THE CONCEPT OF LANDSCAPE IN PROCESSUAL ARCHAEOLOGY AND ITS CONCEPTUAL TOOLS: AN OVERVIEW

EL CONCEPTO DE PAISAJE EN LA ARQUEOLOGÍA PROCESUAL Y SUS HERRAMIENTAS CONCEPTUALES: UNA VISIÓN GENERAL

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Abstract
This article examines the concept of landscape in processual archaeology and its conceptual tools, with a focus on the Anglo-Saxon world. In this approach, «landscape» is equated with the ecological «environment,» informed by American ecological anthropology and systems theory. Cultures are viewed as adaptive subsystems in equilibrium with natural systems, where environmental changes prompt sociocultural responses. Butzer's framework analyses micro-, meso-, and macro-environmental scales using techniques like photointerpretation and paleoenvironmental reconstruction. The landscape is seen as dynamic, shaped by human activity, supporting explanations for demographic patterns and the rise and fall of civilisations like Egypt and Axum. Quantitative tools, such as Willey's settlement-pattern analysis and Christaller's central-place theory, help identify behavioural patterns and resource distribution. This functionalist approach overlooks symbolic aspects of the landscape.

Keywords
Theoretical Archaeology; Landscape Archaeology; Processualism; Landscape

Resumen
Este artículo examina el concepto de paisaje en la arqueología procesual y sus herramientas conceptuales, centrándose en el mundo anglosajón. En este enfoque, el «paisaje» se equipara con el «medio ambiente» ecológico, basándose en la antropología ecológica estadounidense y la teoría de sistemas. Las culturas se consideran subsistemas adaptativos en equilibrio con los sistemas naturales, donde

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los cambios ambientales provocan respuestas socioculturales. El marco de Butzer analiza las escalas micro, meso y macroambientales utilizando técnicas como la fotointerpretación y la reconstrucción paleoambiental. El paisaje se considera dinámico, moldeado por la actividad humana, lo que respalda las explicaciones de los patrones demográficos y el auge y la caída de civilizaciones como la egipcia y la de Axum. Las herramientas cuantitativas, como el análisis de los patrones de asentamiento de Willey y la teoría del lugar central de Christaller, ayudan a identificar los patrones de comportamiento y la distribución de los recursos. Este enfoque funcionalista pasa por alto los aspectos simbólicos del paisaje.

Palabras clave

Arqueología teórica; Arqueología paisajística; Procesualismo; Paisaje

0.-PREAMBLE, OR THE CONTOURS OF A WAY OF THINKING ABOUT THE PROCESSUAL WORLD

This article aims to study the concept of landscape and its conceptual framework in processual archaeology in a historiographical manner, mostly following Reinhart Koselleck's principles of *Begriffsgeschichte* (Koselleck, 1967, 2002, 2011).

Processualism as a trend of thought in archaeology has its symbolic beginnings in the contributions of David L. Clarke (1937-1976) and Lewis Binford (1931-2011) in the late 1960s.

This school is characterised — very briefly — by positivism and the use of the scientific method as a way of interpreting humans and their actions. Concerned with *laws*, processualism aims to transform archaeology into a science, and only through scientific methodology can it achieve this stage: only a robust archaeology informed by scientific methods can *lose its innocence* (Clarke, 1973). This loss — as Clarke would say — is motivated by the abandonment of a culture-historical trend of thought defeated in World War II by the Allies. Thus, the period from the 1950s to the early 1970s will serve as the basis for this new way of thinking about the world.

Believing in the complete objectivity of the natural sciences and in the position of the archaeologist as a scientist, processualism seeks to see archaeology as a science closer to anthropology and more focused on *patterns*, the formulation of *laws* of human development and *experience* (in its scientific sense). Testing models, contrasting hypotheses with data obtained from experiments, and extrapolating based on ethnographic observations: this is the processual *modus operandi*.

In processualism, culture abandons its static category — nor is this, in fact, the focus of processual archaeology — to arrive at a *dynamic* category as an *adaptive* system (see e.g., Flannery, 1968). Culture is thus the result of extra-somatic adaptation to the environment (e.g., Binford, 1962; White, 1959, p. 218), and the archaeologist's job is to explain it (as opposed to merely describing it): more than the description of artefacts, what matters is the *explanation* of cultural phenomena. Culture can also be seen, in a processual logic, as an information system (Clarke, 1968/2015, p. 88). All this creates a fundamental divide between the two ways of doing archaeology —between the culture-historical and the processual archaeologies — because while the former has culture as a central axis in its *praxis*, in the latter, culture is merely one more element within a general system.

It is essential to consider the concept of culture as adaptation, as it provides a more comprehensive understanding of the environment's role in processualism. As cultures shape themselves to their environment, this consideration reveals a natural ecological and environmental determinism, where it is believed that populations sharing the same environment will inevitably develop similar mechanisms of adaptation.

In the wake of *neo-evolutionism* — a very important trend of thought in the processual conception of the world — *laws* of cultural development would even be formulated:

> «Other things being equal, the degree of cultural development varies directly as the efficiency of the technological means with which the harnessed energy is put to work.
> [...]
> Culture develops when the amount of energy harnessed by man per capita per year is increased; or as the efficiency of the technological means of putting this energy to work is increased; or, as both factors are simultaneously increased.» (White, 1943, p. 338)

All of this would strongly inform what would become processual archaeology. This aspect reveals another key dimension of processual thinking: its cultural and societal evolutionism. Verily, the belief in the staged development of humanity is fundamental to this school of thought. Thus, societies follow a linear progression from simple to complex, moving from small groups of egalitarian hunters (*bands*), segmented societies with informal leaders (*tribes*), hierarchically organised social structures with a chief (*chiefdoms*), and finally the state, with laws, centralised government, bureaucracy, etc. (Service, 1962).

Hence, the importance of ethnoarchaeology and ethnography in processualism is clear. In this sense, these branches will provide the basis for the so-called *Middle-Range Theory* (see, e.g., Binford, 1981), that is, what connects the silent material remains of humanity to its living past dynamics; they are, therefore, ethnographically based theories that link behaviour that is measurable through material records to patterns of distribution (for example) based on archaeology. Binford — who developed the concept — would even go so far as to say:

> «Since archaeologists cannot simply suspend their efforts to account for archaeological patterning until ethnological researchers develop a comprehensively descriptive, explanatory body of knowledge about hunter-gatherers, they must themselves do the middle-range research necessary to create and experiment with the intellectual tools that will make patterning in the archaeological record meaningful» (Binford, 2001, p. 114).

Archaeology is once again dependent on the contributions of anthropology, advocating for a greater connection between these disciplines (Binford, 1962). Binford even sees archaeology as the area best equipped to develop the desiderata of anthropology (Binford, 1962, p. 224).

One of the other elements of processual archaeology is systems thinking (Binford, 1965; Binford, 1980; Butzer, 1980a; e.g., Flannery, 1968; Renfrew, 1979; White, 1975), which views societies as *open* systems — that is, permeable to the entry and exit of energy — composed of multiple subsystems, such as culture, technology, ideology, and environment. All the considerations of traditional systems theory apply to these, with positive feedback loops serving to enable change in a system and negative feedback loops being the elements that resist change. Thus, these mechanisms aim at *homeostasis*, or the balance of a system.

All of this is accompanied by a panoply of new methodologies — some of which will be discussed below, particularly those related to the study of spatial archaeology — which will form the basis of processual archaeology (e.g., Trigger, 2008, p. 433). Among these, quantitative methods are particularly important as a way of establishing an environment of objectivity that overcomes previous trends

in historical and cultural thinking. If this were essentially subjective and descriptive, processual archaeology would seek, through statistics and geography (and other related areas), to endow the human past with numerical rationality.

However, after this brief explanation of the processual pillars, it is also important to note that before Binford and Clarke there was a phase of *maturation* — and, essentially, of *reaction* to the interpretative trends of the time — which led to the almost simultaneous development of two new procedural focuses (Binford in the New World and Clarke in the Old). This development was therefore a slow *process* involving multiple thinkers, far removed from the simplistic view that sees theoretical trends as a *succession by substitution*.

Similarly, while it is true that processualism — or rather, processualisms — developed as a critique of culture-historical trends in both the Old and New Worlds, it is no less true that this development in the Americas was driven by a tradition that saw anthropology as its core, as opposed to a more *historical* (*lato sensu*) archaeology in Europe (see e.g., Lucas, 2001, 2012; O'Brien et al., 2005; Wylie, 2002).

All of this will be striking in the way of seeing the landscape.

1. THE LANDSCAPE IN PROCESSUALISM

The study of landscape in processualism takes on specific properties that can be grouped into essential components, namely: *ecology and determinism*, *cultural ecology*, and *systemics*. In fact, the word *landscape* is not frequently used in the discourse of processual archaeologists, but this does not imply that what is done is not an analysis of the material basis of the landscape. Furthermore, if we understand that landscape *is* this material basis and this relationship that emanates from the interactions between humans and nature, then what is being done is fully an *archaeology of landscape*. Of course, this view of landscape does not fit in with a purely aesthetic categorisation of it; however, it is believed that landscape, although also aesthetic, transcends it. Although a complex concept, there has been an influx of works related to the ontology of the subject matter that seek to define the multidimensional nature of landscape (e.g., Agosto, 2025; Agosto & Teuchmann, 2023).

Philosophically, however, landscape in processualism is (tendentially) devoid of any elements other than rationality and economic thinking, being, in practice, more an archaeology of *territory* than of *landscape*. This will also take on contours that are distinct from Hoskin's initial approaches (Hoskin, 1955). However, it is not believed — whether because of the difference with Hoskin or the more *territorial* than *landscape* elements of processualism — that one cannot speak of landscape in processualism.

Landscape occupies its own space in the discourse, plays a role in the hermeneutics of the spaces, territories and communities under consideration, and serves as a tool for extracting general principles of human development and laws: one of the highest goals of processualism.

Landscape in processualism, however, does not occupy a central place in the approaches of most archaeologists of this school of thought, even though they use and analyse space, environment and territory. Thus, the following analysis will focus mainly on authors whose question of landscape occupies a central place in their discourse. This does not imply, however, that the elements seen, for example, in Karl W. Butzer, such as human ecology or systems theory, are not present in other authors; quite the contrary: they are the foundational assumptions and cornerstones of processual thinking. That said, the very nature of processualism lends itself to landscape and territorial studies and has therefore developed considerations and tools for this purpose. This, however, is not entirely reflected in the posterior works in landscape archaeology of Spain, where Criado-Boado and others have been central (e.g., Criado-Boado, 1986, 1988, 1989, 1993, 1997, 1999, 2013, 2015; Ruiz-Gálvez, 2024).

The landscape between the implicit and the explicit: ecology and the environment

The first step towards a processual archaeology of landscape, at least in this ecological view, is, first and foremost, the insertion of humans into the environment (which here appears transfigured as landscape) — as ecological agents — and the attempt to reconstruct the palaeolandscape. Thus, geoarchaeology — that is, the combination of Earth sciences with archaeology — and ecological anthropology will be essential for these approaches.

Processualism, however, does not have a basis in the term *landscape*: it is essentially present as *environment*, either implicitly or explicitly. For example, there is a direct correspondence between what Butzer calls *landscape*, using the term, and what the overwhelming majority of processual archaeologists, such as Binford or Flannery, call *environment* (Binford, 1962; Binford, 1965; e.g., Binford, 1980, 1982, 1990, 2001; Coe & Flannery, 1964; Flannery, 1968, 1972, 1976). This may be due to Hoskin's limited influence on processual archaeology, whether British or American, as well as the much greater impact of ecological and systemic anthropology on archaeological discourse. Thus, landscape and environment are entirely synonymous, so that an analysis of either term implies the other, and it is from this perspective that the present article will be structured. The use of one term over the other, therefore, stems more from a stylistic than a conceptual issue, although — and this should be emphasised — philosophically, what processualists deal with is, in fact, *environment* rather than *landscape*, since it is not an aesthetic category nor, in most cases, the product of a relationship between humans and nature, but rather the environment or biomes.

As an example, consider this excerpt from Flannery ((1968, p. 67)):

> «New data suggest, first, that primitive peoples rarely adapt to whole «environmental zones» (Coe and Flannery 1964: 650).»

A closer analysis of the cited article (Coe & Flannery, 1964), where the term landscape is not used, to the detriment of environment, reveals that these *environmental zones* are nothing more than biomes, which in other places are called landscapes (Butzer, 1971, 1980a, 1981, 1982a, 1982b, 1996; e.g., Butzer, 2015).

To take another example, consider the work of Julian Steward, an influential anthropologist of cultural ecology, in his *Theory of Culture Change: The Methodology of Multilinear Evolution*, where the term «landscape» is not mentioned once, in contrast to «environment» (used 107 times).

This is also corroborated by what has already been stated by María Nieves Zedeño, where:

> «Human modifications of the natural landscape are often called «built environments» by historical archaeologists (e.g., Anderson and Moore, 1988) and «rural» or «vernacular» landscapes by geographers, architects, and historians (e.g., Copps, 1995; Cronon, 1984; Jackson, 1984; Kelso, 1994; McClelland, 1991; Sauer, 1925).» (Zedeño, 1997, p. 72).

Thus, the use of the term «landscape» rather than «environment» is closely linked to the intellectual climate and formal influences of a particular author. Indeed, as Clarke ((1968/2015, p. 142)) points out, it is not surprising that most of these references to landscape as an environment — the hallmark of processualism — come from America, where systems theory and cybernetics were more widely accepted than in British archaeology. In the American case, the popularity of Leslie White's anthropology (White, 1949, 1975, 1959/2007), which predates the advent of processualism, was also central to the greater acceptance of these perspectives. Thus, the term *environment* has its roots in this anthropology, which prevailed in processualism.

That said, when it comes to landscape, and except for the case of Butzer and Jochim, it should be borne in mind that the term is *environment*.

The position that landscape will have in the discourse in this approach will depend considerably on the very nature of ecology in archaeology. In other words, ecology is, first and foremost, *systemic* — or the study of relationships (Jochim, 1981, p. 4), as well as being dedicated to the study of relationships, patterns and their complexity, as well as — explicitly — the search for *functionalist* explanations for human behaviour (Jochim, 1981, p. 3).

Defining a system as «[...] a group of components or variables interrelated such that a change in one produces a change in all others» (Jochim, 1981, p. 5), the landscape — here as the physicality of nature — will be inserted into the web of dependencies between the human and the non-human, believing that the cultural question can be reduced to a matter of systemics:

> «In fact, cultures can be more advantageously examined as ecological systems, in which human populations interact with the biophysical environment, as well as among themselves.» (Butzer, 1980a, p. 517).

As an example of this relationship — and although it is valid for sedentary communities, it is particularly significant here — we have hunter-gatherer groups. In his seminal work *A Hunter-Gatherer Landscape. Southwest Germany in the Late Palaeolithic and Mesolithic* ((1998)) — a study with a fully ecological matrix — Jochim uses the term landscape abundantly, but always within the context of functionalism

and landscape as the material basis of the world. This perspective will be quite frequent in this trope.

Landscape will be fundamental in the ecological perspective, because it, as an environment, belongs to the supreme goal of these studies:

> «I have long held the view that our ultimate goal is the interrelationship between culture and environment, emphasizing archaeological research «directed toward a fuller understanding of the human ecology of pre-historic communities.» (Butzer, 1980b, p. 418).

Furthermore, it is the primary function of archaeologists to study the landscape/environment, since only an integration of environmental systems and cultural systems — which are nothing more than mechanisms for adapting to the environment — can achieve an understanding of humanity:

> «If we view culture as man's extrasomatic means of adaptation, we must isolate and define the ecological setting of any given sociocultural system, not only with respect to the points of articulation with the physical and biological environment, but also with the points of articulation with the sociocultural environment. It is suggested that changes in the ecological setting of any given systems are the prime causative situations activating processes of cultural change.» (Binford, 1972, pp. 159–160).

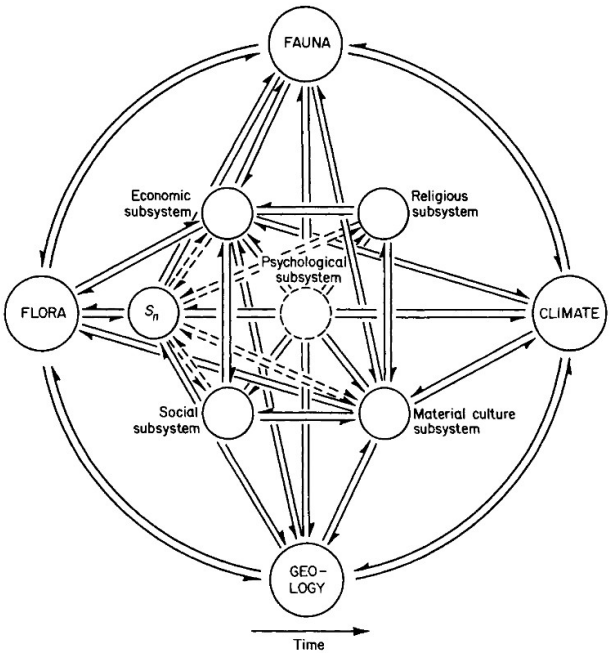

FIG. 1 – A SCHEMATIC MODEL OF THE DYNAMIC EQUILIBRIUM BETWEEN SOCIOCULTURAL SUBSYSTEMS AND THE ENVIRONMENTAL SYSTEM AS A WHOLE (CLARKE, 1968/2015, P. 134). SN REPRESENTS THE SUM OF THE INTERACTIONS OF ALL SYSTEMS AND SUBSYSTEMS THAT COMPRISE HUMAN REALITY

In fact, all of this will guide the landscape in processualism. With regard to systemicity, Clarke (Clarke, 1968/2015) presents the best systematisation of the issue, where the environment is a *system composed of subsystems* (Clarke, 1968/2015, p. 132), just like culture. Thus, human reality is composed of the interaction between both systems — the environmental and the sociocultural — and their subsystems, as diagrammed by Clarke himself (fig. 1).

Because it is a *system*, the environment itself tends towards equilibrium, changes in which strongly affect the socio-cultural system:

> «Thus in so far as a culture is an adaptation to a specific environment, a change in the environment may produce changes in the culture to maintain equilibrium inversely proportional to the culture's technological level» (Clarke, 1968/2015, p. 138).

However, processualism is not only about systems. In this sense, and with regard to geoarchaeology, Butzer ((1982a, p. 38)) defines what he calls *landscape context*, which studies the landscape in three distinct degrees:

1. «Site microenvironment, defined in terms of the local environmental elements that influenced original site selection, the period of its use, and its immediate burial or subsequent preservation. Sediment analyses of site strata represent an obvious study procedure in a sealed site.
2. Site mesoenvironment, primarily the topographic setting and landforms of the area utilized directly for subsistence. This geomorphic information, combined with bio-archaeological inputs, helps define the adjacent environmental mosaic.
3. Site macroenvironment, essentially the regional environment provided by a particular biome or ecotone. The constellation of effective geomorphic processes, together with biotic information (Chapters 10 and 11), is indispensable in constructing a model of the regional ecosystem.»

Thus, landscape participates in multiple scales — the small, the medium and the large (Butzer, 1982a, p. 43), which is a central topic in the study of landscape in processualism. Here, landscape is also intertwined with the characteristics of physical geography. And as can be seen in the previous topic, all of this is at the service of environmental and ecosystem reconstitution. Landscape is therefore a set of potentialities, constraints and, above all, the forces of nature that shape human occupation.

As an object of study, the landscape also has *approach methods*, which, according to Butzer, include (1) aerial visualisation, (2) the distribution of sites in conjunction with the physical characteristics of the terrain, and (3) palaeoenvironmental reconstitution:

1. «Terrain mapping of the mesoenvironment, in conjunction with available aerial photography, detailed topographic maps, and relevant satellite images.
2. Location of other sites and cultural features, preferably in conjunction with systematic archaeological survey, by using geomorphic inference and available aerial photos, possibly aided by geophysical site prospecting.
3. Examination of natural exposures, in terms of stratigraphic subdivisions, sediment properties, and soil profiles, to reconstruct regional landscape history, to provide a wider context for the central site, and to assess possible impacts of the prehistorical community on the environment.» (Butzer, 1982a, p. 41).

Butzer translates all this into the aforementioned scales, with the landscape beginning with the immediate surroundings of the site and the sediments that surround it (Butzer, 1982a, p. 43), as well as all the post-depositional and sedimentary processes that affect the deposits. The landscape is thus a living entity, whose forces must be taken into account if an archaeological analysis is to succeed.

At the next level, the analysis of the landscape is based on a *topographic* vision, which is essential for analysing the resources that a community consumes and extracts, thus moving beyond the scale of the immediate site:

> «Many relatively intensive prehistorical activities are carried out beyond the site microenvironment. Food, fuel, and other materials are derived from a sustaining area: a coast and its adjacent coastal plain; a floodplain and its surrounding low hills; a series of springs and small streams below a mountainside; a series of blowouts and widely spaced valley bottoms, within an undulating sand field; a cluster of lakes dispersed across an old, rolling glacial plain; a range of habitats horizontally and vertically arranged between the floor of a rift valley and its surrounding high volcanoes and fault escarpments
> This medium-scale environment is of immediate importance to both foragers and farmers, because the slope, relief, and forms of the topographic matrix or terrain determine the detailed patterns of soil and biotic distributions.» (Butzer, 1982a, p. 58).

The landscape is here, on this intermediate scale, a *land-scape*: a *land-form* that constrains and facilitates people's lives.

This notion of landscape as the natural in everything is clarified when Butzer explains the existence of a landscape — natural — and a cultural landscape, which acts as an ecological backdrop on which the «deformations» of culture take place:

> «From another theoretical viewpoint, the field of cultural geography (see Wagner and Mikesell, 1962, pp. 1-24) has shown distinct undercurrents that envisage the natural prehistoric or prehuman landscape as the necessary datum line from which cultural 'deformations' are to be measured (Gradmann, 1906, 1936; Sauer, 1927). *The natural landscape, prior to agricultural colonization, is in effect the background, and understanding it is prerequisite to a full understanding of the cultural landscape.* That this goal of reconstructing the natural landscape is indeed attainable is amply illustrated by the prehistoric vegetation studies in Europe by Firbas (1949-52), Iversen (1954, 1960), Godwin (1956), and others.» (emphasis added Butzer, 1971, p. 8).
> It is important to emphasise that landscape is a *backdrop*, but a *dynamic* one, since one of the things that Butzer is going to criticise is precisely landscape as a static category (Butzer, 1980b, p. 417).

The desire to reconstitute the *palaeolandscape* is also evident, along the lines of the belief in an absolute past that can be accessed; a myth of the *origin* that guides processualism.

The question of cultural landscape thus manifests itself as a relationship between the human and the natural (Butzer, 1971, p. 570), but the addition of the word *cultural* is not innocent: if landscape is the natural, culture is a *non-landscape*. (see Butzer, 1971, pp. 605–606), but which can shape it, and it is not possible, even through the *artefactualisation of the landscape* (which will be discussed below), to ignore this aspect:

> «The cultural landscape reflects intensive settlement with effective transformation of the biological environment through agricultural land use. With the introduction of village farming into an area, cultivated fields and biologically altered grazing areas began to dot the landscape.» (Butzer, 1971, p. 596).
> The process of creating cultural landscapes is therefore concomitant with the process of anthropic transformation of the landscape (Butzer, 1971, p. 608; 1996, p. 141). This term

is also used within perspectives analogous to Butzer's — those of ecological archaeology (Jochim, 1998; Jochim, 2023; e.g., Robinson et al., 2023; Vernon et al., 2022).

Finally, and on the scale of the larger analysis, Butzer ((1982a, p. 63)) defines the following:

> «The site macroenvironment is the biome or ecotone of which the medium-scale mosaic is a part. These are the great landscapes that represent the broadest units of study, whether for definition of the regional resource matrix or for definition of the general ecosystem. This regional matrix comprises biotic configurations as well as the assemblage of physical features and processes that, altogether, describe the several interfaces between atmosphere and lithosphere.»

The landscape, therefore, is the biome itself, falling into the frequent trope of equating the landscape with the environment, the latter serving analogously as a scale for archaeological analysis. This will be very present in Butzer's works (e.g., Butzer, 1977, 2015).

This is, to all intents and purposes, the majority of the uses of landscape in processual archaeology, and the use of the term landscape in place of *environment* is clear. (see, e.g., Butzer, 1982a, p. 123; 1996, p. 143; Flannery, 1973, p. 282). But this is not just a backdrop against which the action takes place, but rather — and as the name *human ecology* hints — it is part of the web of relationships between the human and the natural, with the former being able to act on the latter, affecting it forcefully, thus achieving a *artefactualisation of the landscape*, or a *artefactualisation of ecosystems* (fig. 2 and 3) (Mateus, 2004).

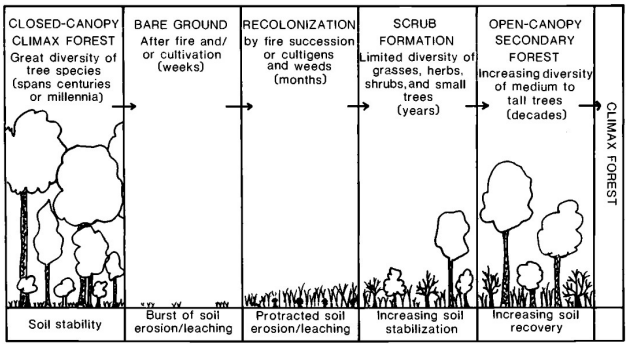

FIG. 2. SUCCESSION OF THE VARIOUS VEGETATION STAGES IN A FOREST (BUTZER, 1982A, P. 125)

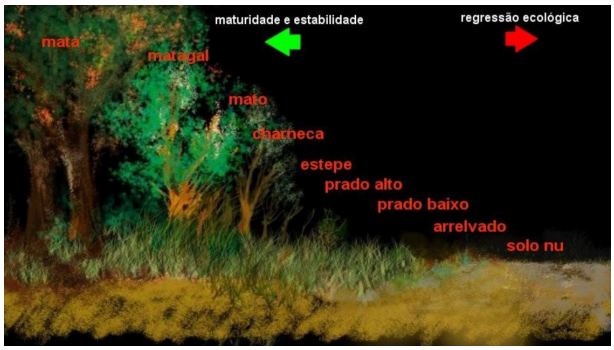

FIG. 3. SCHEMATISATION OF THE VARIOUS STAGES OF THE LAPIDATION OF ECOSYSTEMS BY HUMAN INTERVENTION, OR ECOLOGICAL SUCCESSION (MATEUS, 2004, P. 38)

Another aspect of this type of archaeology and approach to the landscape is a certain ecological *determinism* regarding the landscape, i.e., the landscape is a determining factor — if not a force — for a particular community to settle in a specific area. This archaeology is guided by hypotheses, equations and predictive models, even going so far as (for example) to list the aspects that contribute to the choice of a particular site (Jochim, 2023, p. 891):

1. Distribution of resources;
2. Abundance of resources;
3. Population density;
4. Competition and despotic control;

This rationalism reduces the complexity of human behaviour to platitudes and *rules*, as can be seen, for example, in Michel A. Jochim's long list (1998, p. 15) for the behaviour of hunter-gatherer groups in south-west Germany.

This view of ecology as a determinant transforms communities — or *civilisations*, as Butzer calls them — into mere moments of ecological exploitation, or into *adaptive systems* (vide Butzer, 1981, p. 471):

> «It is therefore possible to view civilizations as ecosystems that emerge in response to sets of ecological opportunities, that is, econiches to be exploited.» (Butzer, 1980a, p. 517).

This serves as an explanation for the appearance and disappearance of kingdoms and empires, and the landscape is therefore the ruler of the fate of these communities, as can be seen in Butzer's reasoning for the decline of Axum (present-day Ethiopia) (Butzer, 1981, 1982b) or the various phases of pharaonic Egypt (Butzer, 1976, 1980a, 2012, 2015).

In a more general sense, the environment, in Butzer's view, is what precipitates historical collapse (fig. 4), serving as the trigger that sets off the downfall of a community.

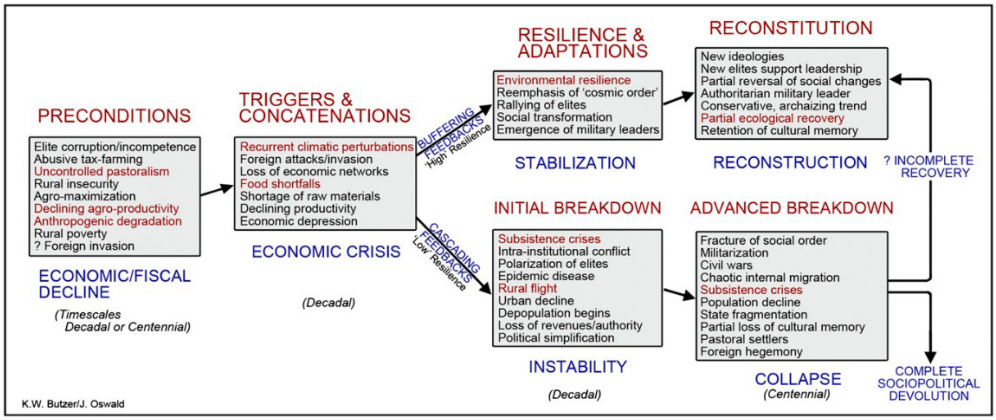

FIG. 4. GENERAL OUTLINE LINKING SOCIETAL COLLAPSE AND THE ENVIRONMENT, ALWAYS FROM A SYSTEMIC PERSPECTIVE (BUTZER, 2012, P. 3636)

These perspectives on the question of landscape will be reflected in terms such as the *functional landscapes* (Butzer, 1991/1992, p. 141), where the whole *functionalist* character of landscape will come together. If the landscape is a *maestro*, then it's important to recognise its various elements.

Semantically, this approach will also encompass various types of landscapes, such as cultural, functional, agricultural, rural, and traditional landscapes. In this sense, and contrary to the positions that see landscape as something *unitary* — and

which therefore exclude the proliferation of *landscapes of anything* — landscape as ecology sees landscape — or the environment — as something that can be modified and, depending on the case, better supported with an adjective.

In short, landscape from this perspective is multiple, physical, and essentially linked to the environment and biomes. Landscape is thus also configured as a *scale of analysis* and as an element that denotes a type of interaction between humans and the natural.

2. CONCEPTUAL TOOLS

Following this presentation of the landscape in processualism, it is essential to examine the tools of analysis and the concepts that have permeated landscape studies during this period. We will therefore emphasise the studies that date from this phase, although, as will be noted, some of these methods have seen an upsurge in recent years.

Of all the conceptual tools — essentially quantitative and coming from geography and demography — we have chosen to briefly present the most representative, namely: an overview of the study of settlement patterns, which includes the *site catchment analysis*, the *central place theory*, the *rank-size rule*, or Zipf's rule, and the *neighbour analysis*, both the more *proximate* and the *relative*.

2.1. SETTLEMENT PATTERNS

Using aerial photographs extensively as a means of prospecting in its original configuration (see Willey, 1953, p. 3), this method seeks to discern patterns in the general settlement of a large territory. Subsequently, this is supplemented with fieldwork, which involves visiting the sites detected through aerial prospecting. Thus, the types of sites (in types and subtypes) and their respective functionality are first defined, as well as the chronology and physical geography of the space — as only this allows for a thorough territorial analysis. It is not, therefore, a method concerned with the symbolic dimension of the occupation of space, but rather, once again, a functionalist analysis of the territory. This does not imply, however, that sites with symbolic functionality are excluded, but rather are always subordinate to the idea of function.

One of the essential tools for a territorial approach and understanding settlement patterns is cartography, whether it is available for the territory under consideration or that produced by archaeologists in the course of their work. Thus, aerial visuality plays a central role in this approach.

The idea of settlement patterns has its origins in Gordon R. Willey's study of the Virú Valley in Peru (1953). Here, the aforementioned approach was applied, first describing the period in question, followed by a summary of the types of sites found, the details of which are provided below. All of this is accompanied by cartography and plans — in short, an aerial view.

All of this allows for an accurate overview, which was completely innovative for the 1950s, systematising the sites and their typologies in order to discuss social structure and «economy».

Of course, it should be noted that Willey predates processualism, but that this method is central to the understanding of patterns, in an attempt to formulate laws of settlement and record dynamics in space-time (see Heilen, 2005) — once again, processualism seeks patterns in the data, going beyond mere description of artefacts or sites. Through this method, it is possible to assess behaviour — an essential aspect of processualism — and even classify it as optimal or suboptimal (see Tiebout, 1957).

Another characteristic of processualism is its regional approach, which contrasts with culture-historical archaeology. In this sense, an analysis of settlement patterns is entirely consistent with the desired outcome.

Furthermore, although the tools have changed since 1953, it appears that the basis for this type of study still rests on the same assumptions today: *aerial visuality*, whether provided by satellite images, LiDAR, or drones, and cartography (e.g., Fisher et al., 2016; Górka, 2024; Menzea & Ur, 2012). The settlement pattern is thus related to the physical characteristics and resources of the territory and, therefore, to the «economy», allowing laws to be formulated (see Tiebout, 1957, p. 84). One example — which, incidentally, demonstrates how economic rationality underlies this method — is Herbert A. Simon's *satisficer* principle ((1957, pp. 200–205)), which posits that human behaviour is essentially economic and rational, but that, in turn, in the exploitation of a territory, the aim is not to capture the maximum amount of resources, but rather the sufficient amount, since human planning capacity is limited:

> «The individual is adaptively or intendedly rational rather than omnisciently rational.» (Wolpert, 1964, p. 558).

All this will make this type of approach a recurring one in processualism and even afterwards, and one that will be supported by other methods and concepts, such as the one below.

2.1.1. Site Catchment Analysis

Another concept from the processual toolbox — or one that has been used extensively in processual approaches — is that of *site catchment analysis*, which also relates to the question of the view from above and cartography.

Starting from a fully economistic notion of the relationship between humans and their surroundings, Vita-Finzi and Higgs pioneered this concept of *site catchment analysis*, which consists of analysing the resources and exploitation potential of the territories that a given community *inhabits*, or, in the words of its creators, «[...] the study of the relationships between technology and those natural resources lying within economic range of individual sites» (Vita-Finzi & Higgs, 1970, p. 5).

The catchment analysis site has therefore, since its inception, been proposed as an economic study of the exploitation capabilities of a territory and the technology used for exploitation, with the merit of integrating the environment as a tool for studying past human communities, overcoming the mere artefactuality of archaeological studies.

This consists of drawing a buffer zone around an archaeological site corresponding to 5km-10km, or one to two hours' walk, in order to define the resource catchment area. From there, the affected areas are calculated based on contemporary resource maps, in an attempt to define the possible «economy» of the site. It should also be noted that the size of these buffer zones would differ depending on the type of «economy».

Therefore, the notion of territory, which for these archaeologists is synonymous with «[...] an area which is habitually exploited.» (Higgs & Vita-Finzi, 1972, p. 30), must first take into account the type of *economy* — the term *economy* is, in fact, widely used in their work — whether mobile, sedentary, or an intermediate regime, the *mobile-cum-sedentary* (Higgs & Vita-Finzi, 1972). This assumption, however, presupposes the existence of a *central* site, which is precisely one of the criticisms of this type of analysis (cf. Rossman, 1976, p. 174).

These authors also base their arguments on ethnographic studies — once again, highlighting the importance of ethnography in processualism — to justify the *radius* of distance, starting from a central point, in the collection of resources from communities. In this case, studies of the !Kung populations were favoured (Lee, 1969), while the latter was already applicable to peasant societies (Chisholm, 1968). Initially, these studies used absolute distance from a point as a metric (10 km for non-sedentary communities and 5 km for agricultural societies), which was eventually replaced by hours of walking (two hours for the former, one hour for the latter) (Roper, 1979, p. 123).

Furthermore, they also propose a definition of archaeological site:

> «We shall define a site as a place where there is a deposit or set of deposits which contain evidence of human activity.» (Higgs & Vita-Finzi, 1972, pp. 27–28).

The question of localisation — almost in the logic of an elementary predictive model — once again took up the ethnographic bases mentioned above, where the aim was to establish which elements would be at the origin of a given settlement.

Thus, and in an approach that depends essentially on modern cartographic quality — as in the seminal work on the *site catchment analysis* of the Mount Carmel region, in the north of the present-day state of Israel (Vita-Finzi & Higgs, 1970) — the territory was systematised in terms of its biotic resources — amount of arable land, quantity of animals available for hunting activities measured in kilos of meat, subsistence patterns, as well as the division of the territory on the basis of exploited territories, based exclusively on space exploitation criteria, and, of course, the *site catchment analysis* for multiple resource catchment territories (e. g., the *site catchment analysis* for the *site catchment analysis* for multiple resource catchment territories (e. g., the *site catchment analysis* for multiple resource catchment territories) (e.g., fig. 5).

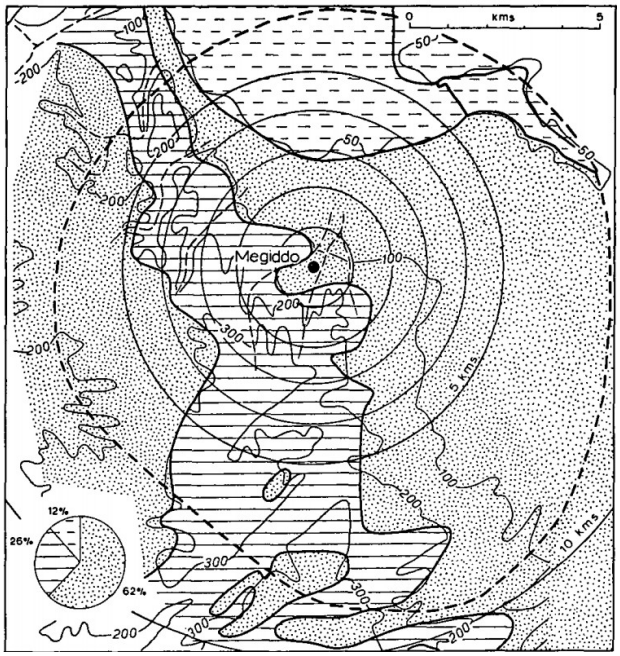

FIG. 5. SHEIKH ALI'S SITE CATCHMENT ANALYSIS, ISRAEL (VITA-FINZI & HIGGS, 1970, P. 28)

This analysis is essentially economicist, reducing the landscape — or rather, the material bases of the landscape, since there is no aesthetic appreciation here or even a *ecological* relationship between humans and their surroundings — to a question of *resources*.

From a philosophical point of view, therefore, nothing that has been mentioned in the aforementioned work relates to the *landscape*, because it cannot be reduced to a mere resource — a *standing-reserve* (see Ruin, 2010, p. 192) to be exploited — but rather to the *territory*: it is an isometric, absolute space (a Newtonian space, in short) that belongs more to a *Homo economicus* than to a *Homo sapiens sapiens*; the relationship that this has with the landscape, however, is that this type of analysis studies — to all intents and purposes — the *material* bases of the landscape, but it is not *landscape* theoretically speaking.

After these first studies, *site catchment analysis* gained a lot of traction in multiple areas of archaeology, being applied by both Americans and Europeans in the most diverse contexts, such as in Mesoamerica (Rossman, 1976; e.g., Zarky, 1976) or in Europe (Davidson & Green, 1989; Drillat, 2022; Jarman, 1972/2015; e.g., Volkmann, 2018).

Likewise, as a natural consequence of the development of adequate methodology, this method has undergone changes. However, the tendency to establish *time-contours* around the sites being analysed to gauge the catchment areas has always been the norm.

2.1.2. Central Place Theory

The *central place theory* — its *Zentralort* — was formulated in 1933 by Walter Christaller (Christaller, 1933/1966), and has been widely used by archaeologists to this day, especially in Scandinavia (Hedeager, 2002; Maixner, 2023; Nicklasson, 2002; e.g., Rindel, 2002; Sindbæk, 2009), although this theory was largely abandoned in geography in the 1980s (see Blotevogel, 1996). However, its major entry point into archaeology was David Clarke's contact with Peter Haggett (Nakoinz, 2012, p. 217) and his seminal work *Locational Analysis in Human Geography* (Haggett, 1965). The theory of central sites, as well as its application tools, such as Thiessen polygons (or Voronoi diagrams) - which will be discussed below - would end up being a procedural mark, as it contributes to the formulation of (Renfrew, 1978, pp. 103–112; see Renfrew & Level, 1979) axioms. Similarly, the *central place theory* can be seen as a *middle-range theory* (Kosso & Kosso, 1995, pp. 591–595).

Christaller's original theory argues, first and foremost, that centrality is a mode of existence of all organic and inorganic matter, found analogously in social forms and in the organisation of humanity.

Thus, central sites structure the territory, being, therefore, the sites that concentrate within themselves the functions of a territory and on which other sites depend — the so-called dispersed sites — which can be of three types (Christaller, 1933/1966, pp. 16–17):

1. Sites marked by an area, such as agricultural sites that are dependent on the surrounding land;
2. Sites marked by a point, such as a distant settlement where the population extracts resources from the region (non-agricultural), and, similarly, sites that are *attached* to the land, such as bridges or borders;
3. And finally, sites that are not dependent on any place, such as isolated monasteries.

There are also several types of central places:

> «Those places which have central functions that extend over a larger region, in which other central places of less importance exist, are called ***central places of a higher order***. Those which have only local central importance for the immediate vicinity are called, correspondingly, *central places of a lower* and of the ***lowest order***. Smaller places which usually have no central importance and which exercise fewer central functions are called *auxiliary central places.*» (Christaller, 1933/1966, p. 17).

This division reveals a hierarchy in human settlements, forming a dense web of interrelated relationships and correlations, dependencies and interdependencies that make up territories. These are also constituted through the consumption of *central goods* (Christaller, 1933/1966, p. 35), which other less central regions consume less. The importance of a central site is also proportionally linked to the consumption of these goods.

On the other hand, the regions that serve these central sites are the *complementary regions*, which are determined by *distance* (Christaller, 1933/1966, pp. 21–22). In relation to this principle, it is relevant to invoke Tobler's first law of geography, which states that «[...] everything is related to everything else, but near things are more related than distant things.» (Tobler, 1970, p. 236). Thus, these central places define their complementary region based on distance and the interdependence links they create.

The combination of central places, auxiliary places and complementary territories forms a complex web that can be systematised into a *system* (fig. 6), where the various central sites have a sphere of influence — from which the population of these centres will consume and seek resources — that encompasses the many sites. These *spheres* are, in fact, hexagonal.

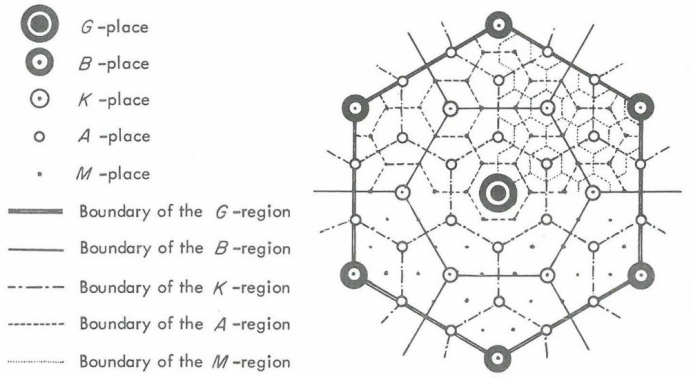

FIG. 6. DIAGRAM SYSTEMATISING THE CENTRAL PLACE SYSTEM AND ITS AREAS OF INFLUENCE, CREATING A WEB OF INTERCONNECTIONS LINKING THE PLACES TO EACH OTHER (CHRISTALLER, 1933/1966, P. 66)

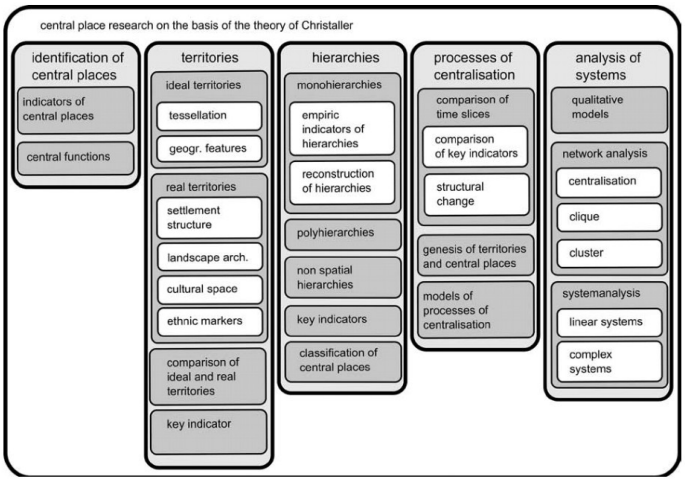

FIG. 7. QUESTIONS AND ISSUES THAT ARISE IN ARCHAEOLOGY FROM THE APPLICATION OF THE CENTRAL PLACE THEORY (NAKOINZ, 2010, P. 261)

Returning to its application in archaeology, the study of these central sites has been linked essentially to their identification, arguing that they provide elements that are not available elsewhere, such as dominance, protection, extraction of raw materials, certain types of artefact production, exchanges, and cult functions (Gringmuth-Dallmer, 1996, p. 8).

With regard to Christaller's theory in archaeology, Oliver Nakoinz systematised ((2010, 2012)) the concept around five central questions: 1) the identification of central sites — through the architecture of space and its materials — 2) their territories, 3) the hierarchy between settlements, 4) the processes of territorial centralisation in diachrony, and 4) the cybernetic analysis of the settlement system (fig. 7).

Thus, Christaller's theory presupposes all these elements, which are widely applied in archaeology. However, the process by which these central sites and their territories are established is a complex one, essentially summarised in the topic of Thiessen polygons, also known as Voronoi diagrams.

Although they are not precisely the same thing, given that Voronoi diagrams are the more complex basis for the simplified Thiessen polygons (Okabe et al., 2000, p. 8), these concepts have been central to delimiting the territories of such central sites since processualism and the consequent advent of central place theory.

This method has served beyond processualism and the West, as it remains present today in multiple geographies and areas of study (e.g., Boots, 1980; Chartrand, 1996; Dytchowskyj et al., 2005), making it a cross-cutting and useful method.

However, there are multiple ways to calculate Thiessen polygons; for example, in archaeology, see Renfrew and Level's *XTENT* model (1979, p. 149) or Oliver Nakoinz's model (2010, p. 253) for calculating weighted Voronoi diagrams.

The aim here is not to discuss Thiessen polygons, as this topic falls beyond the scope of this section, but rather to highlight the existence of this tool in the study of territory in processual archaeology. This method is, however, more akin to an archaeology of territory than of landscape, since it does not deal with the environment — which is the true processual *landscape* — nor with the physical

characteristics of the land, but rather with human organisation *in* the landscape (for a processualist) — which is why this term has been included here.

2.1.3. Rank-Size Rule

The *Rank-Size Rule*, or Zipf's law, is a concept in geography used in the distribution of cities, towns and other types of settlements, which postulates that the population of a settlement is inversely proportional to the hierarchy of settlements (see Dziewoński, 1972, p. 73). That is, Pr = P1 / r, where *Pr* is the population of a site, *P1* is the population of the largest settlement, and *r* is the hierarchy of the settlement (see for a general overview of Zipf's theory, Dziewoński, 1972). Originating in the early 20th century by Auerbach ((1913)), this concept was popularised in 1949 by Zipf ((1949)).

In practical terms, this implies that the size of settlements in a given territory follows a normal distribution logic (in the statistical sense of the term), with several larger settlements and smaller ones, although some argue that, in some cases, this distribution is more convex than normal — i.e.:

> «This is a class of «convex» distributions in which settlements below the size of the largest settlement in the system being examined are generally larger than the rank-size rule would predict. An alternative view is that the largest settlement in such systems is smaller than the rank-size rule would predict.» (vide Johnson, 1980, p. 234).

Thus, changes to the pattern of a normal distribution — where there is a smooth decline in the size of settlements along the distribution — may give rise to interpretations regarding the way the territory is organised (Berry, 1961, 1973; Johnson, 1977; Moore, 1959; Morrill, 1970; see the table below for a summary of the topics, Savage, 1997, p. 234):

1. Primitive curve (*primate*)
   a. One settlement stands out clearly from the others;
   b. Little economic and political development;
   c. Availability of cheap labour in the largest site in the hierarchy;
   d. A settlement system covering a small territory;
   e. Failures in the identification records of other sites;
2. Convex curve
   a. A distribution more akin to the Central Place Theory;
   b. Low level of integration into the settlement system;
   c. Very peripheral sample;
   d. More than one territory is being analysed;
3. Primo-convex curve
   a. The integration of two settlement systems in the same territory, one centralised and the other less so;
4. Double-convex curve
   a. Multiple settlement systems operating in the same territory.

5. Concave curve
    a. Medium-sized sites are larger than expected;
    b. May indicate the presence of specialised sites;

Zipf's law is therefore an empirically based *prediction* that allows us to glimpse *patterns* of human behaviour — the ultimate goal of processualism. It is therefore not surprising that this method has been used extensively in archaeology with the advent of this trend of thinking (Gophna & Portugali, 1988; Johnson, 1980; e.g., Marzano, 2011; Paynter, 1982; Pearson, 1980; Savage, 1997).

After the processual fever, this methodology is not commonly used outside the United States of America (see e.g., Drennan & Peterson, 2004), although there are, of course, exceptions (see e.g., Marzano, 2011).

2.1.3. Nearest/Relative Neighbour Analysis

Finally, we have procedural archaeology reusing quantitative methods from geography (Clark & Evans, 1954), in this case, *nearest* and *relative neighbour analysis*.

Both methods serve to assess the randomness or non-randomness of a spatial distribution, which in the first case may be *random*, *clustered*, or *equally dispersed* (Jiménez-Badillo, 2024; Pinder et al., 1979; Pinder & Witherick, 1972, 1973; see Pinder & Witherick, 1975). In the second case, it is used to assess the position of something in relation to something else, such as a settlement in relation to water points or other characteristics of the physical territory, or the *relative* proximity of a site — whether a necropolis or *habitat* — within a settlement system (see Jiménez-Badillo, 2024, pp. 168–169).

The first method is applied — the *nearest neighbour analysis*:

> «[...] by connecting each node to the node closest to it. One can extend this notion to incorporate the second, third, or even farther closest points, obtaining a k- nearest neighbor network. Because the points are fixed, the linear distance between each pair of points represents an absolute measure of association. This assumes, for example, that a site interacts more strongly with a neighbor located 3 km away than with another situated 20 km distant.» (Jiménez-Badillo, 2024, p. 166).

And in the case of *relative neighbour analysis*:

> «This model delimits regions of influence, but instead of assigning one region for each node (like the VD) [Voronoi Diagrams], vicinity is defined for pairs of nodes. The neighborhood extension depends on the specific separation of each pair-combination of nodes, and varies accordingly, while its shape is determined by certain geometric functions like a circle whose circumference passes through the pair of nodes, the intersection of two circles centered at the nodes, a conical function, or more complex forms (Cardinal et al. 2009). In all cases, two nodes are considered relative neighbors if and only if their area of influence is empty.» (Jiménez-Badillo, 2024, p. 168).

Its practical use is therefore wide-ranging and cuts across the chronology under consideration, and it can be applied both to the dispersion of artefacts at archaeological sites and to the dispersion of materialities and sites across the territory.

Although its use has remained essentially limited to the decades of processualism (Adams & Nissen, 1972; Clark & Evans, 1954; Earle, 1976; e.g., Plog, 1974; Stickel, 1968; Washburn, 1974; Whallon, 1974), these methods have resurfaced in recent years in the form of Geographic Information Systems and a growing quantification of the discipline (Bilotti et al., 2024; De Reu et al., 2011; Hewitt et al., 2020; Kempf & Günther, 2023).

3. CONCLUSIONS

Since the advent of processualism in the 1960s, «landscape» has appeared practically synonymous with «environment», a legacy of American ecological anthropology and systems theory, which was also reflected in British archaeology.

Thus, ecology is understood as a systemic and functionalist science: cultures are seen as adaptive systems that seek balance with the environmental system, so that any change in a natural subsystem triggers socio-cultural responses.

Clarke formalised this intertwining, while Flannery and Steward speak almost exclusively of the environment, as do the overwhelming majority of processualists. Butzer, a notable exception, wrote extensively about the landscape, details three analytical scales of this category: microenvironment (sediments and post-depositional processes of the site), mesoenvironment (topographic matrix from which resources are extracted) and macroenvironment (regional biome), using photographic interpretation, geomorphological analysis and paleoenvironmental reconstruction, with the aim of reconstructing the paleolandscape, still understood here as biome.

This *natural* landscape — for that is what it is — is therefore a dynamic ecological stage, where humans are an integral part. Thus, humans artefactualise the landscape, altering soils, vegetation and environmental balances. However, all this comes at the cost of ecological determinism, where even civilisations have fallen due to environmental issues.

In processualism, landscape archaeology was strongly influenced by quantitative conceptual tools from geography and demography. Thus, emphasis was placed on methods capable of revealing objective patterns of human distribution in space.

The first tool discussed here was the analysis of settlement patterns, led by Gordon Willey's work in the Virú Valley, which combined detailed cartography with aerial photographs to classify sites, establish a chronology and relate them to physical geography. The ultimate goal was to outline settlement laws and evaluate human behaviour as optimal or suboptimal.

Another method, site catchment analysis, created by Vita-Finzi and Higgs, involves drawing a ring of 5 to 10 km (or approximately one to two hours' walk) around a site to quantify the soils, fauna, and other resources within the community's

reach. This is based on economic premises — the territory as a resource reserve — and draws on the ethnography of the !Kung to establish distances.

Christaller's theory of central places reinforces this hierarchical view: higher-order centres concentrate functions and radiate hexagons of influence over smaller places. Integrated into archaeology by David Clarke and operationalised through Thiessen/Voronoi polygons, it provides a framework for identifying centrality, measuring complementary territories and studying centralisation processes over time. Although it has lost ground in geography since the 1980s, it has retained its archaeological vigour, especially in Scandinavia.

The classification size rule (Zipf's law) considers the settlement system as a potentially normal distribution, in which the population of each location is inversely proportional to its hierarchical classification. Deviations — primary, convex, concave curves — allow us to infer levels of territorial integration, economic specialisation or the overlap of different systems. Popular in North American archaeology in the 1970s, it is now applied more sporadically outside the US.

Finally, nearest neighbour/relative analysis assesses whether the spatial arrangement of sites is random, clustered or uniformly dispersed, or measures relative proximity to reference points such as watercourses. Widely used in the processual era, it has been revived with contemporary GIS and the trend towards quantification in the discipline.

Together, these tools consolidate a functionalist approach: they treat space as a matrix of resources, measure distances and densities, and describe settlement systems as networks that are in equilibrium — or not — with the environment. Even when updated with modern technology, they continue to convey the procedural logic of seeking measurable regularities in human occupation of the territory, reducing humans to mere numerical questions.

Thus, and because processualism is still influential, it is crucial to study how it has influenced contemporary landscape studies: an increasingly important endeavour in an era of environmental collapse.

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