Cost-efficient development of nature-based impact assessments

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Premise

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Summary Statement

Cost efficient and simpler tools and techniques as bioindicators and photography, simpler analysis and free tools, as free satellite images, can be used to develop impact assessments. IA expertise is way more important than expensive techniques.

- World class projects;

- Lower HDI countries;

- Vulnerable communities;

- Lack of infrastructure.

Key Performance Indicator - NPI

- Environment assessment usually has 3 pillars of physic, biotic and social fields;
  From net zero to positive impact;
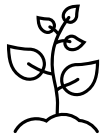
Biotic Matrices

- Biodiversity has evolved from net zero to net positive impact, with evolution from hectare impacted x hectare restored to insert quality into the equation, and increasing the 1:1 balance.
- Latest best practices correspond to net positive impact (NPI) to effectively contribute based on its own impact assessment and it is not reduced to area footprint, it also includes species conservation projects, restoration efforts, species and genetic studies.
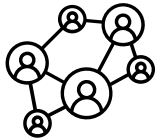
Physic Matrices

- Climate Change also has evolve from net zero to positive impact, with projects targets and carbon storage techniques; multiple projects informs that are not only green with alternative energy generation, but also can sink carbon.

Key Performance Indicator - NPI

- Environment assessment usually has 3 pillars of physic, biotic and social fields;
  From net zero to positive impact;

Social and Economic Matrices

- Social and economics have a much greater complexity.

- To effectively contribute to the regional development, general indexes or indicators must improve overtime with effective contribution from social and economical projects
- The bigger challenge is to set also a target for net positive social and economic impact of projects.

The bigger challenge is to set also a target for net positive social and economic impact of projects. It can be stated as net positive environmental impact (NPEI) regarding all matrices.

Key Performance Indicator - NPI

- Environment assessment usually has 3 pillars of physic, biotic and social fields;
  From net zero to positive impact;

Social and Economic Matrices

- The infrastructure and public services impacts must not be left as externalities, need to be considered in order to implement all necessary socioenvironmental programs, with risk reduction, mitigation or compensation measures.

- Cost-efficient indicator (Vaclav, 2021):
  - Childhood mortality, the number of deceased within the first year of life per thousand is a powerful indicator.
  - It is impossible to obtain a low index without a multiple critical combination of conditions that define good life quality: good health services and newborn and related healthcare, adequate nutrition, sanitary and hygiene conditions, social care to vulnerable families.
  - As primary data, age, weight, height, are simple and can demonstrate the nutrition status of a region.

Air pollution Impact Assessment

Cost-efficient development of nature-based impact assessments

- Biomonitoring may be a cheaper method that can be used to assess air pollution levels because it makes it possible to determine what effects these air pollutants cause in living organisms and their responses.

- The species *Lolium multiflorum*, known as ryegrass, is considered a good bioindicator of metals, since it accumulates these substances during exposure (Illi *et al.*, 2016).

- In a study in southern Brazil, ryegrass individuals were grown in a controlled environment and then exposed to four locations with different degrees of urbanization, besides a control site (CS): a semi-urban area - 10 km from a highway and urban areas - 5 km, 200 m and 60 m from the highway.

Air pollution Impact Assessment

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- At the Control Site (CS), all the metallic elements analyzed showed medians lower than the values identified at the other sampling sites.
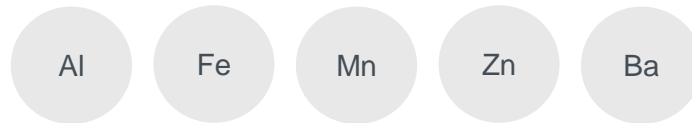
(Al) (Fe) (Mn) (Zn) (Ba)   Showed the highest median values in all the four sampling sites.

- Using Principal Component Analysis (PCA), it was possible to identify three principal components (aided by electron microscopy) (Illi *et al*., 2016):

| PC 1 - Earth's crust | Elements Fe and Al and associated with natural sources of emission, such as resuspension of dust from the soil. (Al and Fe oxides are common soil elements in Brazil). |

| PC 2 - Traffic/industry | Association of Cu, Zn, and Ni are related to vehicle and industrial emissions, such as combustion of fuels and industrial activities. |

| PC 3 - Traffic | Characterized by the presence of Ba and Mn, and to a lesser extent Cr, and related to abrasion and wear of metallic parts. |

Air pollution Impact Assessment

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- The different levels of anthropization, identified at the four sampling sites, demonstrated the degradation of air quality as well as the effectiveness of the use of bioindicators (i.e., *L. multiflorum*).

- The use of *L. multiflorum:*

  ✓ Low-cost method;

  ✓ Easy to apply;

  ✓ Worldwide application as evaluation tool of the effects of air pollutants.

- It can be used complementarily to other standard methods of investigation of air quality (Illi et al., 2016).

Traditionally, air quality mapping involves equipment or station allocation to explore data and high costs	✕	Biomonitoring to explore locations is an easy and simple solution to identify hotspots to concentrate efforts in areas of need, which can be later monitored by standard methods for confirmation and detailing.

Biological Signature - Fauna and Flora Survey using eDNA

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- Environmental DNA or eDNA describes the genetic material present in the natural environmental as sediment, water, and air, including whole cells, extracellular DNA and potentially whole organisms (Ruppert *et al.*, 2019).

- eDNA can be captured from environmental samples and preserved, extracted, amplified, sequenced, and categorized based on its sequence.

- eDNA may come from skin, mucous, saliva, sperm, secretions, eggs, feces, urine, blood, roots, leaves, fruit, pollen, and rotting bodies of larger organisms, while microorganisms may be obtained in their entirety (Ruppert et al., 2019).
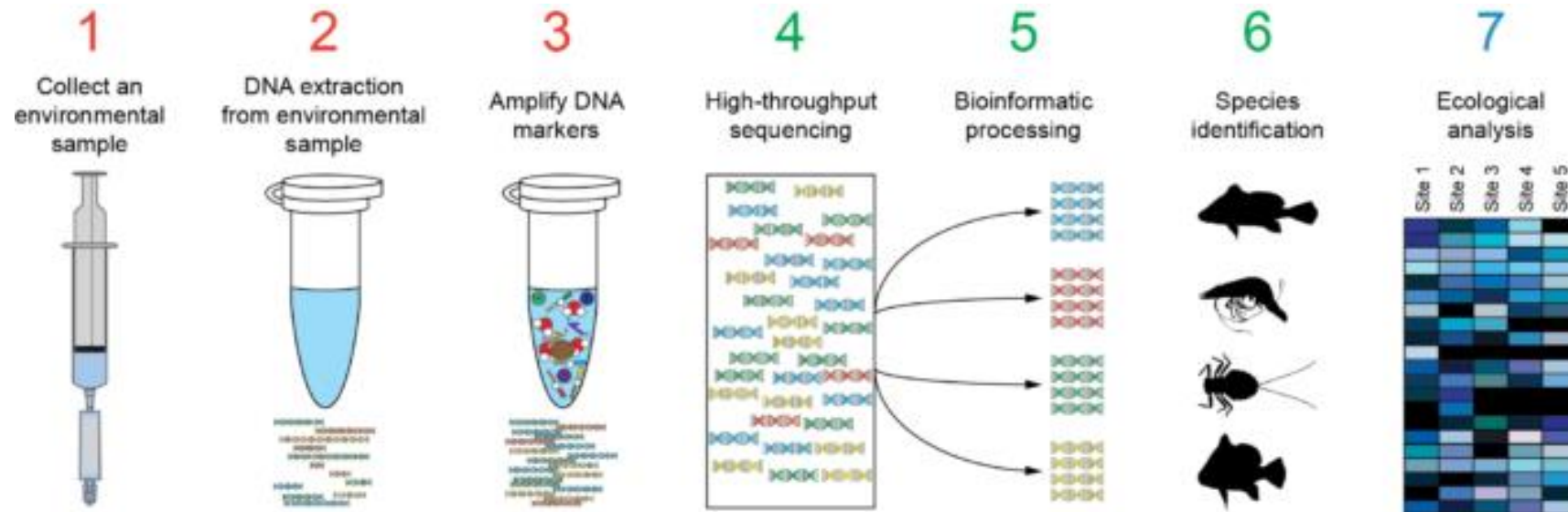
Conventional methods for surveying richness and abundance

Limited by taxonomic identification, may cause disturbance or destruction of habitat, and may rely on methods in which it is difficult to detect small or elusive species, thus making estimates for entire communities impossible (Ruppert *et al.,* 2019).

Biological Signature - Fauna and Flora Survey using eDNA

Cost-efficient development of nature-based impact assessments

- Process involves metabarcoding, which can be precisely defined as the use of general or universal polymerase chain reaction (PCR) primers on mixed DNA samples from any origin followed by high-throughput next-generation sequencing (NGS) to determine the species composition of the sample (Ruppert *et al.*, 2019).

- This method has been common in microbiology for years, but in recent years it has been used to assess macroorganisms.

1 Collect an environmental sample
2 DNA extraction from environmental sample
3 Amplify DNA markers
4 High-throughput sequencing
5 Bioinformatic processing
6 Species identification
7 Ecological analysis

Biological Signature - Fauna and Flora Survey using eDNA

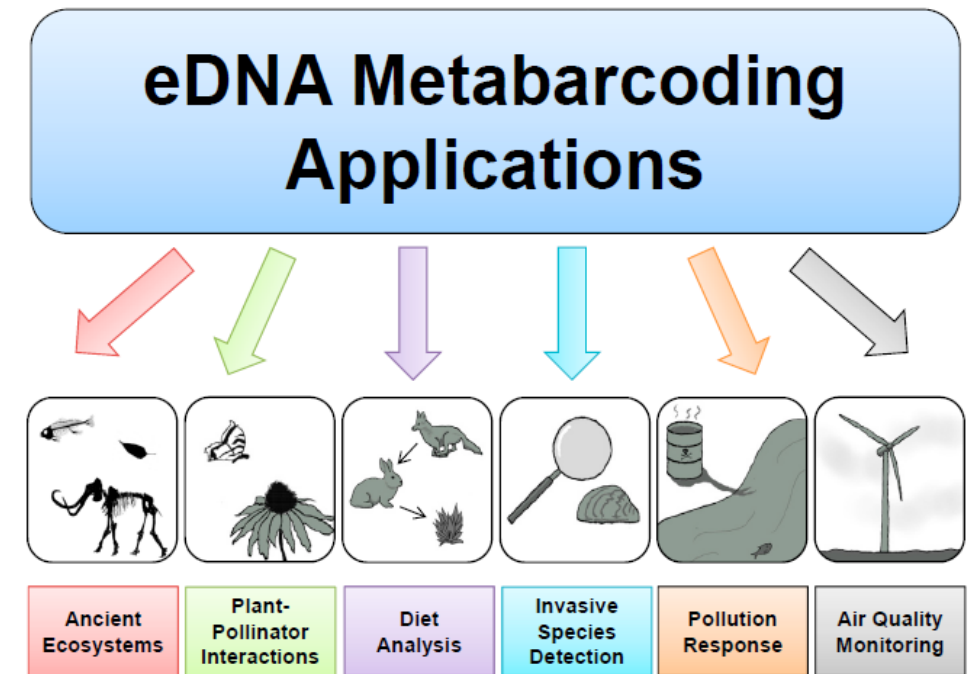Cost-efficient development of nature-based impact assessments

- It presents (Ruppert *et al.,* 2019):

  ✓ Allows detection without a priori knowledge of species;

  ✓ Superior species detectability;

  ✓ Requires lower effort, causes no ecosystem disturbance;

  ✓ Can be implemented in areas where traditional surveys are impossible.

- Chemical signature can also be used to identification.

- As an example, there is the chemical composition of sediments, which can be used as a simplified tool for managing watersheds.

Metabarcoding can be used to (Ruppert et al., 2019):

eDNA Metabarcoding Applications

| Ancient Ecosystems | Plant-Pollinator Interactions | Diet Analysis | Invasive Species Detection | Pollution Response | Air Quality Monitoring |

Statistical methodology to simplify monitoring of mineland rehab. status
Cost-efficient development of nature-based impact assessments

- Impact of mining operations are mitigated by ecological restoration.

- To monitor status through time many environmental variables are assessed, representing herculean effort of analysis, manpower and resources.

- In an iron mining in Carajás National Forest, eastern Amazon, Brazil, was developed a study with the objective to select potential indicators of environmental quality of iron mining waste piles undergoing rehabilitation.
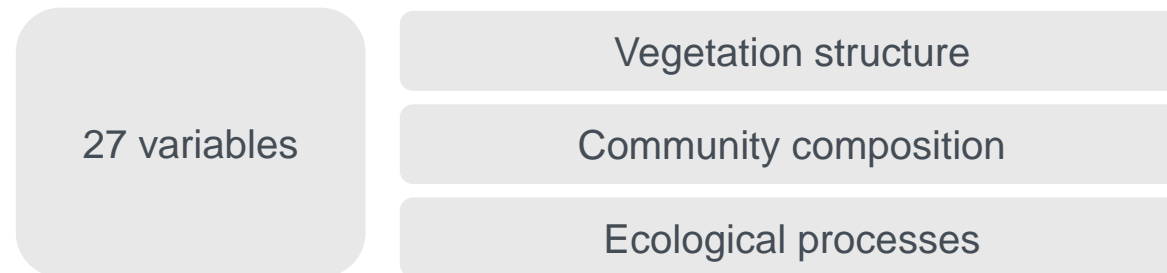
27 variables	Vegetation structure
	Community composition
	Ecological processes

Statistical methodology to simplify monitoring of mineland rehab. status

Cost-efficient development of nature-based impact assessments

- The Shannon index of tree diversity had the highest predictive power for overall rehabilitation status (Gastauer *et al.,* 2021).

- It will simplify and reduce the cost of more comprehensive monitoring activities in minelands undergoing rehabilitation in the future.
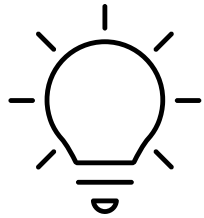
Statistically sound analyses to validate the selection of environmental variables for environmental assessments encourage similar approaches.

- The identification of effective indicators to monitor rehabilitation activities may further contribute to more efficient environmental assessments in future monitoring projects (Gastauer *et al., 2021*).

It can reduce the biomonitoring effort from 6 fauna groups to just the flora matrices, already performed.

Key Messages and Last Words

Wrap up

- Cost effectiveness must be addressed at all times to pursue economic allocation;

- IA expertise is always the most important key factor for a good IA, EA , mitigation measures and positive impacts;

- It is possible to use, combine or correlate alternatives methodologies to reduce costs;

- Consultancy costs tends to increase overtime and may hinder IA effectiveness;

- Key resources allocations must be to mitigate impacts and promote sustainable development;

- Choose the right tool must be always a drive.

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Let's continue the conversation!

Post questions and comments in the IAIA23 app.

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