Monitor The Macroinvertebrate Diversity of the River Nile

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Nile River is the Gift of Life for Egypt

- The Nile River is one of the largest rivers in the world with total length of 6800 km

- There are 10 countries sharing the Nile Basin

- A length of 1035 km passing through the Egyptian territory downstream High Aswan Dam

Nile River is the Gift of Life for Egypt

- Its catchment in Egypt has a population of 82 million capita

- More than 95% of Egyptian population lives along the river Nile valley and delta.

- Egypt's share in Nile Water is 55.5 billion M3/year which represents more than 95% of Egypt's total fresh water resources
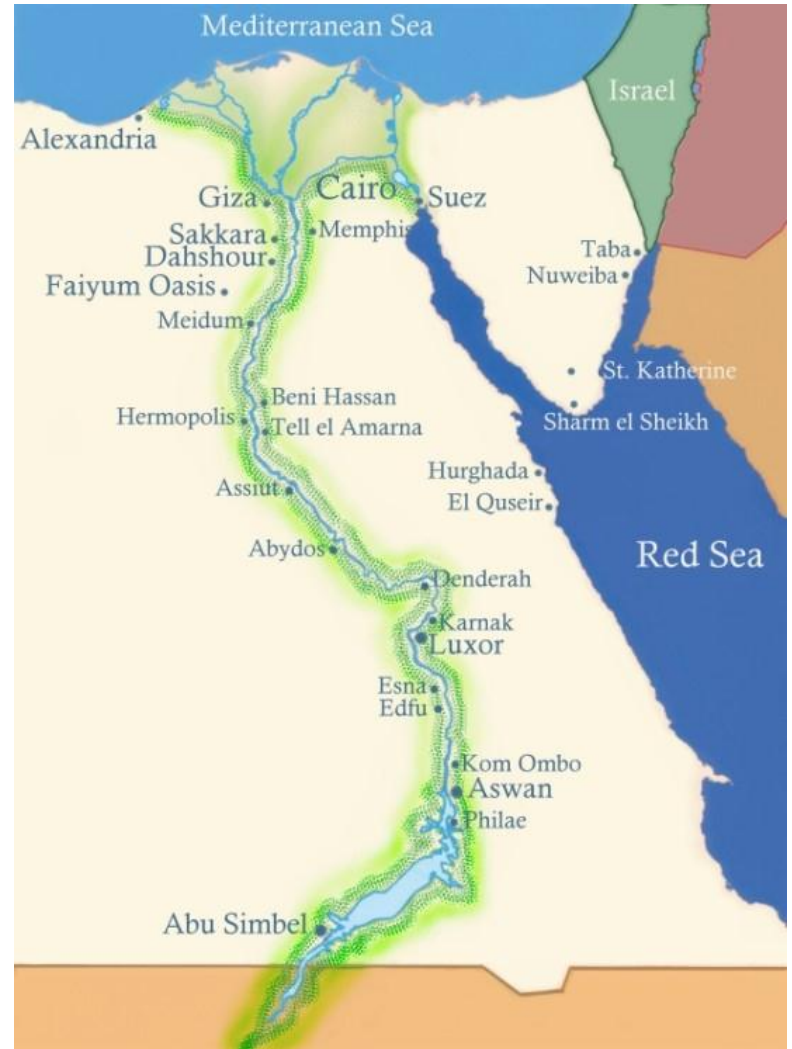
Biological Monitoring of BigRivers

- Biological Monitoring of Rivers using bentic macroinvertebrates is accepted as a useful tool for assessment of water quality
- However, most studies have investigated relatively small rivers no large ones

Biological Monitoring of Nile River

- Information on invertebrates of the river Nile prior to the Aswan Dam was sparse

- In 2006, a study was made to estimate macroinvertebrate biodiversity of the River Nile

- The long term objective of this study was to develop a biotic index for the Nile with a rapid bio-assessment monitoring program

Aims of the Sampling strategy

- Test the method or methods that are capable of sampling the taxa present at site
- Define the number of samples that are required to obtain a representative sample of the taxa present in the river
- The seasonal variation in taxon diversity and the best time of the year for sampling
- The current macroinvertebtare biodiversity at selected sites along the River Nile

Methods of Sampling

- The Nile banks are sedimentary and muddy with steep banks
- The mid stream is more erosional with coarse sand substrate
- There are several methods for sampling large rivers:
  - Dredges,
 - grabs,
  - cores
  - air lift pumps

Methods of Sampling

- These methods are limited because they only work well on soft substrate and

- the volume of the substrate sampled by corers, grabs and air-lift pumps is very small

- An alternative sampling method is the Artificial Substrate colonization Sampler (ASS)

- It has the disadvantage that 3-4 weeks are recommended for colonization during which time the samplers can be dislodged by extreme flows or vandalized

Monitoring program for the Nile River

- 15 sites were selected to provide a wide range of physical and chemical conditions

- Three methods were used:
  - Ekman grab,
  - ASS,
  - Macrophyte sweep net samples
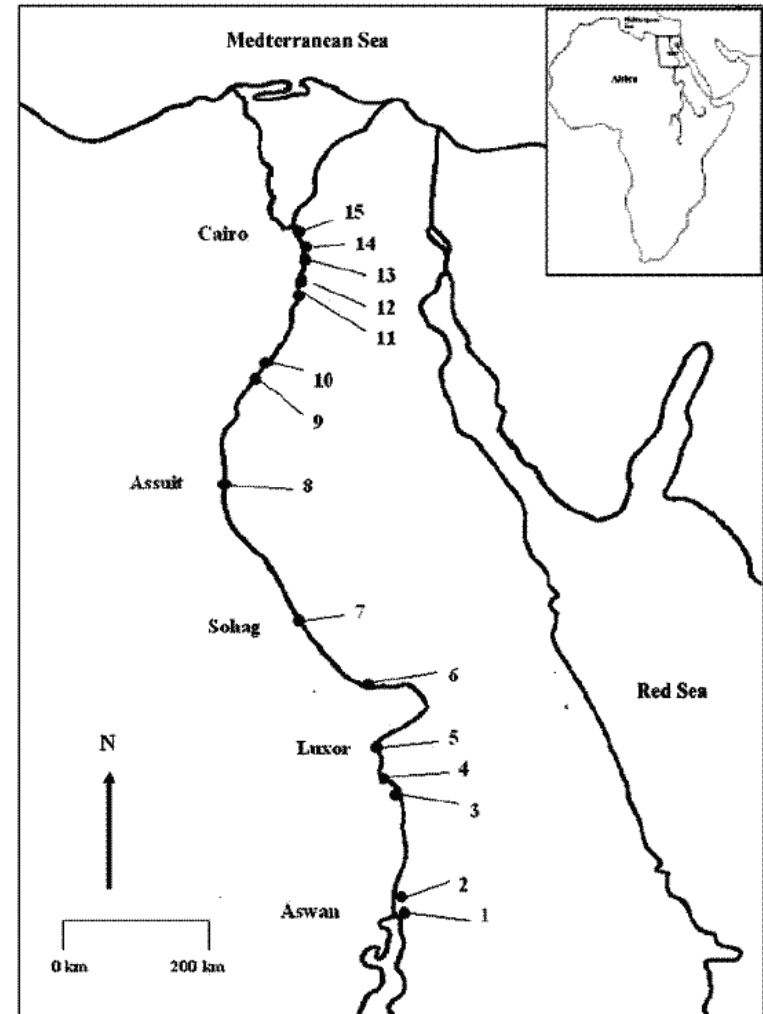
Collection and analysis of Macroinvertebrates

- The east and west banks and the mid stream were sampled at each site

- The sampling program took place from Sep 2001 to June 2002.

- Three pairs of field collection dates were selected:
  - Sep./Oct 2001 (Autmn)
  - Jan. /Feb. 2002 (Winter)
  - May/June 2002 (spring/summer)
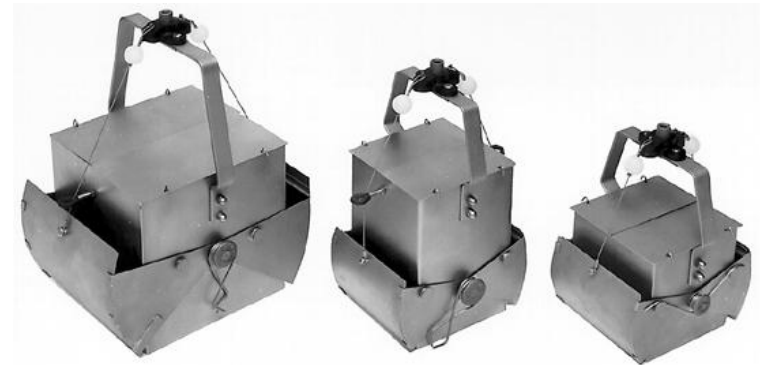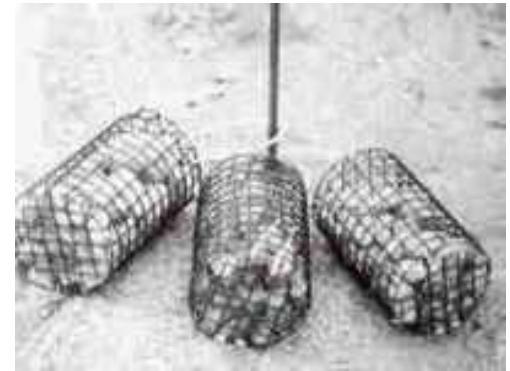
Collection and analysis of Macroinvertebrates

- 3 ASS were deployed and retrieved on the second date after one month

- A maximum of 2 ASS samples were analyzed at each site

- 3 Ekman grab samples with opening area of 250cm2 were taken from each site on each visit

- 2 samples were taken from macrophyte beds at each bank within 0.125 m2 quadrat

- Macrophyte were cut and thoroughly shaken and washed into a 500 µm mesh sweep net.

gef

UN DP
Empowered lives.
Resilient nations.

Treatment of Samples

- The macroinvertebrates (>500μm) were separated from the substrates using 500μm mesh sieves

- They were stored in plastic jar in 7% formalin solution for maximum of 5 days before identification

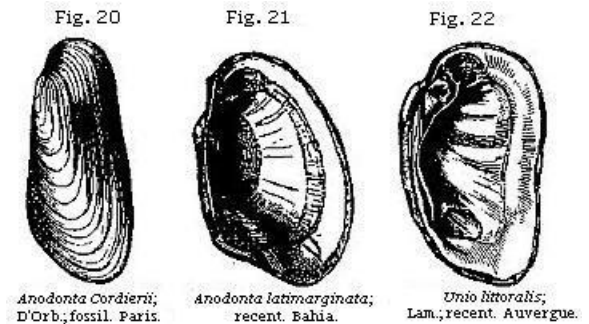- Invertebrates were identified to species level were possible

Treatment of Samples

- The main references used for identification:
  - For annelids : Brinkhurst (1966), Brinkhurst & Jamison (1971) and Hussein (1988)
  - For Mollusca : Walker (1959), Soliman (1972), Abdel Aal (1979), Brown (1980), Flemming (1983), and Ali (1989)
  - Insect larvae and nymphs : Day (1948)
  - Hydra vulgaris : Ewer (1948), Smith (1959), and Campbell (1983, 1987, 1989)
  - Trichoptera was only identified as an order
  - Chironomidae larvae and pupae were also recorded as single taxon

Annelids

Fig. 20   Fig. 21   Fig. 22

Anodonta Cordierii; D'Orb.;fossil. Paris.

Anodonta latimarginata; recent. Bahia.

Unio littoralis; Lam.;recent. Auvergue.

Number of Samples collected and Classification Results

Sampling Method	Item	Sep. 2001	Oct. 2001	Jan. 2002	Feb. 2002	May 2002	June 2002	Total
ASS Method	# of samples collected	27		35		33		95
	# of Taxa per sample	6.4		6.5		8.9		7.2
Macrophyte Sweep Net	# of samples collected	45	42	27	29	34	44	221
	# of Taxa per sample	3.8	3.5	3.4	3.2	3.1	3.3	3.4
Ekman Grab	# of samples collected	135	135	135	135	135	135	810
	# of taxa per sample E&W banks	2.2	2.2	2.2	2.8	3.1	3.1	2.6
	# of samples with no animals in E&W banks	11	17	13	16	4	2	63
	# of taxa per sample mid stream	0.33	0.27	0.22	0.51	0.77	0.98	0.51
	# of samples with no animals in mid stream	35	35	39	34	32	29	204

The Average number of Taxa per sample

- The Average number of Taxa collected from the East – West banks :

| Sampling Method	Average Number of Taxa per sample
Artificial Substrate Sampler (ASS)	7.2
Macrophyate	3.4
Ekman Grab Sampler	2.6

- The average number of taxa from mid-stream using the Grab Sampler was 0.8 taxa per sample

The Cumulative taxon Curve

- Estimate % of the taxa collected by a given number of samples

- The Taxon Accretion Rates were calculated for each method

- Approximate 15 grab ,10 Macrophayte and 5 ASS samples are needed for reliably collect all samples at a site.

- For 80+% of the total taxa is considered reasonable for routing Biomonitoring purposes
  - 10 Grab
  - 5 Macrophayte
  - 3 ASS

Taxon accretion by Artificial Substrate Samples

Taxon accretion by Grab Samples

Taxon accretion by Macrophyte Samples
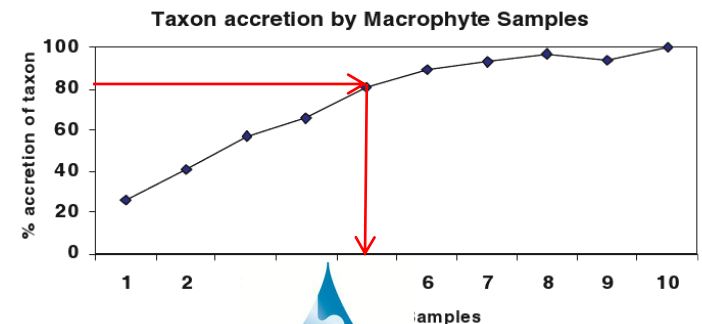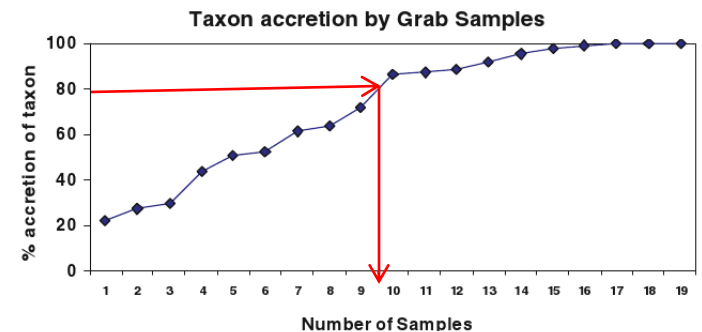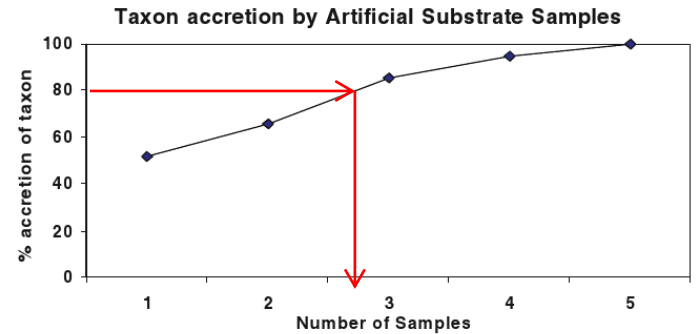
The Seasonal Effects

- Determination of seasonal effects is important for monitoring program design

- Rapid Assessment Biomonitoring program for water quality management often sample habitat, once or twice a year.

The Seasonal Effects

- ASS sampling :
  - Was most successful in May/June with 55% of samples collected for analysis and maximum number of taxa recorded per sample 8.9 taxa.
- Macrophytes sampling:
  - The best time was from June to Oct. with Sep. best of all, the mean no of taxa per sample was 3.8 taxa in Sep.
- For Ekman grab:
  - The highest number of taxa per grab were 3.1 taxa in May and June
- Overall : it appears that the best time for sampling macroinvertebrates for Rapid biomonitoring is the Early summer

Biodiversity of Macroinvertebrates

	East			West			Whole River			Total
	ASS	M	Grab	ASS	M	Grab	ASS	M	Grab	ASS+M+G
No of taxa	29	37	32	36	33	29	38	43	37	50
% of table taxa	58	74	64	72	66	58	76	86	74	100%

- From all collected samples, there were 50 taxa that have been recorded
  - 3   Crustacea
  - 17   Insecta
  - 19   Mollusca
  - 9   Worms, leeches and flat worms
  - 1   Hydrozoa
  - 1   Bryozoa

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- The Grab samples produced 37 identified Taxa
- The ASS samples produced 38 identified Taxa
- The Macrophyte samples produced 43 identified Taxa
- Only one taxon, the bivalve, was exclusive to the Grab Sampler
- 5 Taxa were exclusive to the Macrophytes
- Only one taxon, odonation, was exclusive to ASS

Biodiversity of Macroinvertebrates

- Site 2E is downstream of the Kima fertilizer factory industrial outfall .

- 10 W is downstream of the sewage Discharge of the major city of ElMina.

- Site 8W is downstream the city of Assuit .

- The trend of increasing Biodiversity downstream from sites 10 to 15 is thought to reflect slower flows and sedimentation approaching the delta Barrages

Macroinvertebrates Biodiversity recorded at each site
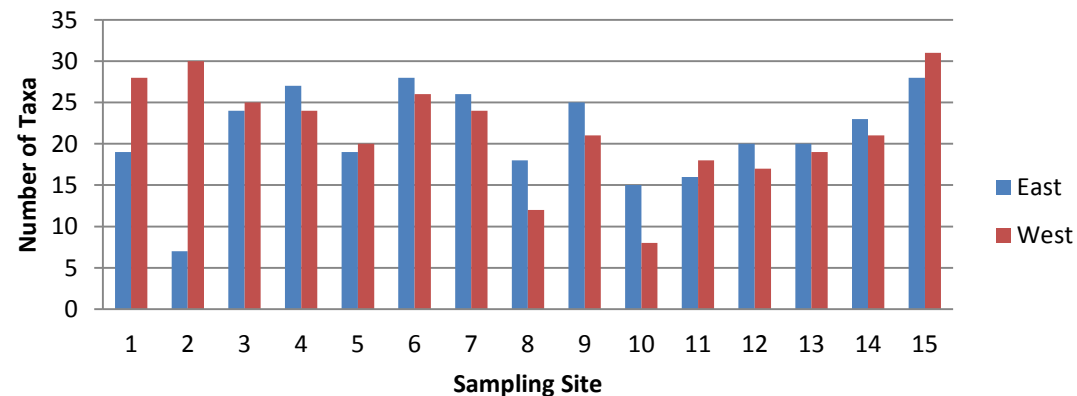
Biodiversity of Macroinvertebrates

- The results of the Mid stream shows

  - Total Biodiversity is low (0-10 taxa).

  - Low Biodiversity upstream site (1-4)

  - Higher Biodiversity occurs when current flow slackens as the River takes a broad meander (sites 6-8).

  - These is a marked increase of Biodiversity on the slow – flowing approaching the Delta Barrage (sites 13-15).
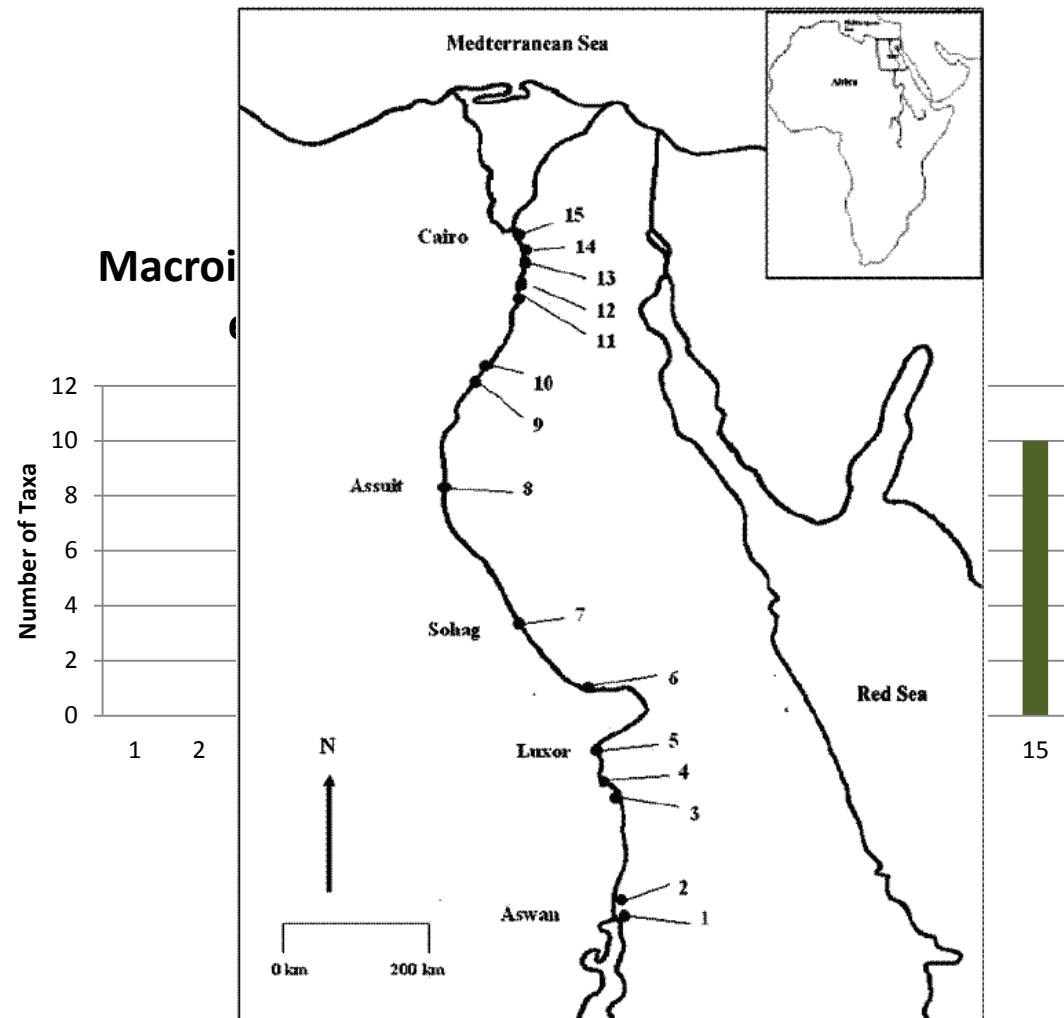
Conclusion

- **The Grab is the least effective method of sampling with many more samples needed.**

- **ASS produced Representative taxon lists with the fewest samples.**

- **The best time for Biomonitoring is early summer.**

- **A reliable sampling strategy would be:-**

  - **Deploy 5 ASS samples in May .**

  - **Supplement this in June with MacroPhyte sweep net samples if there are losses of ASS samples.**

  - **A retriever of only 3 ASS samples would probably be sufficient for long term monitoring.**

Conclusion

- **A list of 50 taxa indicates a low diversity compared to other Rivers**

- **This indicates that the food chains and ecological status may have already been affected by flow regulation and pollution Discharges.**

- **The faunal composition of the bentic invertebrate of the River Nile shows a Range of pollution tolerant worms and leeches and pollution sensitive insect species**