Environmental Archaeology, Palaeobotany and Zooarchaeology

The Environment

- The environment consists of living and non-living systems interacting within a bounded geographic unit: the earth
- The *biotic* (living) part of the environment consists of all living things (fungi, bacteria, plants, animals, humans)
- The *abiotic* (non-living) part of the environment consists of things such as air, water, soil, rock, heat, sunlight, landforms and processes such as weather
- The environment of the prehistoric past is called the PALAEOENVIRONMENT

Roots of Environmental Archaeology are in the 1960s

- movement to a more scientific archaeology
- realization that documenting and understanding changes in the environment are necessary to comprehend and interpret changes in human adaptation
- environmental information is needed as a starting point for formulating economic models of human adaptation
- this environmental information is also needed to determine whether changes in the environment are anhropogenic in origin

The study of past environments, and the relationship between people and their environment is called PALAEOECOLOGY

- Archaeologists work to reconstruct past environments by formulating and testing models of human adaptation
- Initial investigations establish the general climate and environment of a region
- This is followed by more specific conditions at particular sites
- Move from the wider and more general to the more local and specific

Reconstructing Past Landforms

- Any environment exists within a landform consisting of various *abiotic* elements, including geology and hydrology
- All landforms change through time
- The study of how they change is called GEOMORPHOLOGY
- Archaeologists are interested in how geomorphological processes affect archaeological sites, site formation processes (this field of research is called geoarchaeology)
- The reconstruction of landforms is an important aspect of understanding where people may have lived and what resources they may have had access to

Landforms are modified in a number of ways:

- plate tectonics
- vulcanism
- earthquakes
- glacial activity
- erosion and deposition by water and wind
- sea level changes

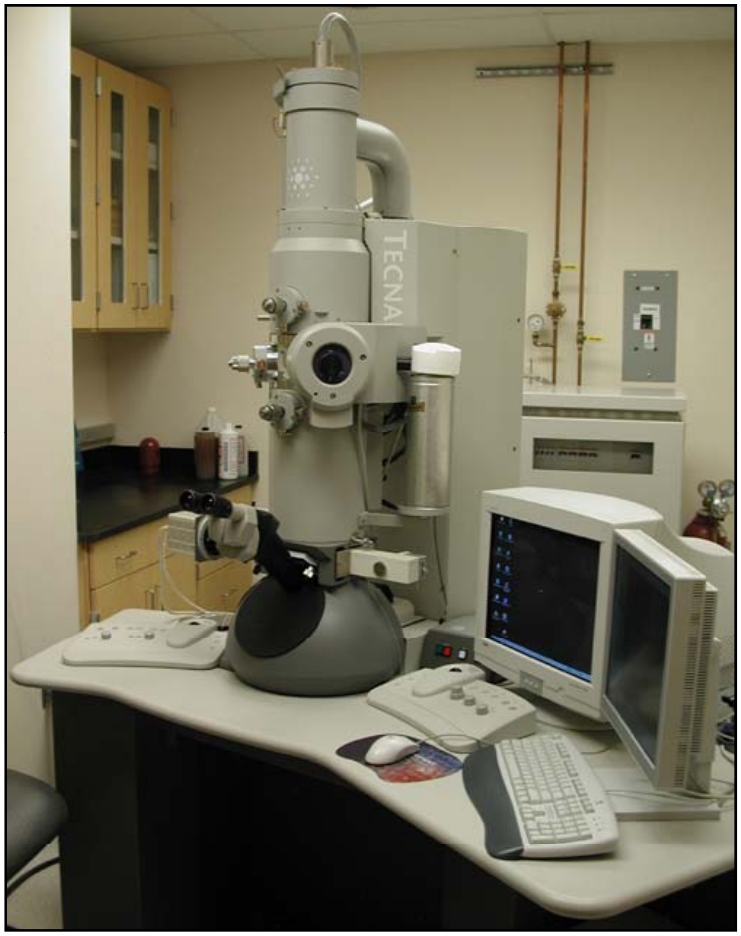
Reconstructing Past Plants and Animals

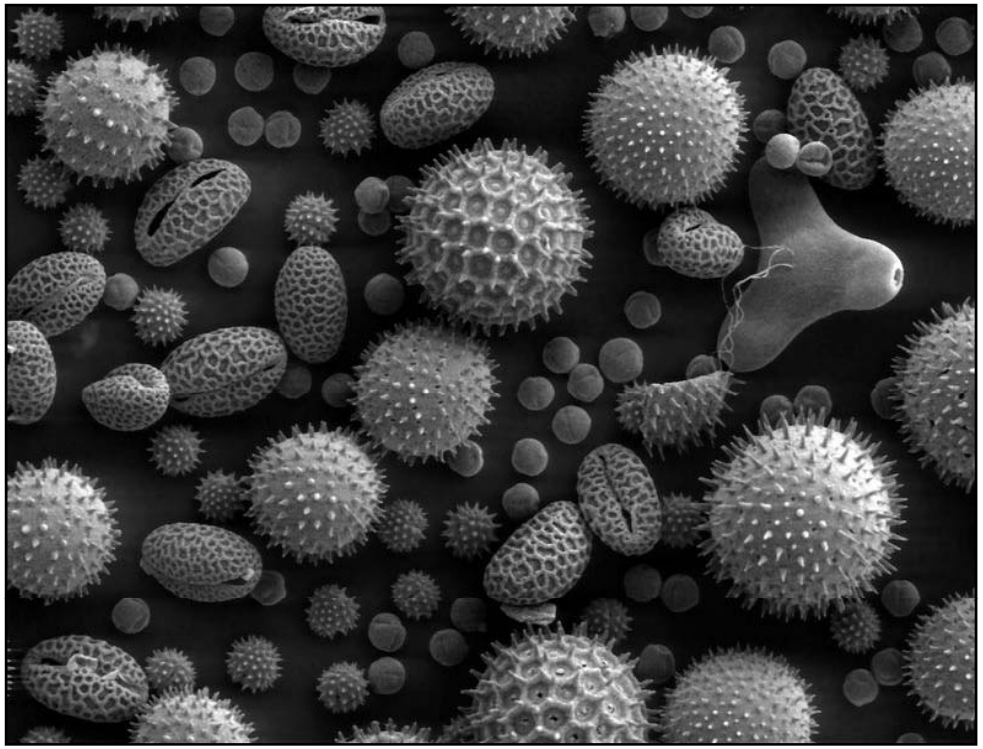
- Reconstructing the record of plants and animals in an environment indicates what was available for people to use
- archaeologists use the reconstruction of past vegetation to model ecozones, which are then used to infer animal population
- Models of the human economy and adaptation are based on the ecozone models
- **There are a number of ways to reconstruct the vegetational history of a region**:
  - **Pollen**
  - **Phytoliths**
  - **Macrofossils**

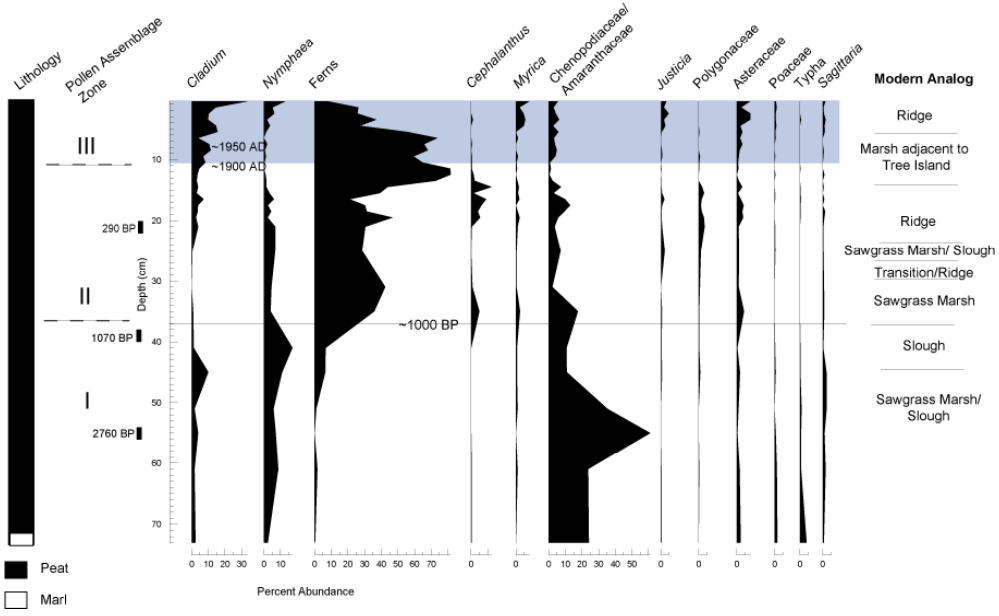
Pollen

- Pollen is the sperm cell of plants
- the study of pollen is called PALYNOLOGY
- Pollen from many plants, especially trees is distributed by wind, and so pollen collects on the earths surface
- Palynologists recover pollen from soils, including archaeological sites
- The analysis of pollen reveals a record of the types of plants in area through time
- This data is critical to environmental reconstruction

Pollen analysis







Scanning electron microscope, pollen image (top right) and pollen graph

Reconstructing Past Climate

- Researchers reconstruct long-term patterns of temperature and precipitation to study changing adaptations to environments
- the study of past climate is called PALAEOCLIMATE
- Investigations of palaeoclimate address broad questions about average global and regional temperatures, ice coverage, sea level
- As data is compiled it allows us to reconstruct smaller regions
- one of the key ways archaeologists and geologists collect information to study palaeoclimate is through CORES, long cylindrical plugs of material removed by hollow drills from ocean or lake sediment or from glacial ice

- Samples can be removed from different layers of the core, dated and examined and tested for relevant information
- Data from cores helps to reconstruct climate over millions of years
- cores can contain any number of types of data:
  - ocean cores might contain foraminifera (microscopic animals), which tell us about sea temperatures
  - rates of sedimentation reveal rates of erosion and deposition
  - cores from lakes reveal varves, annual levels of sediments revealing glacial melt rates
  - cores from ice in glaciers provide information about atmospheric pollution, by testing for atmospheric gases, that reveal increases in CO2 to indicate burning of biomass, or Sulpher to indicate volcanic eruptions

Example:
The Natufian Period in the Levant: 12,500 – 10,000 BP
Sedentarization and climatic changes

- Evidence comes from specific sites, based primarily upon pollen cores from lakes, swamps
- Some evidence from archaeological sites: pollen, fauna and some botanical evidence
- The evidence is open to interpretation.
- This has resulted in differing models of climate change, and therefore upon interpretation of the human evidence

Climate change in the Levant during the Natufian

- Models suggest shifting climatic patterns between dryer and wetter phases
- Generally thought that the early Natufian was wetter than the late phase
- Rainfall decreased during the 'Younger Dryas' period (approx. 11,000 to 10,000 B.P.), which was a world-wide climate event.
- Following the 'Younger Dryas' precipitation increased again but never reached the same levels in the Levant as previously

Natufians as the ‘First Farmers’?

- Climatic crisis of the Younger Dryas (11,000-10,300 bp).
- Decrease in the natural generation of some plants including cereals and the retreat of the natural range of cereals.
- Climatic change had an impact on the Natufian population.
- May have led Natufian populations to *adapt* their behaviour
- May have prompted Natufian populations to experiment with the cultivation of cereals near their base camps.

Human adaptation

- although humans, like other animals adapt biologically to their environment, the main way that human adpat is increasingly through cultural adaptation
- Technology and social organization, including the structure of economic, political and social behavior are cultural responses to adaptive pressures
- Compared to biological adaptation, cultural adaptation is extremely flexible and can be a very rapid adaptive mechanism
- This is true because behavioral responses to external environmental forces can be acquired, transmitted and modified within the lifetimes of individuals

The study of cultural adaptation to the environment is called CULTRAL ECOLOGY

- People respond to environmental pressures and opportunities in a number of ways
- These might include economic organization (division of labor); social organization (kinship systems); political organization (resource allocation or redistribution); religious organization (ceremonies and ritual)
- Economic, social, political and religious organization are often closely connected and mutually re-enforced in a cultural system
- All environments are dynamic and therefore people have to make constant adjustments to maintain some sort of equilibrium
- Cultural practices can lessen the impact of environmental change
- Humans often use technology, which plays an important role in adaptation

Controlling the environment

- all groups make some attempt to control the environment on which they depend, through cultural systems
- Groups attempt to exercise both direct and indirect control of their environments
- Indirect control might be the use of religion and ritual to influence weather, animal behavior and other things beyond human control
- Direct control is the actual physical management or manipulation of resources or landscapes
- Humans have been active manipulators of the landscapes in which they live, with very numerous examples in all parts of the world (Neolithic Britain, Easter Island)

Example:

Human manipulation of the environment: Domestication of plants and animals

Raphael Pumpelly

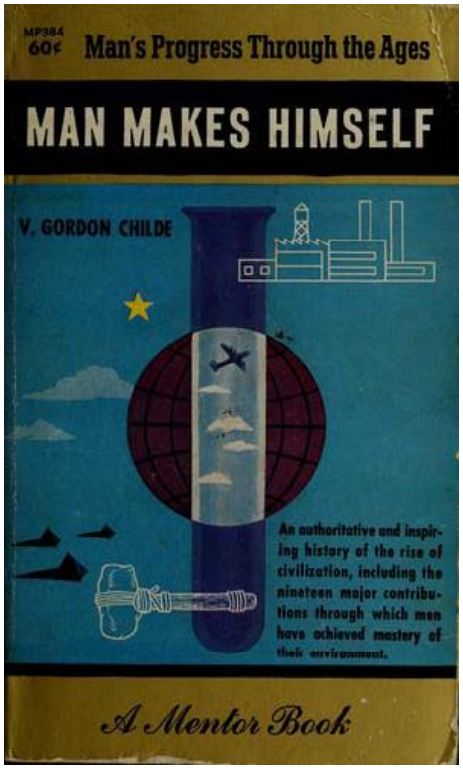
American geologist (1837-1923)

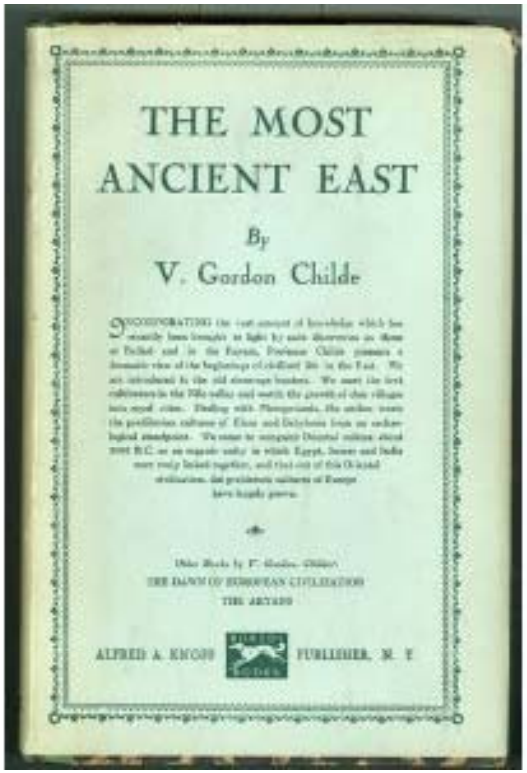
➢The Oasis Theory

- Archaeological expedition to Central Asia 1904
- found evidence that central Asia had once been occupied by vast inland seas or lakes
- these slowly diminished in size, leaving behind the Aral Sea and numerous small lakes.
- suggested that post-Pleistocene desicication was the causative factor in humans domesticating plants
- This occurred in oases where humans and plants had ‘taken refuge’

V. Gordon Childe and the Oasis Theory

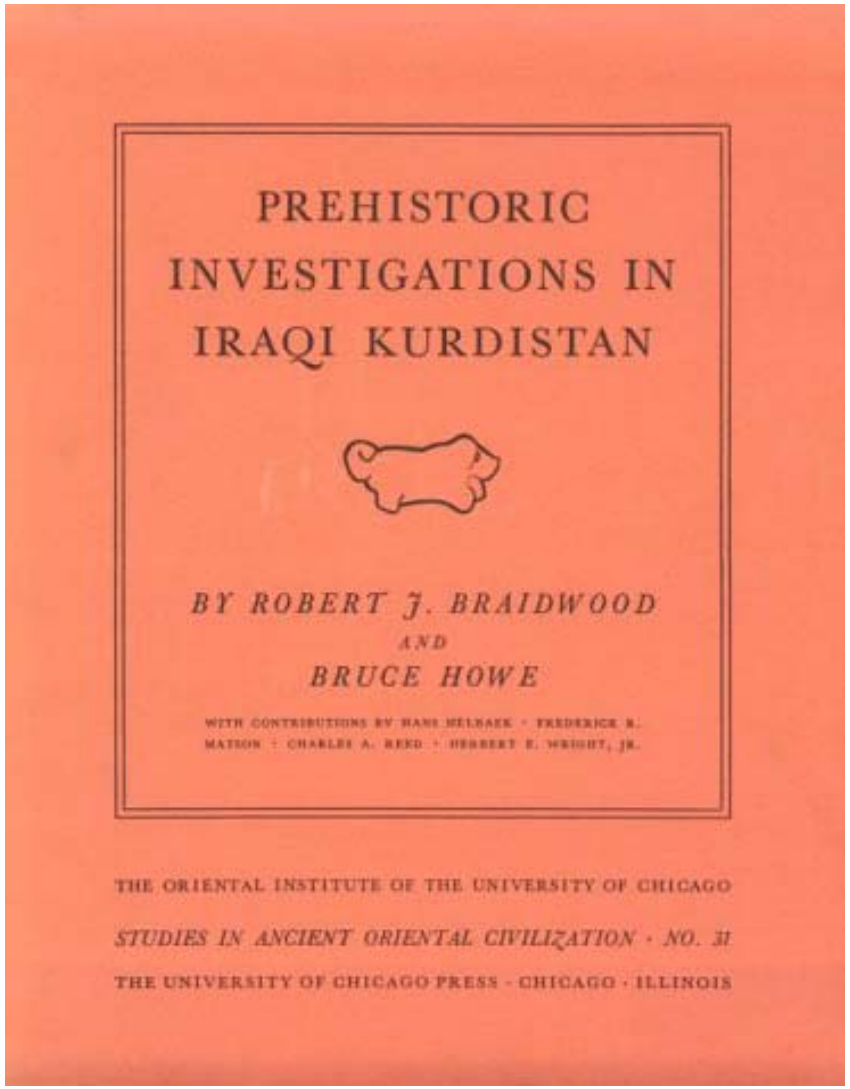
- *The Most Ancient East* (1928)
- *Man Makes Himself* (1936)

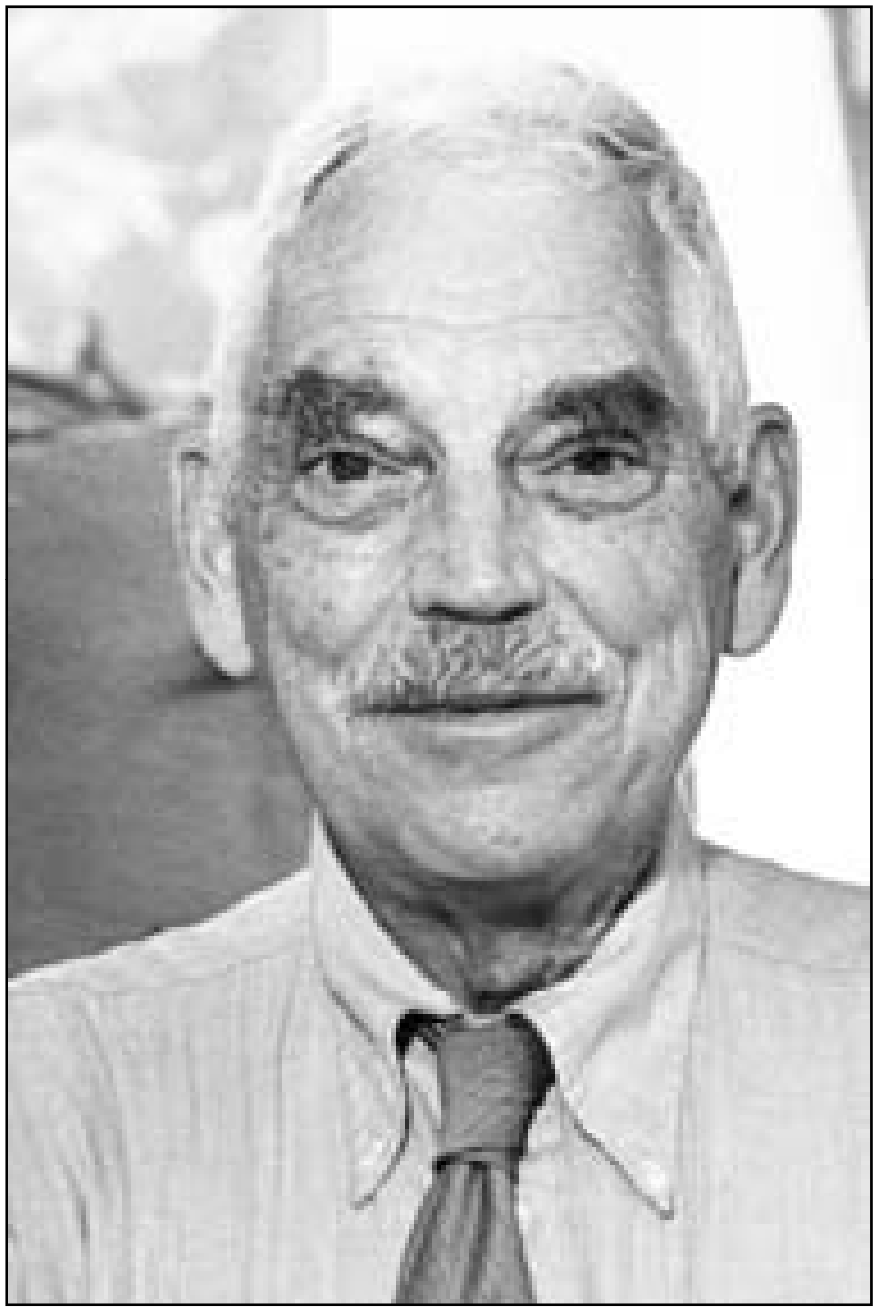




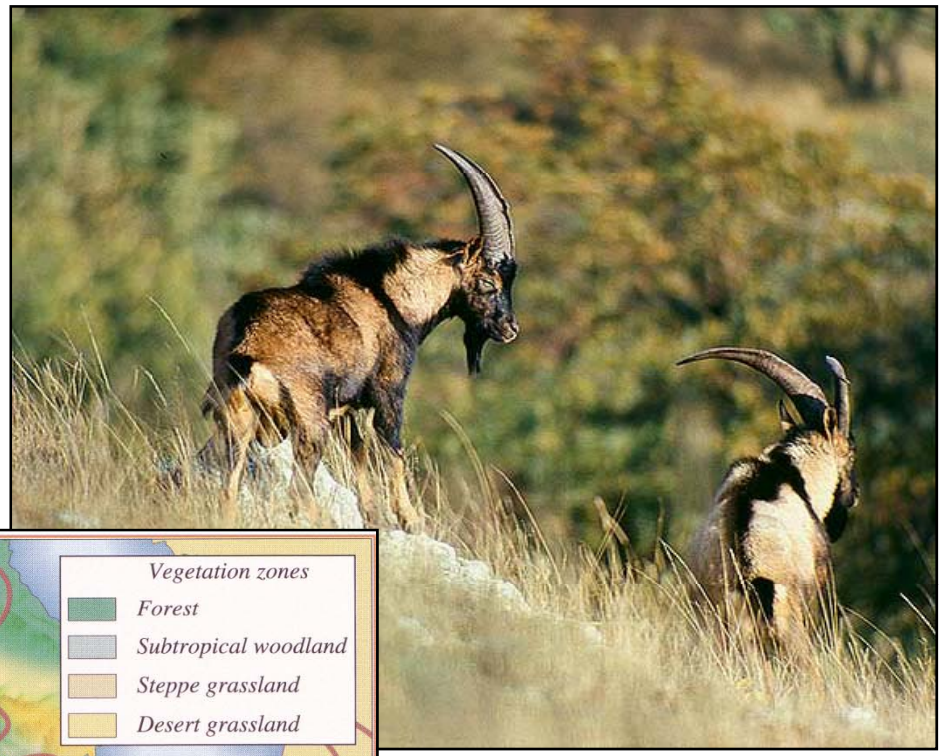
- Natufians were the earliest plant cultivators.
- During a dry phase after the last Ice Age, humans and animals were crowded together at the few permanent water sources (rivers and oases).
- ‘Neolithic Revolution’: with the aid of already domesticated crops humans tamed some animal species
- This theory relies upon ‘stress’ caused by climate change, and also to some extent demographic pressure
- Is evolutionary in its approach, since it assumes domestication is a ‘progressive step’ towards civilization, and one to be expected

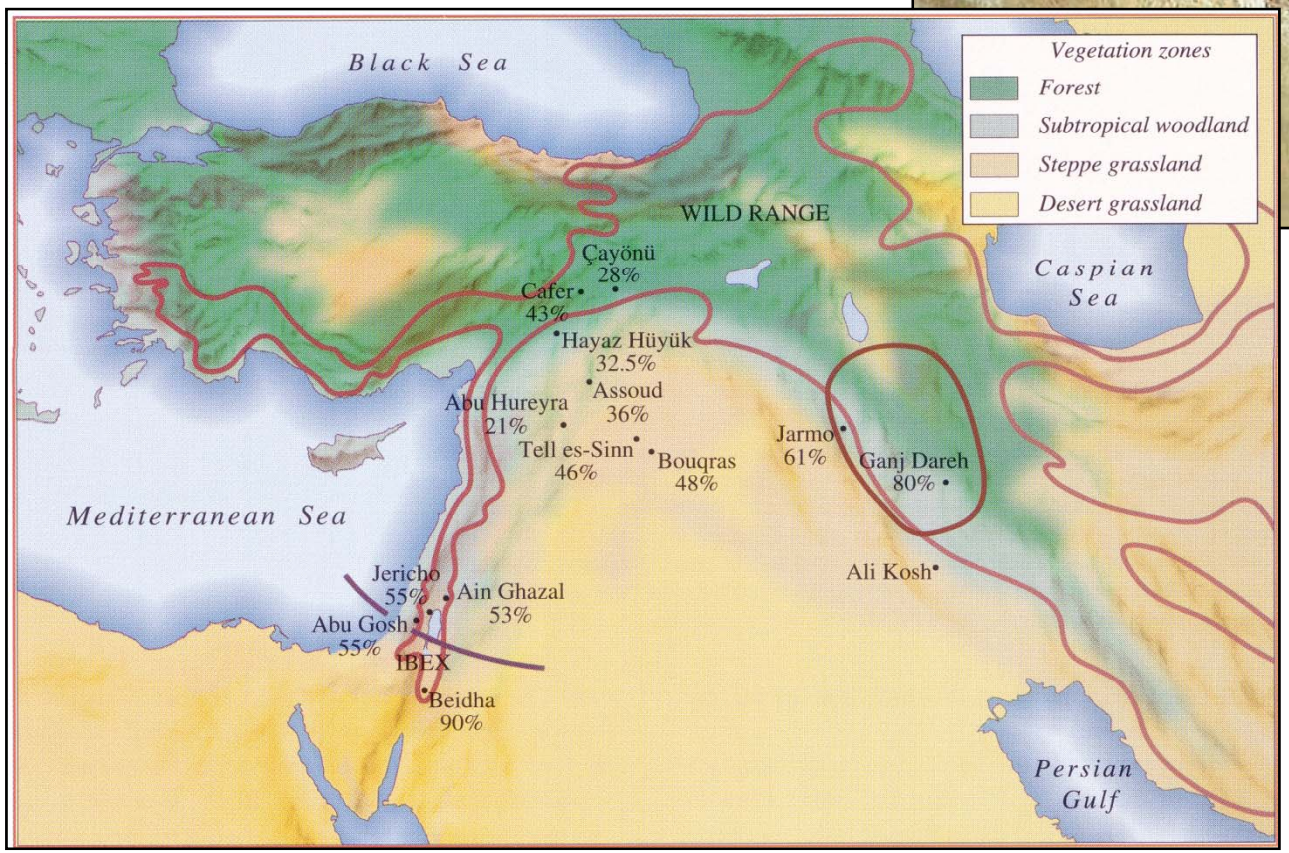
Robert Braidwood
'The Hilly Flanks Theory'





Domestication of goats





➢**Wild Goats**

capra aegargus

- Origins of agriculture not to be found in lowland oases or river valleys
- Agriculture and animal domestication began in the 'Hilly Flanks' of the 'Fertile Crescent' - well-watered uplands – steppe
- Location of the 'wild ancestors' of sheep, goat and cereals (wheat, barley, legumes)
- Focused upon cultural over environmental factors in domestication
- Argued that as human technology and knowledge about their environment grew more sophisticated the would 'recognize' the potential in the local flora and fauna
- Using new environmental and archaeological data he suggested the steppe zones the likely origin of domestication

Lewis Binford — population pressure theory

"Father" of the "New Archaeology" (1931 – 2011)

- Argued that Braidwood like Childe was mistaken about the local for earliest food-producing communities
- His view based on ethnographic data
- Humans colonizing ‘optimal zones’ maintain a ‘dynamic equilibrium’ between population size and natural resources
- Focused upon demographic issues
- As populations increase, groups ‘fission off’ and forced into ‘marginal zones’
- Population pressure and access to wild resources cause groups to intensify their subsistence practices

Palynological studies 1960s and 1970s

H.E. Wright (and others) began examining pollen cores preserved in lake sediments in the Zagros

- Revised theories about climate change
- New evidence suggested significant shift from the Pleistocene to the Holocene
- Focused again upon climate as a determining factor
- New models developed, focused upon:

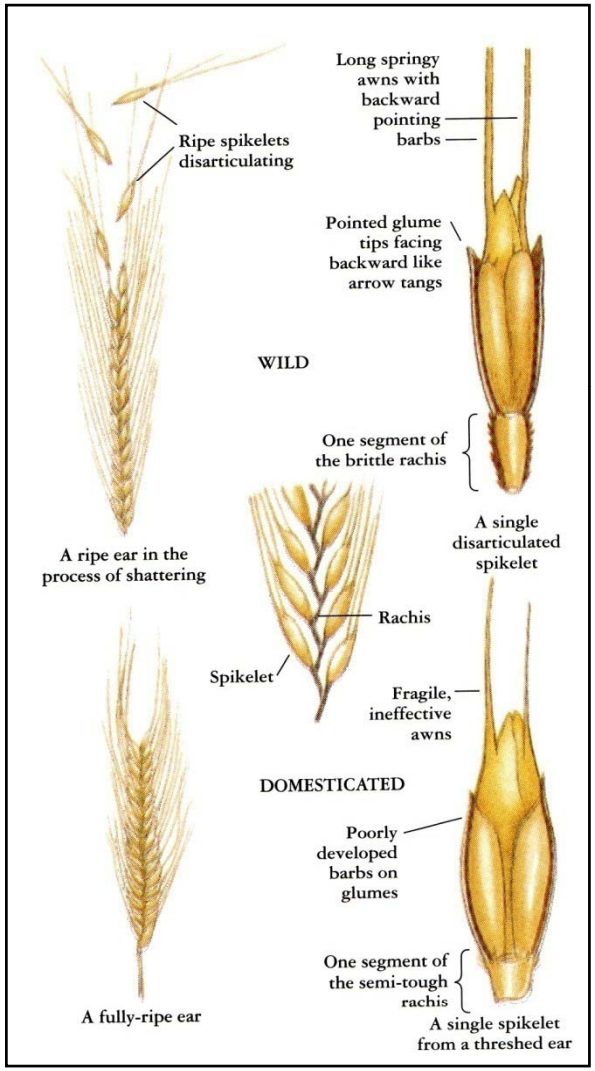
    increasingly available archaeological evidence
        (mostly Levant, but also Zagros)

    'reduced-mobility'

    environmental stress

    'broad-spectrum economy of early Holocene populations

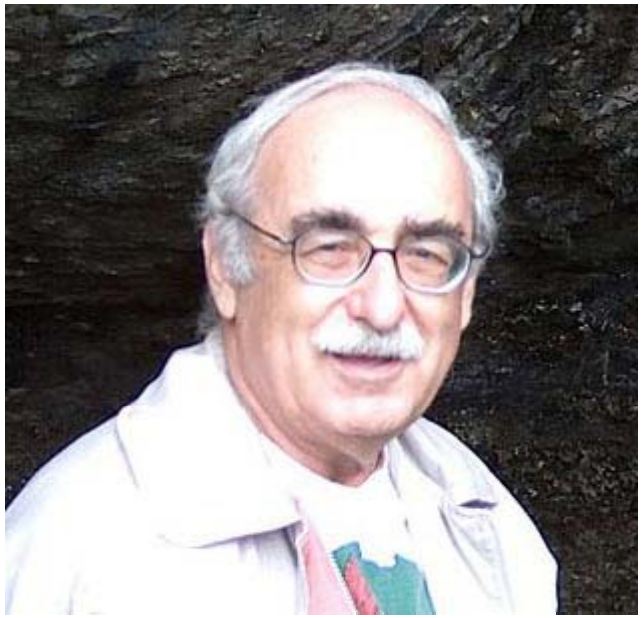
David Rindos

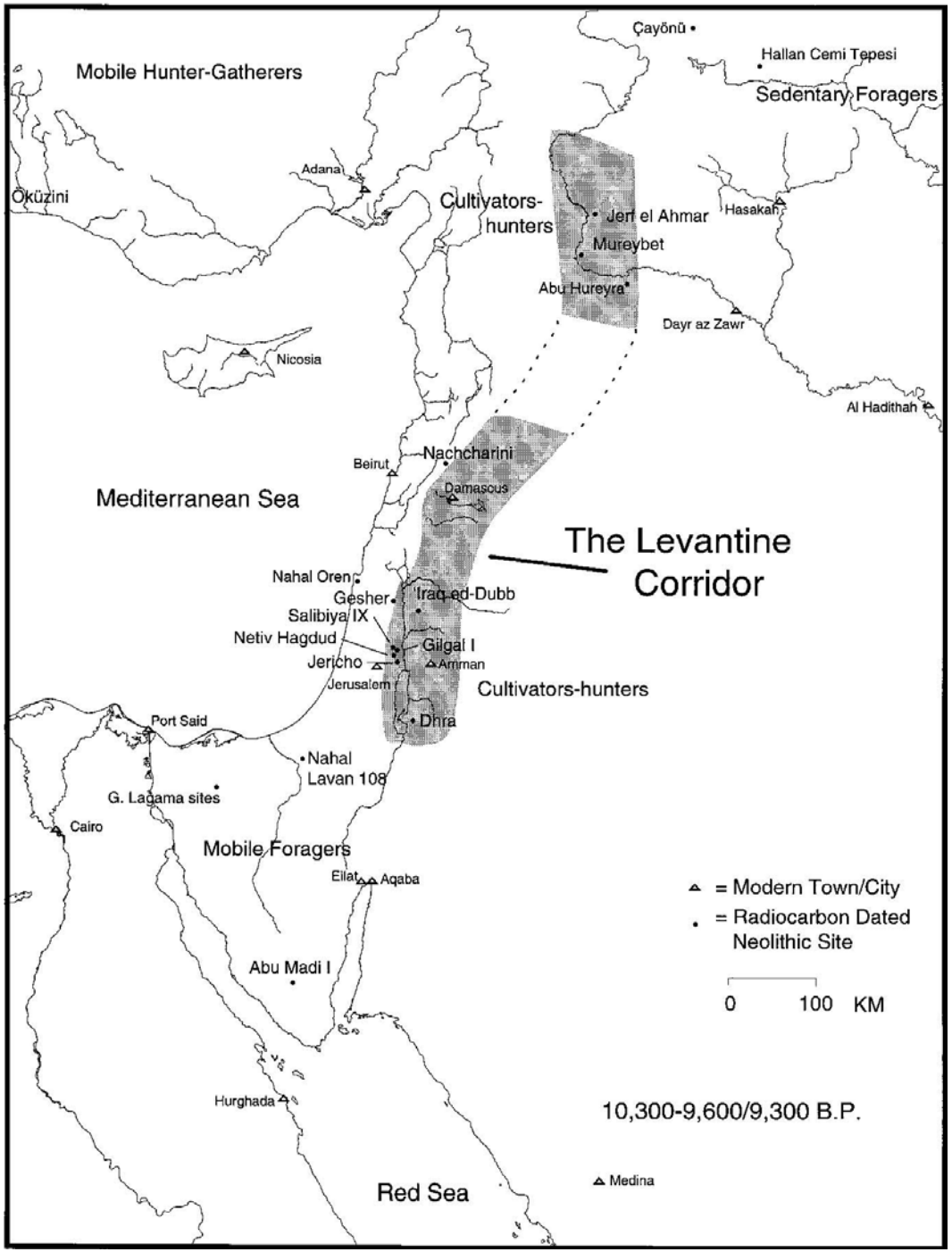


- 1984 – *The Origins of Agriculture*
- co-evolutionary model — 'mutualism'
- plant domestication was a 'co-evolutionary' process of humans and plants evolving together into a symbiotic relationship
- begins with 'incidental' domestication
- plants adapt to special circumstances set by human interactions
- rejects 'human intentionality' in the development of plant domestication

Ofer Bar Yosef

‘The Levantine Corridor’

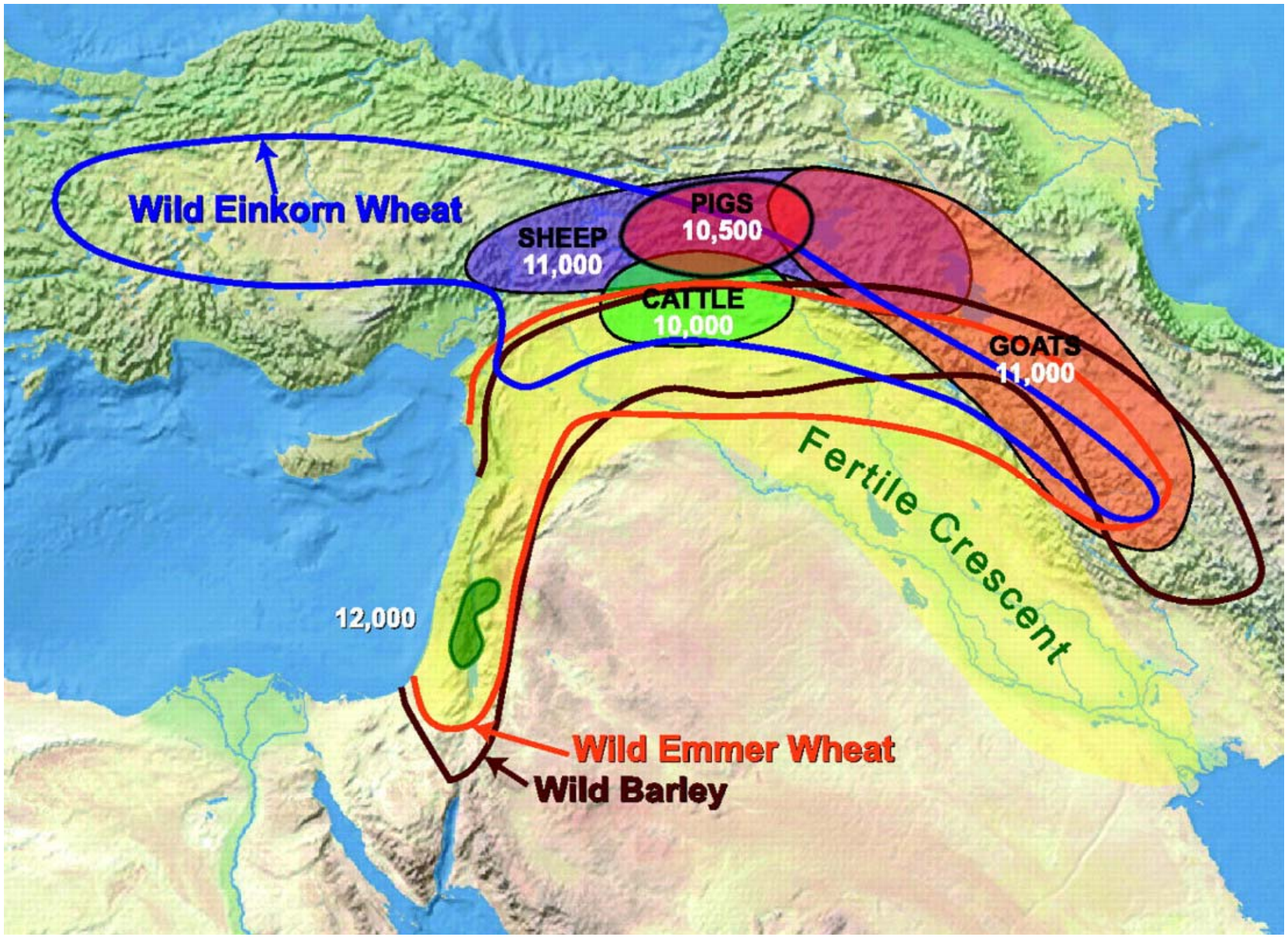




- “Historical Narrative explanation”
- Natufian groups occupied all eco-zones
- Levant was the most favorable zone
- semi-sedentary foragers settle in the coastal Levant
- Natufian technological innovation
- Population growth ➡ demographic pressure
- climatic crisis of the ‘Younger Dryas’
- ‘The Levantine corridor’ - home of seven ‘core domesticates’

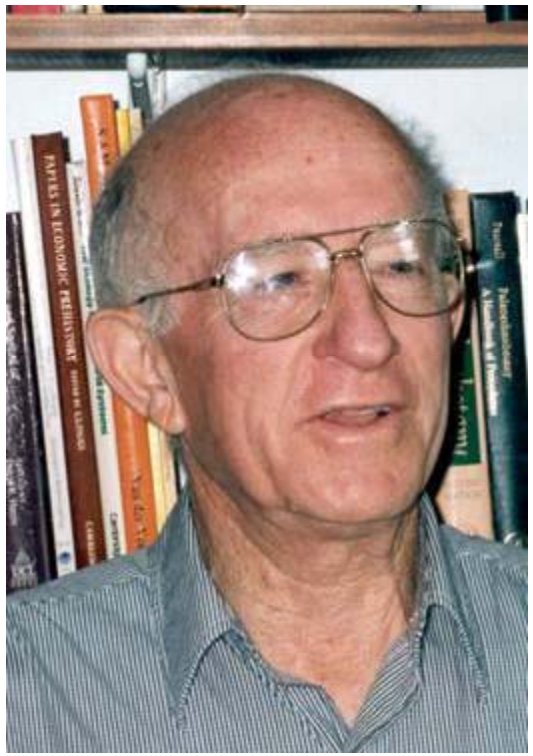
  Zohary – ‘founder crops’ - plentiful water resources

‘Founder crops’



‘Founder crops’

Southwest Asia is the geographic home to what have been referred by Daniel Zohary (1989) as ‘founder crops’



- These include:

  3 cereals: emmer wheat, einkorn wheat and barley

  5 pulses: lentil, broad bean, chick pea, field pea and bitter vetch

- all of these occur in the Levant except the chick pea

Archaeozoology

Archaeozoology is the study of the animal remains from archaeological sites

- Archaeozoologists are interested in the relationship between humans and animals in the past
- Archaeozoologists answer questions about whether animals were scavenged, hunted or herded
- They also examine how animals were butchered, how much meat they contributed to the diet, when animals died, and the process of domestication
- Faunal studies can show what animals were hunted and eaten and in what proportion
- Faunal analysis can also provide an estimate of the ratio of adult to juvenile animals and of male to female animals

Identification and Counts

- The archaeozoological work begins with cleaning, cataloging, and conserving the faunal remains recovered from fieldwork
- The bones are usually numbered so that information on their original provenience at the site is recorded
- Initial sorting of the animal remains often is based on size and type of bone
- Many bones cannot be identified beyond broad categories
- Archaeozoologists collect and deflesh dead animals for comparison purposes

Classification and study collections

The species list is an important step in faunal analysis involving the identification of the finds

- This list contains the names of the different kinds of animals present in the faunal remains at a site
- Many bone fragments cannot be identified, or can only be determined to the genus or family level

The number of individuals of each species is counted

- The **NISP**, the **Number of Identified Specimens** (sometimes also called Number of Individual Specimens), records the total number of bones from a species that have been identified at that location
- The **MNI**, the **Minimum Number of Individuals**, is based on counts of the number of a unique skeletal part from a particular species
- Calculating these numbers is difficult

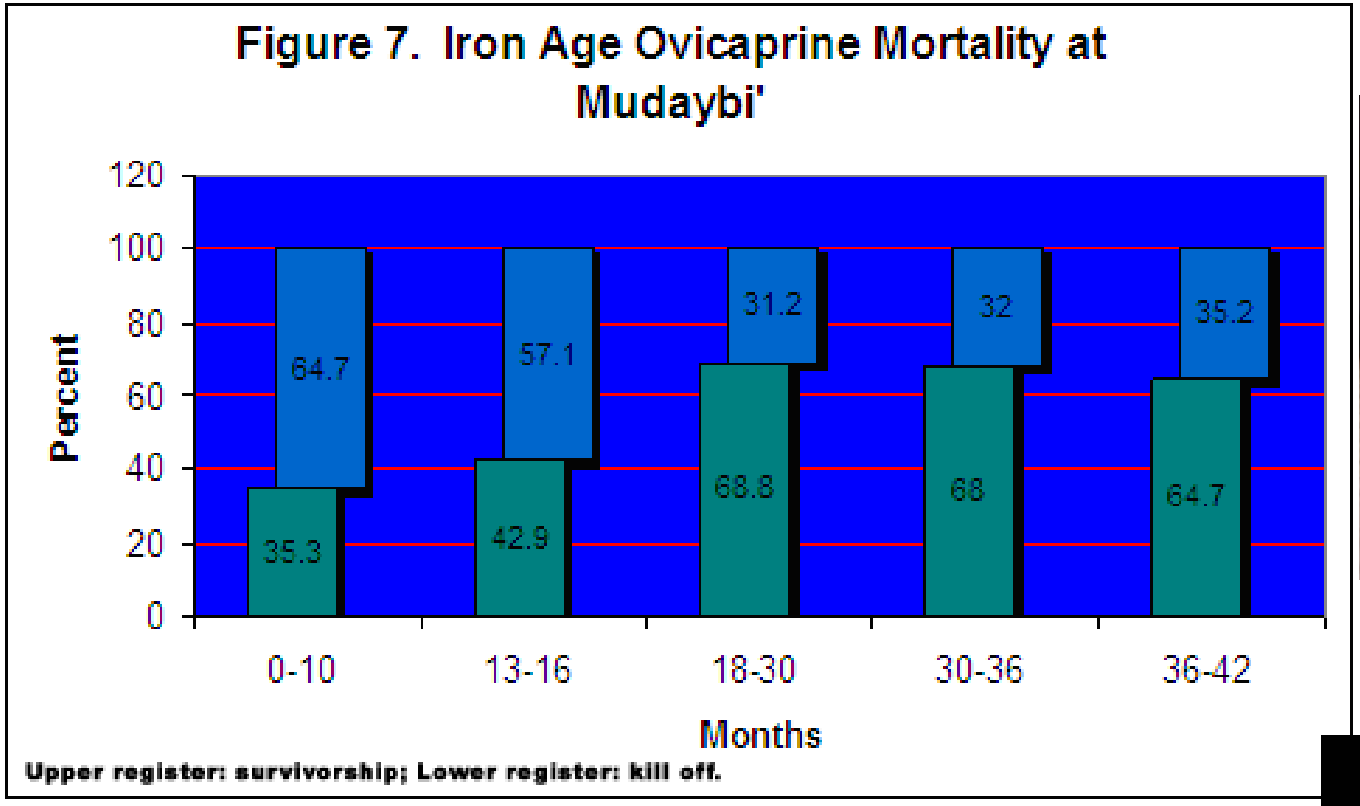
Species identifications

Age and Sex

Age and sex determination is typically only done for the most abundant species or in situations of special interest

- This information can provide insight into the role of herding and animal use
- Questions of site seasonality can also be explored
- There are specific indicators that archaeozoologists look for in the bones and teeth to determine age and sex
- Sex distinctions are found both in the size of animals and in certain bones, teeth, and other body structures
- Age determination is more difficult in animals

Sheep/goat mortality as evidence of diet



Seasonality

- Animal remains provide the best evidence for determining season of residence at the settlements of non-sedentary populations.
- Some species of animals are only present during certain times of the year.
- A number of species of deer lose their antlers at known times of year and replace them some months later.
- Many species of animals have fixed and known seasons of birth.

Example:

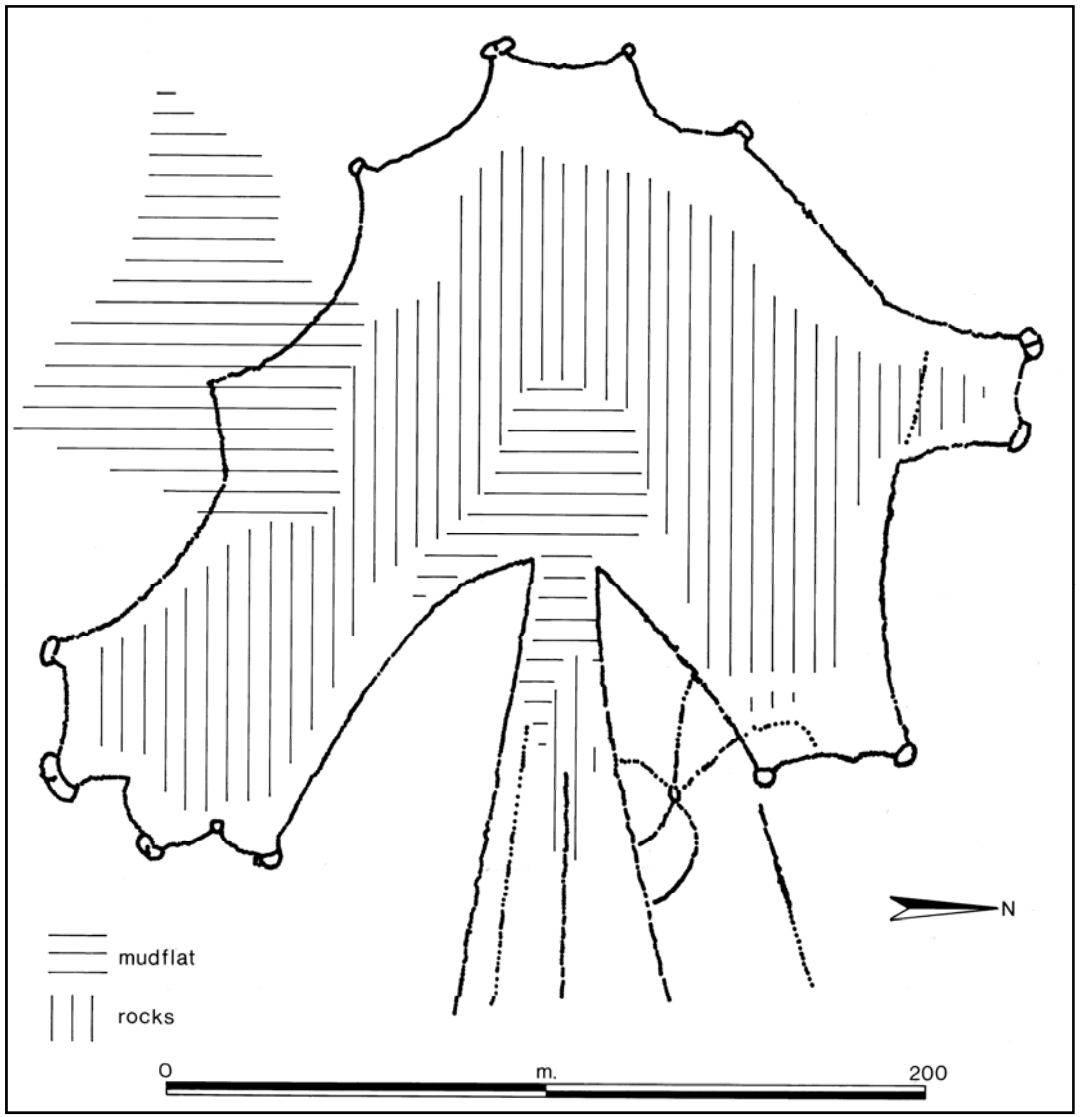
- Faunal and floral remains were analyzed at a Mesolithic site in eastern Denmark.
- The site dates to approximately 4500 BC
- Information from multiple animal species and plant remains suggests year-round occupation

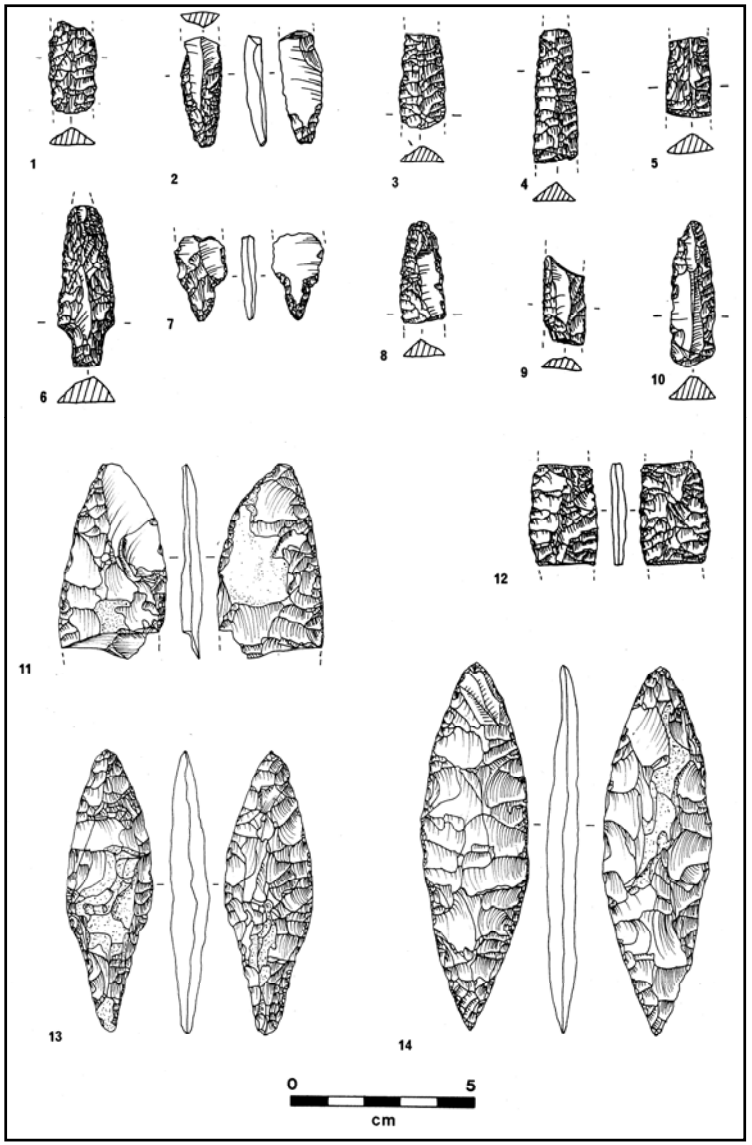
Seasonality in Neolithic Southwest Asia

The question of when sedentism appeared is important for understanding the origins of agriculture

- Seasonality is less pronounced in subtropical and tropical regions, including Southwest Asia where agriculture originated
- Study of gazelle teeth found that sedentism developed during the Pre-Neolithic (the Natufian)
- Gazelle migrations were targets of extensive group hunting activities using specialized hunting traps built at locations along the route

Arabian gazelle migrations

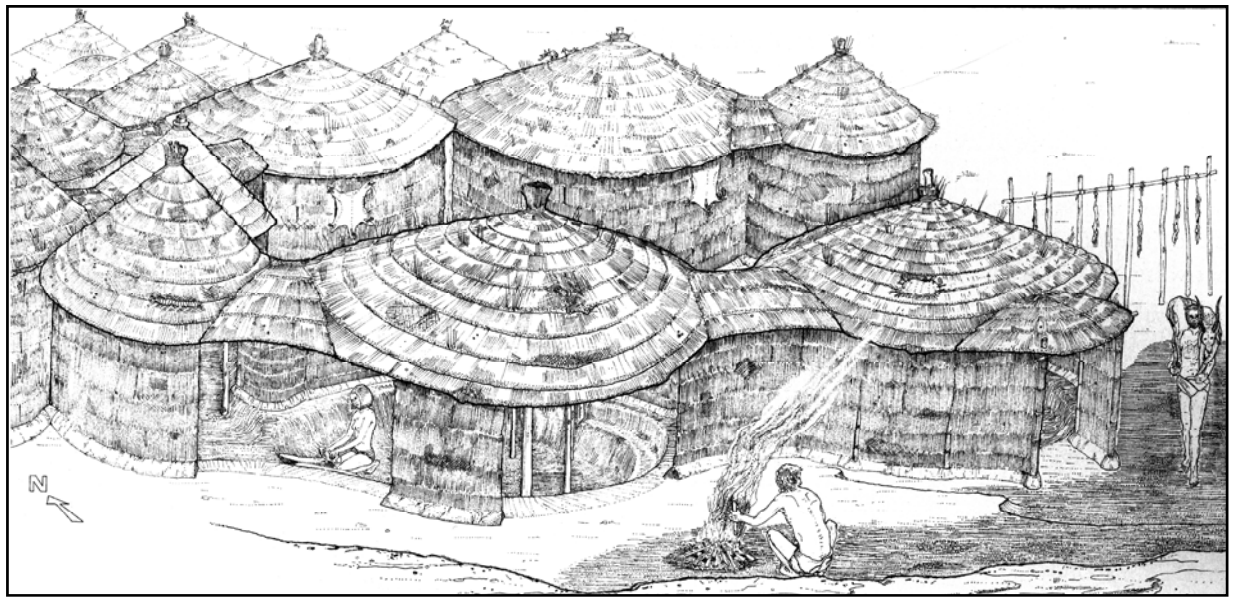




Desert ‘kite’ hunting traps and lithics excavated from the site

Seasonality in Neolithic Southwest Asia

- Other archaeozoological evidence confirms permanent residence at these sites, such as the presence of commensals
- Sedentary residence began 2000 years before the origins of agriculture, and these sedentary habitation sites often exhibit evidence of commensals
- Commensals are species found on sites which benefited from living in human occupation sites: they developed a symbiotic relationship with humans (house mouse, house sparrow, house rats)



Neolithic houses at Abu Hureyra

Commensals in the houses of early sedentary populations

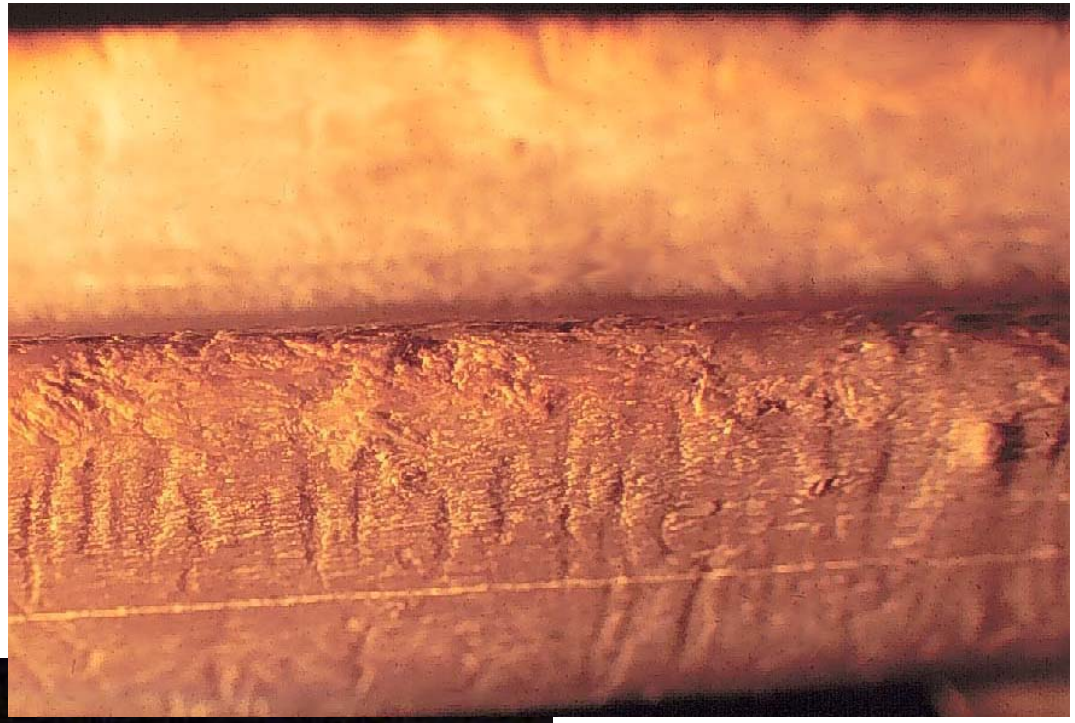
mouse

house sparrow

Taphonomy

- Taphonomy is the study of what happens to an organism after its death
- The discipline includes decomposition, post-mortem transport, burial, and the variety of other biological, physical, and chemical changes that take place
- A number of indicators can be observed on the surface of bone that document various taphonomic processes
- The largely invisible physical and chemical changes that take place in bone after burial are known as diagenesis

Tooth marks

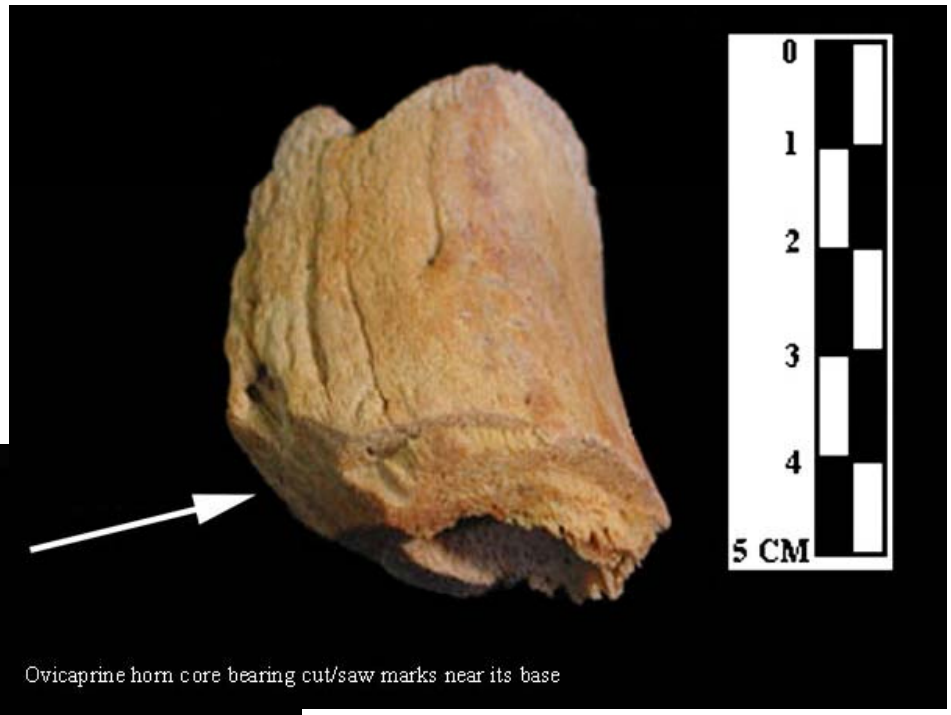


Other taphonomic processes include burning and fragmentation due to physical processes of exposure and scavenging

Butchery

- Butchery is another taphonomic process that animal bones undergo after death and prior to burial
- Animal carcasses were often cut up in certain ways to obtain the most meat possible and to make portions transportable
- Identification of the size and shape of butchered parcels indicates the cuts of meat that were sought after
- Cutting and butchering often leave distinctive traces or cut marks on the bones themselves

Cut marks on bone



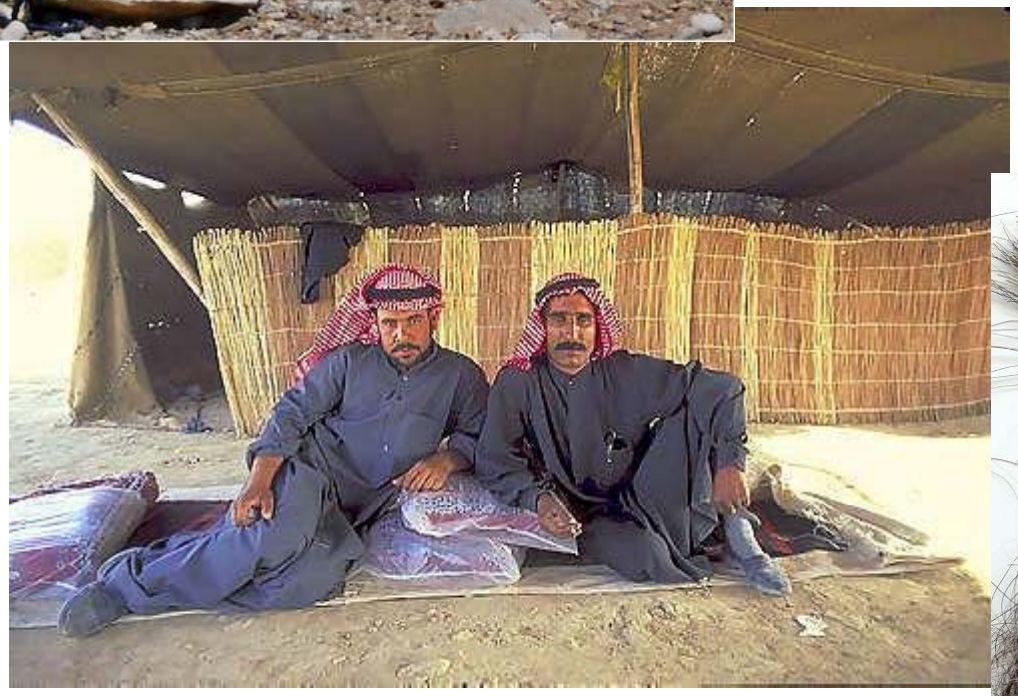
Ovicaprine horn core bearing cut/saw marks near its base

Cut marks on cattle ulna (forelimb)

Secondary Products

- Domestic animals provide a number of products besides meat
- These other uses and materials are sometimes referred to as secondary products
- Several animal species serve as draft animals for humans
- Milk is consumed directly or turned into a variety of dairy products
- Other resources include blood, wool, hair, hides, bones, horns, and antler
- In many cases the fauna can reveal patterns in the type of secondary products being exploited, i.e. the age/sex of the animal at death can infer some of this information

Milk, wool, hair



Goat hair tent