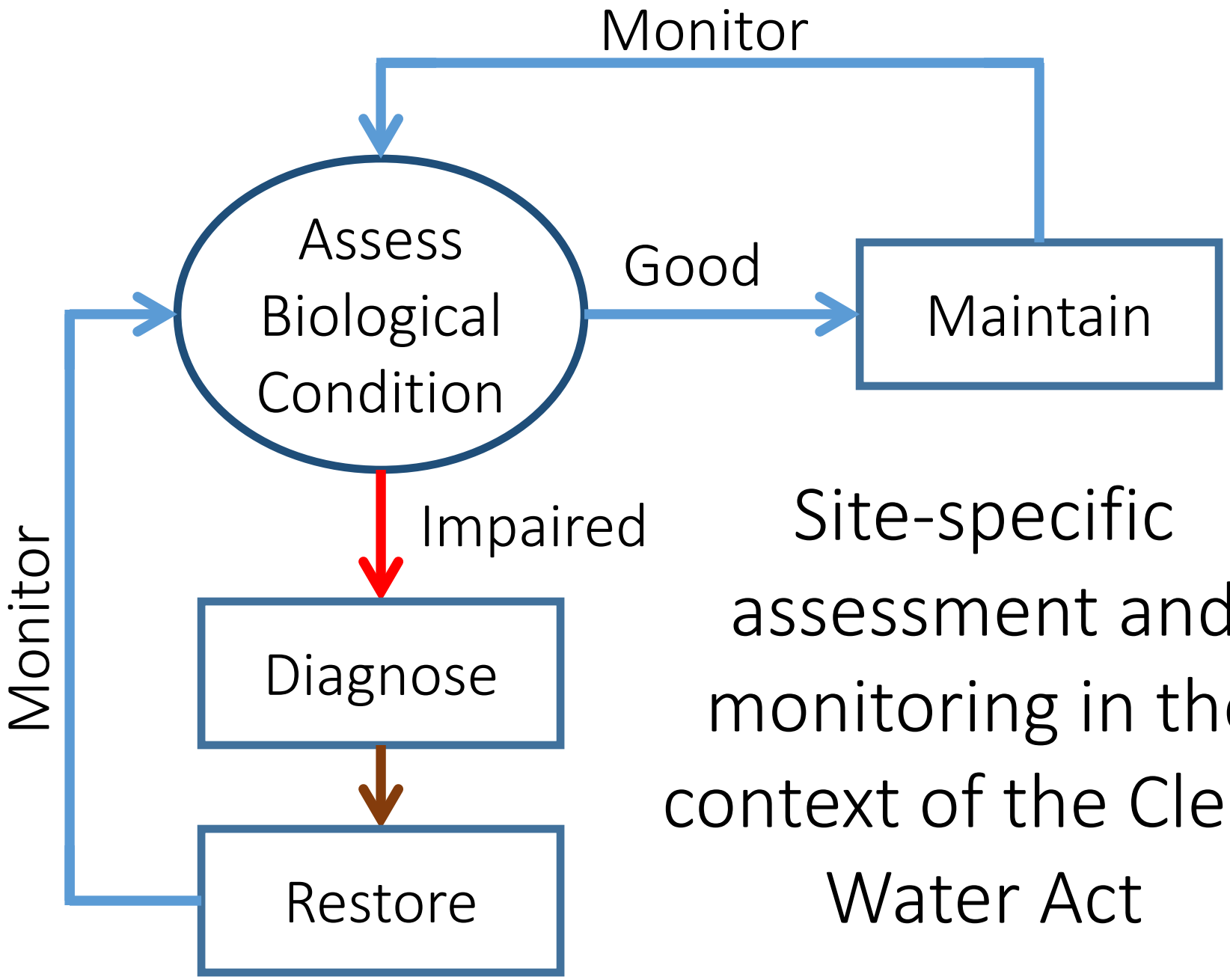


Site-specific assessment and monitoring in the context of the Clean Water Act

Traditional application of RIVPACS models

$$p_i = \sum_{j=1}^{m} p_j c_{j,i} \qquad E = \sum p_i$$

O/E

(site-specific measure of taxonomic completeness)

Traditional RIVPACS-type site-specific assessments

What should be there (E)?

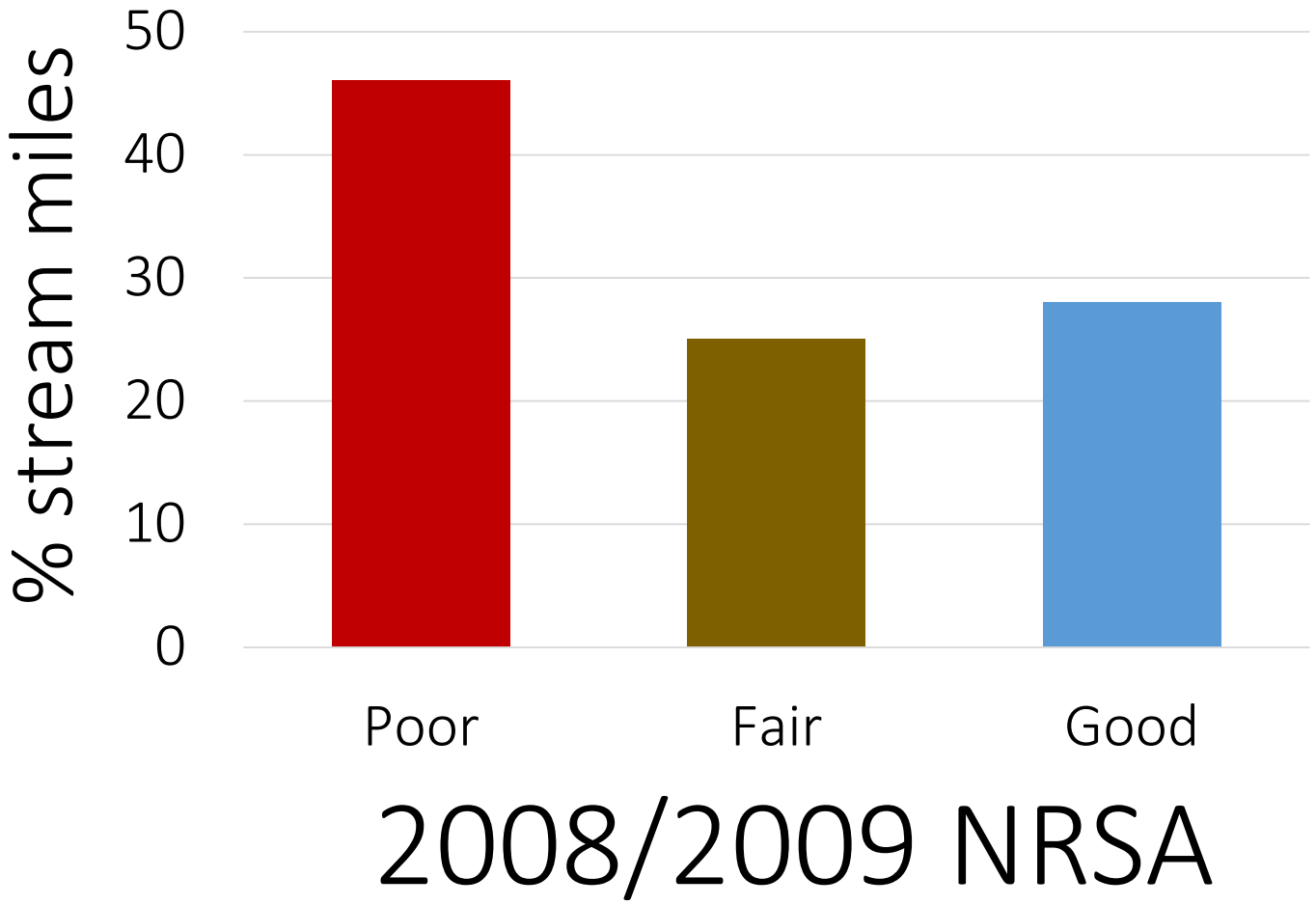
E = 8 species

What is actually there (O)?

O = 3 species

O/E = 0.38

NARS scales up site-specific index values to quantify regional conditions



But what about the status of individual species?

With RIVPACS outputs we can also compare observed frequencies of occurrence with expected ones.

$$F_e = \sum p_i / N$$

$$D_i = F_o - F_e$$

Examples from North Carolina and the Mid-Atlantic Highlands

Multitaxon distribution models reveal severe alteration in the regional biodiversity of freshwater invertebrates

Charles P. Hawkins[1,3] and Lester L. Yuan[2,4]

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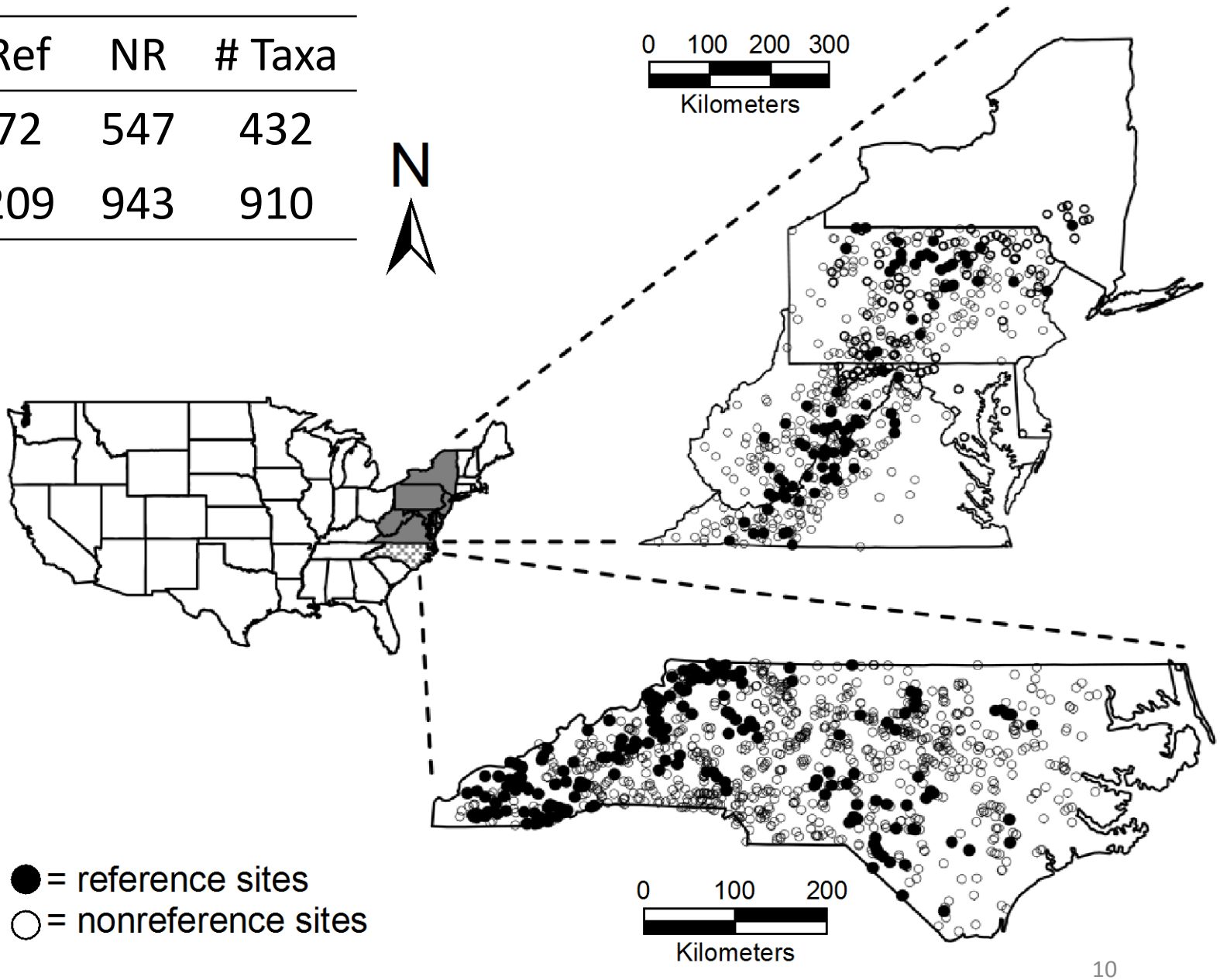
or

https://www.researchgate.net/profile/Charles_Hawkins

# Sites			
Region	Ref	NR	# Taxa
MAH	72	547	432
NC	209	943	910



Model Predictors

North Carolina	Mid-Atlantic Highlands
Latitude	Elevation
Longitude	Day of Year
Elevation	Catchment Area
Stream Width	Carbonate Chemistry
Stream Depth	Ecoregion
% Boulder	
% Rubble	
Day of Year	

How well can we predict F_e?

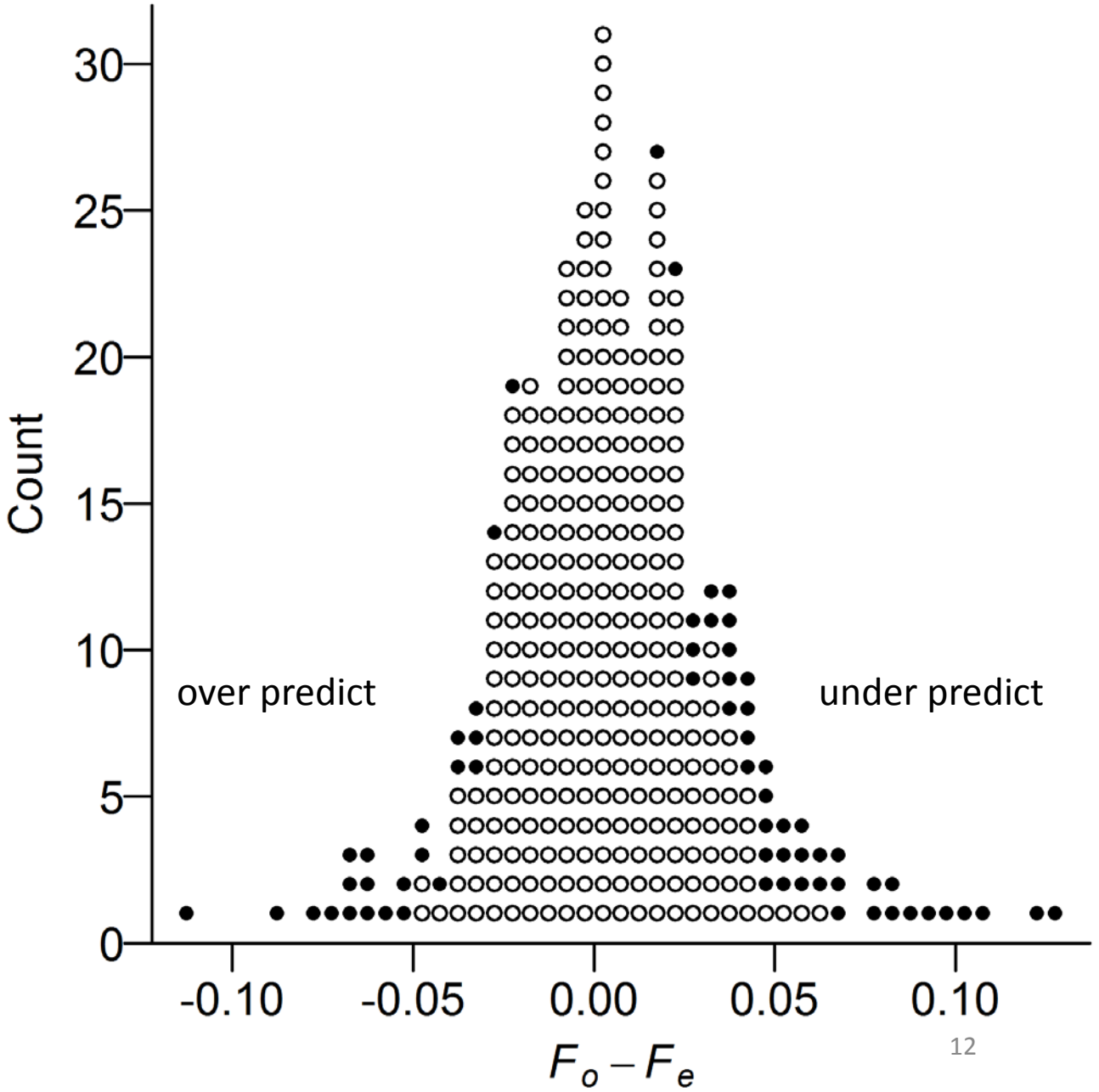
202 NC validation samples.

Used taxa ≥ 5 sites.

D_i values for 350 taxa.

Black dots = 66 taxa (19%) that were either over- or under-predicted.

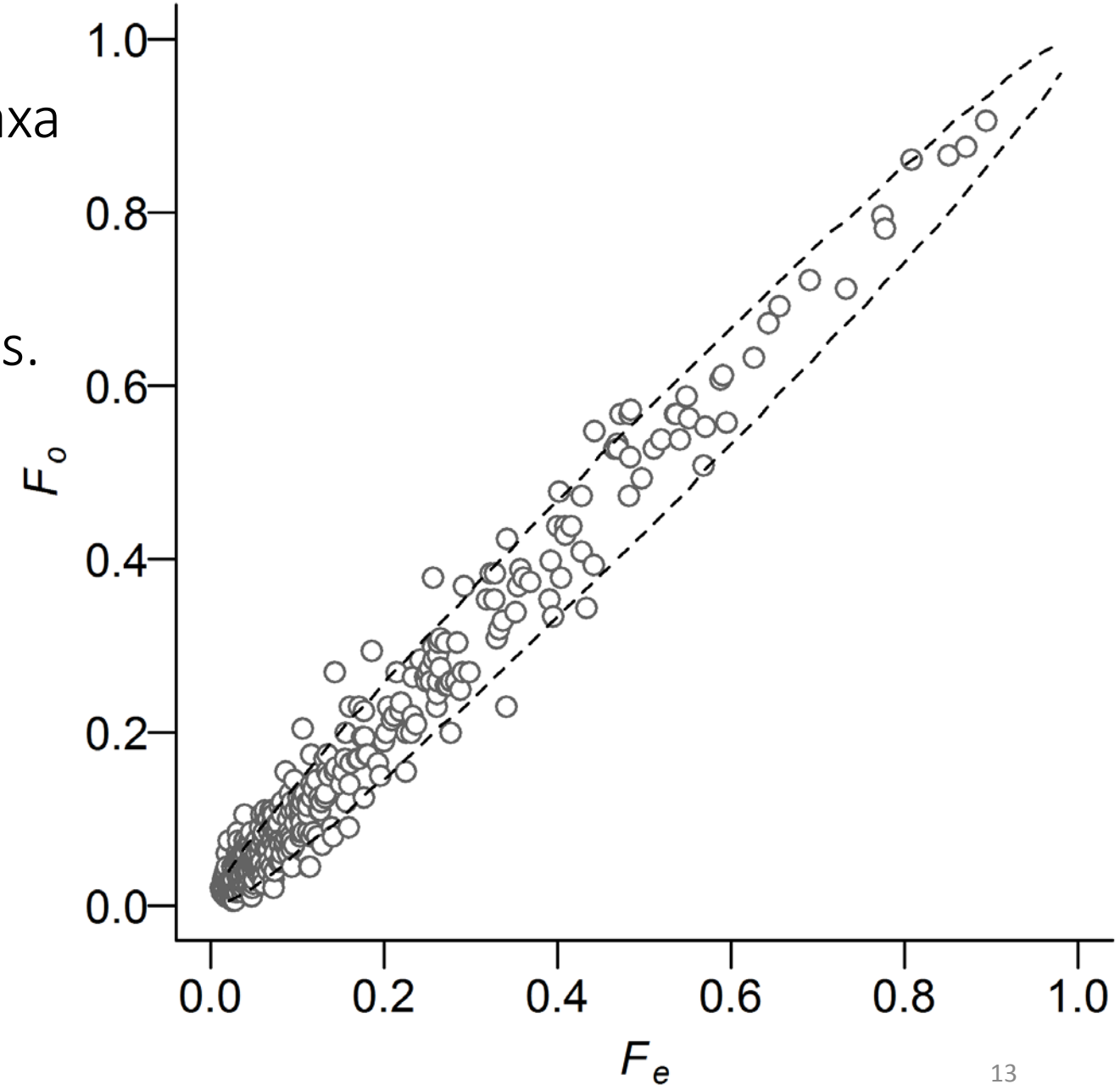
Under-prediction 2X more than over-prediction.

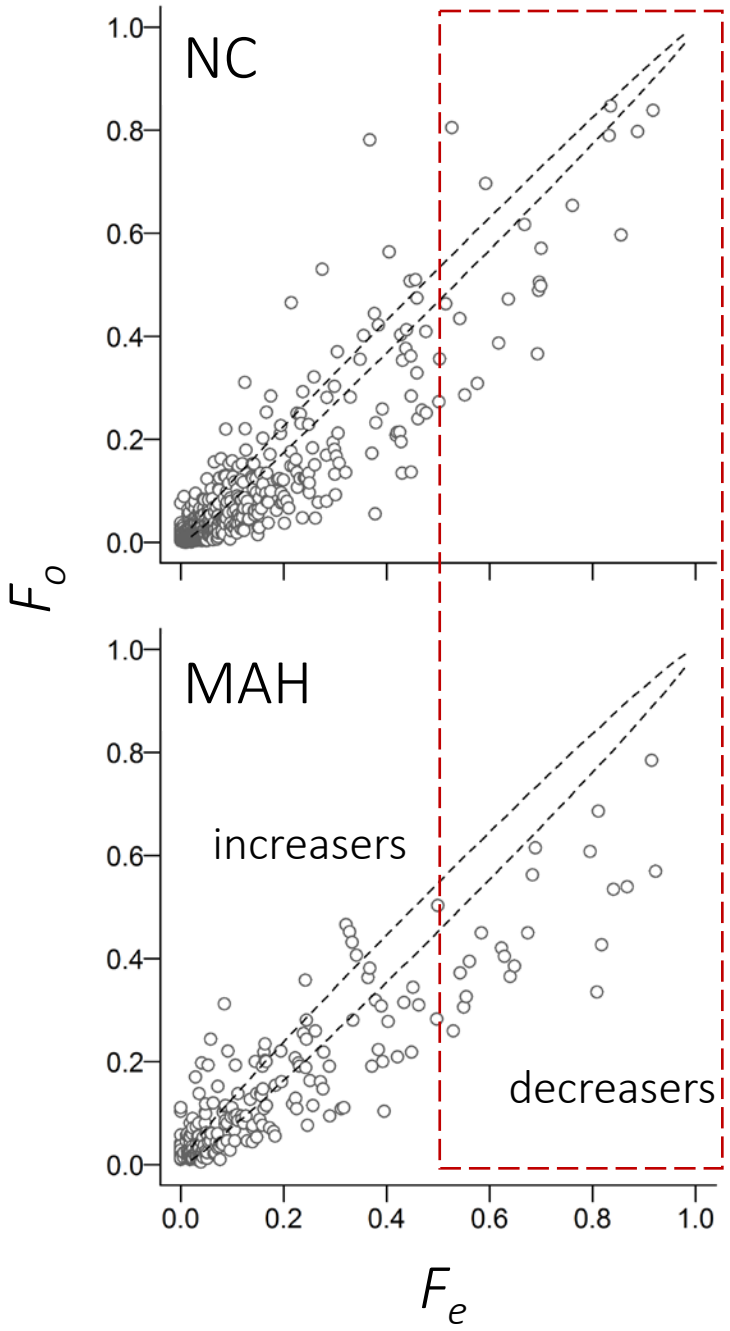


F_o *vs* F_e for 350 taxa from 202 NC reference-quality validation samples.

Ellipse:
95% CI for F_e

Most under/over predictions were for rarer taxa.





Example Taxa

Taxon	D_i
Acroneuria abnormis	-0.26
Isonychia	-0.20
Polycentropus	-0.33
Hexatoma	-0.27
Rheocricotopus robacki	+0.28

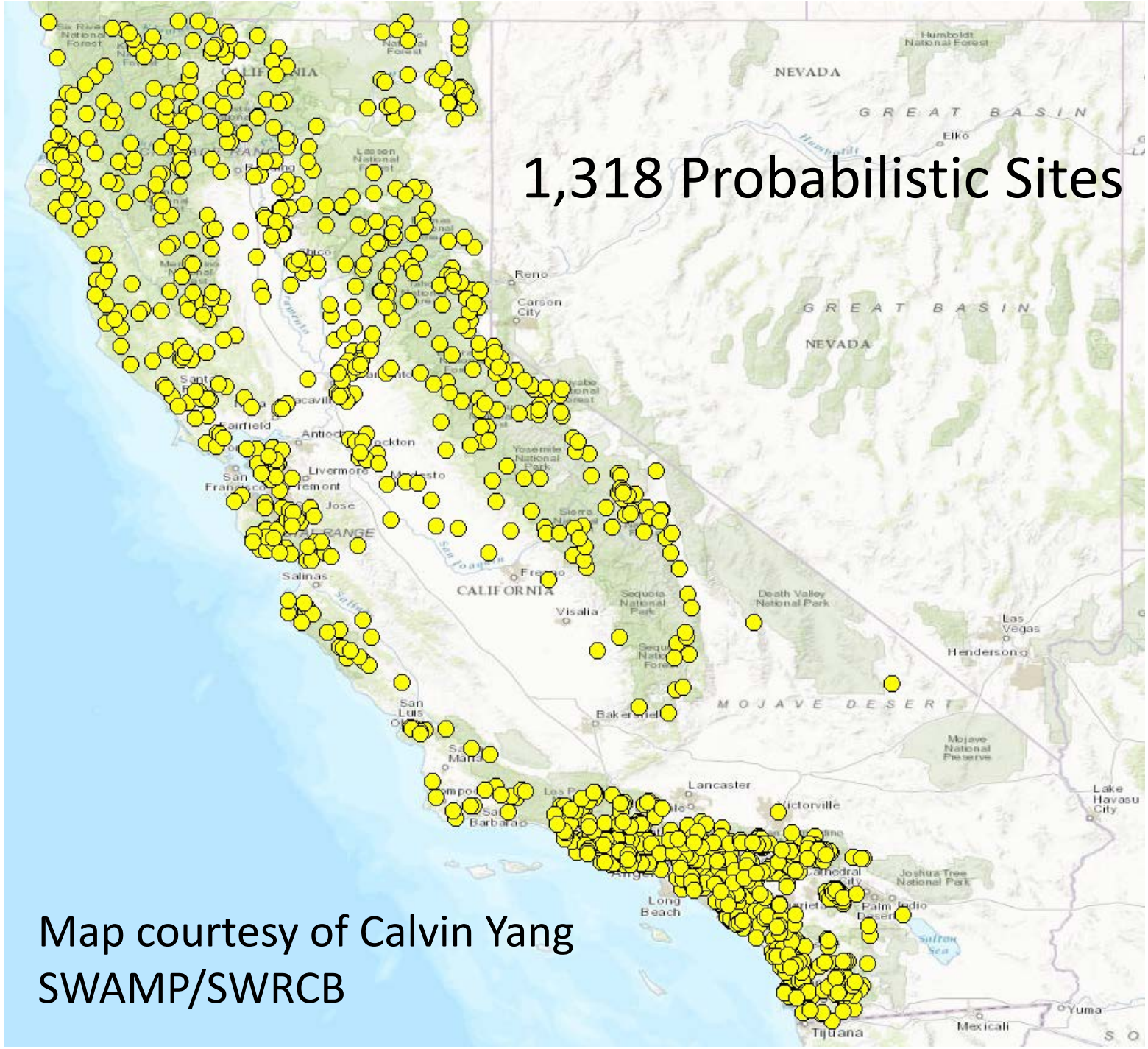
Taxon	D_i
Ephemerella	-0.35
Baetis	-0.33
Stempellinella	-0.39
Epeorus	-0.47
Hexatoma	-0.26

Most common taxa were decreasers!

	North Carolina			Mid-Atlantic Highlands		
Group	# Taxa	%D	%I	# Taxa	%D	%I
Total	547	50	26	251	36	35
Plecoptera	46	74	0	22	68	5
Trichoptera	102	79	7	29	52	21
Ephemeroptera	91	67	10	23	61	13
Diptera	174	36	36	115	30	34
Coleoptera	28	46	36	14	29	57
Odonata	29	2	59	9	11	44
Oligochaeta	25	16	56	18	11	72

So What? / Now What?

- Comparisons of F_e and F_o should be a standard part of NARS summaries of biological condition.
- D_i analyses provide a needed and direct link between CWA and ESA and also informs CBD targets.
- Technical stuff:
  - RIVPACS is a good start but methods that adjust for imperfect detection may be needed.
  - DNA-based IDs could provide needed 'species' level resolution and improve detection estimates.
- California has the data and tools needed to estimate D_i for hundreds of stream invertebrates – who will Pete have do it?


1,318 Probabilistic Sites
Map courtesy of Calvin Yang
SWAMP/SWRCB
NEVADA
GREAT BASIN
Reno
Carson City
Elko
Humboldt National Forest
Lassen National Forest
Yosemite National Park
Sequoia National Park
Death Valley National Park
Mojave National Preserve
Joshua Tree National Park
Las Vegas
Henderson
Lancaster
Victorville
Lake Havasu City
Palm Desert
Indio
Long Beach
Fresno
Visalia
Modesto
Salinas
San Luis Obispo
Santa Barbara
Livermore
Fairfield
Antioch
Stockton
Tijuana
Mexicali
Yuma
MOJAVE DESERT
CALIFORNIA