Ecological Decision-making

Ecology and Anthropological Models
• The need to develop an ecological perspective of human decision-making,

• Creating conceptual contexts to interpret archaeological finds along different frameworks,

• Used to make generalizations about how humans interacted with their environment and made decisions.
• The earliest perceptions of ecology in anthropology were mainly representatives of Cultural Ecology,

• Culture and Environment were treated as separate entities,

• Culture was accepted to be a factor of environment,

• Through adaptations, culture maintained a balanced / homeostatic relationship with the environment,

• Such adaptations are represented by behavior.
• The earliest approaches toward human-environment relationships had functional perspective in understanding adaptation:

• *Environmental Possibilism*: environment makes certain actions possible and people have choices,

• *Human Intentionality*: Humans intend to solve problems,

• *Adaptive Culture*: Humans use culture to adapt to their environment.
• Growing significance of the Neo-Darwinian Evolutionary Theory:
  
  • Adaptive changes not only favors *biological fitness* but they also enhance *social fitness*,
  
  • Social fitness means having an arsenal of varied behavior,
  
  • Diverse set of behaviors allow humans to determine cost-benefit relationships of their actions,
  
  • Behaviors are scale-dependent (i.e., directly proportional to group size),
  
  • Behaviors depend on the type of interaction with environment.
- **Human Behavioral Ecology (HBE):** is based on the Neo-Darwinian Evolutionary Theory.
  - aims to understand how humans interacted with environment,
  - how decisions were made by individuals (methodological individualism)
- **HBE** has microeconomics perspective in order to measure:
  - how each individual assesses the cost-benefit, and
  - how individual reacts to social events and catastrophes
- **HBE** views social processes as the emergent properties of individual's decisions and actions,
  - assumes that human actions are always rational and they have perfect knowledge of returns.
• Cost-benefit models, based on microeconomics, emphasize that the output (benefit) should be higher than input (cost).

• Game Theory: explains how one individual's decisions are influenced by decisions of others in the group (rational behavior).

• It focuses on what individuals do to maximize their returns, which information they process, which costs they consider.

• This approach views society as groups of hoarders and sharers, then assessing how resources are managed in a group.

• GT focuses on how strategic interactions among economic agents lead to what kinds of results in relation to individual's preferences:
  
  • the ultimate decision of sharing or keeping excess food (advantages/disadvantages of each action).
• **Optimal Foraging Theory**: aims to answer what the optimal way of obtaining food would be given the resource limitations.

• The cost-benefit relation here is in terms of caloric return (e.g., spend the least amount of time and calorie for obtaining the source that offers the maximum yield).

• These calculations are based on the expenditures for each resource (time to find, obtain, process, other risks).

• Emphasizes some decisions and choices made by the foragers (hunter-gatherers) in selective use of resources (**Diet breadth**):
  
  • resource and diet diversity,
  
  • environmental changes and impacts on the resources,
  
  • adaptations following loss of resources.
Optimal Foraging Model of an Information "Diet"
• *Patch-choice Model*: views environment as the sum of various patches,

• Each patch offers different resource(s),

• Resource density and energy expenditure are related,

• It is assumed that humans continue to use a patch until as long as the cost of movement is lower than the cost of finding resources,

• When this balance is upset, humans usually move out of that patch,

• This model usually applies to plant resources,
ON OPTIMAL USE OF A PATCHY ENVIRONMENT

FIG. 1. Equinumerous resource species. The decrease, $\Delta S$, in mean search time and the increase, $\Delta P$, in mean pursuit time which would accompany enlarging the diet from $N$ to $N + 1$ species of prey plotted for a hypothetical situation.
• *Ideal-free Distribution*: A model that assumes that humans usually pick the best habitats, if they are the first to come,

• Especially in parts of the landscape where the “good spots” are rare, the late comers do not have these choices,

• With the increasing settlement density, humans do not have the option of choosing the “good spots”,

• Based on technology and specialization, different habitats come in and go out of fashion.
The Earliest Human Impacts

The Pleistocene Hunter-Gatherers
(120-12 Kyr BP)
• When we talk about complex systems, we tend to focus on large scale farming, resource extraction, etc.

• However, all species and any society at any level of complexity have impacted the environment,

• It is usually assumed that hunter-gatherers did not create environmental change **BUT** adapted to such changes,

• Research indicates that hunter-gatherers created cascading environmental changes although evidence is limited and circumstantial,

• Also, some impacts are so old that it would be very difficult to differentiate these from natural changes.
• The earliest humans diverged from apes ~10 Myr ago,

• **Pliocene** hominids (~4 Myr ago) are well known and documented,

• **Late Pliocene** hominids such as Australopithecus had similarities and difference with Homo,

• Late Pliocene groups roughly consisted of 20 individuals or fewer, inhabiting tropical and sub-tropical landscapes,

• Only open landscapes (woodland, savannah) housed larger groups,

• Mostly eating plants, scavenging for meat,

• Diet, population, behavior do not suggest any significant impact on environment,
- **Early Pleistocene (~1 Myr ago)** Homo Erectus identical to modern human (Homo Sapiens sapiens) especially below the neck,

- Increased cyclical environmental shifts of this period, adept at making tools of various types, developed omnivore diet,

- H. Erectus cooperated for hunting, especially of large animals, gradually shifted to carnivore niche and started competing for meat resources,

- The earliest human impacts started when humans migrated from southeast Asia to temperate regions:
  - limited impact on plant population,
  - significant impact on animal population since they were competing with them.
• The source of the adaptive success of the earliest humans:

  • **Niche Construction**: organisms like humans can construct their own niches and environments through behavior and adaptation.

  • These shifts in the human ecology represents the beginning of indirect human impacts on environment,

  • The environmental modification brings adaptations and create feedback cycles as well as the destruction of other niches, which affected other animals' chances of survival,
- **Late Pleistocene** (~120 Kyr ago) Homo Sapiens hunter-gatherer bands displaying complex and patterned behavior visible in their hunting practices,

- mostly carnivores especially in colder climates, emergence of symbolic art and complex lithic (stone tool) technology;

- The human impacts clearly visible on animal population, especially with the start of using the fire (started ~ 500 Yrs ago),

- These hunting behaviors favored fire resistant plants that revived faster,

- These changes imply human niche construction in Asia, Europe, and Africa around 120 Kyr ago (the first global impact of humans)

- By 40 Kyr, the first signs of humans in Australia, 15 Kyr in Americas.
• The pre-modern human impacts can be summarized as:

• resource consumption,

• competition with other animals,

• use of fire.

• Human co-evolved with animals as they were hunting,

• Human success in adaptation was cooperative hunting and hunting techniques, also contributing to animal evolution through killing less agile animal population such as large ones or slow to adapt animals.
The Late Pleistocene Colonization of Pristine Landscapes
— Americas —

- Although the evidence is scarce and circumstantial, the clues for the first human impacts on environments are more available at certain places.
- Because it was difficult to get, the colonization of Americas and Australia took place much later.
- At the time of colonization, in Late Pleistocene, sea levels were much lower, Americas were closer to Asia.
- Ice sheets, 3 km thick, covered much of the north America except Alaska, cold and dry climate that favored tundra and steppe along the glacial.
- Just to the south of ice sheets, milder climate favored mesic vegetation (boreal woodlands).
- Mostly large ungulates, and big carnivores, known as the Arctic fauna, similar to modern African savannah.
• Although controversial, the origins of the first Americans (Paleoindians) ~13 Kyr, considered to have come from Siberia after the regression of the Siberian ice sheets,

• These groups were well adapted to sub-Arctic conditions,

• Possibly in the **Late Pleistocene** people moved south of ice sheet by following coastal or inland passages around ~12 Kyr,

• Fast spread after that point, colonizing the pristine American landscape, which was full of new animal and plant species that were not accustomed to human presence,

• **60% of megafauna** became extinct within a short period in the **Late Pleistocene**: the megafauna that survived the climate change previously could not escape from intensive human hunting.
According to Paul Martin’s Blitzkrieg Model the demic expansion followed large animals, moving to areas where they lived.

The computer simulations suggest that within roughly 1,000 years humans reached to the southern tip of the Americas (~11 Kyr).

Although this model is an oversimplification and the demic expansion at the scale he is suggesting is not possible among the hunter-gatherers, it is true that extinctions took place.

However, megafaunal extinctions do not happen at the same time with colonization and there is not enough evidence for extinctions of megafauna other than bison.

Also, overkill does not match with the Human Behavioral Ecology.
• Based on the evidence, the **Ecology of Colonization** developed by scholars suggests that humans moved in “leap frogs”.

• They colonized lands in mega patches, using and occupying the richest habitats first, then moving into less rich zones,

• It is estimated that it took humans approximately 50 generations to move from the north of America to the south, population filling up the land later,

• The environment that the Paleoindians lived in was diverse, they were highly mobile, had sufficient skill and technological knowledge to kill large animals,

• Their diet seems to have low diversity: focus on high calorie intake, mostly meat consumption due to the availability of large game,

• The Old World evidence suggests a similar case of hunting for reindeer but without major impact over long-terms, which is different from the case of the Americas.
The Late Pleistocene Colonization of Pristine Landscapes
– Australia –

• Marsupial megafauna became extinct because of following human colonization,

• According to R. Webb, there is no evidence for overhunting but because Australia was very dry and had desert landscape to start with,

• The animal population had low diversity, consisted of few large carnivore communities and sparse population of large herbivores,

• Australia had fragile ecosystem, humans had significant impacts by hunting same herbivores and out-competing carnivores, driving them to extinction,

• Rapidly depleting easy-to-hunt resources, humans replaced large carnivores but never co-evolved with herbivores.