EIA contributions to pre-colonial sites knowledge at São Paulo, Brazil

1. Introduction and context

Much before Portuguese colonization, Brazilian territory was densely inhabited by pre-colonials peoples, dating from at least 12,000 years. Some studies found even more ancient results, which brings evidence to other theories for America's occupation, in addition to Clovis Theory. Besides all potential for findings, studies are still scarce for reasons like low incentives, lack of resources and low connection of current society with Brazilian ancient cultures.

São Paulo state has large areas with high odds of findings but struggles with archaeological studies due environmental degradation due economic activities, especially sugarcane industry.

Archaeological sites are protected by law in Brazil since 1961. EIA regulation came in 1986 and reinforced this protection and brought the need of study of archaeology on baseline of projects submitted to EIA. In 2002, a regulation came to standardize archaeological studies on projects submitted to EIA. This regulation, updated in 2015, led to an increase by 10 times of annual archaeological research permits (from 191 in 2002 to 1,858 in 2023), especially preventive/contract archaeology, which is about 95% of total research done in Brazil (IPHAN, 2024).

As most of archaeology studies in São Paulo is preventive/contract model, related to projects submitted to EIA, the potential of new findings and the relation between contract archaeology and EIA, this paper focus on how it is contributing to archaeology knowledge, and which were the main findings related to it.

2. Methodology

A literature review was done to gather data from the contract archaeology studies that are presented in the scope of projects submitted to the EIA. This gathering comprises information about archaeological findings and general data from project, aiming to find out how EIA could contribute to archaeology.

Considering the large amount of EIA projects done in São Paulo since EIA inception in 1986, more than 1,000 available at CETESB files, the government environmental agency at São Paulo, Brazil, some criteria were needed for limiting the amount to be reviewed.

The authors work as reviewers at CETESB, specifically with sugarcane industry projects. So, typology was the first criterion for choosing, limiting the literature review to an important industry of São Paulo, which has 22% of its area occupied by sugarcane crops (IBGE, 2023), most of them in northern territory, which has few archaeological studies.

The second criterion was the kind of finding, related to pre-colonial sites. The territory of sugarcane industry has few archaeological studies and lacks information about pre-colonial peoples. Due its age and current occupation by crops, these sites have higher risk of degradation and loss of material, which could lead to a permanent loss of an important knowledge.

Even with these two criteria, there are still many possibilities for further study. This paper focused on examples of environmental licensing processes with impact assessment in which significant archaeological sites were discovered. These findings contributed to advancing archaeological knowledge about the occupation of the State of São Paulo and Brazil, enabling more in-depth research on the information and

culture of ancient peoples, and where robust heritage education programs were implemented by the project proponents.

3. Results and discussion

Most of EIA sugarcane industry projects conducted at São Paulo are concentrated in the last 20 years due factors like legal requirements, discussed previously (EIA and archaeology regulation) and a specific sugarcane cycle in the 2000's and early 2010's in São Paulo, which had a significant expansion, leading to building of new sites or enlarging existing ones, with the correspondent expansion of sugarcane crops. Three EIA projects with major archaeological findings came from the literature.

Usina Guariroba – Bunge Brasil

This sugarcane industry site belongs to Bunge, a global agribusiness company. Its EIA process was completed in 2009, with the permit for enlarging the site from 951,000 ton/yr to 2,000,000 ton/yr of sugarcane processed. As enforced by regulation, archaeological research was conducted. The study, six pre-colonial indigenous sites were found, at Cardoso and Pontes Gestal towns. The area is mainly occupied and impacted by agriculture activities, as sugarcane. The six sites gather a total of 48,536 ceramic items and 841 lithic items (as strikers, beaters, supports, anvils, and axe blades), found in surface and up to a depth of 30 cm. These items are from Aratu-Sapucaí and Tupi traditions, showing interactions among the two peoples.

The results found were so significant that led to much academic research and helped to provided heritage education activities in public schools in the region, promoting knowledge about local indigenous history and strengthening the feeling of regional identity.

Programa Guarani – Gestão de Recursos Arqueológicos

Guarani S/A was a former company of sugar production and now belongs to Tereos, a French global company of bioenergy and food. The EIA process of Cruz Alta site was completed in 2010, with the permit for enlarging the site from 4,000,000 ton/yr to 5,200,000 ton/yr of sugarcane processed, with sugarcane areas in 15 towns.

The archaeological study in this EIA process found more than 60 sites from Tupi and Jê peoples, dating up to 1,000 years. The remains from different peoples are evidence that the northwestern São Paulo was home to several indigenous groups, coming from different regions, related to ceramic farming groups.

The most important discoveries comprise chipped stone tools, axe blades, ceramic pots and a human skull of 450 years protected by a ceramic pot were found. The finding of a skull, occurred in a crop, was impressive, due acid soil and humid weather conditions in the area, that are bad for bones conservation.

The skull also had a lip adornment like a piercing, used by young individuals after initiation of adult life. It was the first burial to be studied systematically in a Tupiguarani site in northern São Paulo (Zanettini, 2008), a region which lacks archaeological studies.

Figure 1. Image of the skull showing the position of the *tembetá* (labial ornament)

Fonte: Zanettini (2008)

As result, a Heritage Education Program was developed, involving 334 educators and over 6,000 students. The findings were disseminated through educational materials, workshops, exhibitions of replicas of artifacts, educational fairs, and exhibitions in museums. Archaeological research contributed to the understanding of local history, promoting community's engagement in the preservation of archaeological heritage and bringing a deeper connection to their history. Educational initiatives emphasized cultural diversity and questions about the deletion of indigenous occupations in history.

Usina São Manoel

Usina Açucareira São Manuel S/A is a Brazilian company of sugar, ethanol and bioenergy, with one industrial site. The EIA process of enlarging the site was completed in 2011, with the permit for processing 2,565,000 ton/yr to 3,600,000 ton/yr of sugarcane, with sugarcane areas in 5 towns.

The archaeological study in this EIA process found 14 pre-colonial sites with more than 9,000 items, showing a significant cultural diversity in the region, indicating that the place was home to several indigenous peoples, with diverse forms of social organization, technologies, knowledge, and cultures. The region of São Manoel has favored human settlement due to several factors, as proximity to water sources, shelters, fertile soil, abundance of volcanic rocks, flint and clay for making ceramics and arrowheads.

Some of these sites comprise findings like a Tupiguarani ceramic site, called Serrito, dating back 1,220 years, with pots with distinct characteristics indicating possible contacts or reoccupations with indigenous populations of the Macro-Jê. Another site, Serrito II, has rock engravings.

The most important result was found at Caetetuba Site, which had items dating between 9,245 and 11,080 BP, one of the earliest hunter-gatherer occupations in São Paulo. The dating was carried out using Carbon 14, made indirectly, since samples of charcoal stratigraphically associated with the remains were used. The data suggest that the site may have been occupied for at least 2,000 years.

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The main Caetetuba Site feature is the presence of chipped stone tools, such as projectile points and remains of the manufacture of instruments, such as objects used as beaters. This site has a total of 3,473 fragments and artifacts found.

Figure 2. Examples of bifacial projectile points identified at the Caetetuba site.

Fonte: (Zanettini Aqrqueologia, 2016)

This dating is an extraordinary discovery, once brings evidence to a complex America occupation by diverse peoples in different periods, in addition to the Clovis Theory, which says that America has been occupied firstly by Clovis people 13,000 years ago, after crossing Bering Strait. This finding is also extraordinary considering the site is in an area for decades by sugarcane cultivation, an activity which may severely affect conservation of heritage items due agriculture mechanization.

Nível	Material	Tipo	Código Laboratório	Data Convencional	Calibração 2 sigma
100-110 cm	Carvão	C14	BETA-436336	8,210 ± 30 AP	Cal a.C. 7295 até 7225 (Cal AP 9245 até 9175) Cal a.C. 7190 até 7065 (Cal AP 9140 até 9015)
150-160 cm	Carvão	C14	BETA- 436337	9,590 ± 30 AP	Cal a.C. 9130 até 8985 (Cal AP 11080 até 10935) Cal a.C. 8930 até 8775 (Cal AP 10880 até 10725)

Table 1. Radiocarbon dates obtained for the Caetetuba site.

Fonte: (Troncoso; Corrêa; Zanettini, 2016)

Conclusions

The preventive/contract archaeology model currently accounts for more than 95% of current archaeological research in Brazil, many of them related to EIA process of large project seeking environmental permits. This is done due regulation, showing the EIA contribution to archaeology. EIA may enhance archaeology in little-explored regions like northern São Paulo, contributing to an increase in the knowledge.

The studies reviewed in this paper provided valuable evidence about way of life and cultural interactions of pre-colonial populations that had not been appropriated studied before. The dissemination of these results promotes heritage education and public awareness, raising the public awareness about archaeological preservation.

Without a strong legal regulation, archaeological could not be conducted in EIA process, in a way that many remains, including these ones reviewed in this paper, could be irreversibly lost.

Preventive /contract archaeology has driven the development of archaeological research methods and techniques, serves as basis for deeper academic research and further studies. It also provides increased research resources from private investors and helps in employment for archaeologists and other researchers and workers.

Even though, there are some challenges to the archaeology. Although some studies done during EIA process of large projects end up generating further academic research, much of the information and data on archaeological sites found in these projects are retained in the files of the IPHAN, the government agency responsible for archaeology in Brazil. So, these data not always are publicized, so public cannot get in touch with this information, stopping the rescue of identity in places where indigenous populations have been marginalized, excluded, and often erased from collective memory.

Other challenges to archaeology in EIA come from project proponents. Some conduct extensive studies, but not all agree with it. Even being regulated by law, some proponents try to skip doing the archaeological studies on the EIA process or at least try to make simpler studies. This shows the importance of strong regulation, to protect heritage.

Another challenge is about the proper regulation. Streamlining EIA process attempts are common, due political and economic interests to speed up projects and simplify EIA. It is an important challenge and probably a threat to archaeology, once the studies reviewed in this paper showed the importance of EIA process and proper regulation.

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