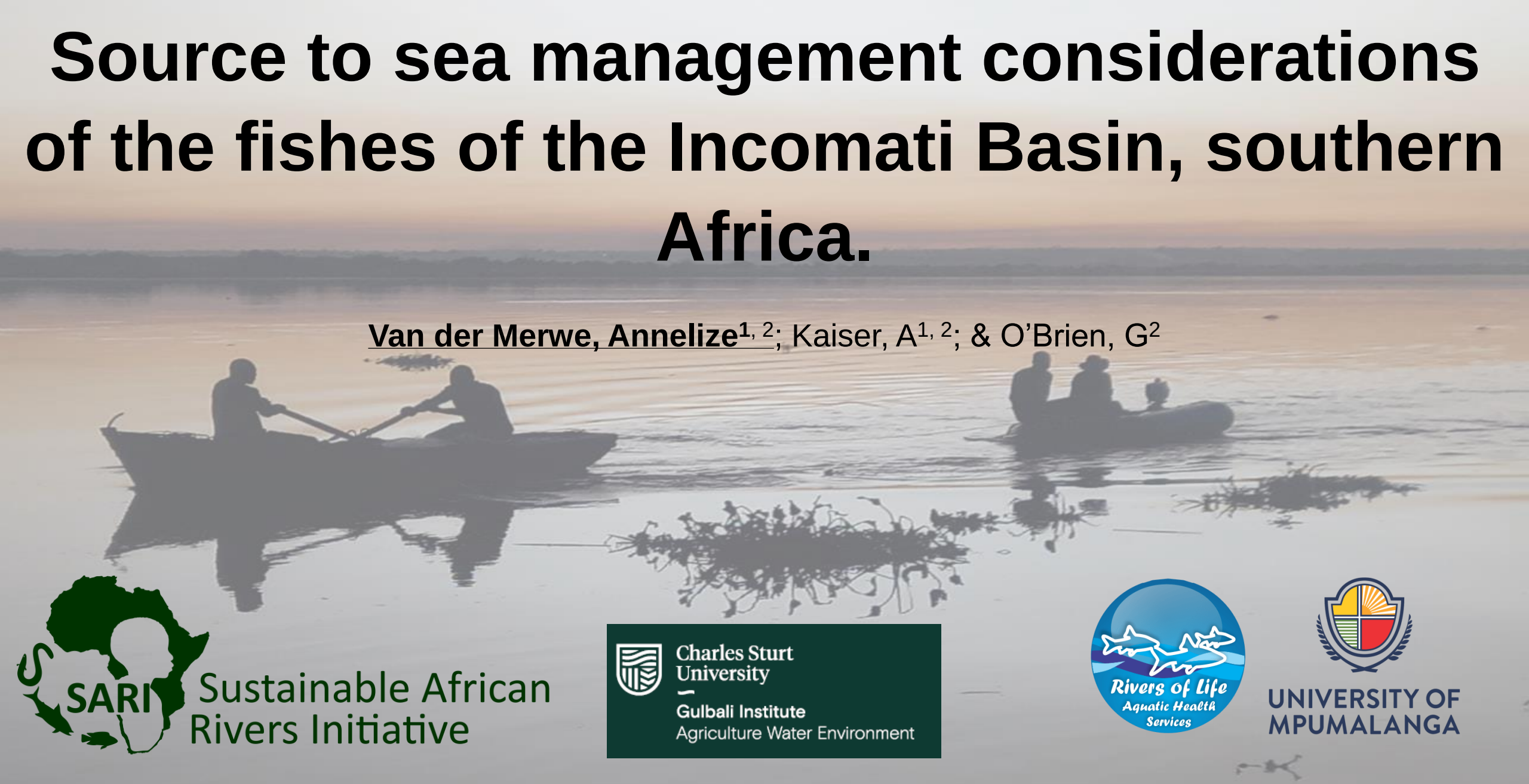
Source to sea management considerations of the fishes of the Incomati Basin, southern Africa.

Van der Merwe, Annelize[1, 2]; Kaiser, A[1, 2]; & O'Brien, G[2]



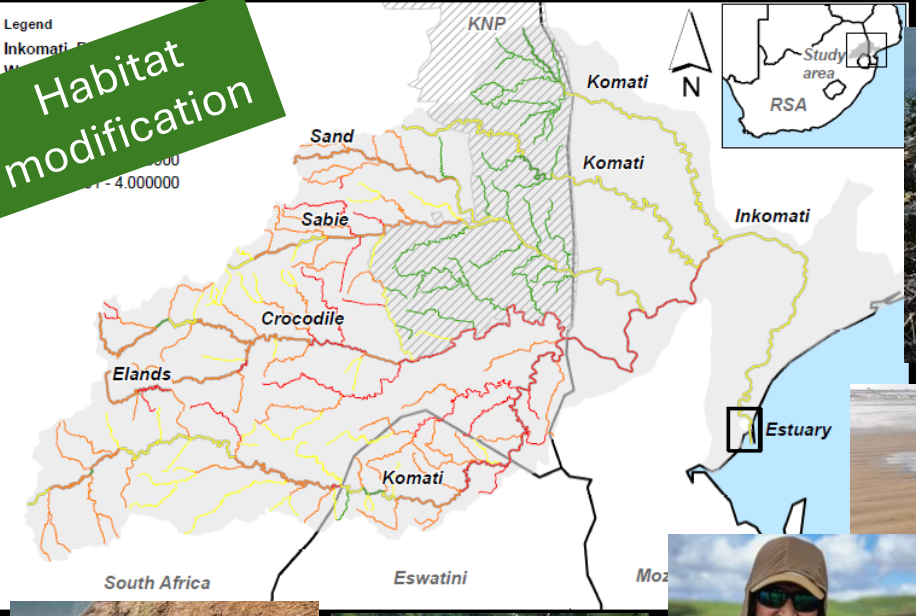
Sustainable African Rivers Initiative

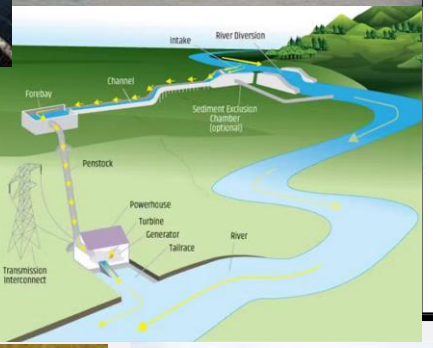
Charles Sturt University – Gulbali Institute Agriculture Water Environment

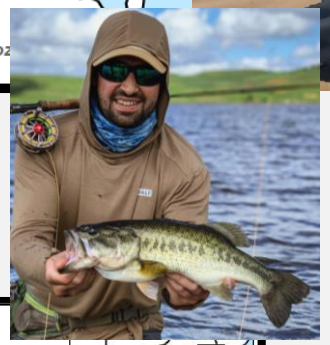
Rivers of Life Aquatic Health Services

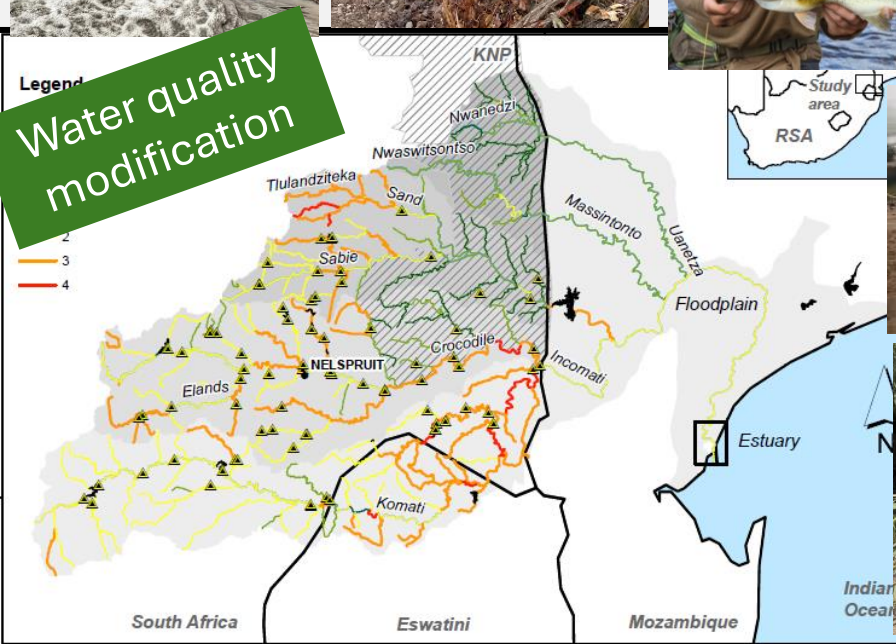
UNIVERSITY OF MPUMALANGA

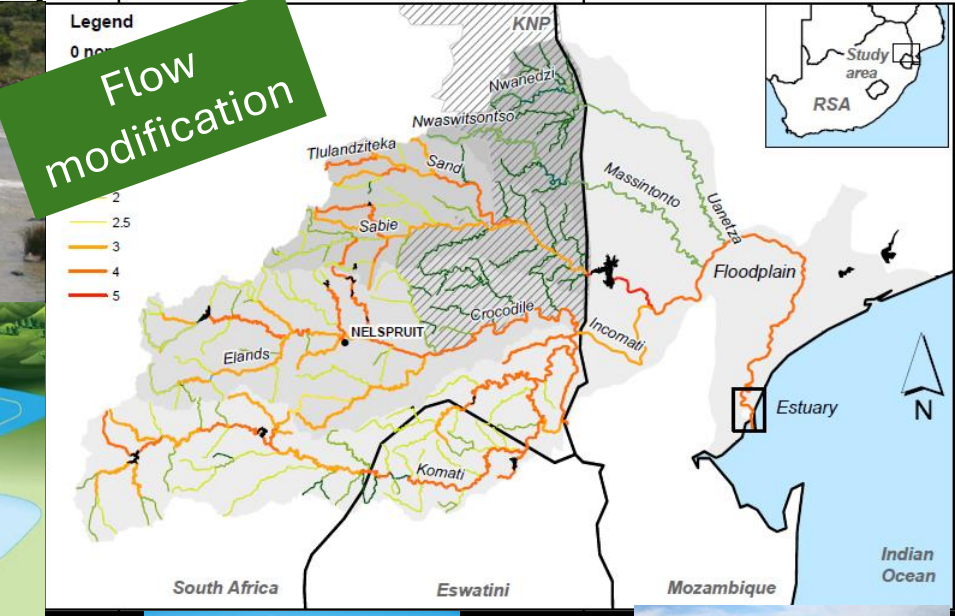
[1]Faculty of Agriculture and Natural Sciences, University of Mpumalanga, Private Bag X11283, Nelspruit, 1200, South Africa.
[2]Gulbali Institute, Charles Sturt University, 386 Elizabeth Mitchell Drive, Albury, New South Wales, Australia.

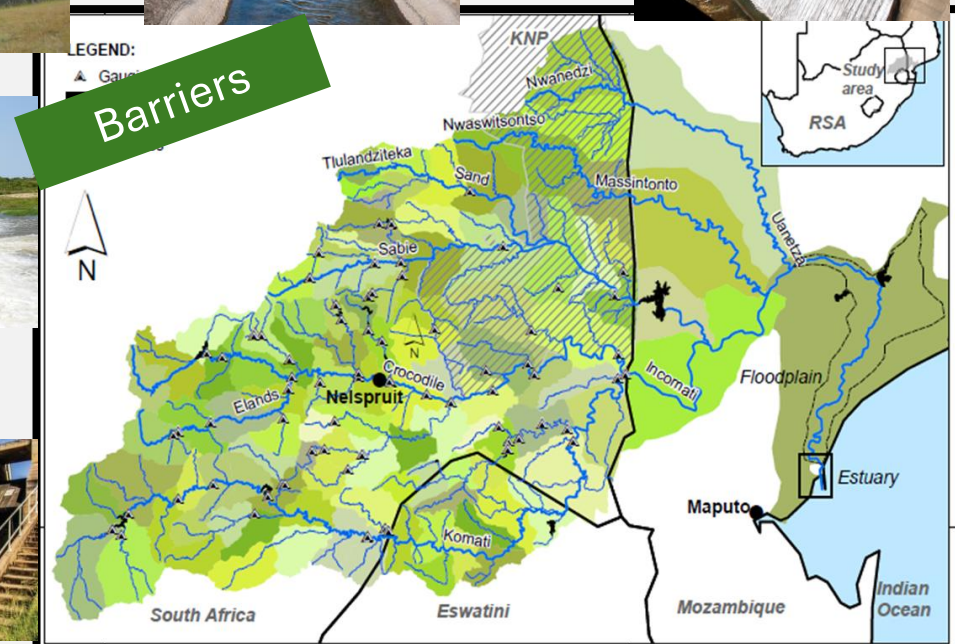

Habitat modification
Legend
KNP
Komati
Sand
Komati
Sabie
Inkomati
Crocodile
Elands
Komati
Estuary
Study area
RSA
N
South Africa
Eswatini


Intake
River Diversion
Channel
Forebay
Sediment Exclusion Chamber (optional)
Penstock
Powerhouse
Turbine
Generator
Tailrace
River
Transmission Interconnect



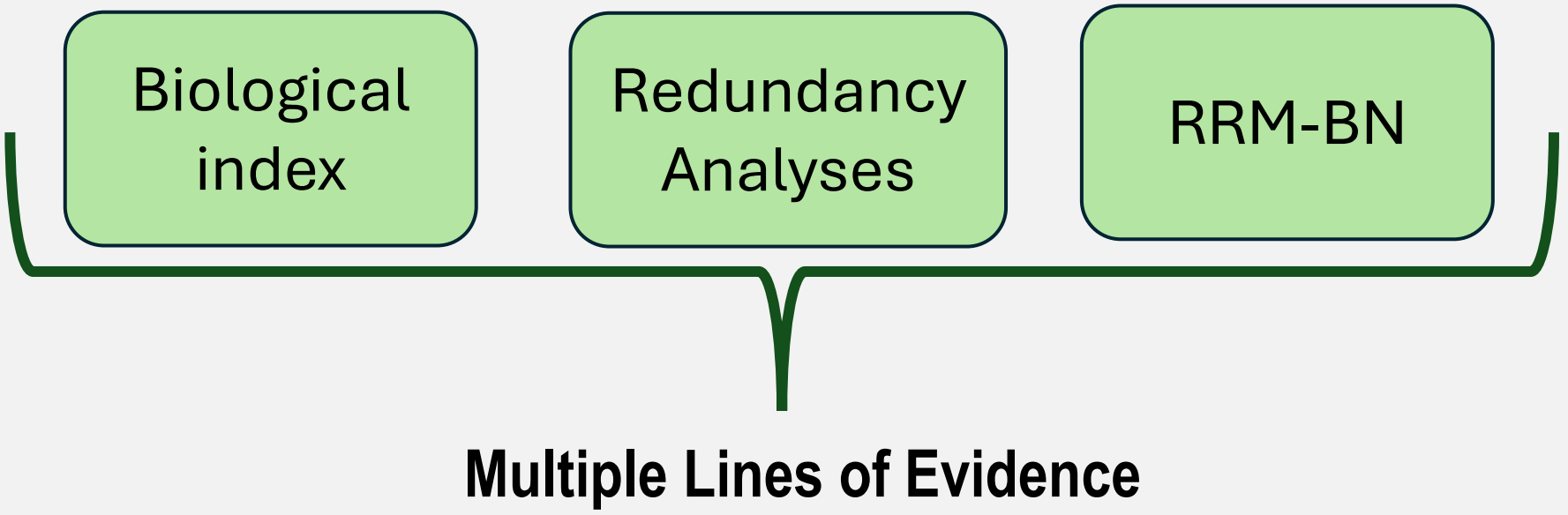

Water quality modification
Legend
KNP
Nwanedzi
Nwaswitsontso
Tlulandziteka
Sand
Massintonto
Uanetza
Sabie
Floodplain
Crocodile
NELSPRUIT
Incomati
Elands
Komati
Estuary
Study area
RSA
N
South Africa
Eswatini
Mozambique
Indian Ocean


Flow modification
Legend
KNP
Nwanedzi
Nwaswitsontso
Tlulandziteka
Sand
Massintonto
Uanetza
Sabie
Floodplain
NELSPRUIT
Crocodile
Incomati
Elands
Komati
Estuary
Study area
RSA
N
South Africa
Eswatini
Mozambique
Indian Ocean

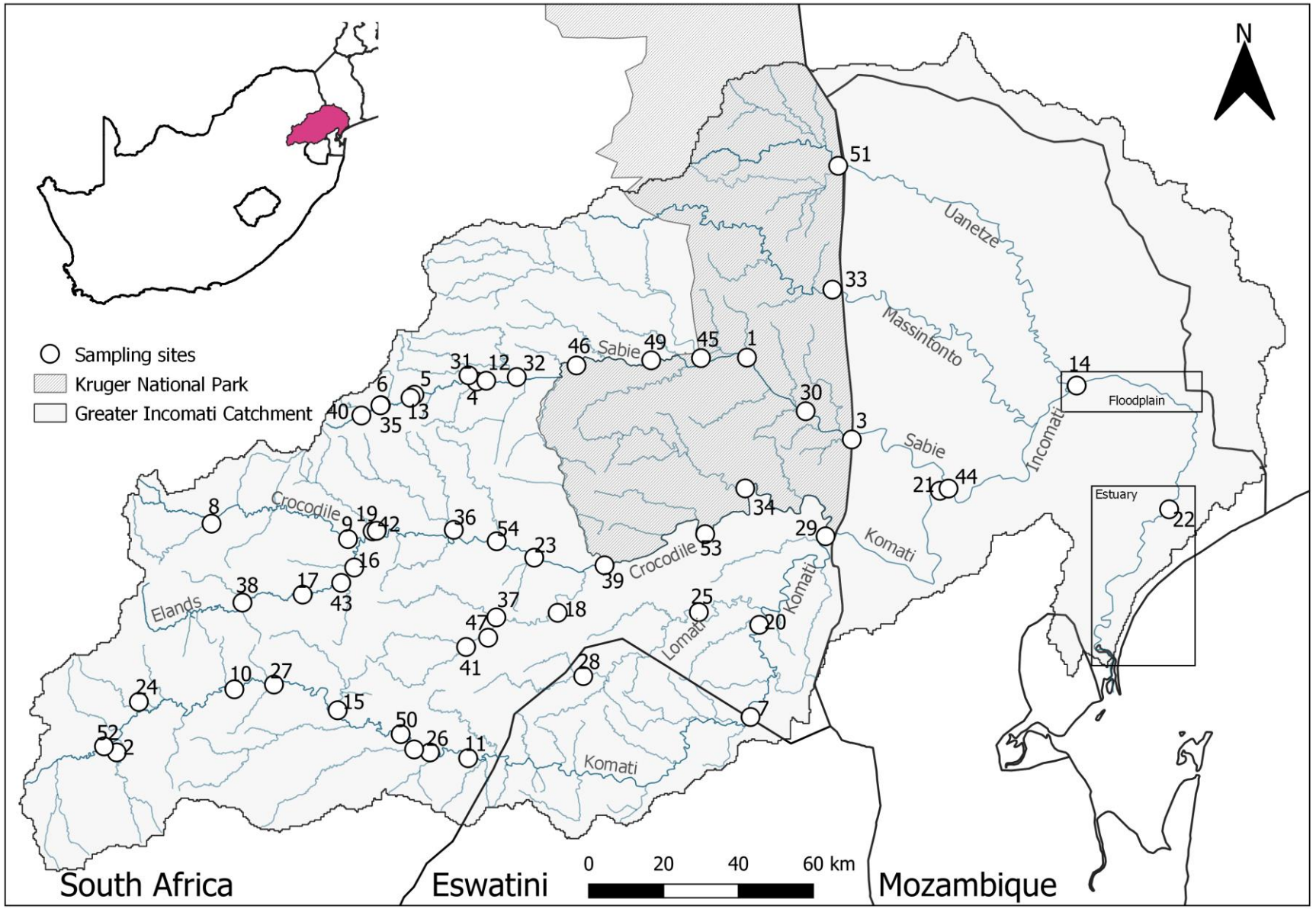

Barriers
LEGEND:
KNP
Nwanedzi
Nwaswitsontso
Tlulandziteka
Sand
Massintonto
Uanetza
Sabie
Floodplain
Crocodile
Nelspruit
Incomati
Elands
Komati
Maputo
Estuary
Study area
RSA
N
South Africa
Eswatini
Mozambique
Indian Ocean

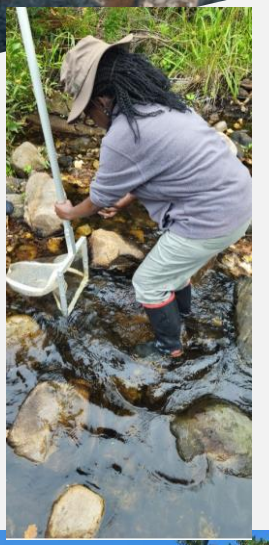
Aim:

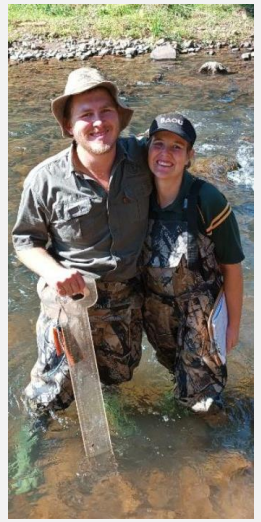
Evaluate the state of fish communities in the Incomati Basin and environmental drivers of these communities.



Study Area and sampling Methods







Results: Descriptive

	All	Uanetze	Sabie	Crocodile	Komati	Incomati
Expected species	70	27	45	45	48	27
Observed species	50	8	36	35	32	22
Abundance	6684	391	1851	3407	724	330
Nr sites	54	2	16	18	15	2
Ave. spp per site	0,94	4	2,25	1,94	2,13	11

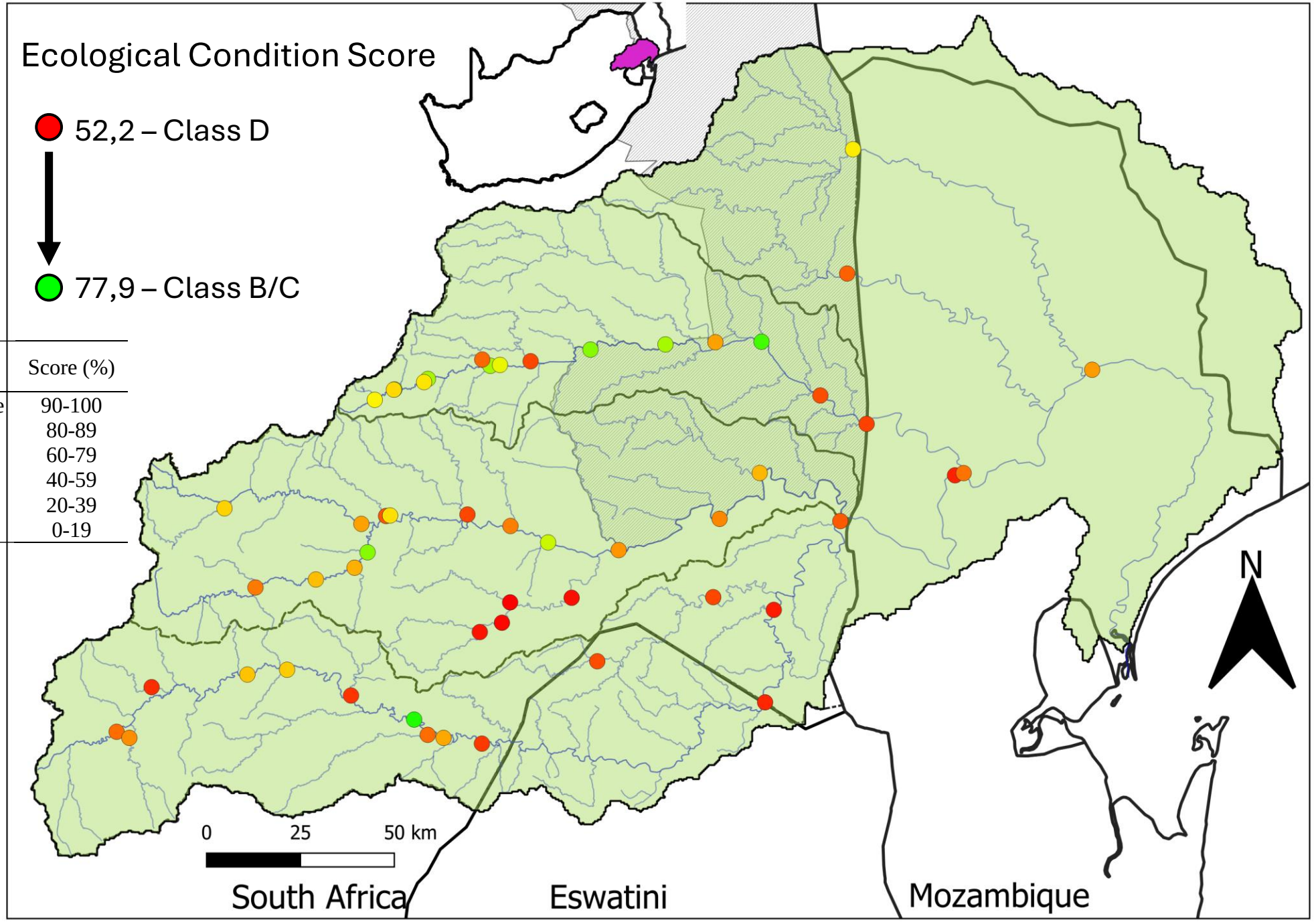




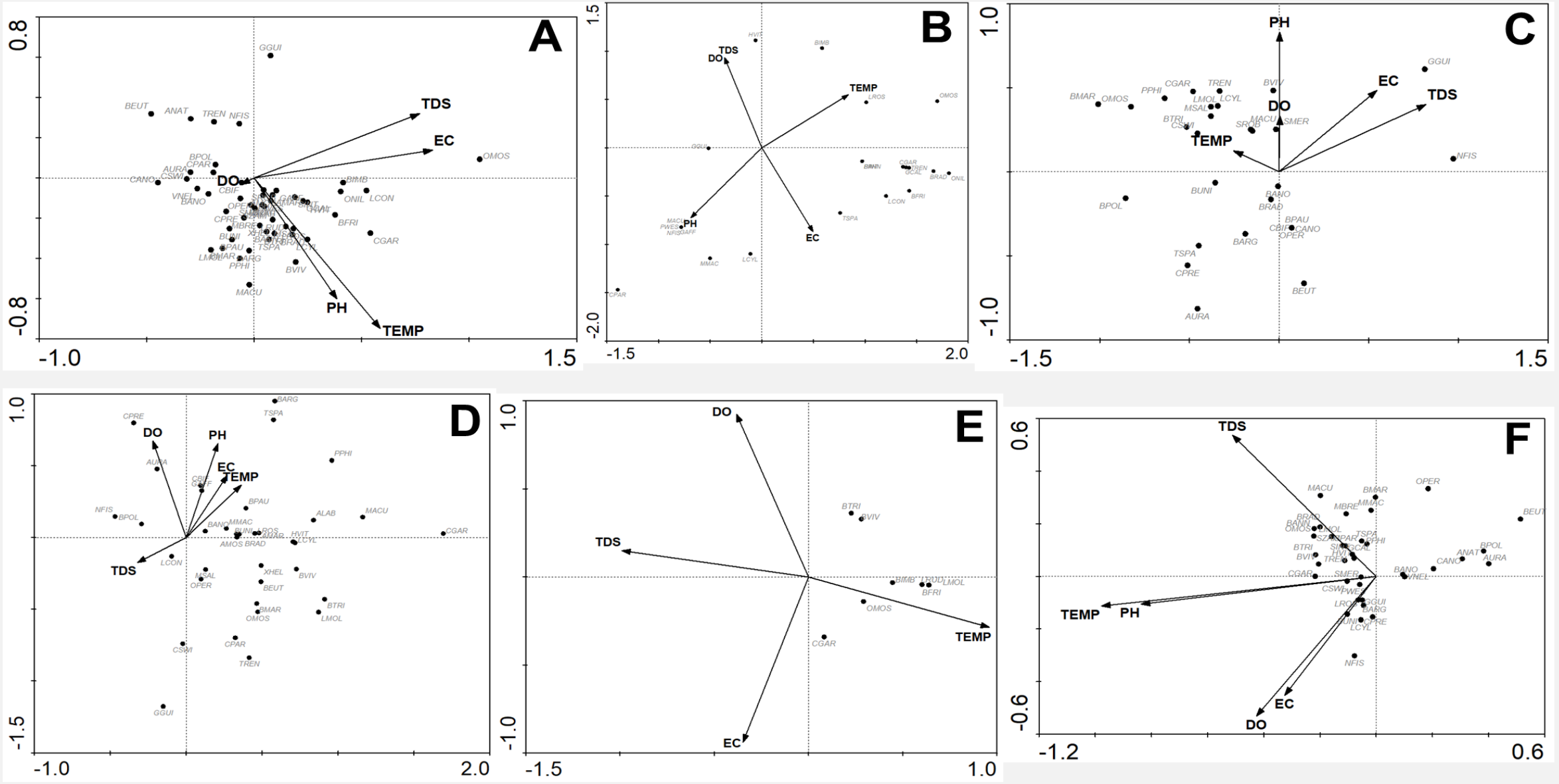



Results: FRAI

Ecological Categories	Description	Score (%)
A	Unmodified, natural state	90-100
B	Largely natural	80-89
C	Moderately modified	60-79
D	Largely modified	40-59
E	Seriously modified	20-39
F	Critically modified	0-19



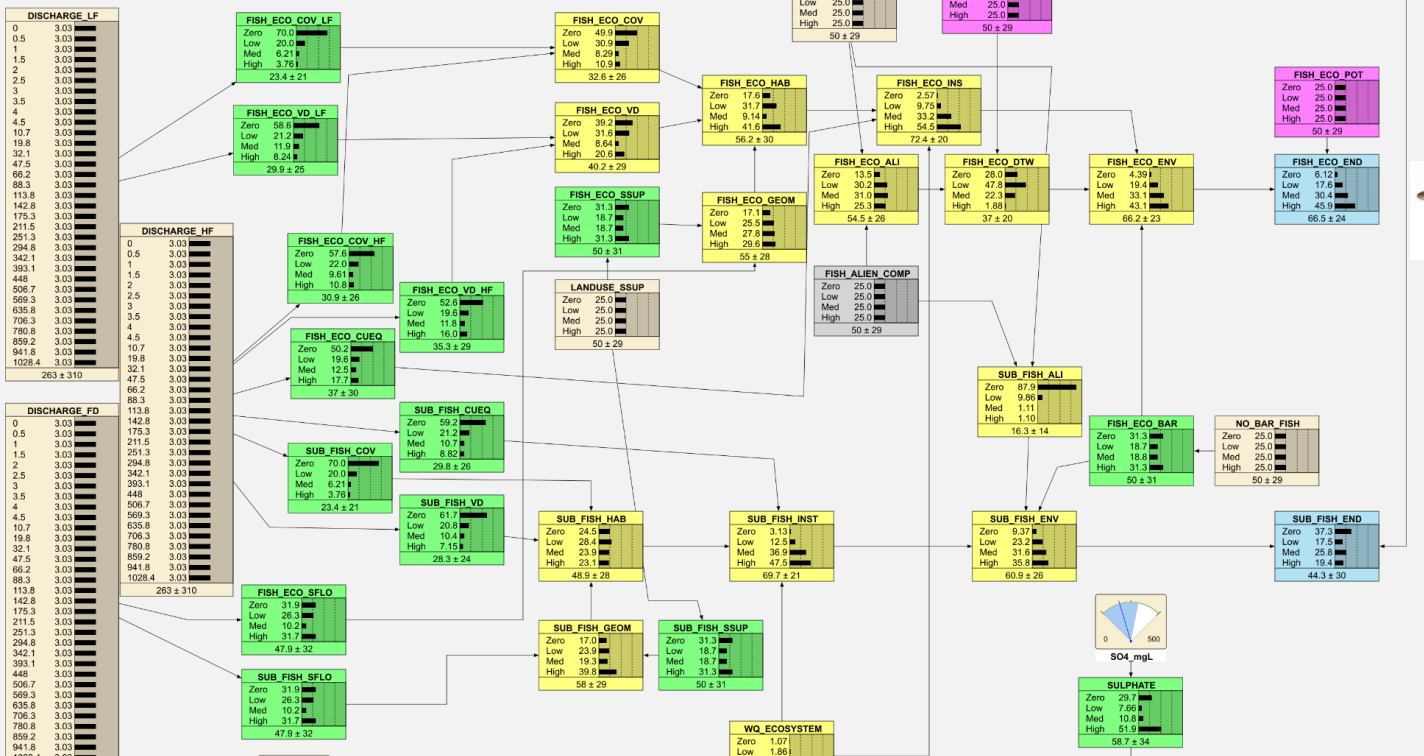
Results: Redundancy Analyses



Results: Redundancy Analyses

✓ Significant Relationship ✗ No Relationship

Analyses	Uanetze	Sabie	Crocodile	Komati	Incomati
Interriver	✓	✓	✓	✓	✓
Intrariver	✓	✓	✓	✓	✓
Year	✓	✓	✓	✓	✗
Seasonal	✗	✗	✓	✓	✗
VD	✗	✓	✓	✓	✗
WQ	✗	✓	✓	✓	✓
Substrate	✗	✓	✓	✓	✗
Cover	✗	✓	✓	✓	✗



Percentiles	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0.1	11.245	27.745	32.051	38.705	56.327	35.134	17.273	16.714	1.960	1.700	1.834	1.963
1	5.565	26.085	29.351	32.547	36.540	29.466	16.896	9.582	1.860	1.574	1.102	1.300
5	2.424	13.909	16.398	21.423	25.730	15.728	8.184	1.907	1.270	1.013	0.803	0.883
10	1.487	8.072	11.900	12.973	16.142	10.096	4.973	1.726	1.155	0.909	0.756	0.735
15	1.347	6.093	8.701	10.867	11.709	6.180	2.544	1.532	1.090	0.851	0.703	0.656
20	1.187	4.993	6.940	8.875	9.764	3.654	2.309	1.373	0.968	0.811	0.677	0.625
30	0.877	2.441	4.907	5.030	4.799	2.593	2.052	1.229	0.863	0.724	0.624	0.572
40	0.741	1.769	2.596	3.535	2.796	1.972	1.681	1.115	0.790	0.669	0.566	0.517
50	0.635	1.397	1.997	2.315	2.278	1.777	1.474	0.948	0.729	0.612	0.497	0.459
60	0.579	1.239	1.671	1.873	1.949	1.680	1.334	0.836	0.651	0.523	0.431	0.409
70	0.523	1.056	1.499	1.688	1.651	1.324	1.099	0.721	0.563	0.461	0.388	0.367
80	0.467	0.887	1.259	1.383	1.491	1.132	1.003	0.616	0.482	0.429	0.353	0.333
85	0.422	0.744	1.048	1.311	1.391	1.056	0.921	0.583	0.460	0.408	0.341	0.324
90	0.386	0.658	0.914	1.122	1.259	0.978	0.662	0.498	0.431	0.389	0.325	0.306
95	0.284	0.550	0.740	0.928	1.089	0.848	0.606	0.450	0.387	0.354	0.296	0.266
99	0.220	0.387	0.357	0.775	0.773	0.643	0.518	0.313	0.324	0.299	0.272	0.215
99.9	0.210	0.251	0.331	0.666	0.745	0.582	0.371	0.307	0.317	0.299	0.252	0.192

Ecological Endpoint

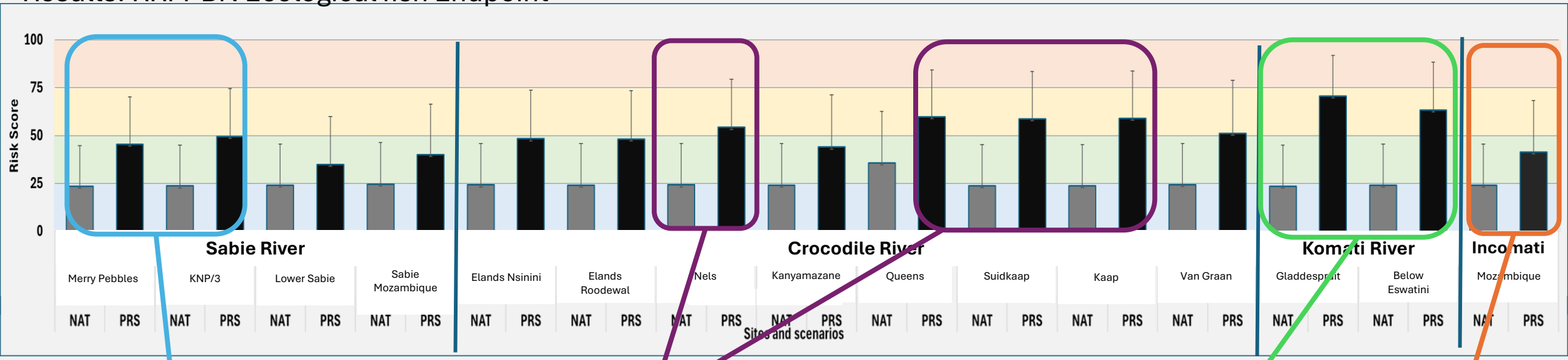
Subsistent fisheries Endpoint

Water quality standards

(water quality scoring with reference to Chinese drinking water standards)

COD(mg/L)	0~0.75	0.75~1.5	1.5~3	3~7.5
TOC(mg/L)	0~1.25	1.25~2.5	2.5~5	5~12.5
TDS(ppm)	0~250	250~500	500~1000	1000~2000
Backlight color	Blue	Green	Yellow	Red
Score	90~100	80~90	60~80	0~60
Judgment	Fine	Good	Average	Poor

Results: RRM-BN Ecological fish Endpoint



Merry Pebbles:
- Camping sites
- WWTW
- River crossings
- Plantations

KNP/3:
- Low Diversity
- upstream issues, close to border – communities

Nels:
- River crossings
- Invasive plants
- ↑ Tank water abstraction
- Urban/Industrial area

Queens/Suidkaap/Kaap:
- Plantations
- upstream issues
- WWTW
- Invasive plants/fish
- ↑ Barriers
- Surrounding Communities

Gladdespruit:
- Invasive species
- Barriers upstream
  - ↓ release
- Communities
  - plant removal
- Water Quality

Below Eswatini:
- Water quality (communities)
- Barriers
- Habitat removal/change

Dilution?

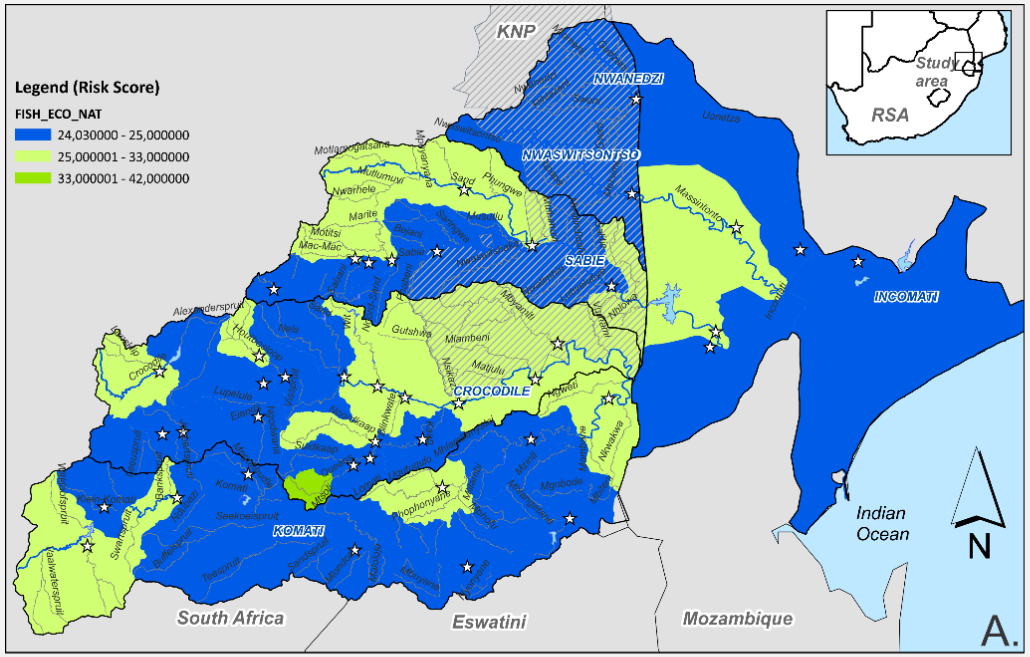
Invasive Species

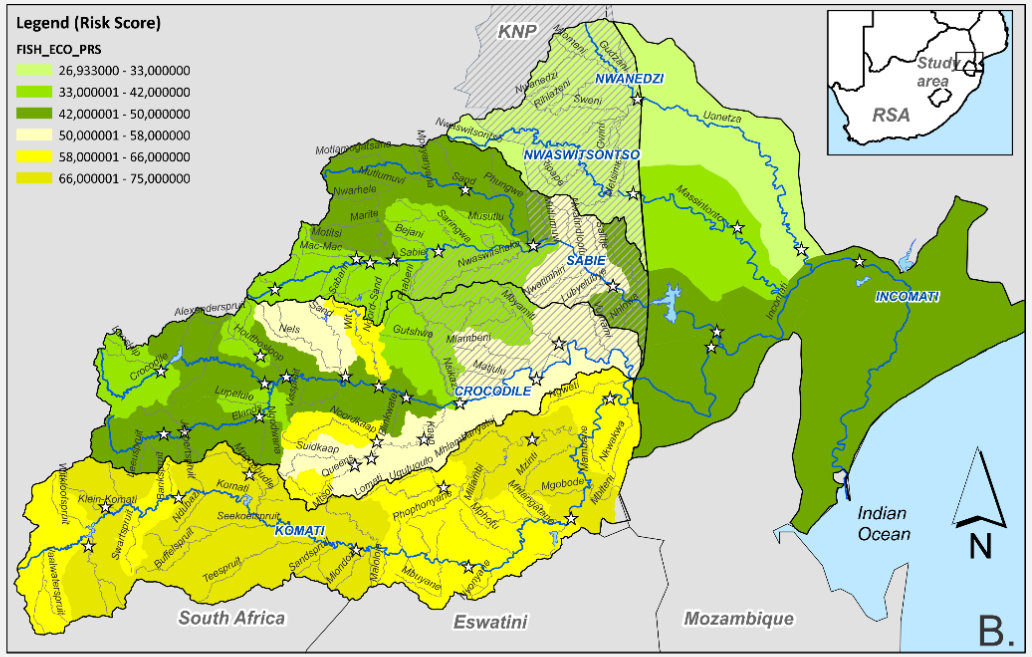
Overfish

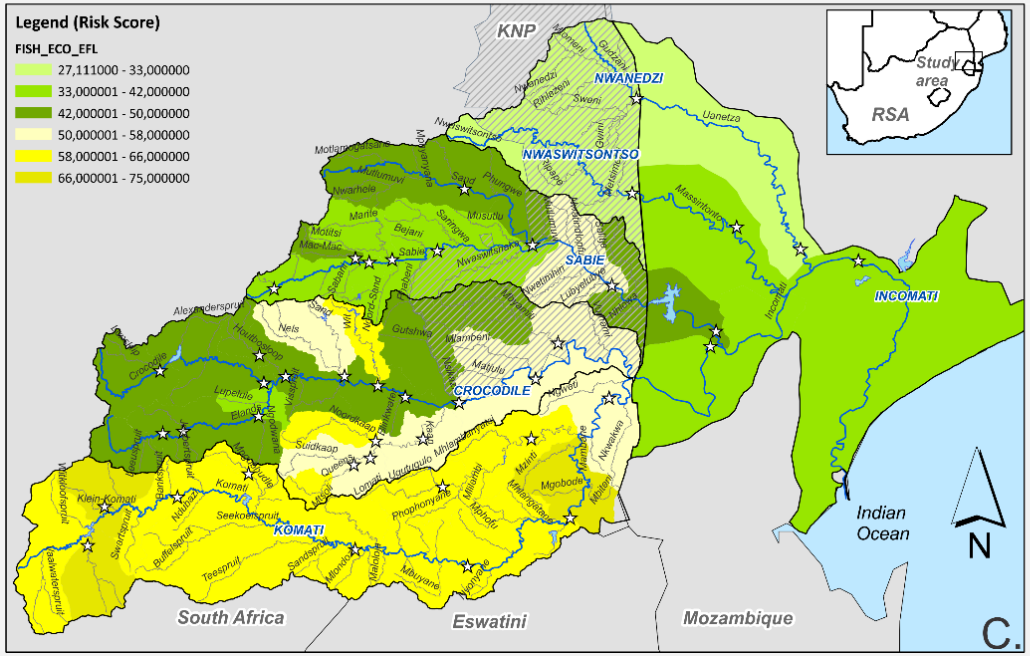
Barriers

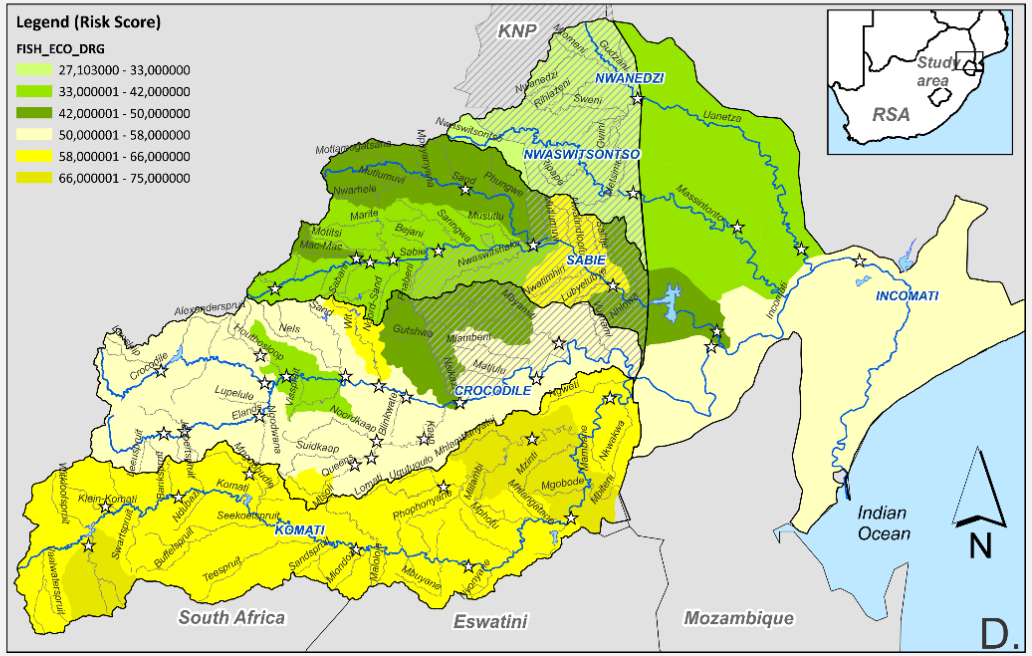
Farming

Results: RRM-BN Ecological fish Endpoint

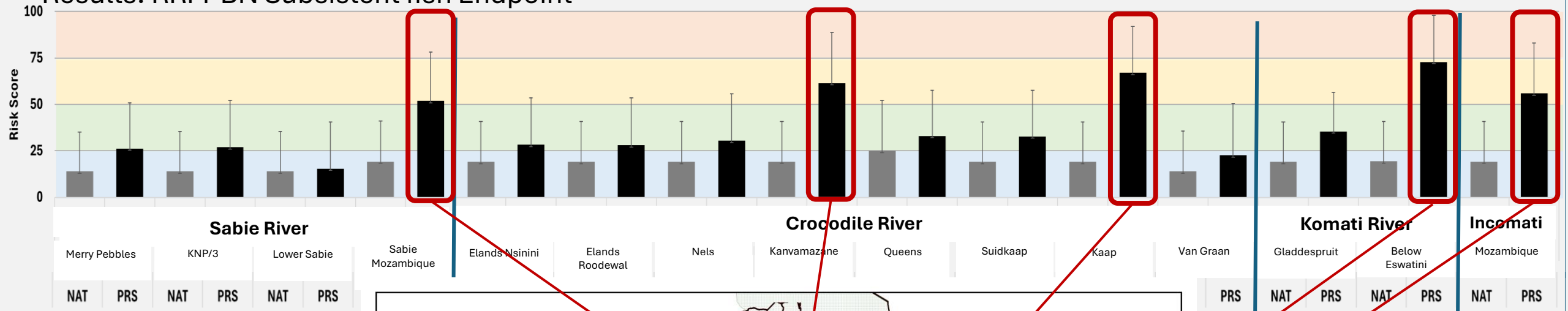


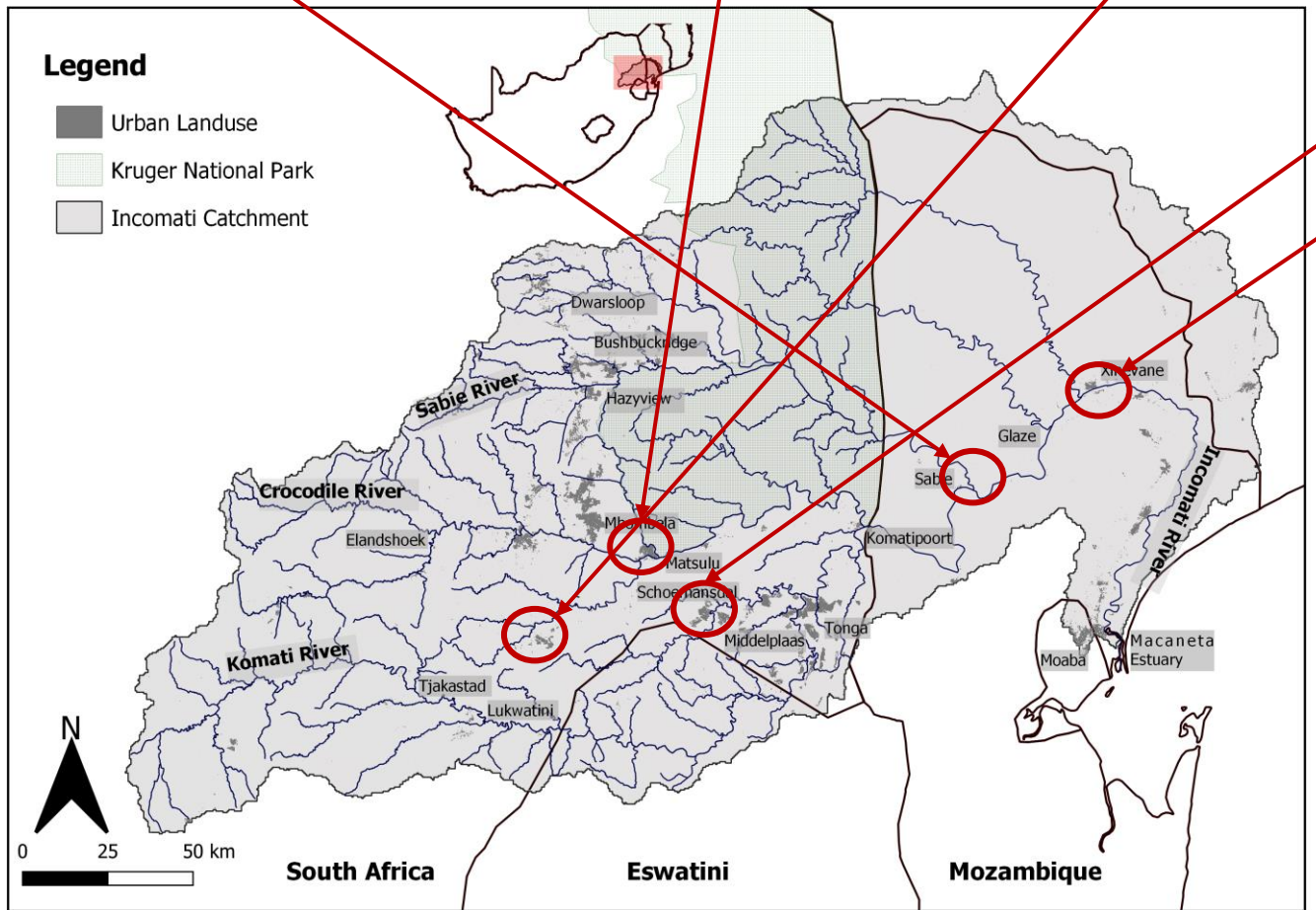




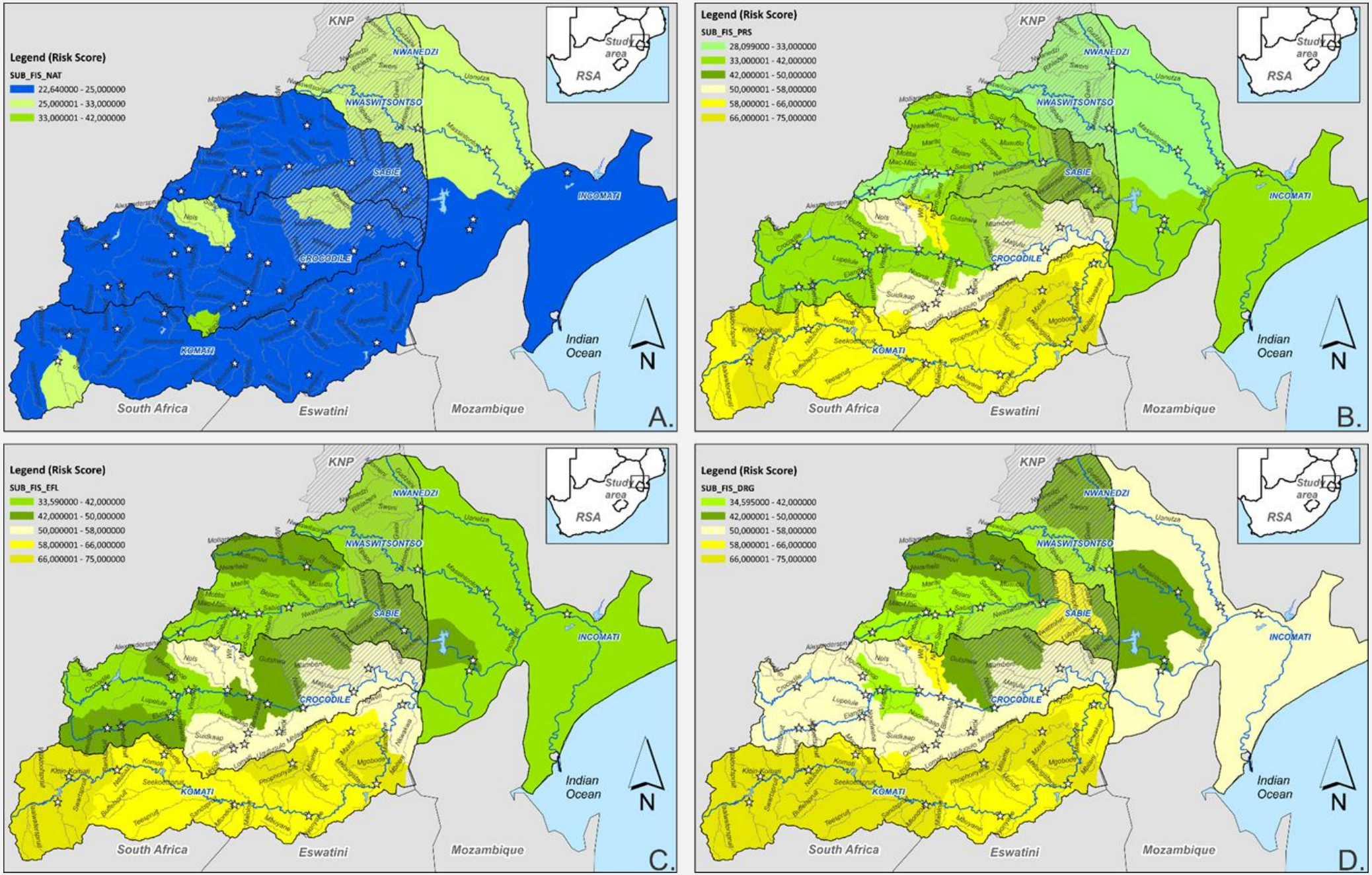


Results: RRM-BN Subsistent fish Endpoint





Results: RRM-BN Subsistent fish Endpoint



Discussion

Fish communities vary considerably but is in a stable state

- 71% of expected species collected

FRAI assessment, moderately modified state - linked to RQOs

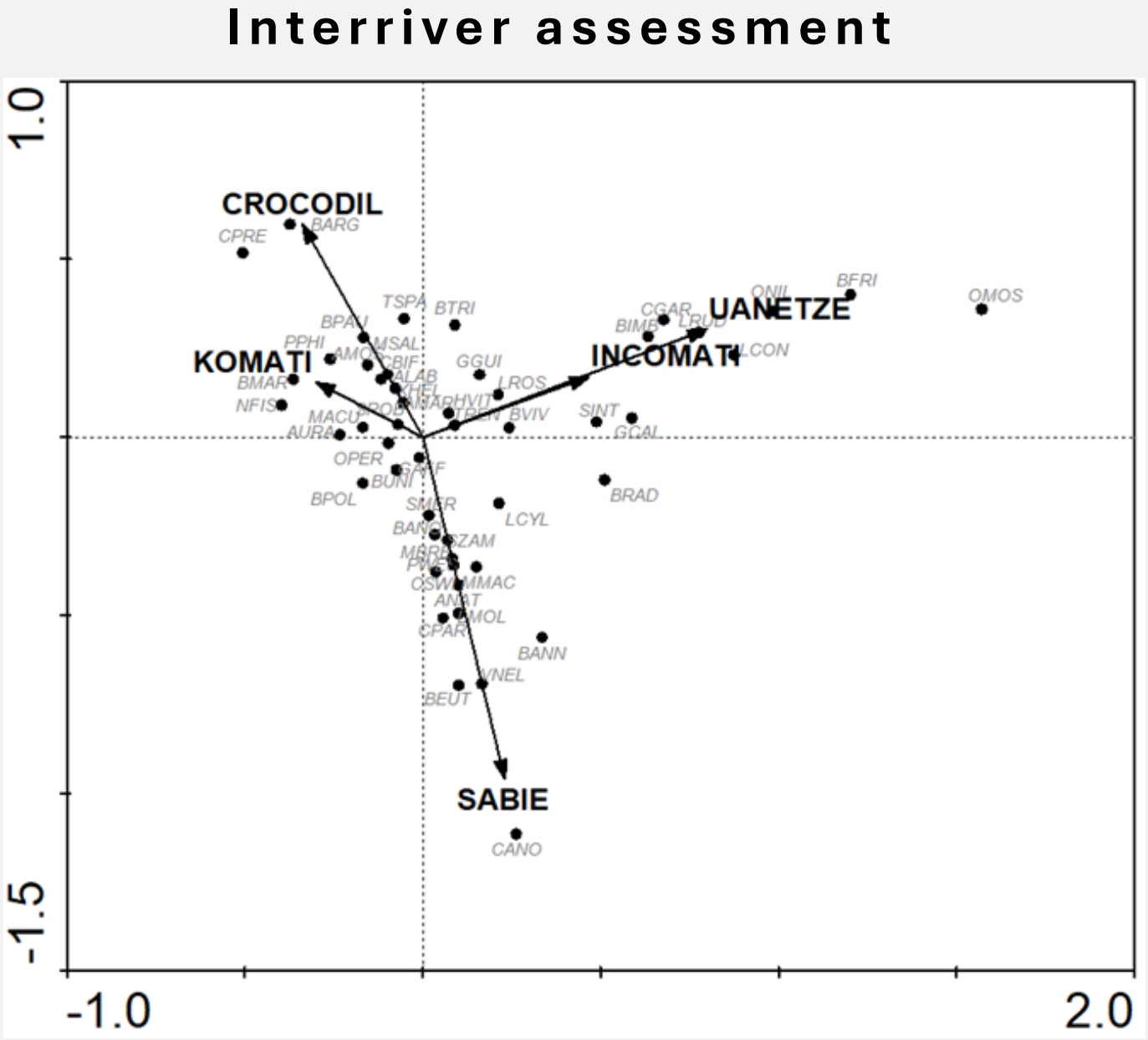
- more than 23% under TEC

Ecological risk assessment - areas of concern/environmental stressors

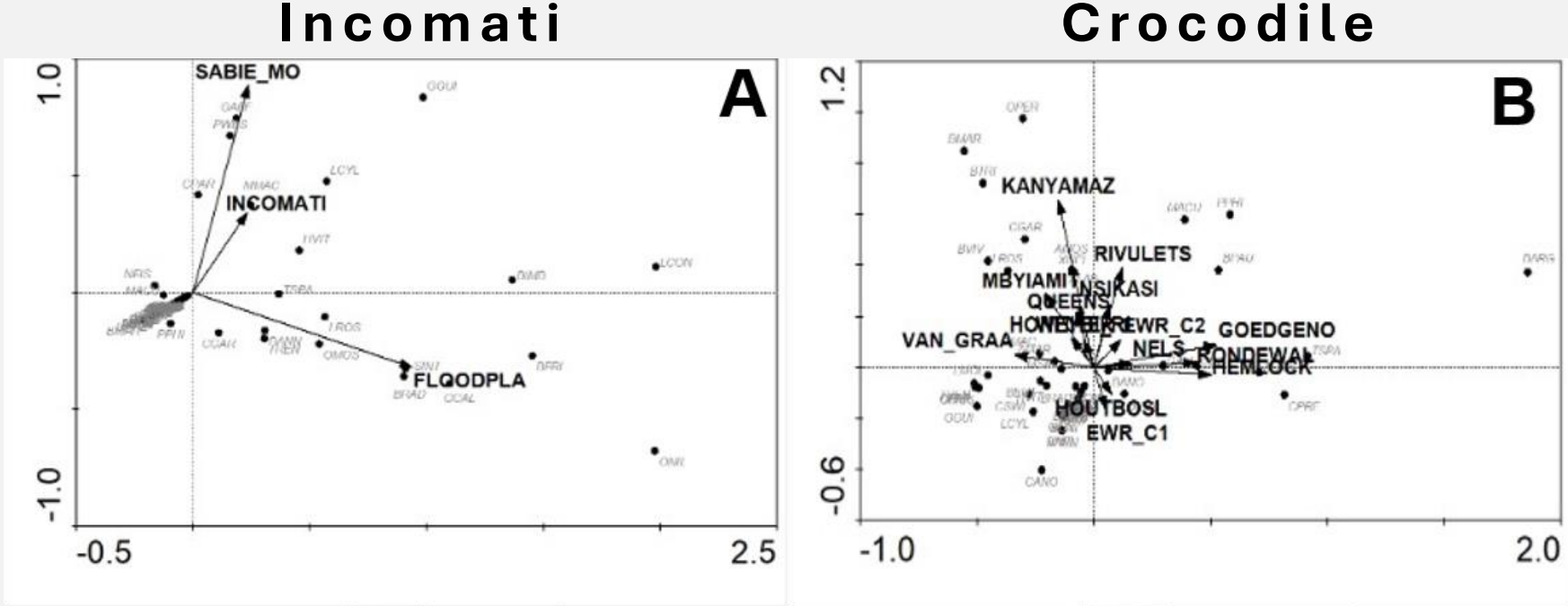
Catchment specific stressor management needed.

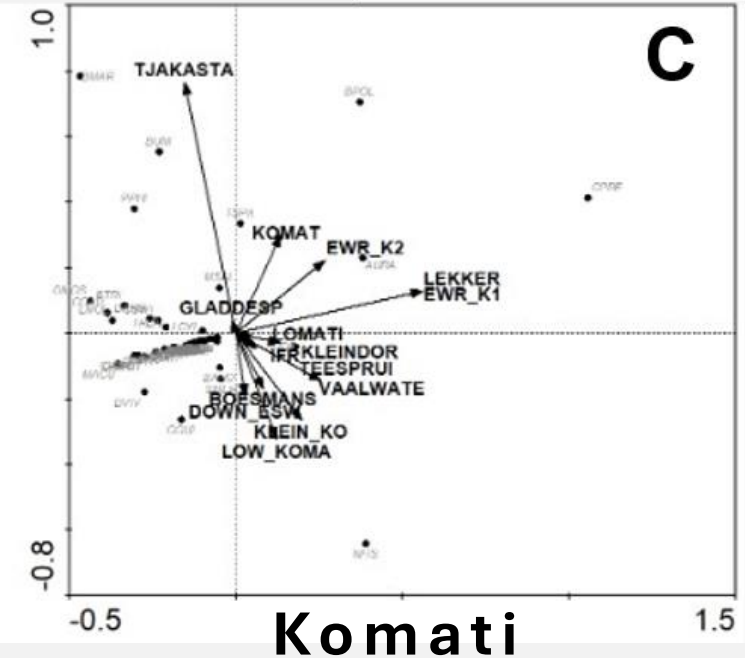

South African
NATIONAL PARKS
Charles Sturt
University
Gulbali Institute
Agriculture Water Environment
IWMI
International Water
Management Institute
INKOMATI-USUTHU
CATCHMENTMANAGEMENTAGENCY
Mpumalanga
TOURISM AND PARKS AGENCY
ARA-Sul
Administração Regional de Águas do Sul
SARI
Sustainable African
Rivers Initiative
NWU
Rivers of Life
Aquatic Health
Services
UNIVERSITY OF
MPUMALANGA

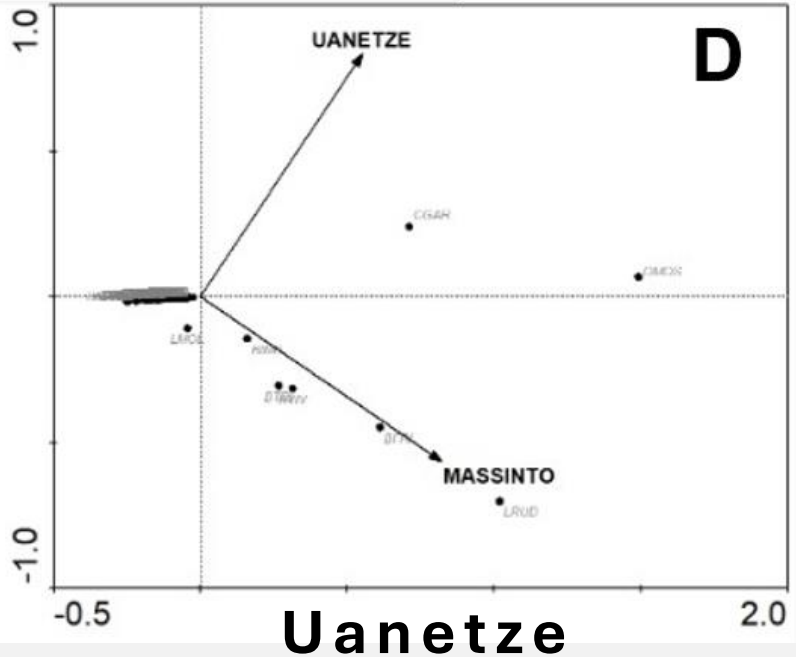
Results: Interriver

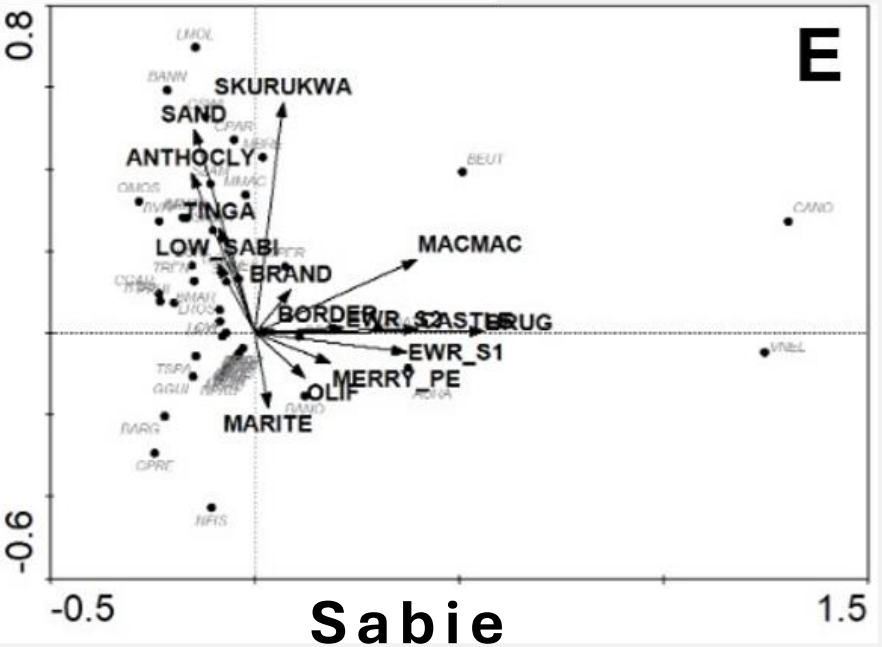


Results: Intrariver



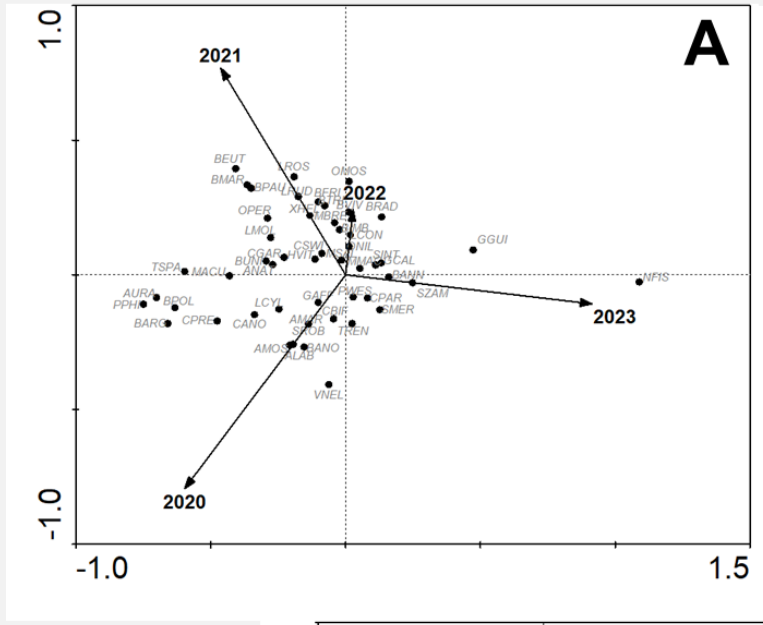




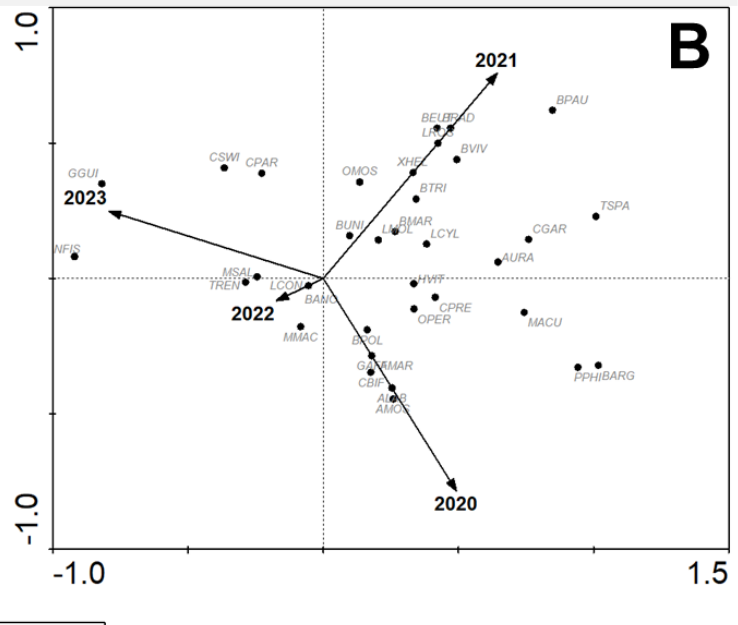


Results sampling years:

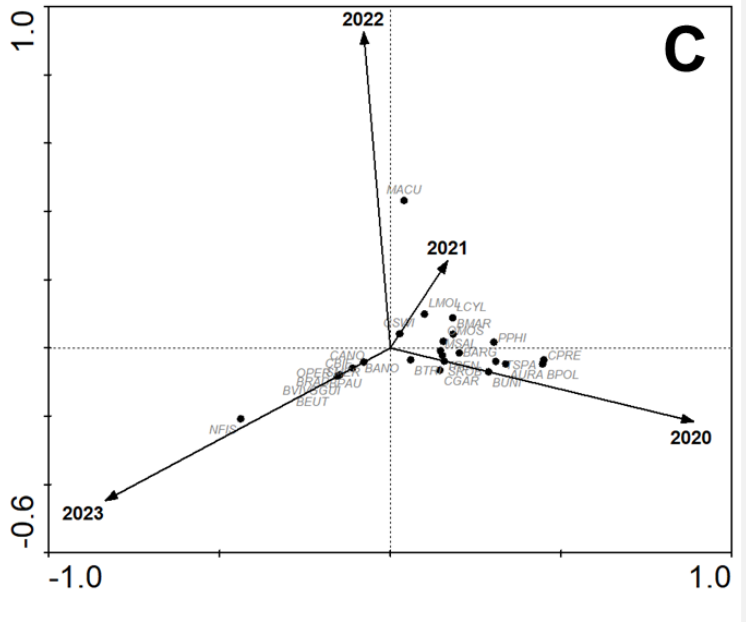
All

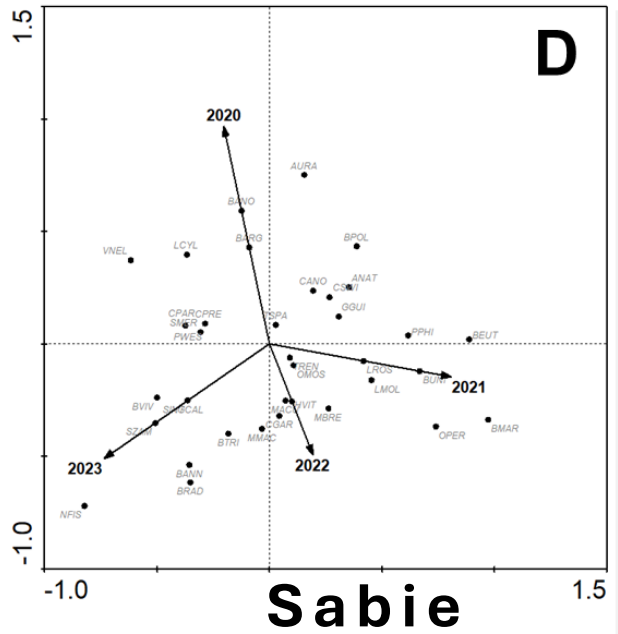


Crocodile

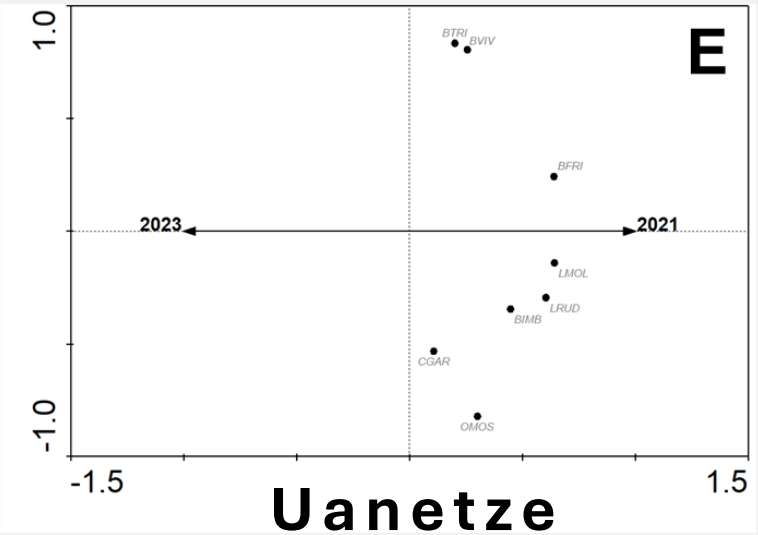


Komati



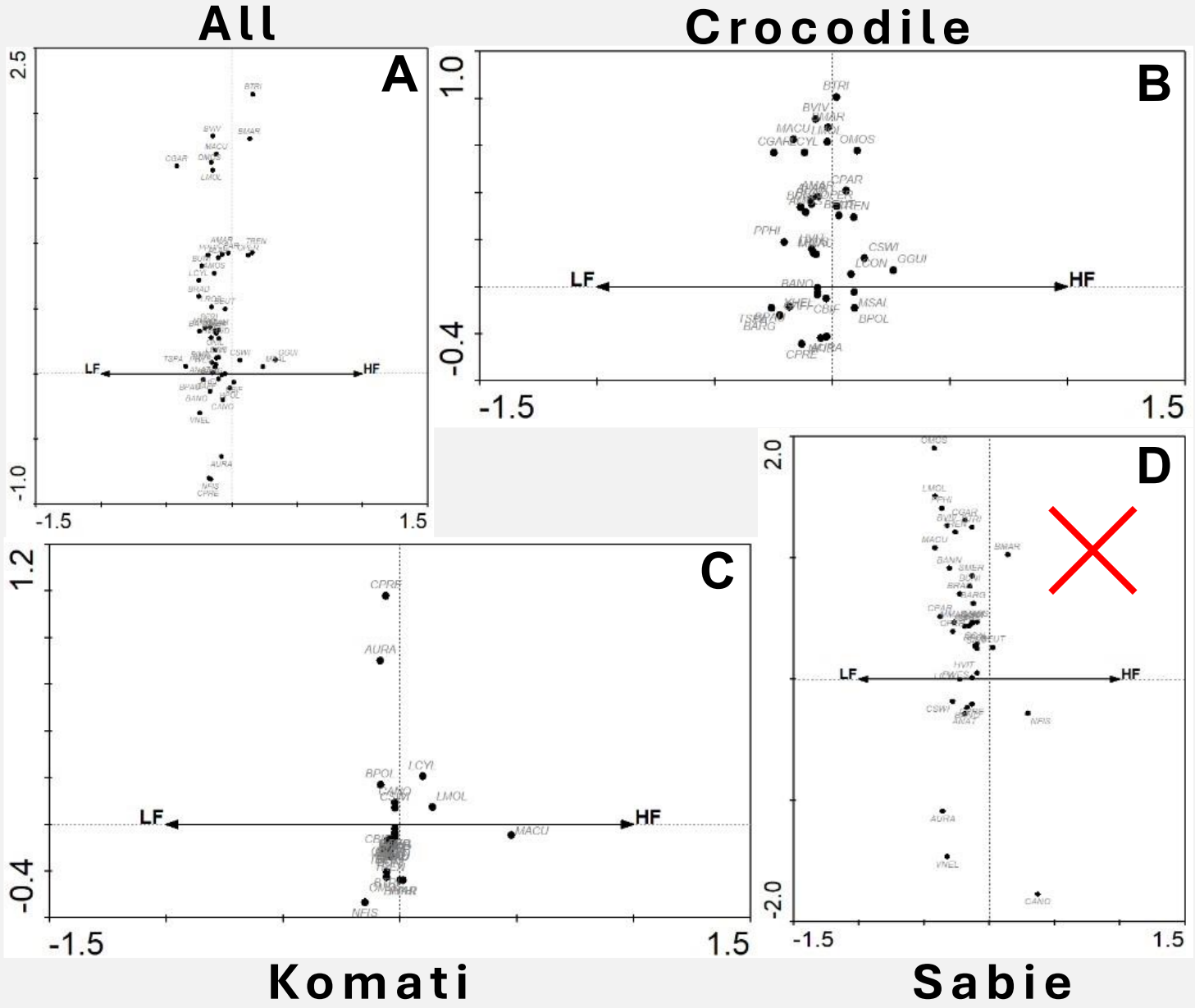


Sabie



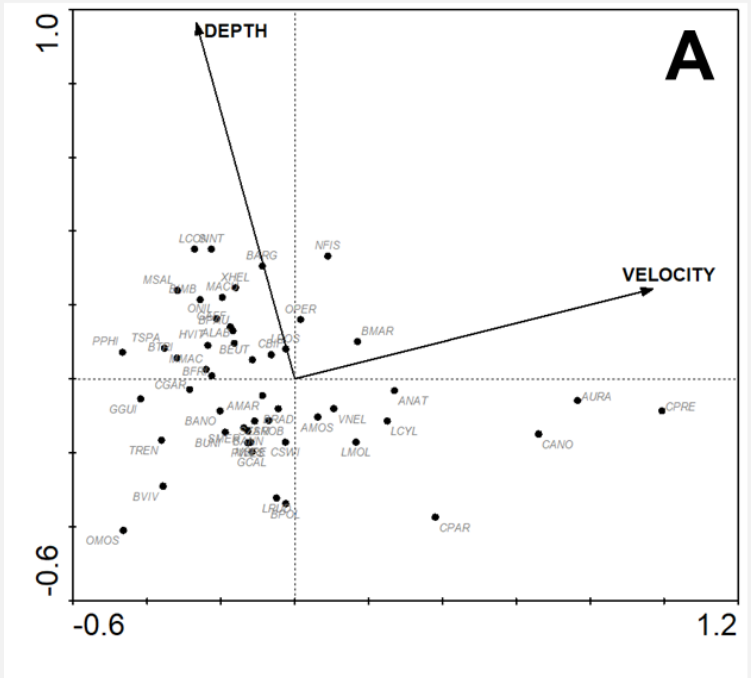
Uanetze

Results: Season

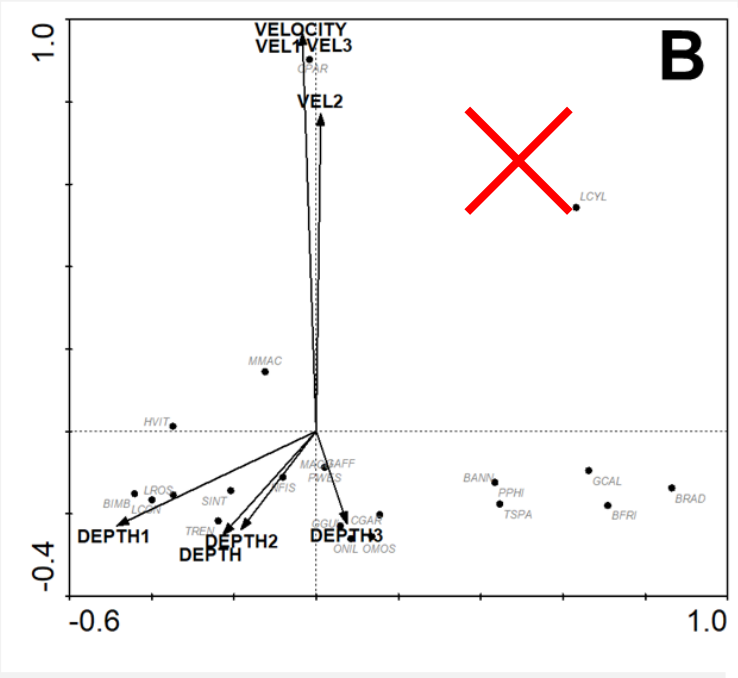


Results: Velocity-Depth

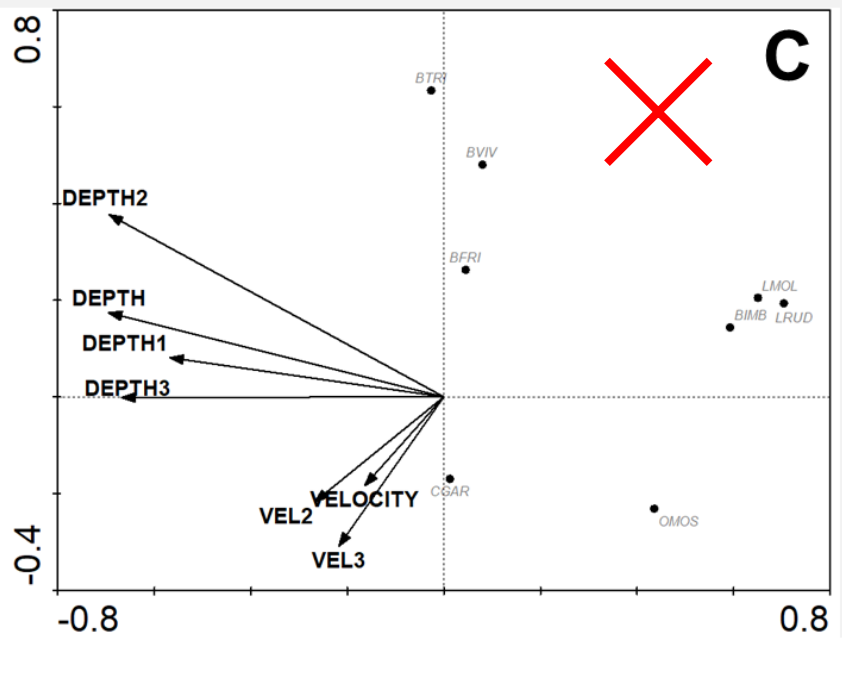
All

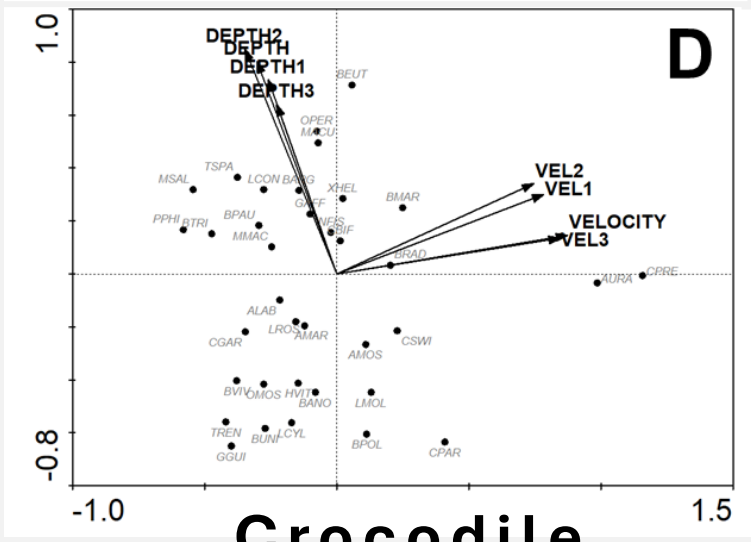


Uanetze

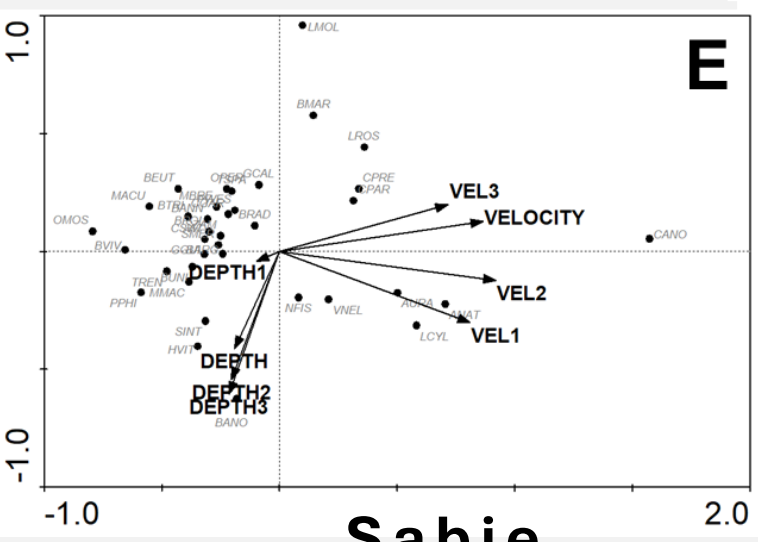


Incomati

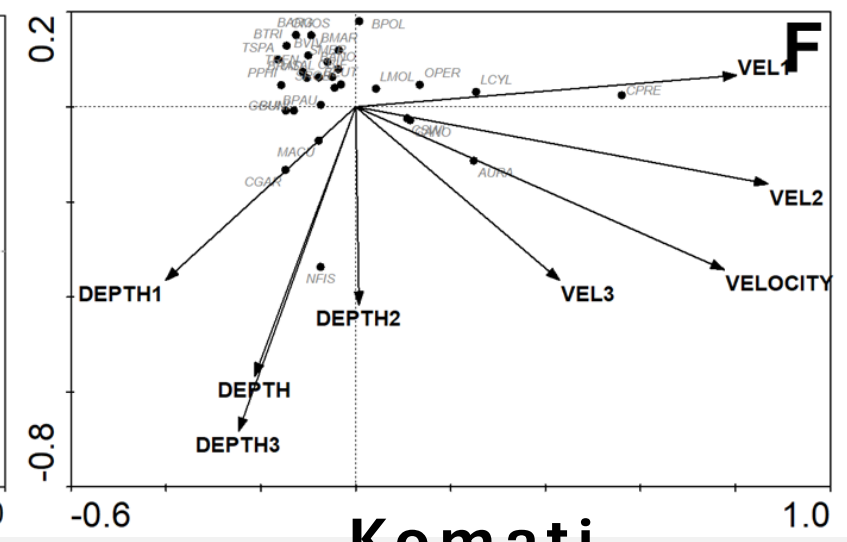




Crocodile



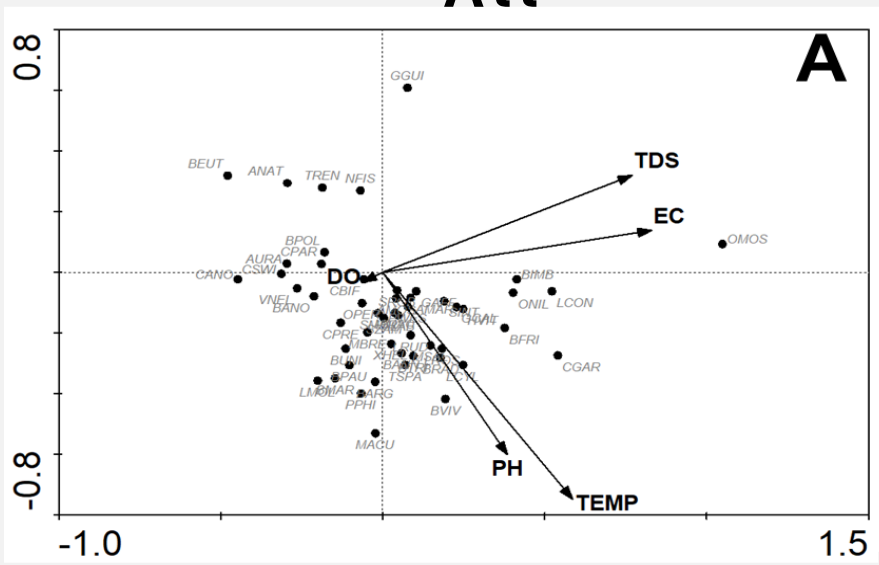
Sabie



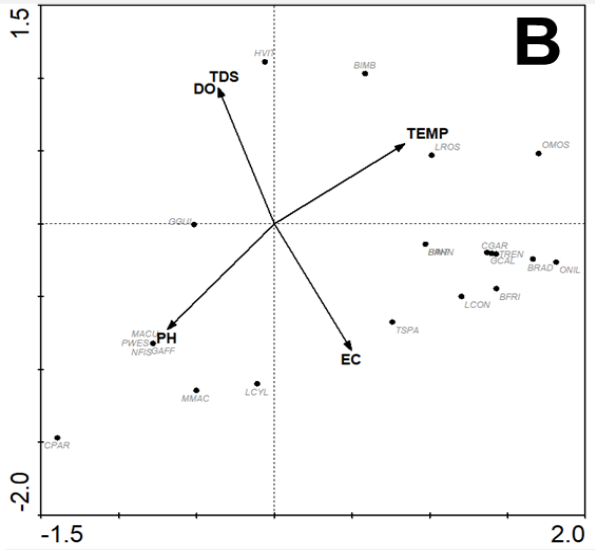
Komati

Results: Water quality

All



Incomati



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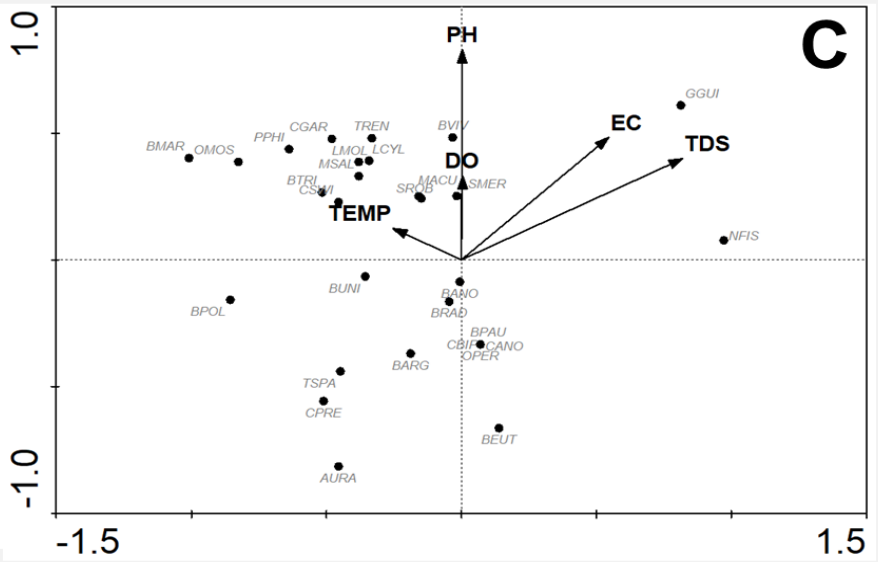
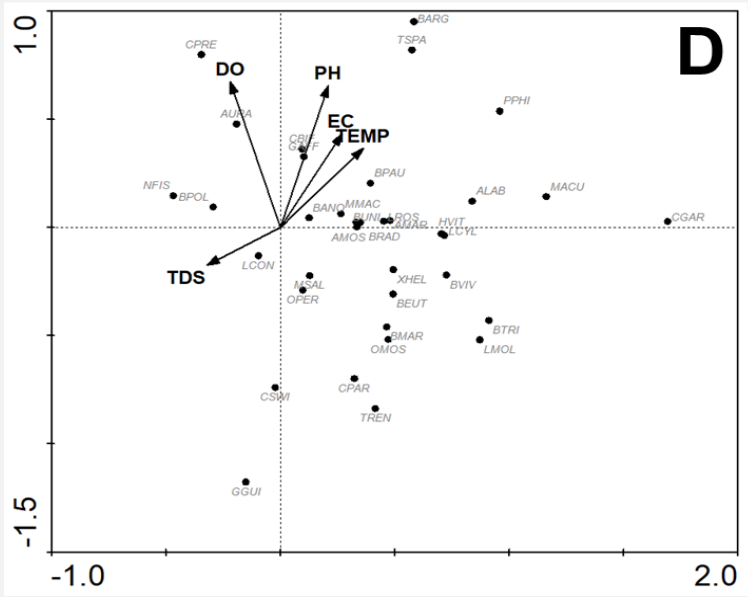
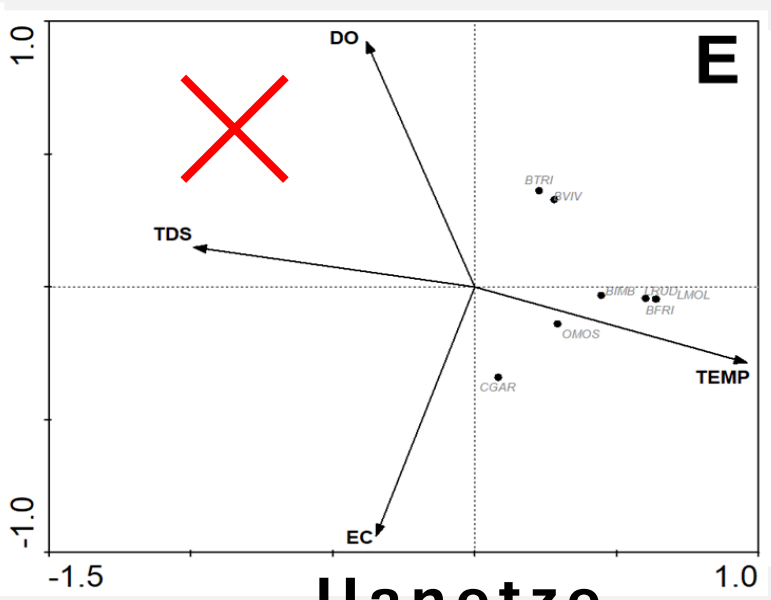
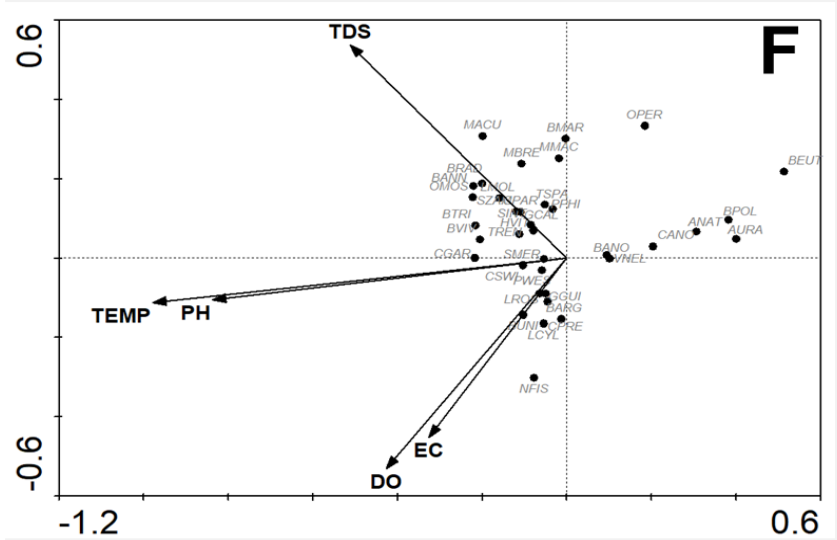




Crocodile

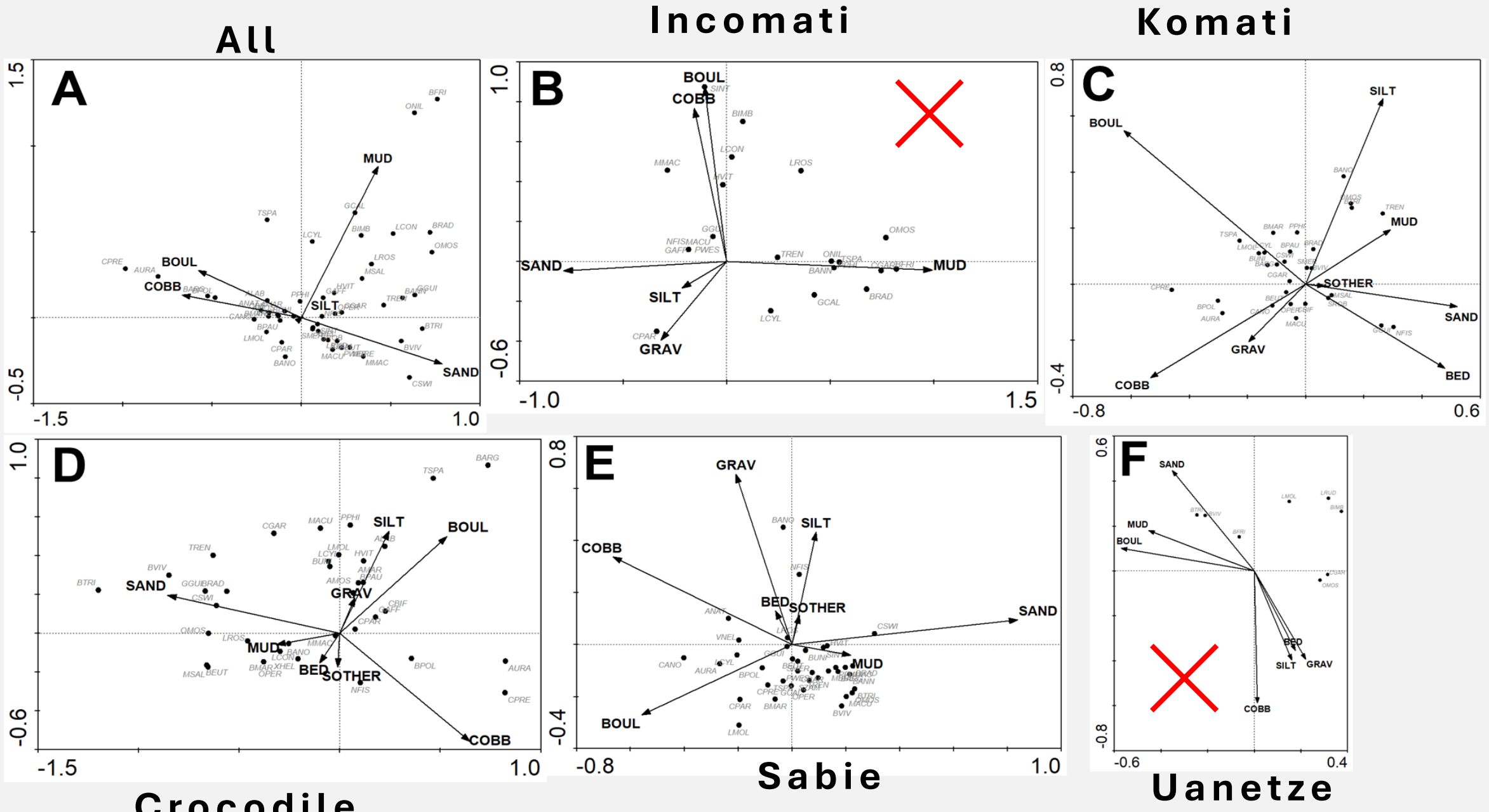


Uanetze



Sabie

Results: Substrate Diversity



Results: Cover Features