THE IMPACTS OF THE YOUNGER DRYAS PERIOD ON PLANT AND ANIMAL FOOD RESOURCES OF THE ANCIENT NATUFIAN CULTURE AND THE ECONOMY

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ABSTRACT

THE IMPACTS OF THE YOUNGER DRYAS PERIOD ON PLANT AND ANIMAL FOOD RESOURCES OF THE ANCIENT NATUFIAN CULTURE AND THE ECONOMY

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This masters thesis investigates the environmental/climatic change that is thought to have brought about the economic shift and transition from Palaeolithic economic system of hunting gathering to Neolithic economic system of agriculture and domestication period around 11.000-10.000 years ago. This study uses the collected animal and plant data of the Natufian culture in the Levant region from the previous zooarchaeological and archaeobotanical literature anlyses. It shows a significant mathematical difference in the zooarchaeological assemblage measures between the Early and Late Natufian sites by calculating Economic value parameters of the Early and the Late Natufian sites, a comparison analysis was made in terms of percentage frequencies of animals site by site and between early-late periods. The result shows a significant animal food supply decrease and change-shift shown during the Younger Dryas climatic crisis times of the whole Late Natufian period sites total and early to late site by site individually, compared to whole Early Natufian period sites. It shows there is a possibility that some big-base camp Late Natufian occupation sites were better able to create coping mechanisms against food crisis/food shortage and more successfully than other Late Natufian sites during the climatic food crisis period. It shows supporting with the animal-plant data and changes in the human bones, burial practices, human teeth, diet changes and anthropological studies evidence, a big social-economic-cultural change and a huge food crisis was highly possible and humans highly possibly lived an economic crisis and an highly connected-related social-cultural crisis during the Younger Dryas in the Late Natufian times human societies.

Keywords: Younger-Dryas, Epipalaeolithic, Levant, Natufian, zooarchaeology.

ÖZ

GENÇ KURULUK DÖNEMİNİN ANTİK NATUFYAN KÜLTÜRÜNDEKİ BİTKİSEL VE HAYVANSAL BESİN KAYNAKLARINA OLAN ETKİSİ VE EKONOMİ

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Bu tez, günümüzden yaklaşık 11.000-10.000 yıl önce Paleolitik donem (Eski Taş Devri) avcı toplayıcı ekonomik sisteminden Neolitik dönem (Yeni Taş Devri) tarım ve hayvancılık ekonomik sistemine gecişe neden olduğu düşünülen çevresel ve iklimsel degişikliği incelemektedir. Bu çalışma daha önceki arkeozoolojik ve arkeobotanik çalışmalarda elde edilmiş Levantin bölgesindeki (kıyı ve karasal İsrail - batı Ürdün - Filistin - güney Lübnan ve güneybatı Suriye bölgesi) Natufyan kültürünün hayvan ve bitki bulgularını kullanmaktadır. Çalışma, erken ve geç dönem Natufyan yerleşimleri arasındaki Ekonomik değer ölçücülerinin hesaplanması ve hayvanların yüzde sıklığı yolları kullanılarak, farklı yerleşimler birbirleri arasında ve erken-geç dönemler toplamında bir karşılaştıma analizi arkeozoolojik ölçümlerde kayda değer matematiksel bir fark göstermektedir. Çalışmanın sonucu, geç Natufyan döneminin Genç Kuruluk iklimsel krizi dönemlerinde, erken-geç dönem yerleşimler kendi aralarında ve tüm erken-geç dönem toplamı karşılaştırıldığında hayvansal besin kaynağında kayda değer bir azalma ve değişim-geçiş göstermektedir. Sonuçlar, geç Natufyan'da büyük temel yerleşim yerlerinin besin krizi/besin kıtlığı durumlarına karşı diğer geç Natufyan dönemi yerleşimlerine göre kıyasla iklimsel besin krizi döneminde daha başarılı mücadele ve hayatta kalma yöntemleri geliştirmiş olma olasılığını göstermektedir. Çalışma, hayvan-bitki bulguları ve insan kemikleri, insan dişleri, yemek/yeme alışkanlıklarındaki değişimler ve antropolojik çalışmaların kanıtlarının da desteklemesiyle birlikte, geç Natufyan döneminin insan toplumlarının Genç Kuruluk iklimsel krizi dönemlerinde büyük bir sosyo-ekonomik-kültürel değişim ve büyük bir besin krizi ve bununla yüksek oranda ilişkili sosyokültürel bir krizi yaşadıklarını göstermektedir.

Anahtar Kelimeler: Genç-Kuruluk, Epipaleolitik, Levantin, Natufyan, zooarkeoloji.

To My Family…

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CHAPTER 1

INTRODUCTION, AIMS OF THE RESEARCH AND THE RESEARCH BASIS OF THE THESIS

1.1. AIMS OF THE THESIS

This thesis will analyze the processes and the driving forces behind the transition from a Paleolithic economic (food gathering) and socio-cultural system to the Neolithic (food producing) system. By focusing on economic changes/aspects and the related climatic/ecological changes/shifts, as well as changing environmental factors, it will attempt to reveal what may have driven the initiation of agriculture at that particular time. The study will largely be based on past theories relating to the transition from the Paleolithic to Neolithic system, or, in other words, from a hunter gatherer-based food gathering economy to an agricultural and domestication-based food production economy. This study primarily focuses on theories that analyze the impact of environmental change on this transition to agriculture; with supporting arguments being drawn from case studies and from archaeobotanical and archaeozoological excavation reports, including archaeobotanical (cereals) food remains and archaeozoological (animal bones) food remains. This will allow an analysis of the quantity and type (animal/plant species) of food supplies prevalent at the time, from which it will be possible to calculate the change in the total environmental food supply potential in the Levant area. It is assumed that this will be an indicator of environmental/climatic change, based on the use of archaeobiological data taken from the examples of the transition between the Paleolithic and Neolithic systems and the transformation of the Natufian cultures in the Levant.

The reason for why I choose this subject is because I had an undergraduate degree in economics and mainly I'm highly interested in analyzing the origins and social/economic/environmental reasons for the transition from food gathering economies to food production economies. The emergence of agriculture and the spread of food production were the starting point for the formation of settlements, the centralization process and the rise of the modern urban social/cultural system. This, in turn, led to the emergence of contemporary cities/metropolises, worldwide urbanization, a social/cultural evolution, and the liberal urban market economics of the present day. Previously published Neolithic transition theories that have put forward environmental and socio-cultural reason-based arguments are yet to be verified, and as such they are still the subject of much discussion today. It is hoped that this thesis can take a look from a new perspective, and thus contribute to a better understanding of the subject matter.

Looking at the theoretical roots of this study within the framework of the Settlement Archaeology program, this master's thesis research study analyses the agricultural transition, domestication and Neolithic transition in an interdisciplinary manner, bringing to the table economic science and also archaeobiological research for study alongside archaeology. Archaeobiological data, when used to address environmental/climatic and economic/socio-cultural problems, can have a solid base under the umbrella of settlement archaeology disciplines and other interdisciplinary archaeological studies.

The aim of this research study is to analyze the agricultural, domestication and Neolithic transition, considering the environmental/climatic changes revealed in earlier archaeobotanical/paleoclimatic researches and other sources; the natural/environmental reasons for the economic change, and their effect on the potential natural food supplies throughout the region; and how climatic change influenced the socio-cultural efforts towards this transition. To this end, this thesis will take a more critical and deeper look at the subject of the agricultural transition than has been provided by previous theories.

The primary questions to be answered by this study are: 'Was there a food crisis/food shortage after the environmental/climatic change/shift began in the Levant? Did this food crisis continue for the duration of this climatic change up until the agricultural transition, prior to the start of the Neolithic period?'; while the study will also answer the questions of: 'Is there archaeobiological evidence explaining a biological/environmental or economic connection between the origin of the food crisis and the agricultural transition in the Levant after the period of this climatic change ended? Was the transition from hunting-gathering to the initiation of agriculture (food production/food storage) due to a change in the economic structure of society? Was it a strategy to cope with environmental constraints, a risk buffering technique, or another storage strategy taken up by societies in the Levant?'

1.2. INTRODUCTION TO THE LITERATURE REVIEW

Previous literature on the subject includes a definition of the concepts, a chronology and geography of the agricultural transition, and the period in which the agricultural transition from food gathering to food producing is thought to be have started in the area of Levant-Palestine and the Fertile Crescent, fertile arc region (verimli hilal/bereketli hilal in Turkish), as defined by Braidwood (Braidwood 1995: 56). This geographical area includes south-west Syria, northern Iraq, south-west Iran, south-east Turkey, the entire region of Palestine and Israel and west Jordan **(Figures 3 and 5)**, and has previously been the subject, along with the agricultural transition, of in-depth studies and analysis by Bar-Yosef and Braidwood.

It is thought that the agricultural transition in the Levant-Palestine region and the Fertile Crescent occurred some time after the start of the Epipaleolithic period in EPPNA (Early PPNA), and lasted until the MPPNB (Middle PPNB).

Table 1. Chronology of the Southern Levantine region (Created using data of Twiss 2008: 8 after Banning 1998, Kuijt and Goring-Morris 2002, Twiss 2007b cited in Twiss 2008:8).

Period	Radiocarbon B.P.	Calibrated B.C.
Epipaleolithic	Before 10200	Before 9700
PPNA	10200-9400	9700-8500
PPNB		
MPPNB	9500-8300	8500-7250
LPPNB	8300-7900	7250-6700
PPNC	7900-7500	6600-6250
Late Neolithic	7500-6000	6250-5300 ?

Table 2. Some known Natufian Sites and their chronology (Created using data of Munro 2004: 59) **(Calibrated by Oxcal C14 2009, B.P. to B.C. dates conversion/calibration program version 4.1)**

Site	Cultural Phase	Approx. Time Range (Uncal B.P.)	Radiocarbon Dates (Cal B.C.)	References
El-Wad Cave (Chamber III)	**Early Natufian**	**13000-11000**	**12727-12294, 10171-10108**	**Weinstein-Evron 1998**
Hayonim Cave (Phase I-III)	**Early Natufian**	**13000-11000**	**11831-11471**	**Bar-Yosef 1991**
Hayonim Cave (Phase IV-V)	**Late Natufian**	**11000-10200**	**10932-9874**	**Bar-Yosef 1991**
Hayonim Terrace (Level II)	**Late Natufian**	**11000-10200**	**10932-9874**	**Valla, Le Mort and Plisson 1991**
Hilazon Tachtit	**Late Natufian**	**11000-10200**	**10754**	**Grossman 2003**

1.3. PAST AND RECENT THEORIES OF AGRICULTURAL TRANSITION

The Paleolithic to Neolithic agricultural transition period has been analyzed from many different perspectives, including environmental, natural climatic or human social cultural economic subsistence in ancient times, and many theories have been voiced by researchers in this field. **(See Table 3)**

A number of researchers have focused on natural climatic changes in the region from that time period, and agree that changes were experienced around that time in both the average temperatures and also sea and lake levels in the region. Others have focused on social/cultural aspects, suggesting that organized feasting may have been the driving force behind the transition; while there are also theories that attribute the transition to population pressure, explaining that a rapid population increase created a shortage of food, alongside other human impacts. **(See Table 3)**

I want to choose and analyze the previous transition theory **(See Table 3)** about the impact of environmental change over the origination of agricultural transition. This thesis will include an analysis of the theory of the Younger Dryas – being the impact of the environmental/climatic change on the transition to agriculture in the Levant area. The archaeobotanical and archaeozoological evidence/food remains/bones discovered in the Levant/Natufian area from this period have been previously studied by many archaeological and archaeobiological researchers, including Bar-Yosef, Bar-Oz, Colledge, Miller, Hillman, Munro and Davis, who have all done extensive work in this field.

The ‘Feasting’ theory, and the related ‘Competitive Feasting’ theory, are related to the feeding power/responsibility of a group of people over another group of people, and are concerned with the impact of social/socio-cultural change on the agricultural transition. Previously studied and analyzed by Hayden and Dietler, this theory will be revisited in this thesis so as to take another look at the process and reasons for the agricultural transition, making an interpretation and analysis of the theory and the climatic event of Younger Dryas, and linking it with the advent of a possible food crisis.

Table 3. Past and recent theories of agricultural transition (Created using data of Weisdorf 2005: 564), The development of research into agricultural origins and transition theories in the history

Time	Hypothesis	Main Theory	Reason for Refusal
?-1930	“Stage”	Agriculture was the final stage in a unilinear development path	External pressure was believed to have generated the shift
1930-1950s	“Oasis”	The shift was motivated by changes in the environment	Climatic changes were too slow, earlier interglacial periods did not result in the adoption of agriculture
1960s	“Natural Habitat”/ “Nuclear Zone”	Abundance of leisure time led to plant experimentation	Evidence suggests that farming arose out of necessity rather than opportunity
1960s-1980s	“Marginal Zone”	The shift was generated by population pressure in infertile zones	The first domestications took place in resource abundant societies
	“Population Pressure”	The shift was generated by population pressure on a global scale	Skeletal evidence did not indicate a food crisis
	“Overkill”	Animal extinction indicated the presence of a food crisis	Animal extinction and agriculture did not occur together, neither geographically nor chronologically
1980-1990s	“People-Plant Interaction”-“Human Plant Symbiosis”- “Co-evolution”	The shift resulted from unintentional human behavior/manipulations – Land exploitation and energy input are strongly correlated	All still under consideration
1980-1990s	“Competitive Feasting” – “Feasting”	The first domestications were important foods	The first domestications were delicacies
1990-2000s	**“Younger Dryas” - hypothesis – abrupt and harsh shift to colder and drier conditions – possible**	**The shift was motivated by changes in the environment – climatic change of Younger Dryas**	**Still under consideration - food crisis ???**

Table 4. A chronology of the period of the Younger Dryas climatic event (Created using data from Bar-Yosef 1998:90)

C14 Uncal.	C14 Uncal.	C14 Cal.	C14 Cal.	Traditional Levantine Chronology		
B.P.	B.C.	B.P.	B.C.	Pottery Neolithic		Cultural Entities
7000	5000			Pottery Neolithic Climatic Crisis		
		8000	6000	Final PPNC		
8000	6000			Late PPNC		
		9000	7000	Middle PPNB		Tahurian
		10000	8000	Early PPNB		
9000	7000			Northern Levant		Southern Levant
		11000	9000	PPNA	Aswadian?	Sultanian
10000	8000			Mureybetian		Khiamian
		12000	10000	Late Natufian	Harifian in Negev and Sina Peninsula region	Younger Dryas climatic event
11000	9000	13000	11000	Early Natufian		
12000	10000	14000	12000	Earliest Manifestation ?		
13000	11000	15000	13000	?		
		16000	14000	Epi-Paleolithic (Geometric Kebaran, Mushabian, Hamran, etc.)		

1.4. THE YOUNGER DRYAS THEORY

The Younger Drays theory refers to the environmental climatic change that started in the Early Holocene period in the Levant region and continued until the PPNA period, which coincides with the advent of agriculture in the Levant. This natural climatic change brought significant changes/shifts in average temperatures and precipitation, resulting in a relatively brief global return to a colder and drier climate in the area. However, there is evidence that in around 7612 B.C. a short arid period was observed in the Levant.

This climatic change affected the hunter/gathering semi-nomadic cultures that resided in the region (Natufian, Kebaran, Khamian, Sultanian), and this fact, possibly in conjunction with other factors (i.e. cultural social pressures and social interaction) may have brought about changes to the prevalent economic subsistence methods, economic buffering and storage strategies of the time.

The Younger Dryas theory addresses both the direct and indirect effects of environmental change. According to the theory, the agricultural transition was driven by changes in the environment, however this theory is still under consideration (see Table 3, Weisdorf 2005: 564).

I tend to believe that the transition to domestication may have emerged as a combined result of environmental changes and economic and social factors, as referred to in the theory of 'Feasting' and 'Competitive Feasting'. The main questions raised by the Feasting theory are: 'Which foods were the first domesticates? Were luxury foods/goods (defined as scarce, and thus highly valuable goods; those in widespread use; or those with a high exchange value) or subsistence foods/goods the first domesticates?' I believe that, because the possible food crisis, subsistence goods could be the first domesticates for human to survive.

1.5. METHODOLOGY

The methodology includes an analysis of previous literature and transition theories, especially analyzing reviews of the theory of Younger Dryas. Archaeobiological reports from sites that have revealed evidence of the agricultural transition and the transformation cultures of the Natufian area in the Levant during the transition between the Paleolithic and Neolithic cultures will be reviewed, as well as archaeobotanical and archaeozoological reports (from food, plant and animal remains).

An estimation of the changes in natural food supplies will be made after the selection and measuring of effective economic and environmental parameters, being indicators of economic change and agricultural transition, the impact of climatic change and its possible initiation of a food crisis, and changes in economies. This will be achieved through a comparison of the quantities of animal and plant remains, changes in the diversity of animal and plant species, and the characteristics of these species in the food supply from before and during the period of the Younger Dryas environmental change. Indicators of a possible food shortage/famine will also be sought through an estimation of how much food can be obtained from hunting/gathering; how much people can get from the food supply as ‘input’, and how much effort/physical labor was needed to produce (process) the food as an ‘output’. Differences in the estimated input/output ratios of the food supply from before and after the Younger Dryas environmental change event may indicate a possible food crisis/famine, and from this data it will be possible to deduce the environmental and economic reasons for the hypothesized food crisis, and the resulting economic and socio-cultural impacts.

In a bid to prove that a food crisis did occur as a result of the Younger Dryas event, a possible decrease in food supplies, indicated by a decrease in the input/output ratio from before and after Younger Dryas period, will be investigated. This may provide evidence that the events of this period were the underlining reason for the economic and socio-cultural impacts that in turn brought about the transition to a new economic system (the Neolithic food producing system, from the Palaeolithic hunting/gathering system).

Proving or disproving the existence of a food crisis at the time is critical, as this may have affected and influenced the birth of a new economic and environmental mechanism and strategy that took the form of agriculture and animal domestication through primitive agriculture techniques at the time of the transition, and in the specific Natufian areas/sites in the Levant.

The Younger Dryas theory, which places the responsibility for the birth of agriculture solely with environmental change, is lacking in proof, however it would be logical to assume that this may have been the first step in the “Neolithization” process. It would safe to say that the climatic change of the Younger Dryas preceded a food crisis; and since food was scarce there would have emerged a need for social/cultural/organizational change to create a buffer to cope with food crises in the future. This would have brought about the initiation of agricultural specialization in food production; and accordingly, combining and completing the Younger Dryas theory with the Feasting theory is my idea of what may have happened and Feasting will be my possible future research as the social/cultural/political and maybe religious/cultic impact over agricultural transition.

1.6. LIMITATIONS FOR DATA GATHERING

Limitations may be experienced in the gathering of reliable data and sufficient archaeological, social, botanical and zoological material to represent the whole agricultural transition period. There may also be limitations in collecting comprehensive information on animal and plant species for all the Natufian culture sites in the Levantine Epipaleolithic; as well as in collecting objective interpretations of the archaeological data from the available articles.

CHAPTER 2

THE LITERATURE REVIEW

2.1. AN INTRODUCTION AND THE PATTERN OF THE HISTORY OF THE DEVELOPMENTS ON THE AGRICULTURAL ORIGINS RESEARCH

The agricultural origins were so much researched by evolutionary thinkers who had long been interested and fascinated by understanding and solving the first origins of agriculture and the steps of the origination of agriculture that made thinkers and researchers to think about so widely. According to the research about the pattern of the historical developments of the agricultural research, at first Darwin, by his theory of biogenetic evolution of the Origins of Species in 1874, he did not speculate on the agricultural origins, but in the 20th century, the scholars and researchers were more speculating on the agricultural origins. In the 20th century the Soviet agronomist, an agricultural scientist, Nikolai Vavilov, the American geographer Carl Sauer, and the British archaeologist Gordon Childe thought widely about the agricultural origins, they made research and wrote effective books, papers and publications on the origin of agriculture in the 1920s and in the 1930s for questioning the intellectual history of the origin of agriculture question (Flannery 1973 and Mac Neish 1991: 4–19 cited in Richerson, Boyd and Bettinger 2001: 1-50).

These past research and discoveries were necessary and speculative and effective but some unclear and uncertain, because of lack of archaeological data, but but these past research on agricultural origins stimulated interest of the scientists and the people in the agricultural origins question more highly, deeply and widely. After second World War around after 1950s the American archaeologist Robert Braidwood first started the systematic study of agricultural origins, by using the known history of ancient village sites in the Near East and from the presence of wild ancestor species of many plants as crops and animal domesticates in the same region, Braidwood thought that this area was like a main center, the locus of the origins of the initiation of early domestication and agriculture (Braidwood et al. 1983 cited in Richerson, Boyd and Bettinger 2001: 1-50). Then he thought on a program of excavation in the foothills of the southern Zagros Mountains in the northern/north eastern Iraq using a multi disciplinary archaeology team of archaeologists, botanists, zoologists, and earth scientists to extract the maximum useful information from the excavations. At that time the opportunity for the use of dating method of C14 dating was so much useful for determining the true ages of the sites. The Near Eastern sites which were older than around 16136 B.C. excavated by Braidwood (Braidwood and Howe 1960 cited in Richerson, Boyd and Bettinger 2001: 1-50) were settled and occupied in the ancient times by hunter gatherer communities who put much more importance on hunting and unspecialized gathering than on collecting and processing the seeds of especially productive plant resources (Goring-Morris and Belfer-Cohen 1998, Henry 1989 cited in Richerson, Boyd and Bettinger 2001: 1-50). In these times the dating results of the Braidwood team were given as calendar dates before present (B.P.), where present was taken as 1950 at the year of that time, and dating results and ancient dates were measured from C14 dates according to Stuiver's calibration curves in 1998. After the research the Braidwood team showed that about 11,000 years ago (B.P.) from now (10932 B.C.), hunter-gatherers were collecting wild seeds, may be the ancestors of nowadays' wheat and barley, and were hunting the wild ancestors of domestic goats and sheep. In 8233 B.C. in the site of Jarmo in northern Iraq, the team excavated an early farming village. By this excavation and research it was understood that, the Jarmo people were settled in permanent villages cultivating early-domesticated varieties of wheat and barley and nowadays' Jarmo people were using the same seed processing technology as their hunter gather ancestors 9,000 years before. Many continuing research made in and around this field now provide a logical detailed picture of the origins of agriculture in several independent centers and its continuous diffusion to almost all of the earth and the all sites suitable for cultivation. These past research did not discovered any region or site in which agriculture developed earlier or faster than in the Near East and Levant region, but a North Chinese center of domestication of the plant millet (Panicum miliaceum) may prove almost an earlier date but it is not certain. Other centers of agriculture seem to have developed later, or more slowly, or with a different system of stages. The spread of agriculture and domestication from the centers of originition/initation of agriculture and domestication to more remote areas was highly researched and well documented for Europe and North America. Ethnographic and ethnoarchaeological research also gives information and cases where hunters and gatherers were persistant for staying in areas that seems highly suitable for agriculture in the ancient times, also in the hunter gatherer communities of the recent times in the most of western North America and the Australia. Research attempts for understanding this complex hunting gathering and agricultural origins pattern are one of the major focus of archaeological science (Richerson, Boyd and Bettinger 2001: 1-50).

The timing of originitation and invention of agriculture highly varies quite geographically and chronologically. The Near Eastern Neolithic is the earliest so far known by these agricultural origins research done for many years by the related field's agricultural, archaeological, archaebotanical, archaezoological and other interdisciplinary socio cultural anthropologists working for the early Neolithic and Epipaleolithic period. According to the agricultural origins research including all the world, in the North, and possibly in the South, China, however, agriculture probably followed within a thousand years of the beginning of the Holocene, actually known as the best documented for agricultural origins evidence, clearly agricultural complexes are still considered as later in China (An 1991, Crawford 1992, Lu 1999 cited in Richerson, Boyd and Bettinger 2001: 1-50). Agriculture may prove to be as early in North China as in the Near East, since the earliest dated sites, which were extended back to 7540 B.C., represent advanced agricultural systems that must have taken some time to develop. According to the research done and excavations in North China, in the north of the earliest dated agricultural sites show and document a technological change for the initiation of agriculture around 11396 B.C. by showing and signaling a shift toward intensive plant and animal domestication and agriculture that may have set agricultural origination process to start and continue to develop and spread in the ancient China region and also begin to spread in the near sorrounding area and sites around the China region (Elston et al. 1997 cited in Richerson, Boyd and Bettinger 2001: 1-50). The exact sequence/order of events for the agricultural origins also varies quite widely like in the Near East, the agricultural origins process was started with sedentism and it was continued with agriculture in the shift from the early to late Natufian periods sequence in the Levantine (Richerson, Boyd and Bettinger 2001: 1-50).

According to the research, the agricultural origination processes involved in a complex system of steps as the origin of agriculture are many and densely entangled. The origination of agriculture can be seemed as a natural experiment in cultural evolution. Many researchers and authors gave climate change a key explanatory role and a theory for the origination of agriculture begining with Reed (Reed 1977: 882-3 cited in Richerson, Boyd and Bettinger 2001: 1-50) and then after 1980s-1990s Bar-Yosef, Bar-Oz, Colledge, Hillman, Munro and others gave an importance to the impact of climatic change on agricultural origins mostly in Levant region in the Near East relating the agricultural origins to the Younger Dryas climatic event. The coevolution of human subsistence strategies and plant and animal domesticates also played an important role in agricultural origins (Blumler and Byrne 1991; Rindos 1984 cited in Richerson, Boyd and Bettinger 2001: 1-50). Hunting and gathering subsistence may be a logical strategy for the origination of agriculture (Cohen and Armelagos 1984; Harris 1977 cited in Richerson, Boyd and Bettinger 2001: 1-50) and some local factors may be necessary to provide the initial system to start the use of relatively low quality, high processing effort plant resources that will result in plant domestication. Some of the researchers gave a key role for the population pressure theory for the agricultural origination (Cohen 1977 cited in Richerson, Boyd and Bettinger 2001: 1-50). According to the research it can be proposed that much about the origination of agriculture can be understood that agriculture was impossible during the last glacial. According to the paleoclimatic research and pollen analysis from the lakes of the Near East, during the last glacial, climates were variable and very dry over large areas and atmospheric levels of CO were too low. Last glacial climates were characterized by high amounts of climatic fluctuations on time scales of less than a millennium (Richerson, Boyd and Bettinger 2001: 1-50).

According to the research, because of agricultural subsistence systems are directly connected to the good or bad weather conditions and the extreme conditions of weather, and because the cultural evolution of subsistence systems making specialized use of plant resources occurs relatively slowly, agriculture could not start and evolve in that time period (Bar- Yosef 1998; Flannery 1986 cited in Richerson, Boyd and Bettinger 2001: 1-50). But in the long run, agriculture was needed to be origined in the Holocene. Compared to the Late Pleistocene period, more stable Holocene climates allowed the evolution of agriculture in wide areas with relatively warm, wet climates, or watery areas which had access to irrigation. According to the research prehistoric populations tended to grow rapidly and their population increased to the carrying capacity set by the environment and the efficiency of the food subsistence system. Local communities that discover, invent or gain more intensive subsistence strategies will increase in number/in population and they will apply competitive pressure on smaller populations with less successful subsistence strategies. So this can be interpreted by some scholars and researchers by the creation of agricultural origins theory of feasting by Hayden (feeding and subsistence pressure and force of one strong ruler society/or group of people or community on another weaker community or group of people) and this makes sociocultural change and formation of class system and socioeconomic competetion. In the Holocene, these inter group competition may have generated a competitive system that will tend to the way of the origin and diffusion of agriculture (Richerson, Boyd and Bettinger 2001: 1-50). There is a great difference among local historical sequences of the adoption and diffusion of agriculture in the Holocene. According to the research, in the Near East, agriculture may have evolved rapidly in the early Holocene and may have become a center for its diffusion to the rest of western Eurasia. Hunting and gathering subsistence systems were used and had a high importance in most of the Western North America until European and Near Eastern settlements started agriculture and domestication. Each local historical site and area/region is a natural experiment in the factors that limit the rate of agricultural, economic and sociocultural evolution of more successful subsistence strategies.

By using the past research and analysis, the evolution of agricultural subsistence systems must be relative and connected to the climate variation and fluctuations of the Younger Dryas climatic event in the Levant region around between 10932 B.C. and 9389 B.C. in the Natufian culture period by the possible food crisis of Early Natufians and possible agricultural subsistence strategies of Late Natufians that was mostly proposed by many researchers as the main reason and main factor for the agricultural origination as the force of increasing successful subsistence strategies of the cultures in the period of shift between late Pleistocene and early Holocene (Richerson, Boyd and Bettinger 2001: 1-50).

2.2. THE POLLEN, VEGETATION AND OTHER TYPES OF EVIDENCE FOR THE YOUNGER DRYAS CLIMATIC EVENT

When we come to the literature analysis as the review of past research about and around the area of past great climatic changes, the Younger Dryas and it effects on Natufian communities, possible originations of a food crisis. Subsistence strategies and origins of agriculture in a specific geographical area directly connected with this study topic. One of the previous evidences for this study was presented by the research by Moore and Hillman that suggesting the Late Glacial worldwide episode of cooling known as the Younger Dryas, which is approximately between 10932 B.C. and 9389 B.C. It had an high significant effect on climate, vegetation and human economy in southwest Asia and in the Levant (Moore and Hillman 1992: 482-494). In the Levant a pollen core extracted from the Lake Huleh and plant remains from the early village of Abu Hureyra 1 located in North Syria indicates that forest became and returned into steppe in response to the change of drier climatic drier conditions created by the Younger Dryas. Similar effects were seen also in pollen cores from around the other places, ancient sites or from other ancient occupations/settlements in Southwest Asia. This abrupt change in climate and vegetation changed and forced the inhabitants of Abu Hureyra and other sites of ancient Natufian culture occupation in the Epipaleolithic/Natufian period in Southwest Asia and in the Levant to change and modify the strategy of plant gathering and animal hunting strategies and also this abrupt change in climate conditions led to significant disruptions in ancient social cultures and settlements over a wide area. It was argued my many of the researchers of this field that this abrupt climatic changes were a contributing factor in the subsequent development in agriculture in southwest Asia (Moore and Hillman 1992: 482-494).

The transition from hunting and gathering to farming in southwest Asia connected with the environmental changes which were happened at the end of the Pleistocene period, a worldwide increase in temperature that melted huge amount of ice and ice sheets and this caused sea levels to rise, changes and instabilities in atmospheric circulation systems and shifts in vegetation zones and this climatic changes and instabilities shifted into the reverse by the cooler and drier conditions like in Younger Dryas happened almost at the beginning of the Holocene period.

There were adjustments made in human adaptations and impacts of climate changed modified subsistence strategies of the people/human that resulted in the development of agriculture by human. The region within southwest Asia with the most substantial record of environmental and cultural change is the Levant. The Younger Dryas climatic episode occurred there during the second stage of the Epipaleolithic period, as in Epipaleolithic 2 between 12103-9389 B.C., corresponds to one constant and well known culture which was the Natufian culture spread in the Palestine, Levant, Jordan and Israel region. This Natufian stage of the Epipaleolithic period of the Levant and the Southwest Asia was important because it was the last period of hunting and gathering, the type of subsistence strategies and economies shifted from non-settled or semi settled/semi mobile gathering/collecting and hunting economies to more settled/less mobile production (as plant agriculture and animal domestication) economies. It was also important during the Epipaleolithic 2 that the inhabitants of some sites in the Middle Euphrates river and in Palestine adopted a more sedentary mode of life. The changes in economy and settlement that took place were more important for understanding the conditions and circumstances which agriculture and animal domestication developed in (Moore and Hillman 1992: 482-494).

2.2.1. VEGETATIONAL, POLLEN CORES AND PALEOCLIMATIC CHANGE EVIDENCE FOR THE PALEOCLIMATIC CHANGES IN THE LEVANT REGION BEFORE THE YOUNGER DRYAS

According to the past research the archaeobotanical evidence for vegetational and climatic changes and the ancient climatic fluctuations in the Levant comes theoratically from two regions/sites, both located in the Syrio African rift system. The Ghab region in the northwestern Syria located some 50 km near to Yayladağı border gate of Samandağ district of Antakya province of Turkey and close to the most southern border line of Turkey and near to south of Antakya (Hatay) province region of Turkey, and also near the region of Aleppo (Halep), Idlib and Lattakia (Laskiye/Laskiya) provinces on the mediterrenean coastline of northwest of nowadays' Syria. The Hula (Huleh) region is located in northern Israel as shown in the below map. The Late Quaternary pollen record of the Ghab was researched in the past by Niklewski, van Zeist and Woldring (Niklewski and van Zeist 1970, van Zeist and Woldring 1980 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) and these past researches was summarized by the Baruch and Bottema's research (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19). The evidence from the Hula region is based on a 16 m long core recently researched and studied jointly by the researchers. Several archaeobotanical and palynological studies done in the Hula area in the past, two of which came together chronologically with this core (Horowitz 1971, 1979; Tsukada, Bottema and van Zeist, 1981 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). According to the archaeobotanical and pollen based research done in these areas in Hula and Ghab region/sites in Israel and in Syria by Baruch and Bottema and according to Baruch and Bottema, the former study has low stratigraphic resolution and questionable chronology, after a revised calculation of the original pollen sum, based on more justifiable ecological considerations, quite different conclusions were taken from the same information (Bottema and Van Zeist 1981 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). Later another study was done in these regions by Bottema and Van Zeist (Bottema and van Zeist 1981; Van Zeist and Bottema 1982 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19).

The Ghab region and valley in North West Syria, forms the northernmost extension of the Syrio African Rift system. This north-south oriented graben, through which flows the Orontes river, is flanked on the west by the Alouite Mountains rising in gradually from the Mediterranean coast up to about 1700 m, and on the east by the lower, but much steeper, Zawiye Mountains, with elevations like 800 m. Like the rest of the other sites in the east Mediterranean region, the nowadays' usual climate in the Ghab area is characterized by dry, hot summers, and mild winters categorized as the Mediterranean climate and as usual along the sea coasts the 'maki' (maqui) type Mediterrenean vegetation. According to the research there is marked local difference, especially with respect to precipitation, according to the varied topography. The western mountains annual precipitation amounts to ca. 1300 mm, while 10 km to the east, over the valley itself 190 m it decreases by nearly 50 percent reaching only 700 mm. The western flanks of the Zawiye Mountains yearly precipitation is almost 600 mm, decreasing to less than half this amount on the eastern flanks. The Ghab area vegetation according to the research, the natural vegetation cover of the western flanks of the Alouite Mountains, can be reconstructed from still existing forest remnants, consists of three main altitute levels/belts as Ceratonia siliqua, Pistacia lentiscus up to 300 m, Quercus calliprinos, Pistaciapalaestina up to 800 m.

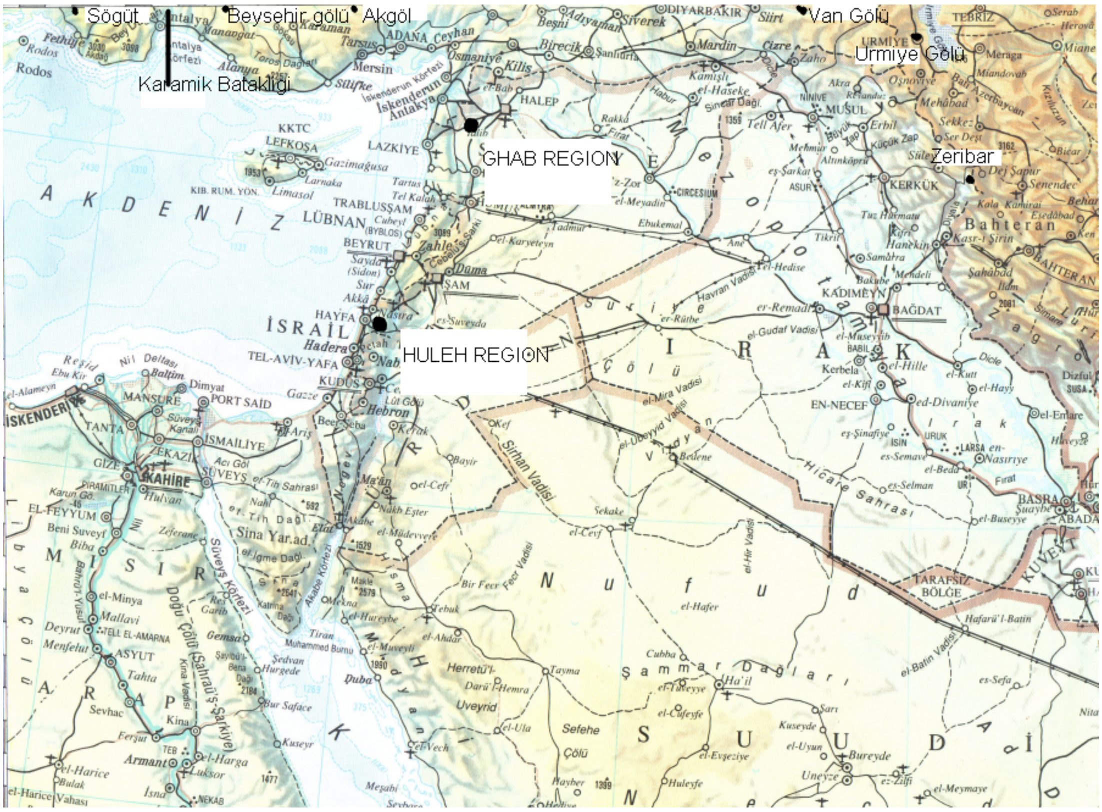

Figure 1. Map for the location of the pollen sites shown (some other major Near Eastern pollen sites are also shown) (Created by using Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19, Moore and Hillman 1992: 482-494 and Grosser Weltatlas, 1993, Ansiklopedik Büyük Dünya Atlası - The Big World Atlas Encyclopedia: 144).

Quercus infectoria, together with the other deciduous oaks (type of/group of plants that makes its leaves fell down in the winter and autumn seasonal times) above 800 m. Remainings of the same vegetation belts can be seen on the east facing slopes as well, but they are much more increased due to the greater aridity on the eastern side (Niklewski and Van Zeist 1970 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). The pollen diagram in below pages is the summary/short version of a composite diagram, representing three different cores. The Ghab I diagram, covering the Late Pleistocene – Holocene period, was prepared from an 11 m long core taken at the northern end of the valley (Niklewski and Van Zeist 1970 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) and the upper section of this diagram is shown, zones 1-5 corresponding to subzones Y5-Z3 of the original diagram. A radiometric date of 9407 B.C. has been obtained from the 1.29-1.37 m level, corresponding to the zone 1/2 boundary. The Ghab II and III diagrams, covering the later stages of the Holocene were prepared from much shorter cores, 3 m and 3.3 m long respectively, taken at the southern end of the valley, some 30 km to the south of Ghab I region. The complete version of these diagrams, as well as the way in which they were correlated with the Ghab I diagram to make up the combined sequence shown was widely researched and discussed in detail by Van Zeist and Woldring (1980) (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

According to the research the original Ghab I diagram demonstrates rather high arboreal pollen values for the period immediately prior to zone 1 of the diagram shown in the pollen diagram. During subzone Yl of the original pollen diagram which, according to the chronology covers the period from almost 23051 B.C. to around 21826 B.C., the AP values were as high as 50 percent, while during subzones Y2-Y4 (21826 B.C. to 14365 B.C.) they fluctuated between 20 percent and 45 perent A sharp decline marked the next period, represented by zone 1 of the diagram in **Figure 2** as the subzone Y5 of the original diagram, which covers the time span from 14365 B.C. to 10932 B.C. the AP values decreased to almost 0%, to their lowest values for the entire sequence. A complete reversal of this trend took place in zones 2 and 3 where the AP values rose again, reaching their apex at the end of zone 2 as the beginning of zone 3, with values of 60%. Accoring to the research done here, during the final stages of the Pleniglacial, during which the northern hemisphere glaciers advanced to their maximum extent, climatic conditions in the Ghab area were favorable for the expansion of arboreal vegetation. In the following period, however, corresponding to the European Late Glacial, the forests in the Ghab area contracted to their smallest extent ever. In north-western Europe this was the period in which the glacial climatic regime started to become worser. Global temperatures rose quite markedly, especially during the Allerod interstadial 11829-10932 B.C. but in the Ghab area region this rise was not sufficient for a parallel rise in rainfall/precipitation and this resulted in severe aridity. These climatic conditions changed like from 10932 B.C. onwards, as may be concluded from the fact that the forests began to expand again. This forest re-expansion was caused and highly effected by the global decline of temperatures which took place during this period, coming together with largely with the European Younger Dryas, according to the research in the Ghab area this cooling down must have brought about a marked change in the runoff/evaporation ratio, and may have also been coupled with an increase in precipitation. A further increase in precipitation must have taken place at the onset of the Holocene, since the forests continued to expand despite the renewed rise of global temperatures (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

When we come to the Hula (Huleh) region area/sites and Hula (Huleh) valley regions, it occupies the northernmost of the four main large basins which make up the Israeli part of the Syrio-African Rift. Through the valley runs the Jordan River on the southwards, on the way of the large basaltic block of Korazim, which dams the Hula Valley in the south. A lake and marshes have existed here at least since early Quaternary times (Horowitz 1979 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19), but due to large drainage operations carried out, only a small portion of them is presently preserved as a nature reserve. To the west of the valley the mountains of the Upper Galilee rise to about 600-800 m at maximum 1200 m, their west facing side sloping towards the Mediterranean sea, while their eastern slopes descend steeply towards the Hula basin. The Golan Heights which lie to the east of the valley includes a basaltic plateau, sloping southwards from about 1000 m at the foot of Mt. Hermon to about 300 m in around the Sea of Galilee, the Hermon range, which is the highest summits in the area, lies to the northeast of the valley, to a maximum altitude of about 2800 m (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

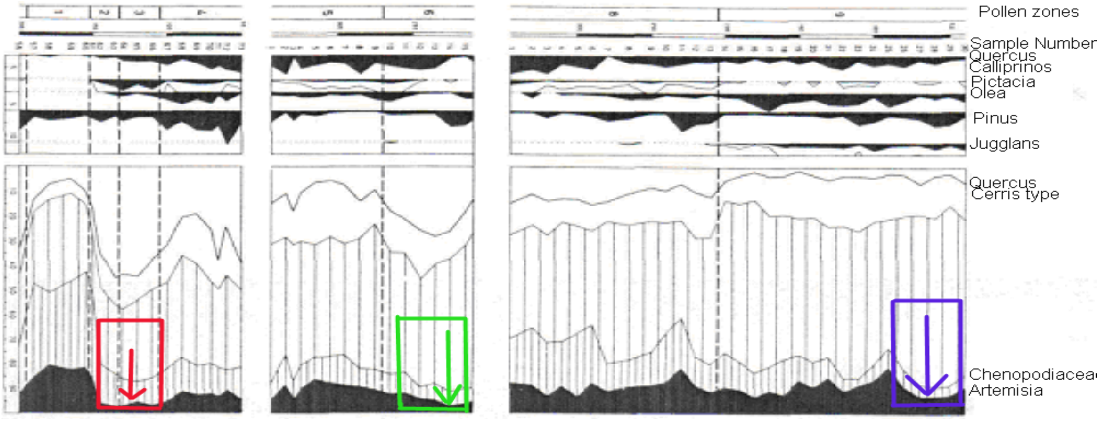

Figure 2. The Ghab region pollen diagram that shows the evidence for Younger Dryas climatic event (after van Zeist and Woldring 1980). On the pollen diagram, arboreal (tree) and non arboreal (non-tree) pollen ratio changes shown during the time and paleoclimatic events. The red, green and blue arrow points show the minimum levels of arboreal (tree) pollen ratio that decreased highly, **the red arrow shows the high decrease of arboreal (tree) pollen and the decrease of forest and tree line during the Younger Dryas period.** (Created by using Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19)

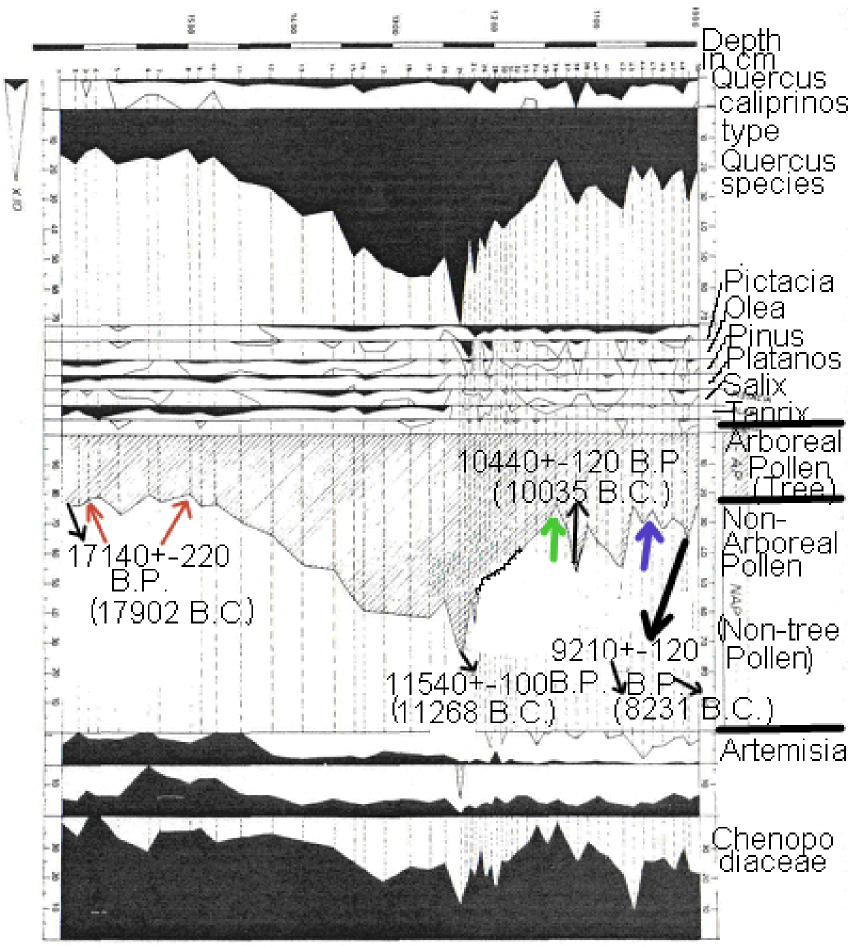

Figure 3. The Hula (Huleh) region pollen diagram that shows the evidence for Younger Dryas climatic event, pollen diagram showing arboreal (tree) and non arboreal (non-tree) pollen ratio changes and the red, green and the blue arrow points indicate the minimum points, the high decrease in the arboreal (tree) pollen**, the green arrow shows the high decrease of arboreal (tree) pollen and the decrease of forest and tree line during the Younger Dryas period**. (Created by using Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19)

Like in the Ghab region, precipitation here also varies/fluctuates according to the topography. The amount of precipitation is in the range of 1200-1500mm on the Hermon, and around 1000 mm on the highest summits of the northern Golan and Upper Galilee, decreasing to about 600-500 mm in the southern parts of the Golan and Upper Galilee, and to about 450 mm in the central part of the Hula Valley itself. According to the research by Baruch and Bottema and according to the research by Zohary in 1973, 1980, the Hula Valley lies in the heart of the climax zone of the Quercus ithaburensis plant type park-forest, destroyed and scattered patches of remainings of these plants are still can be seen both in the valley and on the surrounding slopes of the mountains. According to the research most frequently Quercus ithaburensis is together here with Pistacia atlantica that dominates part of the slopes to the west of the valley, where it forms, together with Amygdalus korschinskii, a kind of a steppe-forest. Other common components of the Quercus ithaburensis park-forest here are Styrax offlcinalis, Ziziphus spina-christii and Z. lotus. Above 400-500 m the Tabor oak park forest starts with the typical Mediterranean vegetation of maquis (maki in Turkish) of Quercus calliprinos and Pistacia atlantica; above 700 m they are mixed with the deciduous (leaf leaving) Quercus boissieri. A kind of mountainous steppe-forest dominated by Quercus boissieri and Primus ursina is found in the Hermon range, above 1200 m; other deciduous oaks like Junipreusexcelsa were also spread in here (Shmida and Livne 1980 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19).

In the pollen diagram it shows the lower part of a pollen diagram prepared from a 16.25 m long core taken from the central part of the Hula valley as where the nature reserve is presently located. The curves of selected plant types were shown and a general curve representing the changes in AP/NAP ratio. As also shown on the pollen diagram, this section of the core has been radiometrically dated at four levels according to the research. No zonation of the diagram has been done, but the diagram can be subdivided into three sections. The lowest section as spectra 1-14, is characterized by gradually rising AP values from about 20% to about 40%. The central section may be further subdivided into a lower subsection as spectra 15-21 marked by rapidly rising AP percentages reaching a maximum value of nearly 75% and an upper section spectra 22-36 in which the AP percentages rapidly decrease down to 25%. The uppermost section spectra 37-50 is characterized by moderate AP values fluctuating between 25% to 50%. As in the Ghab, the forest was mainly spread by deciduous oaks, but the most common species must have been mainly the Tabor oak, which is more different than the other Near Eastern deciduous oak species; a slight contraction of the Tabor oak park-forest in favour of the evergreen Kermes oak maquis is noticed, though, in the upper spectra. Throughout the diagram the NAP are dominated by Gramineae, reflecting the high share of bank vegetation among the non-arboreal plant taxa around the lake. In the lower section of the diagram the percentages of Artemisia and chenopods as the steppe and desert plants are also relatively high, whereas in the upper section they became decreased considerably (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

According to the research and the ancient pollen evidence, assuming a constant rate of sedimentation between the radiometrically dated levels, the lowest section may be dated between 18028 B.C. and 13153 B.C. In the earlier part of this period forest cover in the Hula area must have been rather limited, whereas the cover of steppe and desert plants must have been quite extensive. Climate was dry this time-span overlaps with the Pleniglacial maximum, it may be assumed that it was also rather cold. From about 16136 B.C. in spectrum 8 onwards more humid conditions must have step by step developed in the Hula region, resulting in a gradual expansion of the forest. From about 13153 B.C., this process accelerated, with humidity attaining its maximum value, and the forest became enlarged in this area to its maximum extent, at about 11329 B.C. According to the research the marked rise in humidity in the Hula area, during this time-period, must have resulted from an increase in precipitation, as this was also a period of an amount of rise in global temperatures; this is the later part of this stage, which overlaps with the early stages of the Allerod. Over the next 1000 years or so, from about 11329 B.C. to about 10442 B.C. climatic conditions in the Hula area became worser rapidly, causing the forest to contract and made it to became smaller (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

At the beginning of this stage temperatures were rather high, and temperatures decreased and highly dropped during the second half of this period was overlapping and reaching to the time span of Younger Dryas paleoclimatic event as in from 11932 B.C. to 9389 B.C. According to the research and the evidences and the paleoclimatic reconstructions made, just before the beginning of the Pleistocene to

Holocene transition climatic conditions in the Hula seem to have been almost as harsh and harder and worser as like in the Pleniglacial maximum some of 7000 years before this time period. At this period relative humidity in the Hula area increased again, at the beginning of the Holocene, as the pollen record evidence says there is a reexpansion and again an increase of the forest. A rather conspicuous increase in precipitation must have taken place since global temperatures were also increasing. The conditions were not as good as they had been during the earlier phases of the Late Glacial, the deciduous oak forests were not so wide spread, but the evergreen oaks expanded slightly, which had some amount more drought resistivity (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

By this research the Ghab region and the Hula region pollen diagrams given above show opposite trends with respect to the climatic histories and paleoclimatic reconstructions of their respective areas, during Late Pleistocene-Early Holocene periods. The Pleniglacial conditions in the Ghab seem to have been more humid than in the Hula region (Niklewski and van Zeist 1970, Bottema and van Zeist 1981 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). During the Late Glacial period the Ghab became extremely arid, while in the Hula region humidity rose considerably. In the period of Younger Dryas humidity started to rise in the Ghab region, whereas in the Hula it was decreasing. During the Early Holocene conditions seem to have become more or less similar in both areas, as the rising humidity in the Hula region seems to have reached values similar to humidity and temperatures in the Ghab region in these times and in these periods. According to the research an evidence from the Levantine pollen diagrams could have a dating error. But in the Hula region diagram, the relevant section of the Hula core has four consistent radiometric dates, and because the diagram presented here had a great similarity to the corresponding section diagram in the research by Tsukada, obtained independently more than two decades ago (Bottema and Van Zeist 1981; Van Zeist and Bottema 1982 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). According to this research this possibility should be more carefully considered with respect to the Ghab, since the suggested chronology of the relevant section of the Ghab diagram (Niklewski and van Zeist 1970; Van Zeist and Woldring 1980 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) was based on a C14 radiocarbon type dating. Another explanation could be that during the final stages of the Pleistocene period, climatic conditions in the Levant actually differed. For the nowadays climate today in the area, a uniform climatic regime continues over the entire region, while at a period it appears to have been divided into two subregions, a northern one and a southern one, marked by diachronic historic paleoclimatic developments, fluctuations and changes (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

The region of Levantine pollen diagrams had the palynological pollen record based information from the Near East as distributed spatially. According to the research nowadays most information comes from the area north of the Levant as south west Anatolia and central Anatolia, and western Iran, whereas palynological pollen evidence from the southern end of the region is not present as the period is under discussion as concerned. The pollen record of South west Anatolia generally displays very low arboreal pollen values during Late Pleistocene period times. In some of the pollen diagrams of as an example Beyşehir Gölü done by Bottema and Woldring 1984 (Bottema and Woldring 1984 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) has some increase in tree pollen during the Late Glacial period becomes similar with the Hula region pollen records. As another example according to the research, in Sögüt Golü (Van Zeist et al. 1975 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19), very unfavourable conditions for tree growth at the transition towards between the Holocene and Pleistocene periods show similarities with the Ghab region pollen records. But on the contrary the pollen record of South west Anatolia displays most favourable conditions for tree growth during the Holocene according to the research. This formed climatic fluctuations and difference with the developments in the Hula region as well as in the Ghab region/sites. A dry Late Glacial period was also reflected by pollen diagrams from western Iran (van Zeist and Bottema 1977; Bottema 1986 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) but the subsequent rise/increase in humidity was far more slower than in the more western regions according to the research. In interpreting the various sources of the Late Pleistocene palaeoclimatic record of the Near East in terms of atmospheric circulation patterns has been made by Rognon in 1987 who shown the development of dry conditions in central Anatolia and the northern Levant, and according to the research during the Allerod time span, to an eastwards displacement of the polar ice cap and the contemporary increase in humidity in South west Anatolia and in the southern Levant to the formation of a high pressure belt over the South East Mediterranean and Red Sea regions and through the sea coasts. The ancient prehistoric climatic developments in the same areas during the Younger Dryas abrupt paleoclimatic event were shown by Rognon to the contemporary global decrease in temperatures, together with the shifts in the position of local high and low pressure zones (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

According to the research, if the cultural developments are concerned it may be taken from the Hula region pollen diagram that the origins of the ancient Natufian cultural complex in the region referred to as its core area by largely overlapping with the Mediterranean territory of the southern Levant occurred under the most favorable climatic conditions continuing throughout the final Pleistocene Early Holocene time-span and during the transition period between them. There are the agricultural origins models of the researchers suggesting that the emergence of the Natufian culture may have resulted from environmental stress (Bar-Yosef 1987, Bar-Yosef and Vogel 1987, Goring-Morris 1987, 1989 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19). It actually seems that the success of the Natufian subsistence strategies, largely based on sedentism in the Mediterranean territory (Bar-Yosef 1983, 1987 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) was underlined by the improved climatic conditions. Therefore the presence of Natufian base camps as the bigger settlement sites in the northern Levant, especially the Early Natufian (Bar-Yosef 1987; Byrd 1989 cited in Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19) should have done/must have done or had to do something, had to create a survival/subsistance mechanism, had to form an original successfully working subsistence strategy to cope with the unfavorable climatic conditions continuing there during most of the Late Glacial period. According to the research of Bar Yosef, Valla, Baruch and Bottema (Bar Yosef, O. and Valla, F. (eds), Baruch and Bottema 1991: 11-19), the final disappearance of the Early Natufian culture may be resulted from the deterioration of climatic conditions in the Mediterranean Southern Levant during the later phases of the existence/reformation of the Natufian with the Late Natufian culture. Considering the size of the area, the presently available palynological data from the Levant is represented with two diagrams spaced around 300 km away from one another. According to the Baruch and Bottema's ideas and their research around the area, more pollen diagrams situated in between these two sites, mostly in south, are necessary before the vegetational and climatic history of the Levant can be safely reconstructed on a regional scale and they think that this will certainly not be an easy task to achieve, because of the scarcity of pollen carrying sediments in this part of the world in the Near East and in the Levant Area (Bar Yosef, O. and Valla, F.(eds), Baruch and Bottema 1991: 11-19).

When we look at the summary of the palaeoenvironmental reconstruction of the area, the time span covered is approximately 11.000 years, between 18028 to 4846 B.C. This period covers up the Pleniglacial, Late Glacial and Post Glacial stages/periods of the Late Pleistocene and Early Holocene. Ice sheets covered extensive areas of the northern hemisphere for the duration of the Pleniglacial stage before 16136 B.C. In the Late Glacial period between 16136 B.C. - 9389 B.C., the ice began to retreat, and by the Post Glacial stage after around 9389 B.C., ancient climatic conditions were similar to those of the nowadays present day of the region. During the gradual warming phase, after the ice sheets had begun to retreat northwards, there were periodic fluctuations in temperature. By the research done, in northern Europe, these climatic fluctuations/oscillations are well proved by palynological, sedimentological and fossil coleopteran evidence (Pennington 1974 cited in Colledge 2001:3-4). Between the dates of 11829 and 10932 B.C., there were two interstadial periods, the Boiling and the Allerad/Allerod periods as mentioned before in above, when temperatures rose rapidly. These were continued and succeeded by markedly colder phases, the Older and Younger Dryas as abrupt and hard ancient climatic episodes, when the glaciers increased southwards again. The severe conditions of the Younger Dryas lasted until 10.000 B.C. and, after this period, during the Boreal phases of the Early Holocene, after the end of Younger Dryas period the climate became better, as warmer and more humid, and these climatic changes were clear worldwide (Colledge 2001:3-4). According to the research in the Levant area, there are few sources of evidence on which to base paleoclimatic reconstructions. There is a scarcity of waterlogged sediments and together with this only two palynological studies have been done as, in the Hula Basin as part of the Rift Valley in northern Israel, research done by Baruch and Bottema 1991, 11-19, (Baruch and Bottema 1991, 11-19 cited in Colledge 2001:3-4) and in the Ghab Valley, northern Syria (Niklewski and van Zeist 1970, 737-754; van Zeist and Woldring 1980, 111-125 cited in Colledge 2001:3-4). As mentioned above before, an 16m core was taken from the waterlogged sediments in the marshes surrounding the lake within the Hula Basin and four radiocarbon dates have been obtained, and two bracket the entire core between the dates of 8233 and 18028 B.C.

According to the research of Baruch and Bottema, they have divided their diagram into four sections on the basis of the proportions of arboreal pollen in the spectra as the lowest section, dated between 18028 and 13153 B.C., as the spectra 1-14 on the pollen diagram, the arboreal pollen levels gradually rise, and this has been interpreted as a cold, dry phase, when forest cover was limited and extensive areas were covered by steppe and desert plants. From 16136 B.C. as corresponding to spectrum 8, the researchers analyzed that more humid conditions must have developed, causing expansion of forest cover. In the second section of the diagram as between the spectra 15-21, dated between 13153 and 11329 B.C., the arboreal pollen values showed a critical high increase, and Baruch and Bottema conclude that this was a period when there was a marked increase in humidity which allowed for considerable growth of the forests. At this time, temperatures must have risen and precipitation increased. In the next section of the pollen diagram in between the spectra 22-36, dated between 11329 and 10442 B.C., the arboreal pollen levels decrease, and this has been interpreted as a period when the climate deteriorated causing the forests to contract according to the research done. In the final section of the diagram in spectra 37-50, dated from the Holocene/Pleistocene boundary, there are fluctuations in the arboreal pollen values. Initially, the values are similar to those in the lowest part of the diagram, and the authors state that at this time, conditions must have been as harsh and hard as they were in the earliest phase. Towards the top of the pollen diagram, the arboreal pollen increases again, and at this stage the forests must have become renewed as the climate improved. Baruch and Bottema noted that the arboreal pollen was dominated by that of deciduous oaks, with some evergreen oak in the upper levels of the diagram. The non-arboreal pollen was dominated by grasses, but with relatively high proportions of steppe and desert taxa in the lowest phase These palaeoclimatic reconstructions correspond well with those defined for northern Europe. The lowest section of the Hula diagram corresponds with the Pleniglacial, the second section of the Hula pollen diagram covers the initial stages of the Late Glacial, the third includes the Younger Dryas episode, and the final section coincides with the Early Holocene Post Glacial phase according to the research (Colledge 2001:3-4).

As mentioned before above, the palynological pollen record results of Hula region compared to the Ghab Valley, in northern Syria, are different. The climatic trends do not correlate with those mentioned above. The cores from this area are poorly dated and it has been suggested that errors in dating are the reason for the lack of synchrony with the climatic phases in the southern Levant (Baruch and Bottema 1991, 17, Moore and Hillman 1992, 489 cited in Colledge 2001:3-4). It has also been suggested that a possible reason for the disparity was an actual difference in climatic conditions between the northern and southern Levant during the Late Glacial (Baruch and Bottema 1991, 17, Bottema 1995, 890 cited in Colledge 2001:3-4). For this reason, Baruch and Bottema mentions that pollen sequences for the Late Glacial and Holocene can only be correlated over short distances (Bottema 1995, 890 cited in Colledge 2001:3-4). Results from sedimentological studies undertaken in the Negev Desert in Israel are in agreement with the climatic changes defined by the results from the Hula pollen diagram. According to the pollen research in the Hula reion, phases of pedogenesis have been identified in desert sediments dating to between 14000 and 11000 B.C. (Magaritz 1986, 226; Goodfriend and Magaritz 1988, 146 cited in Colledge 2001:3-4). So proving that during this time, equivalent to the Late Glacial interstadial episodes, there was sufficient moisture to allow for soil development. According to the research in a study of land snails used as indicators of desert migration, Magaritz and Heller defined an arid period between c. 11,000 and 10500 B.C., overlapping with the abrupt and hard paleoclimatic event of Younger Dryas climatic change (Magaritz and Heller 1980, 160 cited in Colledge 2001:3-4).

As similar to this, charcoal analyses from five terminal Pleistocene sites in the Central Negev provided evidence for a dry spell from 10932 B.C. until 9389 B.C. (Baruch and Goring-Morris 1997, 257-258 cited in Colledge 2001:3-4). These results were supported by the work of Macumber and Head (Macumber and Head 1991, 170 cited in Colledge 2001:3-4) who conclude that, during a dry period, some time after 10932 B.C., the level of ancient Lake Lisan fell, causing considerable incision of the wadis/valleys bordering the Rift Valley. Rossignoi-Strick (1995, 913 cited in Colledge 2001:3-4) has shown that there is a discrepancy between the land-based

C14 and marine dates for the Younger Dryas climatic change episode. Rossignoi-Strick suggests that the land-based dates are too old, perhaps because of geological contamination of the material by older carbon. The clear and correct dating of the great abrupt changes in climate may remain uncertain. It seems apparent that the climatic changes which took place during the Late Glacial would have caused shifts in the boundaries between the woodland, steppe and desert regions. These would probably have been most effective at the desert margins, so there appears to be a connection between temperate zone warming events and southward shifts in the position of the northern boundary of the desert regions in the Middle East (Goodfriend and Magaritz 1988, 146 cited in Colledge 2001:3-4).

In similar, according to the research, during more humid phases, there would have been a southern and eastern extension of the Mediterranean woodland region. Gordon Hillman has shown in the past the variations in the composition of the vegetation that occurred as a result of the Late Glacial climatic changes in the Levant (Hillman, Moore 2001, 76-84 cited in Colledge 2001:3-4). According to Hillman's research, paleoclimatic reconstructions are based on studies of the present day/nowadays' vegetation in the region, on climatic records, on geological and topographic data and on recent settlement patterns (Hillman, Moore 2001, 49-51 cited in Colledge 2001:3-4). He has concluded that at around 11500 B.C. the Oak-Rosaceae park-woodland would have been as close as 15km south of Late Epipalaeolithic site of Abu Hureyra, which is today situated in the Irano-Turanian climatic region (Hillman, Moore 2001, 328-329). Seeds and fruits recovered from early occupation layers were of species common to this vegetation zone, thus providing further evidence of the more southern/eastern expansion of woodland and of the bordering steppe forest at this time. (Moore and Hillman 1992, 486, Hillman, Moore 2000, 329-330 cited in Colledge 2001:3-4) This was supported by the finds of wood charcoal identified as that of steppe forest tree species, which have been found on archaeological sites dated to the Late Glacial period as coming/reaching to the Epipalaeolithic and Pre-Pottery Neolithic periods, located in present day steppic areas of the Levant and the Near East (Willcox 1991, 120-121 cited in Colledge 2001:3-4).

2.2.2. THE CLIMATIC EVENT OF YOUNGER DRYAS AND THE EVIDENCE FOR THE YOUNGER DRYAS AND RELATED ENVIRONMENTAL IMPACTS OF THAT CLIMATIC CHANGE IN THE LEVANT REGION

The abrupt, strong, wide spread paleoclimatic event of Younger Dryas was first recognized in the pollen record of northern Europe in the history as during the Late glacial period as the temperature rises and the glaciers began to retreat, the vegetation of tundra was replaced by birch and pine type of woodland. These ancient climatic trends started during the Boiling and Alleröd pollen phases which were researched by Iversen in 1954 (Iversen 1954 cited in Moore and Hillman 1992: 482-494).

By the abrupt start of Younger Dryas in the 3rd pollen zone the temperature fell sharply, the glaciers started to be melted rapidly again like before it happened, the woodlands retreated southward directing the open tundra type plant by the name of "Dryas octopetala" which is a species of plant which has eight petal leaves (8 - "octo" in Latin) and this plant species was survived from the drier and colder conditions of the ancient climatic event of "Younger Dryas" from which the name of this period was coming/derived from the plant species of "Dryas octopetala" and the word "younger" refers to the youngest/the most recent/last ancient huge paleoclimatic event closest to today (Moore and Hillman 1992: 482-494 cited in Moore and Hillman 1992: 482-494). This Younger Dryas dry and cold climatic period lasted approximately around 800-1000 radiocarbon years from 10932 B.C. to 9389 B.C. (Berger 1990 cited in Moore and Hillman 1992: 482-494). Radiocarbon dates for the end of the Younger Dryas is not certain because they fell in a period during which the calibration curve levels off for at least three centuries, the age of this event has been established at 10993 B.C. (Decker and Kroner 1986; Becker et al. 1991 cited in Moore and Hillman 1992: 482-494). The pollen evidence suggests that the climate turned so cold during the Younger Dryas that it approached the conditions of the full glacial. This was confirmed by studies of fossil cokoptera in Britain (Coope 1977:330 cited in Moore and Hillman 1992: 482-494). In the Preboreal and Boreal phases the temperature rose once more and the forest advanced rapidly northward. According to the past research, the precise timing and the effects of the rises in temperature and moisture are still not certain and they are still controversial under discussion, analysis and review. By the research done the evidence of fossil coleoptera confirms the unbalanced/instable and oscillatory nature of late glacial period environmental change, suggests that the abrupt changes and fluctuations in temperature may have preceeded by several centuries the advances and the retreats of the forest based vegetation areas and zones (Coope 1975:167 cited in Moore and Hillman 1992: 482-494).

The abrupt Younger Dryas period of cooling was originally started to be a concept theoretically and defined/named in northern Europe, but parallel vegetation changes occurred also in other places of the world, by making it a world wide strong climatic event. So it is used the term Younger Dryas by not only coming from the "Dryas" plant species type dominated tundra in the far north but also for all the other changes in vegetation that were brought by the same climatic period. The evidence for Younger Dryas is the one period of cooling of sufficient intensity and duration to be seen clearly in the stage 1 Late Glacial section in deep sea cores from the Pasific Ocean (Shackleton and Opdyke 1976 cited in Moore and Hillman 1992: 482-494). Another evidence is a well defined episode in the Greenland ice cores (Dansgaard et al. 1982 cited in Moore and Hillman 1992: 482-494). Studies of coral reefs of Barbados have provided direct evidence of the effect on sea levels of the Younger Dryas cooling. The rise in sea level slowed highly and sharply between 10932 B.C. and 10442 B.C. and then the sea level increased slightly and slowly from 10442 B.C. to 9389 B.C. (Fairbanks 1989:639 cited in Moore and Hillman 1992: 482-494).

The Younger Dryas paleoclimatic change event fit into and came together with the period of major mammal extinctions in Eurasia and North America, lending weight to the hypothesis that such rapid climatic fluctuations contributed to those events. Haynes (Haynes 1991:447 cited in Moore and Hillman 1992: 482-494) has argued that a period of drought corresponding in time to Younger Dryas was a factor in the decrease of many species of the Rancho La Brea fauna in the North America. According to the past research given that the Younger Dryas episode of cooling was a worldwide phenomenon, its effects should have been felt in Southwest Asia but pollen cores and sedimentological analyses have showed little indication and evidence that it had a significant influence on the environment there and the main reason for this is that the environmental sequences for the different sites/regions of

Southwest Asia and around the Levant area are not so deeply identified and drawn in detail. According to the research relatively small number of pollen cores have been analyzed in the Southwest Asia, and they have not provided such detailed replicated sequences of vegetation change as those from northern Europe or North America or other places and these sites were dated with very few amount of radiocarbon measurements (Moore and Hillman 1992: 482-494).

As an evidence the pollen cores extracted from locations in the Levant, the Ghab section of the Orontes Valley and Lake Huleh, much of them is a marsh nowadays, showed that the forest cover expanded during the Late Glacial (Niklewskt and van Zeist 1970; van Zeist and Bottema 1982 cited in Moore and Hillman 1992: 482-494). The Ghab core suggested that the forest expanded quite steadily. The Huleh sequence, analyzed by Tsukada and later reviewed/edited by van Zeist and Bottema, did indicate that the vegetation cover fluctuated during the period in which the forest was expanding, but this section of the core lacked radiocarbon dates, A general increase in forest cover, especially cedar, until sometime between 11829 and 10932 B.C. is again apparent at Karamık Bataklığı in western Anatolia, and the same could be inferred for oak forest at Söğüt Gölü$_s$ although with only two dates available in each case, exact correlation is difficult (van Zeist and Bottema l982, van Zeist et al 1975). A steady increase in forest cover could also be seen in the cores from Lake Zeribar in the Zagros Mountains in the Northeast Iraq, but there it was delayed until the mid Holocene (van Zeist and Bottema 1977 cited in Moore and Hillman 1992: 482-494), reflecting the arrival of trees migrating from forest refuge remote from Zeribar. The information and evidence available from geomorphological studies was more different. Fluctuations in the levels of lakes across southwest Asia provided some information for a very general reconstruction of climatic sequences (Roberts 1982 cited in Moore and Hillman 1992: 482-494), but they were not successful enough to detect the impact of the Younger Dryas episode, Sedimentological studies in the southern Levant and Sinai yielded very small relevant information for the Late Glacial period (Goldherg 1981 cited in Moore and Hillman 1992: 482-494).

This evidence from the research showed that it was seemed as the temperature rose during the Late Glacial period rainfall also increased, shifting to an expansion/increase of forest cover (van Zeist and Bottema 1982 cited in Moore and

Hillman 1992: 482-494). So it appeared that the transition to farming took place in better environmental conditions (Moore 1985:12 cited in Moore and Hillman 1992: 482-494). By the newer recent evidence for Younger Dryas, the pattern of ancient climatic change in environment over most of the sites in southwest Asia from the Late Glacial into the early Holocene needs to be understood with the two evidence that have been obtained in the Levant. First, Baruch and Bottema (Baruch and Bottema 1991 cited in Moore and Hillman 1992: 482-494) have extracted and analyzed a new pollen core from the Huleh Basin that provides a more detailed, well dated sequence of vegetation change from the end of the Pleniglacial almost. 5844 B.C. into the early Holocene. The information was related for the discussion concerns the changing ratio between arboreal and nonarboreal pollen. At the end of the Pieniglacial the ratio of tree pollen to grasses and steppe plants was low, about 20 percent (Moore and Hillman 1992: 482-494).

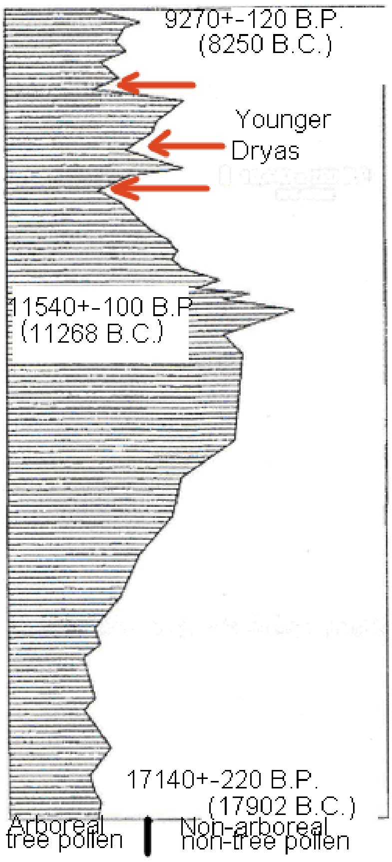

Figure 4. The changes in the ratio of arboreal (tree) to nonarberal (non-tree) pollen in the diagram from Lake Huleh that shows the evidence for Younger Dryas climatic event, and **the red arrow points indicate the minimum points, the high decrease and rapid fluctuation in the arboreal (tree) pollen, and the decrease of forest and tree line during the Younger Dryas period's highly fluctuating climate conditions**. (Baruch and Bottema 1991 cited in Moore and Hillman 1992: 482-494)

Then according to the research at an estimated date of around 16136 B.C. the ratio of tree pollen increased steadily until it reached a maximum of 75 percent at 11268 B.C. Baruch and Bottema suggest that the increase in tree cover was caused by a marked rise in precipitation because it happened during the period of Late Glacial warming, other researchers such as Et-Moslimany (Et-Moslimany 1986 cited in Moore and Hillman 1992: 482-494) argued that such a change can be attributed more specifically to increased availability of moisture during the growing season of spring and summer, regardless of precipitation during the autumn and winter. Thereafter the forest became smaller and/or became thinned rapidly until almost 10731 B.C. when the ratio was slightly less than 25 percent arboreal pollen. Then the ratio of arboreal pollen was recovered to nearly 50 percent at 10035 B.C. and then decreased again over the next few centuries according to the research. The same trends was detected in the Tsukada core, but it was more clearly visible in the Baruch and Bottema's pollen research diagram where they are more closely dated. It was shown from Baruch and Bottema's analysis that the improved conditions for forest growth that took place in the region during the Late Glacial were spread over several millennia. The improvement tends to correlate with the lengthy period of climatic warming to be seen in the Barbados coral reefs (Fairbanks 1989 cited in Moore and Hillman 1992: 482-494). One of the important observations was the sharp reversal in the arboreal-nonarboreal pollen ratio from almost. 11329 to 10731 B.C. that Baruch and Bottema believe that this change/shift of arboreal pollen marked the Younger Dryas ancient paleoclimatic event. By this evidence the cooler conditions that obtained which is connected with a sharp decline in precipitation during the growing season and to a great reduction in forest and vegetation cover around the Southeast Asia and Levant area (Moore and Hillman 1992: 482-494).

According to the research another important source of evidence for environmental change in the Levant during the Younger Dryas was the food plant remains recovered from the early village of Abu Hureyra site located in North West Syria in the Euphrates. The first/earliest settlement in Abu Hureyra was chronologically Abu Hureyra 1 of Epipaleolithic 2 cultural period, was occupied from around 11329 to 9389 B.C. (Moore 1991 cited in Moore and Hillman 1992: 482-494) by a settled population of hunters and gatherers (Hillman, Colledge, and Harris 1989, Legge and Rowley-Conwy 1987 cited in Moore and Hillman 1992: 482-

494). Some type of charred seeds and fruits recovered through systematic flotation have provided a record both of vegetation change and human plant exploitation throughout the occupation of this epipaleolithic village of ancient Abu Hureyra in North West Syria (Hillman, Colledge, and Harris 1989 cited in Moore and Hillman 1992: 482-494) On the later sites/occupations with clear patterns of context related variation, ancient change in plant use can generally be shown only when there are large numbers of productive samples derived from equivalent context types from each phase of occupation (Charles and Hillman 1992, Hillman 1981 cited in Moore and Hillman 1992: 482-494). According to the research by Moore and Hillman, it was possible to use the floated samples from Epipaleolithic Abu Hureyra as from 39 of the 80 levels excavated to explore ancient change by the factors that the source deposits were relatively uniform and they were dominated in most cases by mixed accumulations of ashes from many years of fires that was done together with numerous cycles of seasonal activities, and most of the float samples were extracted from very large volumes of these deposits ranging from 370 to 4000 liters and each contained thousands of identifiable items of food plants according to the research. The Abu Hureyra I period of occupation was divided into three periods, Period IA as 11329-10932 B.C. is the oldest stratigraphy of Abu Hureyra. During Abu Hureyra IA the inhabitants gathered plant foods from three vegetation zones, the flood plain of the Euphrates which has high moisture and water, the adjacent steppe area, and a wide spread forest steppe region that was within foraging distance of the site Abu Hureyra. The other extended eastward region from the edge of the oak-Rasaceae type of forest has an unknown distance to the west (Moore and Hillman 1992: 482-494).

The dominant common ancient vegetation of the Abu Hureyra region was steppe as it is nowadays' vegetation of the site. Three classes of food plants represented in the remains indicate that the ancient climate conditions had much more moister during the spring and summer times growing seasons compared to the nowadays' climate. Remains were consisting of fruit stones and seeds of the hackleberry tree, Cehis tournefortil, plum, pear, and medlar, all characteristic of the Mediterranean oak Rosaceae forest zone, together with seed remains of a white flowered asphodel Asphadelus microwarm climatic characteristic of the Mediterranean zone usually indicates that the oak Rosaceae forest zone must have been closer than the 120 km to the west for it could theoretically extend under natural conditions in today's climate in this region according to the research. The presence of Pistacia fruitlet remains and the absence of Pistacia wood charcoal which did not grow close enough for its twigs or wood to be gathered as fuel, remains of this tree suggests that, but it must have grown much closer than it does today's climate. (Hillman, Colledge, and Harris 1989 cited in Moore and Hillman 1992: 482-494). The nearest grown area of Pistacia steppe-woodland are now high on the Jebel Abu Rujmein 90 km to the south, and on the Jebel Abdulaziz 180 km to the east-northeast. In the Period of 1A of Abu Hureyra site, Pistacia type of vegetation intersected the steppe in the form of lines of trees growing along low wadi terraces, to within a few kilometers of Abu Hureyra, just as it today intersects the Azraq Desert Basin in eastern Jordan along the Wadi Butum according to the research (Moore and Hillman 1992: 482-494).

Another source of evidence that Period IA was characterized by relatively moist springs and summers comes from the remains of wild einkorn wheat and two wild ryes. In today's climate in this region, these wild cereals are characteristic of the ecological zone between oak Rosaceae forest and steppe, and although two of these type of vegetations are able to extend well beyond the forest edge on deep, fine grained soils (Blumler 1984, 1992 cited in Moore and Hillman 1992: 482-494) and some recent surveys in the area suggested that these vegetations cannot intersect with the steppe as far as the Pistada steppe forest area (Hillman, Colledge, and Harris 1989).

According to the research nowadays, even without grazing and cultivation, it is impossible that plants could grow any closer than 800 km to the west and north. But when they were gathered by the people of Abu Hureyra 1, they must have been growing very much nearer than that according to the research (Moore and Hillman 1992: 482-494).

This same pattern of gathering and climate conditions continued throughout Abu Hureyra Period 1A, until that an abrupt and hard climatic change of Younger Dryas came and started to effect Abu Hureyra and other wide regions in the Syria and in the Levant. According to the research and some evidence from the site and region show that the inhabitants of Abu Hureyra appear to have that they decreased and stopped all gathering of tree fruits of the forest or forest edge reigons. An explanation for that can be that the fruits were now out of range of foragers from people living in Abu Hureyra because increasing aridity was preventing fruit formation on trees in the nearest areas of the forest edge and was effecting and causing the start of a forest decrease, this explanation was supported by the continuous set of changes at the beginning of Period IB of Abu Hureyra around 10932-10189 B.C., which showed a brief episode of sharply increased exploitation of the wild cereals, grains of feather-grass as Stipa species, and seeds of asphodel species (Hillman, Colledge,. and Harris 1989 cited in Moore and Hillman 1992: 482-494). The researched showed that this fits the temporary increase in yields from forest edge grasses and other herbs such as asphodel that might be expected when the trees started dying back and this caused to have less shadow on the herb layer. The evidence from the research for this brief episode early in Abu Hureyra IB period comes from two rich samples and, despite the essential similarity of the formation processes reflected in most of the Abu Hureyra 1 levels and the huge amounts of deposit sampled, a difference in two samples could theoretically represent no more than abnormal taphonomy. By this Younger dryas climate change of abrupt and clear climatic change, a complete decrease in the use of asphodel seed, plants, they may be used for food or medicine according to the research, and a dramatic decrease in the use of the three wild cereals and some of the feather grass species started according to the evidence. These changes, combined with decreasing use of Pistacia fruit lets, suggested that increasing aridity was also causing a retreat of its herbaceous plants of the forest edge and area following the earlier death of the trees. This idea and thought was supported by the increased use of small-seeded legumes such as the clovers and medicks as Trifolium, Tritgonella, and Medicago poisonous plant species which requires high detoxification, which would generally have served as staples only when other major plant foods were becoming scarcer. Also, again according to the research a number of these small-seeded legumes can tolerate very arid conditions, and some of them would have continued to be available in very high amounts (Moore and Hillman 1992: 482-494).

It was estimated from the 12 radiocarbon C14 measurement dates from Abu Hureyra Period IB that this abrupt climatic change began about 10600 B.C. (Moore 1992 cited in Moore and Hillman 1992: 482-494). These climatic trends/patterns became even more marked in Period 1C around 10400-10000 B.C., when it was seen also a decrease in the use of valley bottom foods, it may be reflecting a decreased overbank flooding as a result of lower levels of precipitation over the Anatolian catchment of the main water sources of the Euphrates. Abu Hureyra is in a semiarid region where small changes in climate can cause to major adjustments in the composition and extent of vegetation zones and their component communities (Davis 1986, Webb 1986 cited in Moore and Hillman 1992: 482-494). By the research done it was argued that the most economical explanation of a series of shifts in the pattern of plant collecting is a change, fluctuation and an alteration in the composition of plant communities in the Abu Hureyra catchment area brought about by climatic change. According to the research Abu Hureyra was inhabited long enough for the effects of the Late Glacial climatic fluctuations to be reflected in the vegetation record, and Periods IB and IC coincided with the Younger Dryas when cooler and more arid conditions continued and spread in many regions. Reduction in moisture availability during the spring and summer growing seasons in the low altitute and some up/high altitude areas of southwest Asia was strongly shown as evidence by the forest decrease seen in the pollen cores taken from Lakes Huleh and Zeribar, and Karamik Batakligi (van Zeist and Bottema 1977, 1982, van Zeist et al, 1975 cited in Moore and Hillman 1992: 482-494), and this pollen zones can also be extended to the Ghab region (Moore and Hillman 1992: 482-494).

By the evidence and research done here by Moore and Hillman, it was the decrease in the availability of growing season moisture that was seen as reflected in the record of vegetation change at Abu Hureyra, as aridity increased by the Younger Dryas, the forest and forest steppe ecology decreased in the west direction, to be replaced by more drought resistant types of steppe areas. As the result of this change, the availability of many ealier consumed foods was highly reduced, and together with this the inhabitants of Abu Hureyra seem to have increased their consumption of other foods such as the small seeded legumes as foods, this allowing the Abu Hureyra inhabitants to continue occupation for several centuries more. The population was already sedentary by Period IA, and the limiter factors on population growth medium by a mobile existence would probably have already been relaxed (Hillman 1987 cited in Moore and Hillman 1992: 482-494). The resulting combination of increasing population and declining availability of previously preferred plant staples in the vicinity of Abu Hureyta may have imposed increasing stresses on the carrying capacity of the local environment, and so contributed to the temporary abandonment of the settlement. After Abu Hureyra was reoccupied a few centuries later, its new inhabitants were already farmers according to the research findings.

The records of Late Glacial vegetation change from the new Huleh region core and Abu Hureyra showed similar trends in the effects of abrubt climate change and the effected vegetation, an initial development of forest and forest edge vegetation reflecting a relative high amount of growing season moisture, followed by a sharp reversal of drier climatic conditions as drier conditions set in during the Younger Dryas, and connected with this, the comparison of radiocarbon dates would suggest that the effects were experienced slightly earlier in the southern Levant than farther north of the Levant region. But according to the research it is mentioned that it should be also allowed for the possibility of interlaboratory error when comparing sequences of dates obtained by different laboratories. It was added by the researchers that some recent studies have shown that the dates obtained by different laboratories for the same samples may vary systematically by several hundred years (Scott 1990 cited in Moore and Hillman 1992: 482-494). But as in case of errors in measurements again the abrupt climatic change and the effect of abrupt change in vegetation at all analyzed sites and regions were correlated/connected with the worldwide Younger Dryas ancient climatic episode of high environmental cooling and drying.

According to the research by accepting that the Younger Dryas had a significant effect on the environment of the Levant, it should be examined in some of the other pollen cores obtained years before to see if its impact can be shown elsewhere in southwest Asia and mostly in the Levant. The part of the original Ghab core covering the Late Glacial and earlier Holocene as the pollen zone Z showed much of the same climatic trends as the most recent lake Huleh core as a major expansion of forest followed by a decrease, then another growth of tree cover once more again repeated (Niklewski and van Zeist 1970 cited in Moore and Hillman 1992: 482-494). The core had three radiocarbon dates, but only one of them related to the last 40,000 years according to the research. This date of 10,080 ± 55 B.P, seemed to correspond to the climax of the main period of forest expansion, suggesting that the Ghab region's vegetation sequence was different with the rest of the Levant, shown that the vegetation sequences from Lake Huleh and Abu Hureyra seem to correlate well, and that Abu Hureyra is just 180 km near of the Ghab region, the explanation for this difference was that the radiocarbon date, obtained from a sample of shells, was not relevant corresponding with its stratigraphic position. According to the research of Baruch and Bottema (Baruch and Bottema 1991 cited in Moore and Hillman 1992: 482-494), they allowed the possibility that the date may have an error (Moore and Hillman 1992: 482-494).

Then according to the evidence from the Ghab core would indicate that the cooler conditions of the Younger Dryas climatic change event were also felt and environmentally effective in northwest Syria where they caused a high decrease in tree cover. In the east at Lake Zeribar in the Zagros Mountains, the Late Glacial was marked by the increase in the pollen of herbaceous plants as the chenopods and Artemisia (van Zeist and Bottema l982 cited in Moore and Hillman 1992: 482-494), implying an increase in moisture during the growing season and this cliamtic trend was sharply reversed for several centuries after around 11,500 B.P, an climatic change event happened that again was correlated chronologically with the Younger Dryas. It was mentioned according to the research and evidences found that there was a decrease in amount of moisture during this period, just like as seen before in the Levant, a similar reduction/decrease in moisture availability during the growing season of plants was thought as continued with the high decrease in cedar pollen after around 11500 B.C. at Kararnık Bataklığı in western Anatolia and the climate continued to be in decrease and decline in temperature and humidity/precipitation/rainfall until the start of the Holocene (van Zeist 1975 cited in Moore and Hillman 1992: 482-494).

According to the research one of the similar regions with a good pollen record from the Pleniglacial through the Holocene is in northern Greece as an example (van Zeist and Bottema 1982 cited in Moore and Hillman 1992: 482-494), the general trend in the published pollen curves was similar as these were dry, steppic conditions in the Pleniglacial that persisted into the Late Glacial. Then oak and pine forest spread throughout the region as temperature and growing season moisture increased. The initial phase of tree growth at Tenaghi Philippon on the Plain of Drama took place during the Late Glacial, and was then sharply reversed at an estimated date of around 10,500 B.P, before resuming once more in the early Holocene (Wijmstra 1969:523 cited in Moore and Hillman 1992: 482-494). This return to dry, steppic conditions appears to correspond approximately to the Younger

Dryas and correlates with the vegetation record from southwest Asia and the Levant. According to the research these pollen sequences all suggest that the colder conditions of the Younger Dryas had a significant impact on vegetation throughout southwest Asia and also in the southeast of Europe. Everywhere the Younger Dryas climatic event in southwest Asia was continued by a decrease in moisture/humidity that caused a temporary reverse to partially steppic vegetation conditions as more typical of the Pleniglacial according to the research. It should also be added that the five pollen cores cited above show both the Younger Dryas episode in the Ghab region and also with the two continuing changes in the vegetation cover in this region. All five pollen cores indicate a period of intense aridity from around 18,000 to 15,000 B.C. This changes were followed, 15,000 to 11,500 B.C. by a sharp increase in growing-season moisture reflected in dramatic forest expansion at Lake Huleh, the Ghab region, Karamık Bataklığı, and Tenaghi Philippon, and an increase in grasses and other herbs, together with more arid tolerant Artemisia and chenopods, in the mountain-steppe flora around Lake Zeribar according to the research done and the pollen evidence shown in this area (Moore and Hillman 1992: 482-494).

According to the research, the recently found evidence has a number of significant implications for the understanding of human adaptations during the late Epipaleolithic in the Levant and for the adoption of agriculture. The improvement in the environment and in the climate that began in the Late Glacial around 15,000 B.C. provided increasingly favorable conditions for hunter-gatherers throughout the region from late Epipaleolithic 1 till early Epipaleolithic 2 periods. This helped to explain the success and structure of such groups, as an example like Geometric Keharan and early Natufian in the southern Levant (Bar-Yosef and Belfer-Cohen 1989 cited in Moore and Hillman 1992: 482-494), and the Epipaleolithic period inhabitants of Abu Hureyra 1A on the Euphrates. The climatic reverse conditions that followed deeply changed/made to fluctuate the environment in which such groups lived. The return of drier conditions sharply by the Younger Dryas climatic event in the Levant reduced the enlargement area of the forest and caused the rich zone of open forest steppe along its edge to decrease in the west direction, and probably to decrease in forest width. Then by the climate there was a sharp reduction in the extent of plant zones most favorable for the, groups of Epipaleolithic 2 hunter gatherers.

These conditions appear to have lasted about a millennium, connected with the duration of the Younger Dryas in the Levant and in elsewhere. The environment improved and climate became better, warmer and wetter with higher precipitation towards the end of the period, an the evidence of the recent evidence of Huleh core and pollen evidence from the Ghab region, but the ratio of arboreal pollen never reached the level it had reached in the Late Glacial before the end of the Younger Dryas. It was seemed that the pollen cares suggested an improvement of conditions from the Late Glacial till the early Holocene period, while Leroi Gourhan's studies of the pollen core from Epipaleolithic 2 peirod sites from this region indicated that their environment around were often quite steppic (Darmon and Leroi Gourhan 1991, Henry 1989:73, Leroi Gourhan 198 cited in Moore and Hillman 1992: 482-494). By some evidence, it was seen/proved that steppe species of plants increased around those sites during the eleventh millennium B.C.. because the climate became drier. The decrease in moisture availability in during Epipaleolithic 2 period and would have had a considerable impact on continuing human patterns of foraging. According to the research it may have taken several centuries for the full effects of this climate change to be felt because especially on sites in the better watered zones but they would have been experienced by people throughout the Levant, and adjustments in subsistence would have been necessary in that times which may have shifted these subsistence strategies to the beginnings of agriculture and the beginnings of animal husbandry (Moore and Hillman 1992: 482-494).

According to the research and according to the zooarchaeological measures and evidence in the Levant about this climatic change event, the pattern of hunting remained the same throughout the sequence of occupation at Abu Hureyra 1, indicating that the change and fluctuations in climate had no adverse effect on the density of the herds of Persian gazelle as Gazella stihgutturosa, a steppe species that was the main source of meat for food consumption (Legge and Rowley-Conwy 1987 cited in Moore and Hillman 1992: 482-494). At other Epipaleolithic 2 sites in the forest zone the increase in the proportions of the various gazelle subspecies killed compared with Epipaleolithic 1 (Moore 1982:227 cited in Moore and Hillman 1992: 482-494) may partly reflect the end of more hard climatic conditions. So it can be seen that, the inhabitants of Abu Hureyra apparently modified their gathering of plants in response to the alterations in the vegetation in the site catchment. Abu

Hureyra is the Levant site excavated and that was inhabited throughout the Younger Dryas, and also Abu Hureyra is also the only one to have given a long sequence of plant remains. So according to the research, it should not be expected to see such direct evidence of changes in subsistence from other sites occupied for shorter lengths of time (Moore and Hillman 1992: 482-494).

These evidence from these research done shows the major changes in culture and the pattern of settlement as the Levant environment and climate fluctuated and shifted for some time. Most of the more substantial sites in the Natufian heartland were inhabited during the earlier stages of that culture. Some of the Natufian sites that were effected from climate changes were Mugharet el Wad (Garrod 1957 cited in Moore and Hillman 1992: 482-494), Ain Mallaha (Perrot 1966 cited in Moore and Hillman 1992: 482-494), Wadi Hammeh 27 (Edwards et al. 1983 cited in Moore and Hillman 1992: 482-494), and several many other Early and Late Natufian sites, that the Natufian culture has been found in its most developed form. They were important sites with their architecture and other structures, rich assemblages of bone and ground-stone artifacts, bone artifacts, and also exquisite naturalistic carvings in bone (Moore and Hillman 1992: 482-494) and stone. As Garrod (Garrod 1957:224 cited in Moore and Hillman 1992: 482-494) noted in her original survey of the culture, and Valla and Henry have since analyzed (Henry 1989:181, Valla 1988:582), most of those elements in the later Natufian, and occupation on sites in the Natufian heartlands. It appears that according to the research and the archaeobotanical and archaeozoological evidence this disturbance in the settlement patterns in the later Natufian coincided with the environmental destrucion and natural damage of the Younger Dryas (Moore and Hillman 1992: 482-494).

It would seem that conditions worsened sufficiently to decrease the pattern of subsistence plant gathering at sites in the Natufian heartland and with it the relatively sedentary life of their inhabitants. If supplies of wild plants and animals were no longer so abundant close by those sites because of environmental deterioration and abrupt climatic change, their inhabitants would have been obliged to modify/edit their subsistence activities to find another way like the initiation of agriculture and animal domestication. It appears that Natufian's inhabitant's initial response was to resume a more mobile pattern of hunting and gathering, which had probably characterized life in the Pleniglacial period. In the far south, in the Negev and Sinai region going to the direction of Egypt, there were quite rapid changes in culture and the pattern of settlement, but there was continuity of occupation (Goring-Morris 1987:436-439 cited in Moore and Hillman 1992: 482-494). So, the deterioration in climate apparently had less impact there.

The transition from Epipaleolithic to Neolithic period around 10000 B.C. was connected with the end of the Younger Dryas climatic episode. It was a time of major readjustment in culture and settlement patterns throughout the Levant. Settlements in the steppe zone were left and the Azraq Basin and the oasis of Ei Kum became deserts. (Cauvin 1981:387, Garrard et al. 1988 cited in Moore and Hillman 1992: 482-494), for not to be reoccupied for at least a millennium. Even in the better-watered zones occupation decreased at nearly all sites because of the last hard climatic event of Younger dryas. At the small number of Natufian settlements like Abu Hureyra, Jericho, and Beidha that were inhabited both in the Epipaleolithic and they succeeded to continue in the Neolithic periods, occupation was briefly decreased and destroyed/ended at the end of the Epipaleolithic period of the Levant. According to the research the new Neolithic age pattern of settlement was based initially on a relatively few large sites in locations with rich soils and ample surface water, that is in locations that were suitable for agriculture. Remains of domesticated cereals and pulses have been found at Jericho and Tell Aswad, dating from about 10000 B.C. (Hopf 1983, van Zeist and Bakker-Heeres 1979 cited in Moore and Hillman 1992: 482-494), and later at Abu Hureyra. The economic and sociocultural transformations that marked the transition from Epi-paleolithic to Neolithic therefore appear to have been rapid.

According to the research of Moore and Hillman, the Younger Dryas climatic episode evidently had a significant impact on the environment of southwest Asia and on especially sites in the Syria and in the Levant region. It interrupted the Late Glacial improvement in climate and vegetation, and caused a brief return to the conditions of the Pleniglacial. The consequences were severe for the Epipaleolithic 2 peoples of the Levant. Their modes of gathering were some destroyed and not working and the resulting stresses of subsistence led to wide spread changes in the location of patterns of settlements. The transition from Epipaleolithic to Neolithic and from hunting and gathering to farming did not happen at about the same time after the Younger Dryas ended. According to the research it was suggested that the disruption that took place in Epipaleolithic 2 patterns of adaptation acted as a powerful force for the Natufian people/inhabitants of the Levant to develop new modes of subsistence like agriculture and animal domestication and may be after that the formation of permenantly settled regular village lives. It can not be said that the Younger Dryas episode was the only factor that led to this result for the origination of agriculture and animal domestication but among other processes, the adventages/benefits of sedentary life, demonstrated at Abu Hureyra at least, and population growth during the Epipaleolithic undoubtedly contributed to the outcome (Hillman 1987, Moore 1985:13 cited in Moore and Hillman 1992: 482-494). But, according to the Moore and Hillman's research, the Younger Dryas climatic change was probably a significant catalyst in each of the areas within southwest Asia and the Levant where agriculture and cultivation is likely to originate (Moore and Hillman 1992: 482-494).

There are many different independent patterns and development ways of successful subsistence techniques to survive in the wild nature, that the most successful one of the subsistence systems was agriculture, began during the early Holocene and developed during the Holocene period that correspond with the Epipaleolithic and Early Neolithic, PPN period. Plant based type of subsistence systems were not known in the Pleistocene, even from the late Pleistocene when human populations were quite sophisticated according to the research. Recent known data and paleoclimatic research from ice and ocean core climate proxies show that by not including/counting Younger dryas abrupt and hard paleoclimatic change event in the Epipaleolithic, last glacial climates were extremely open, ready and hostile to agriculture, dry, low in atmospheric CO_2, and extremely variable on quite short time scales. It was analyzed and hypothesized by the research of Richerson, Boyd and Bettinger that agriculture was impossible under last-glacial conditions. According to this research, the quite abrupt final change of the climate from bad and hard to the better and suitable climatic conditions after Younger dryas ended in the Levant region as the amelioration of the ancient climatic conditions was followed immediately by the beginnings of plant intensive resource use strategies in some areas, although the turn to plants was much later in other places. Almost all developments of subsistence strategies in the Holocene are progressive and agriculture became the dominant strategy in all type of agriculturally suitable environments. It was also mentioned and hypothesized in the Richerson, Boyd and Bettinger's research that, in and during the Holocene period, agriculture was needed and compulsory, in the long run. The research and analysis of Richerson, Boyd and Bettinger was using a mathematical analysis to explain and argue that the rate limiting process for agricultural subsistence developing patterns must generally be the rate of innovation of agricultural subsistence technology or subsistence related social cultural organization and social cultural change or transformation or social cultural evolution. According to the research, at the observed rates of subsistance methods innovation and development, population growth will always be rapid, population will increase enough to sustain a high level of population pressure. So this research was entering into the area of population pressure theory of the agricultural origins that refers to the idea that agricultural transition was originated because of the widely and rapidly increasing population in the areas and reaching to the limit or carrying capacity of the natural food resources of that region and the near geographical surroundings of that region (Richerson, Boyd and Bettinger 2001: 1-50).

According to the paleoclimatic research, the Pleistocene geological time period was characterized by highly bad conditions of glacial marginal cold periods and climatic reversals, fluctuations and retreats. Using a variety of proxy measures of past temperature, rainfall, ice volume, mostly from cores of ocean sediments, lake sediments, and ice caps, paleoclimatologists have constructed a clear and interesting picture of climate deterioration over the last 14 million years (Bradley 1999; Cronin 1999; Lamb 1977; Partridge, et al. 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50).

According to this paleoclimatic pattern and ancient climatic fluctuations research, the Earth's mean temperature dropped several degrees and the amplitude of fluctuations in rainfall and temperature increased. For some reasons, glaciers wax and wane togetherly connected to the changes in ocean circulation, carbon dioxide, methane and dust content of the atmosphere, and changes in average precipitation and the distribution of precipitation (Broecker 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50). The resulting pattern of fluctuation in climate is very complex. As the climatic deterioration, becoming worser of climatic conditions continued in the past, different cyclical patterns of glacial advance and retreat involving all these variables have dominated the climatic pattern. Acoording to the past climatic change pattern a 21,700 year cycle dominated the early part of the period, a 41,000 year cycle between about 3 and 1 million years ago, and a 95,800 year cycle during the last million years (deMenocal and Bloemendal 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50).). There is a Milankovich's hypothesis that is researched that these variations are driven by changes in the earth's orbit, and hence the solar radiation income in the different seasons and latitudes, and these values totally fits the estimated temperature variation, but there are still doubts remained for this Milankovich's hypothesis (Cronin 1999: 185-189 cited in Richerson, Boyd and Bettinger 2001: 1-50).

By the analysis done it can be said that there was a rapid climatic variation in the late Pleistocene period, the long time scale climate change associated with the major glacial advances and the climatic pattern reversals, retreats. The millennial scale climatic variations shown in this core also in connection with the Greenland record. Peterson's research (Peterson et al. 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50) show that ancient climatic indicators for the tropical Atlantic hydrologic cycle have a strong millennial scale signal that likewise closely matches the Greenland climatic pattern. Reports of proxy records apparently showing the ultimate Younger Dryas millennial-scale cold episode, strongly expressed in the North Atlantic records 12600-11600 B.C., have been reported from all over the world, including Southern German oxygen isotope variations (Grafenstein et al. 1999 cited in Richerson, Boyd and Bettinger 2001: 1-50), organic geochemistry of the Cariaco Basin, Venezuela (Werne et al. 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50), New Zealand Pollen (Newnham and Lowe 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50), and California pollen (West 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50). The Younger Dryas episode has received very high and significant attention because the time period of Younger Dryas was easily and clearly dated by C14 and also the Younger Dryas abrupt and harsh paleocliamtic event was sampled by many lake and mountain glacier cores more successfully and significantly compared to older millennial scale big ancient climatic events. By the Cronin's research, (Cronin 1999: 202-221 cited in Richerson, Boyd and Bettinger 2001: 1-50) the Younger Dryas was frequently detected in a different direcion pattern of Northern Hemisphere climate sites/regions from all latitudes. The main different thing and arguement about Younger Dryas involves data from the Southern Hemisphere of the world, where the data from Southern Hemisphere often do not show a cold period coinciding with the Younger Dryas, although some records show a similar Antarctic Cold Reversal just showing the Northern Hemisphere Younger Dryas (Bennett et al. 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50).

Some other ancient climatic records provide support for millennial-scale climate fluctuations during the last glacial that cannot be totally correlated with the Greenland ice record. Cronin (Cronin 1999: 221-236 cited in Richerson, Boyd and Bettinger 2001: 1-50) anlayzes paleoclimatic records from the deep tropical Atlantic, Western North America, Florida, China, and New Zealand. Recent additions to his catalog include Southern Africa (Shi et al. 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50), The American Midwest (Dorale et al. 1998 cited in Richerson, Boyd and Bettinger 2001: 1-50), the Himalayas (Richards et al. 2000), and northeastern Brazil (Behling et al. 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50). Clapperton (Clapperton 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50) gives evidence for millennial-scale glacial advances and retreats from most of the American mountains, Alaska and western North America through tropical America to the Southern Andes. While the complex feedback processes operating in the atmosphere, biosphere, ocean systems are not completely understood by the researchers (Broecker 1995: 241-270 cited in Richerson, Boyd and Bettinger 2001: 1-50), some physical mechanisms could have linked temperature fluctuation in the both hemispheres. Related to this Broecker and Denton (Broecker and Denton 1989 cited in Richerson, Boyd and Bettinger 2001: 1-50) proposed an explanation based upon the effects of melt glacial water on the deep circulation of the North Atlantic.

According to the research, the last glacial period communities must have always been in the process of irregular reorganization as the climate varied more rapidly than they could reach social and economic equilibrium to find/gather or produce food to survive. The pollen record from the Mediterranean region shows how much more dynamic plant communities were during the last glacial (Allen, et al. 1999; Heusser 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50). Pleistocene fossil beetle faunas are able to move and change their geography and their behaviour more rapidly than plants because many species, especially predators, change their ranges more rapidly than plants. So plants, the flora can be better indicators of the ecological impacts of the abrupt, large amplitude climate changes recorded by the physical climate indicators from the last glacial like the hard and abrupt Younger Dryas paleoclimatic event (Coope 1987 cited in Richerson, Boyd and Bettinger 2001: 1-50).

It was argued that by the researchers if the evolution of intensive plant exploitation systems have tracked intense millennial and submillennial scale variation. According to the research, plant food rich diets take considerable time to develop and plant foods are generally low in protein and often high in toxins and also some time is required to work out a balanced diet rich in plant foods, it can be hard to replace the legumes or any other plant instead of part of the meat in diets. Becoming better in subsistence methods and developing agriculture for ancient societies may have created health declines because of the total energy of the foods collected or produced were not enough but for to cope with this and solve this subsistence problem sometimes very successful adaptations and subsistence strategies were shown by the societies. (Cohen and Armelagos 1984; Katz et al. 1974 cited in Richerson, Boyd and Bettinger 2001: 1-50) Changes in the trends of social cultural organization by social evolution or by borrowing tend to be slow (Bettinger and Baumhoff 1982; North and Thomas 1973 cited in Richerson, Boyd and Bettinger 2001: 1-50). It was doubted by the researchers that even sophisticated last-glacial hunter-gatherers would have been able to solve the complex nutritional and scheduling problems associated with a plant rich diet while coping with unpredictable high amplitude and abrupt climatic changes on time scales. By all these agricultural origins research in the world, the direct archaeological evidence suggests that people began to use widely and deeply the technologies that initiated/originated the agriculture and the agricultural methods only after about 15000 B.C. (Bettinger 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50).

Related to this agricultural origins field, according to the research of pattern of ancient changes and fluctuations in the $CO2$ levels in the athmosphere, there was a carbon dioxide decrease and a in connection there was a $CO2$ limitation of photosynthesis that is limiting amount of plant species variability and plant growth.

Plant productivity was also limited by lower atmospheric CO2 during the last glacial. The measure of CO2 content of the atmosphere was about 190 ppm during the last glacial, compared to about 250 ppm at the beginning of the Holocene (Richerson, Boyd and Bettinger 2001: 1-50).

Photosynthesis on earth is CO2 limited over this range of plant variation (Cowling and Sykes 1999; Sage 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50). Beerling and Woodward (Beerling and Woodward 1993; Beerling et al, 1993 cited in Richerson, Boyd and Bettinger 2001: 1-50) have shown that fossil leaves from the last glacial have higher stomatal density, a feature that allows higher rates of gas exchange needed to acquire CO2 under more limiting conditions. This higher stomatal conductance also causes higher transpiration water losses per unit CO2 fixed, increasing the aridity characteristic of glacial times. Beerling (Beerling1999 cited in Richerson, Boyd and Bettinger 2001: 1-50) estimates the total organic carbon stored on land as a result of photosynthesis during the Last Glacial Maximum using a spatially decreased the world's plant production model coupled to two different global climate models to provide the environmental factors forcing for plant growth. The model results differ substantially, one indicating a 33% lower, and the other a 60% lower, world's carbon store at the Last Glacial Maximum compared to the Holocene. Mass balance calculations based on stable isotope geochemistry also indicate a qualitatively large drop, but uncertainties regarding terrestrial carbon C lead to a similarly large range of estimates. Low mean productivity, along with greater variance in productivity, would have greatly decreased the demand for plant resources during the last glacial. Lower average rainfall and carbon dioxide during the last glacial reduced the area of the earth's surface suitable for agriculture (Beerling 1999 cited in Richerson, Boyd and Bettinger 2001: 1-50). Diamond (Diamond 1997 cited in Richerson, Boyd and Bettinger 2001: 1-50) argues that the rate of cultural evolution is more rapid when innovations in local areas can be shared by diffusion. A reduction in the area suitable for agriculture and the isolation of suitable areas from one another will reduce the rate of development in agriculture and make the evolution of agriculture harder and later in the time for communities.

A slower rate of cultural evolution would prevent the rapid adaptation of successful susbsistance strategies during any favorable locales or periods that might have existed during the last glacial. On present evidence we cannot determine whether aridity, low CO levels, millennial scale climate variability, or sub-millennial scale weather variation was the main factors in preventing the evolution of agriculture. Low CO and climate variation would also prevent and make slower the evolution of dependence on plant foods everywhere.

According to the biological human evolution research, Hominids as the ancestors of human communities evolved as mostly plant eating omnivores. (Milton 2000 cited in Richerson, Boyd and Bettinger 2001: 1-50), and the basic technology for plant exploitation existed at least ten thousand years before the Holocene (Bar-Yosef 1998 cited in Richerson, Boyd and Bettinger 2001: 1-50). So at the very first, plant foods including large seeded grasses were being eaten by human in suitable places on earth (Kislev et al. 1992 cited in Richerson, Boyd and Bettinger 2001: 1-50). After these big, hard and abrupt paleoclimatic events and high amplitute paleoclimatic fluctuations started to end, there were subsistence responses for the amelioration of the climate, by the climate getting better, hunter-gatherers in several parts of the world began to exploit locally abundant plant resources more efficiently, as the evidence says, during the Bolling-Allerod climatic period of near interglacial warmth and stability in climate regime. The Natufian cultural sequence in the Levant is the best-studied and so far earliest example for the use of food subsistence methods in the Late Natufian period. (Bar-Yosef and Valla 1991 cited in Richerson, Boyd and Bettinger 2001: 1-50). One last siege of glacial climate, the Younger Dryas around from 12900 B.C. until around 11600 B.C., reversed/changed these subsistence trends during the Natufian cultural period (Goring-Morris and Belfer-Cohen 1998 cited in Richerson, Boyd and Bettinger 2001: 1-50). The Younger Dryas climate was more variable and fluctuating than the following stable climate of Allerod-Bolling period and more stable Holocene climate (Grafenstein et al. 1999; Mayewski et al. 1993 cited in Richerson, Boyd and Bettinger 2001: 1-50). During the Younger Dryas period there was ten abrupt, short, warm cold cycles that was shown in the evidence of Younger Dryas ice record that perhaps created and felt as bad, abrupt and hard climate shifts and fluctuations all around the world. After 11600 B.C. the Holocene period of relatively warm, wet, stable, CO_2 rich environments began. Subsistence intensification and eventually agriculture was followed in the PPNA and in the Early Neolithic of the South Eastern Anatolia region and in the

Northern Levant. So it can be said that the shift from Late Pleistocene period's glacial to Holocene climates was a very environmental and climatic large change, and took place much more rapidly than cultural and social evolution of the ancient human communities (Richerson, Boyd and Bettinger 2001: 1-50).

The agricultural origins research involved some other forms of the climate-change hypotheses described above, but archaeologists have proposed mainly three main hypotheses in general as the climate stress, population growth, and cultural evolution in order to explain the timing of agricultural origins. These theories/hypotheses were created/formulated before the nature of the Pleistocene-Holocene transition was understood, but these are still the hypotheses most widely analyzed by the archaeologists, early agriculture scientists and paleoclimatologists (MacNeish 1991 cited in Richerson, Boyd and Bettinger 2001: 1-50). Related to this Younger Dryas climate stress theory, Childe (Childe 1951, Richerson, Boyd and Bettinger 2001: 1-50) proposed that the high aridity, dryness at the end of the Pleistocene period stressed forager populations and led these human populations to invent and develop subsistence strategies and to develop the agriculture. Wright (Wright 1977 cited in Richerson, Boyd and Bettinger 2001: 1-50) argued that Holocene climate amelioration brought pre-adapted plants into the Fertile Crescent areas where agriculture first evolved. (Bar-Yosef 1998) and Moore and Hillman (Moore and Hillman 1992 cited in Richerson, Boyd and Bettinger 2001: 1-50) argue that Natufian sedentary hunter-gatherers probably undertook the first experiments in cultivation under the pressure of the Younger Dryas climate deterioration. Earlier/Early Natufian culture people lived in settled villages and exploited the wild ancestors of wheat and barley beginning in the Allerod-Bolling warmer climate period lasted from 14500 B.C. until 12900 B.C. (Henry 1989 cited in Richerson, Boyd and Bettinger 2001: 1-50) and then reverted to mobile hunting-and-gathering during the sharp, short Younger Dryas climate deterioration in around 12600 to 11600 B.C., the last of the abrupt high amplitude fluctuations that were climatic characteristic of the last glacial (Bar-Yosef and Meadow 1995; Goring-Morris and Belfer-Cohen 1997 cited in Richerson, Boyd and Bettinger 2001: 1-50). Post-Natufian or it can be said as Later/Late Natufian cultures began to domesticate the same species during Younger Dryas, in the later phases of Younger Dryas climatic period and after the Younger Dryas ends in around 11600 B.C., after the warmer and stable climatic conditions returned. It was suggested that the late Natufian intensification of subsistance methods that may gave way to agriculture in response to the Younger Dryas can be a trend leading to agriculture and these developments of Natufian during Younger Dryas climate stress was in the way of to produce the first steps toward domestication. The Late Natufian preserved and also developed the remnants of the earlier Natufians, more intensive and successful Natufian susbsistance technology and social cultural organization that served to start the Levantine transition to agriculture at an unusually advanced stage after the Younger Dryas ended. Events in the Younger Dryas time period also provide an opportunity to understand the effects of CO_2 concentration was changing partly independently of climate variability. (Richerson, Boyd and Bettinger 2001: 1-50) The general rise in CO_2 concentration in the atmosphere began 2-3 millennia before temperatures began to rise and continued to increase steadily through the Younger Dryas (Sowers and Bender 1995 cited in Richerson, Boyd and Bettinger 2001: 1-50). The Younger Dryas period development of subsistence strategies of the Natufian suggests an effect of millennial and/or sub-millennial variability of climatic fluctuations factor on agricultural origins in the Natufian culture in the Levant region. (Richerson, Boyd and Bettinger 2001: 1-50) Related to this Cohen's (Cohen 1977 cited in Richerson, Boyd and Bettinger 2001: 1-50) book argued that slowly accumulating global scale population pressure was responsible for the main origins of agriculture beginning at the 11600 B.C. time period. Cohen tought that the subsistence innovation of agriculture was originated and developed by increases in population density, but the Richerson, Boyd and Bettinger's research believe that a long, slow build up of population gradually made people to develop successful subsistence systems to prevent food shortages/food crisis caused by population growth, starting a trend to domesticates and agriculture for subsistance. (Richerson, Boyd and Bettinger 2001: 1-50)

Table 5. Table for the summary of paleoclimatic evidence used to reconstruct paleoclimatic events as the Bolling-Alleroid, Younger Dryas, and Early Holocene relevant to the transition to agriculture in the southern Levant. Dates are in calibrated years B.C. (Created by using Munro 2003: 47-71)

Short summary/ timeline/ chronology for paleoclimatic developments/ changes/ shifts in the ancient time periods, climate indicator and references for the Levant region

Time Period and Climate	Indicator	Reference
ca. 19,000-13,000 B.P. (ca. 20417 B.C.-13153 B.C.).	Increased arboreal pollen	Baruch and Bottema 1991
Wet and Warm	Expansion of Mediterranean forest	Colledge 1991, Henry and Turnbul 1985
	Increased water levels in Lake Lisan	Macumber and Head 1991, Yecheili et.al 1993
	High groundwater table	Macumber and Head 1991
	Paleosol formation in the Negev	Margaritz and Goodfriend 1987
	Freshwater lake existed in Sinai	Goldberg 1977
	Decrease in O18 in cave speleothems in Israel	Bar-Matthews at al. 1999, Frumkin et al. 1999
ca. 13000-11500 B.P. (ca. 13153 B.C.-11329 B.C.)	Decreased arboreal pollen	Baruch and Bottema 1991
Dry and Cool – Younger Dryas climatic event	Shrinking of Lake Lisan	Macumber and Head 1991, Yecheili et.al 1993
	Northward shift of arid adapted snails	Margaritz and Heller 1980
	Increase in O18 in deep sea cores	Kudrass et al 1991
	Increase in O18 in cave speleothems in Israel	Bar-Mathews et al 1999, Frumkin et al 1999
ca. 11500-7000 B.P. (ca. 11329 B.C.- 5844 B.C.)	Increased arboreal pollen	Baruch and Bottema 1991
Return to Wet and Warm conditions	Decrease in O18 in Mediterranean sea cores	Luz 1982
	Decrease in O18 in cave speleothems in Israel	Bar-Mathews et al 1999, Frumkin et al 1999
	Standing freshwater in Jordan valley	Tchernov 1994

According to the paleoclimatic and pollen research evidence, the three major climatic trends are relevant to the transition to agriculture in the Levant as the Bolling-Allerod interstadial period, a postglacial warm and wet phase, the Younger Dryas, a brief, yet harsh, cold and dry event, and the Early Holocene which was characterized by warm and wet climate conditions can be seen on the above table for the chronological summary of supporting paleoclimatic evidence. The big and effective palaeoclimatic changes/shifts begin shortly after the termination of the extremely cold and dry Würm glaciation (oxygen isotope stage 3) with the onset of the Bolling-Allerod interglacial (ca. 19 kya) which was characterized by climatic amelioration and a rise in annual precipitation and mean temperature. This warming trend accelerated with the begining of the Natufian period (ca. 14,5 kya) and peaked around 13,5 kya in the heart of the Early Natufian phase. In the southern Levant, the beginning of the Bolling-Allerod is evidenced by a gradual increase in the O2 values of cave speleothems recovered near modern nowadays' Jerusalem (Bar-Matthews et al. 1999; Frumkin et al. 1999 cited in Munro 2003: 47-71). Pollen spectra from Hula Lake cores (Baruch and Bottema 1991 cited in Munro 2003: 47-71) and the excavations/surveys at the Jordanian sites of Wadi Hammeh 27 (Colledge 1991 cited in Munro 2003: 47-71) and Wadi Juyadid (Henry and Turnbull 1985; Sellars 1998 cited in Munro 2003: 47-71) contain abundant arboreal pollen from around 17 kya until well into the Natufian period, and indicate an expansion of the Mediterranean forest (Baruch and Bottema 1991 cited in Munro 2003: 47-71). Geomorphological data from the Wadi Hammeh area in Jordan reveal a long sequence of deposition in the wake of steadily rising waters in Lake Lisan from the end of the Late Glacial Maximum to around 13 kya (Yechieli et al. 1993; Macumber and Head 1991 cited in Munro 2003: 47-71). At final stage of the period, the formation of paleosols along the northern fringe of the Negev desert prior to 13 kya indicates a period of high moisture beginning around 18 kya (Margaritz and Goodfriend 1987 cited in Munro 2003: 47-71). Around 13 kya the Younger Dryas interrupted the warming trend of the Bölling-Allerød and returned the Levant to near glacial dry and cold conditions (Overpeck et al. 1989 cited in Munro 2003: 47-71). The Younger Dryas has been identified by spikes in oxygen isotope ratios from the deep sea cores from across the globe (Kudrass et al 1991 cited in Munro 2003: 47-71), and locally in the southern Levant in speleothems from caves in central Israel (Bar-Matthews et al. 1999; Frumkin et al. 1999 cited in Munro 2003: 47-71). Pollen spectra also record a reduction in arboreal pollen related with the Younger Dryas event on both global (Engstrom et al. 1990 cited in Munro 2003: 47-71) and local scales. (Baruch and Bottema 1991 cited in Munro 2003: 47-71)

After these, the increased aridity was documented around 13 kya in Wadi Hammeh, Jordan where a cessation of sedimentation and the initiation of the trend of rapid drying of Lake Lisan started (Macumber and Head 1991; Yechieli et al. 1993 cited in Munro 2003: 47-71). The Younger Dryas abrupt and harsh paleoclimatic event mostly ended at the Pleistocene/Holocene boundary as between at the end of Pleistocene and at the beginning of Holocene ages at around 11,5 kya with a return to better cliamtic conditions just as the Natufian period came to a close and agriculture began. The Early Holocene was marked by warmer and wetter conditions than today, but never reached those characteristic of the Early Natufian phase according to the research (Bar-Yosef 1996 cited in Munro 2003: 47-71). Significant decreases in oxygen isotope ratios obtained from Mediterranean Sea cores and dated to the Early Holocene tended to improved climatic conditions. Declines in the oxygen isotope ratios are interpreted as a reaction of glacial melt water and freshwater in response to increased temperatures and precipitation/decreased aridification (Luz 1982 cited in Munro 2003: 47-71).

The Hula pollen spectrum is marked by increased arboreal pollen counts in the Early Holocene and points to a reexpansion of the Mediterranean forest. So deciduous trees that prefer warmer climates never reached the extent of the Early Natufian distribution, and more drought resistant conifers continued to dominate the forest line. Finally, faunal assemblages as animals from Pre Pottery Neolithic A (PPNA) sites in the Jordan Valley, including Netiv Hagdud and Gilgal, were rich in freshwater birds, rodent, and aquatic plant species, indicating proximity to a substantial body of fresh water (Leroi-Gourhan and Darmon 1991; Tchernov 1994 cited in Munro 2003: 47-71). The beginnings of the Natufian culture emerged against a background of mild climatic conditions. During the Early Natufian phase, the Mediterranean zone as can be said the richest of the Levantine habitats was at its broadest extent, and precipitation and temperatures were at their post glacial peak. As an interesting thing according to the research, the high climatic changes and bad, abrupt and hard paleoclimatic fluctuations of Younger Dryas corresponds to the beginning of the Late Natufian phase (around 12,8 kya).

The evidence shows populations living in the core Natufian areas were faced with shrinking habitats, and some declines, probably some food stress/food shortage and the general decrease in resource productivity per unit land area. The time of the end of the Younger Dryas when the climates became better as warmer and less drier, more precipitation in around. 11.5 kya roughly correlates with the disappearance of the Natufian adaptation and the initiation of the PPNA period and PPNA cultures. Subsequent reexpansion of the Mediterranean forest and the return to warmer and wetter conditions overlaps with the appearance of the first agricultural settlements in the Jordan Valley where rich alluvial soils provided a suitable setting for early primitive agriculture (Munro 2003: 47-71).

As a summary of this part, there is many paleoclimatic changes during the Late Peistocene and Early Holocene transition periods, and one of them is Younger Dryas started and effected the Ghab (Northwest Syria) and Hula regions (Israel-Levant) as this climatic change was proved by the analysis of pollen cores from the Ghab and Hula regions' lakes and the evidence of the decline of vegetation area and change/decrease in the forest line around these regions in the time of Natufian culture in the Levant that corresponds to the time of Late Natufian culture. This climatic change had highly effected the Late Natufians and the evidence shows people living in the Natufian areas were faced with less vegetation and less plant habitats, and some decreases, possibly some food stress/food shortage and the general decrease in resource productivity per unit land area. After the time of the end of the Younger Dryas when the climates became better as warmer and less drier, more precipitation increases on that region and after the disappearance of the Natufian adaptation and the initiation of the PPNA period and PPNA cultures comes and the return to warmer and wetter conditions overlaps with the appearance of the first agricultural settlements in the Jordan Valley where rich alluvial soils provided a suitable setting for early primitive agriculture as evidence shows.

CHAPTER 3

THE EPIPALEOLITHIC ANCIENT NATUFIAN CULTURE IN THE LEVANT REGION

According to the Natufian culture research, excavations and the surveys in the Levant region, in the begining, the Natufian culture was originally defined as its name was firstly given as “Natufian” culture by the research, excavations and surveys of Garrod in 1957 and Neuville in 1951 on the basis of Natufian culture lithic, bone, and ground stone industries and burials uncovered in excavations at cave sites on Mount Carmel and in the Judean hills. Perrot made excavations at Ain Mallaha (Eynan), and found out semisubterranean (halfly underground) houses and Perrot found out the possible village life of the Natufian (Braidwood 1975). Houses, burials, art objects, and many pounding and grinding stones and objects, and a rich Natufian bone industry, characterize sites in the Natufian homeland in the central Levant. The big sites/large sites as the big base camps of Natufians that contain such features have been classified as base camps to recognize and separate them from smaller sites that contain the remains of smaller less important structures or no structures, no burials, and a poor bone industry. The later phase sites can be interpreted on the basis of their lithics and deposits as Natufian camps and settlements of various sorts and some of them are relatively far from Natufian territories, as belonging to a different archaeological cultural entity and different regions (Bar-Yosef 1983; Bar-Yosef and Belfer-Cohen 1992.; Belfer-Cohen 1993; Byrd 1989, Henry 1989 cited in Bar Yosef and Meadow 1993:55-71).

Many descriptions and research of the Natufian tend to sum up its two phases together as counting/analyzing and interpreting Early and Late Natufian phases together. According to the research the radiometric C14 dates, stratified sites, and additional archaeological features indicate that the division between early and late Natufian has the great highly crucial importance. Early Natufian base camps are characterized by semisubterranean (halfly underground) houses. Late Natufian sites have yielded poor remains such as the long terrace walls and the cemetery area at Nahal Oren Terrace (Noy 1991 cited in Bar Yosef and Meadow 1993:55-71).

By the research and by the basis of the biological evidence also, Natufian base camps in the homeland area are thought to be the remains of sedentary groups. Natufian graves were uncovered in all these base camps. Stratigraphic indications from Hayonim Cave and Ain Mallaha demonstrate that graves were dug in deserted house structures (dwellings) and outside houses and not under the floors. Graves were either shallow or deep pits and were occasionally built/paved with stones or covered/coated with lime. This pattern continued into the Neolithic period. Mortuary and burial practices varied in the Natufian culture as in primary burials, bodies were supine, semiflexed, or flexed, with various orientations of the head. The number of inhumations ranges from single to collective, although the latter type is more common in the early Natufian. Several cases of skull removal have been observed in late Natufian contexts at Hayonim Cave. Secondary burials (one burial over another burial on the top) were either isolated or mixed with primary burials, and scattered human bones occur within occupational deposits.

According to the research a special type of Natufian burial is a series in which humans and domestic dogs were buried together; these have been found at Ain Mallaha (Davis and Valla 1978 cited in Bar Yosef and Meadow 1993:55-71) and Hayonim Terrace (Valla 1996 cited in Bar Yosef and Meadow 1993:55-71) dogs, particularly puppies, may have been kept as pets or else had ritual significance, it was like a semi domestication of animals like mainly dogs and gazelle in the Natufian, possibly of a kind known from much later Near Eastern documents. The keeping of individual animals of all sorts both domestic and wild is a feature common in modern hunter-gatherer and agricultural societies, and it was known by the research that the some kinds of partial domestication origined and occurred back in the Upper Paleolithic. Given appropriate behavior in the species concerned and sufficient stock, the capture and raising of individual wild animals may lead to reproduction in the domestic animals, a primary defining feature of animal domestication (Bokonyi 1969 cited in Bar Yosef and Meadow 1993:55-71). It seems likely that the wolfs were partially domesticated by multigenerational interaction with human groups earlier than any other social species. (Bar Yosef and Meadow 1993:55-71).

According to the research the Natufian lithic industry is characterized by extensively used cores, small, short, wide bladelets and flakes, and a substantial high frequency of blades that in the Natufian core area were made into sickle elements. Frequencies of tool types vary and microliths and geometries reach 40 percent or more in every assemblage. The microliths of the early Natufian assemblages vary in shape and frequency and include Helwan and backed lunates, trapeze-rectangles, and triangles. In the late Natufian, however, backed lunates generally dominate. Special tools are picks as the forerunners of the ax-adze group of the Neolithic period and sickle blades that bear a sheen covering a relatively wide area on both faces of the blade. Through experimental and microscopic studies (Unger-Hamilton 1991 cited in Bar Yosef and Meadow 1993:55-71), these have been shown to have been used for harvesting cereals. They were hafted in bone or, more often, wooden handles. Ground stone tools occur in large numbers in base-camp sites and in lesser numbers in the more ephemerally occupied camps. They include bedrock mortars, portable mortars, bowls of various types, cup-holes as shallow depressions made in limestone slabs, mullers, and pestles. The boulder mortars weighing up to between 100 to 150 kg with a 70 to 80 cm deep hole have sometimes been called stone pipes. Grooved stones include sandstone whetstones for shaping bone objects, as well as basalt and limestone shaft straighteners that bear burning marks which result from rubbing heated wooden shafts. This evidence suggests the use of bows by the Natufians. The Natufian bone industry is far richer in both quantity and forms than that of any earlier or later Levantine archaeological entity. Use-wear analysis indicates that many pieces were employed for hide working and basketry (Campana 1989 cited in Bar Yosef and Meadow 1993:55-71). Barbed items are interpreted as parts of hunting devices as spears or arrows, hooks and gorgets for fishing, and hafts for sickle blades. A large number of bone implements are decorated. (Bar Yosef and Meadow 1993:55-71).

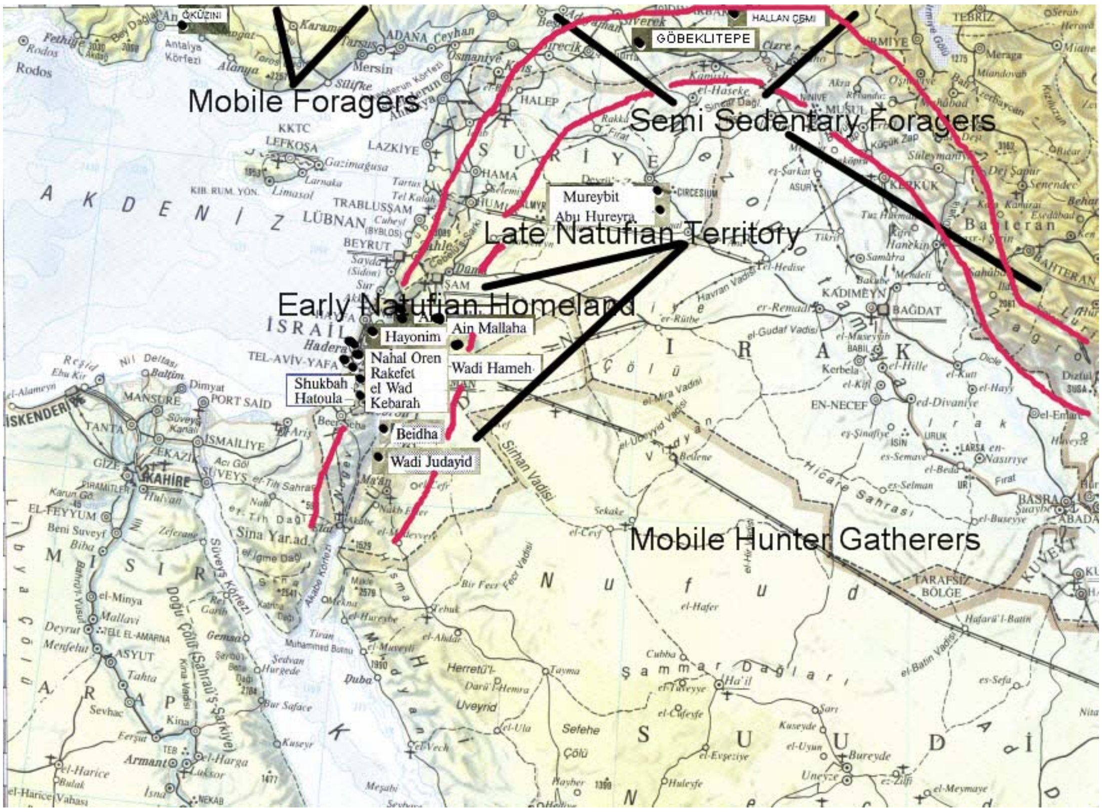

Figure 5. A map of the southern Levantine region, showing the fertile crescent with red mark, showing the other hunter gatherer, sedentary and forager groups closer to Natufian and showing the main Early and Late Natufian boundries with black mark and showing the sites mentioned in the text by showing the locations of most of the Natufian sites and also showing other important sites far from Natufians living at the same time period. (Created by using Bar-Yosef 1998, 131 and Grosser Weltatlas, 1993, Ansiklopedik Büyük Dünya Atlası - The Big World Atlas Encyclopedia, 144.)

In these past excavations, most Natufian sites were excavated before recovery techniques such as systematic dry sieving and flotation were introduced. In recent excavations at Hayonim Cave and Hayonim Terrace and the last seasons at Ain Mallaha, Nahal Oren, and Wadi Hammeh 27, flotation failed to retrieve significant quantities of floral remains. In some excavations, the few grains recovered were later dated by Accelerator Mass Spectrometry (AMS) to a relatively recent age. The poor preservation of vegetal remains typical of sites located within the Mediterranean phytogeographical belt results from the terra rosa soils. Sediments in this zone are getting wet in each winter and dry up and crack in the summer, destroying paleoethnobotanical remains and causing both downward and upward movements of small particles. Charcoal flecks in desertic loess in the Negev are better preserved, but the best preservation is in the drier deep deposits of the lower Jordan valley, Damascus basin, Euphrates River, and southeast Turkey. An additional expression of the paucity of carbonized material is the scarcity of charcoal radiocarbon dates from

Natufian sites. The idea that the Natufians may have been the earliest farmers was suggested by Garrod in 1932. Inspite of later criticism the idea was reviewed by others and supported by experimental studies on sickle blades (Unger-Hamilton 1991 cited in Bar Yosef and Meadow 1993:55-71). Systematic cultivation, however, would have rapidly caused the domestication of wheat and barley (Hillman and Davies 1992 cited in Bar Yosef and Meadow 1993:55-71), and even for the early Neolithic in the Pre Pottery Neolithic A the state of domestication of cereals is still under controversial and under discussion. The intensive and extensive harvesting of wild cereals as part of an anticipated summer mobility pattern seems to be a more acceptable and cautious interpretation for Natufian communities (Bar Yosef and Meadow 1993:55-71).

Natufians hunted mainly gazelles as the main food animal sources along with other types of huntings, depending on the geographical location of each site. In the coastal ranges, deer, cattle, and wild boar were common, while in the steppic belt more equids and ibex were taken. At Beidha, goats were the principal animals hunted, especially the Nubian ibex as Capra nubiana, but perhaps also the wild goat as Capra aegagrus, for which the relatively fertile cliffs and slopes above the site would have provided suitable habitat at the southern limit of their range. But, ibex probably lived in the arid gorges below Beidha (Uerpmann 1987:116 cited in Bar Yosef and Meadow 1993:55-71), a habitat not suited to the wild goat. Waterfowl formed part of the diet, especially in sites along the Jordan valley where both migratory and nesting ducks gathered during seasons of water stress (Pichon 1991 cited in Bar Yosef and Meadow 1993:55-71). Seasonal fishing of freshwater species is well documented from Ain Mallaha (Desse 1987 cited in Bar Yosef and Meadow 1993:55-71). This activity seems to have been less important along the Mediterranean coast, although scarce fish remains from Hayonim Cave and the new excavations at El-Wad, and the presence of bone gorgets and hooks at several sites, indicate that old recovery techniques are often responsible for the incomplete information (Bar Yosef and Meadow 1993:55-71).

Late Natufian sites are present over a large geographic region from Mureybet in the Middle Euphrates valley to the Negev, but sites of this period within the Mediterranean belt are poorly known. A few major sites were excavated and surveyed in the Negev highlands and the south Jordanian plateau (Byrd 1989; Henry

1989 cited in Bar Yosef and Meadow 1993:55-71), while in the lowlands of the western Negev and northern Sinai, small sites were found containing typologically limited tool kits, including lunates, end scrapers, and retouched blades all showing intensive use of the microburin technique. A seasonal settlement pattern can be reconstructed for the later Natufian on the basis of indirect evidence, as we explained earlier. Winter camps are dispersed in the sandy lowlands stretching from the seashore to about 60 km inland; these have a much higher carrying capacity than the loessic plains. Early spring or summer was marked by movement into the highlands, where people could stay until fall. Locally hunted resources included gazelle, ibex, and hare, and the intensive collection of plant foods is indirectly suggested by the presence of numerous pounding tools, including bedrock mortars and some grinding stones (Bar Yosef and Meadow 1993:55-71).

The large late Natufian camps in the Negev, lacking features that characterize the Mediterranean base camps such as burials, art objects, and a rich bone industry (Goring-Morris 1987 cited in Bar Yosef and Meadow 1993:55-71) perhaps should not be called Natufian. A great variety of marine shells, collected mainly from the shores of the Mediterranean (a few are from the Red Sea), point to the presence of an exchange network with desertic groups or to the aggregation of groups that descended into the Arava valley and the shores of the Gulf of Eilat during the winter. According to the research, the increasing aridity of the Younger Dryas period around between 10800-10300/10200 B.C. forced the late Natufian people and society and Natufian economy to change for to find subsistence strategies (Bar Yosef and Meadow 1993:55-71).

In Late Natufians, foods were cereals harvested in wild stands. According to Bar Yosef and Meadow, some late Natufian sites can be interpreted as a return to the lifeway of mobile hunter gatherers. The impact of the Younger Dryas is attested by the abandonment of early Natufian sites and the establishment of late Natufian settlements, often in new localities beyond near to the original early Natufian homelands. The cold and dry Younger Dryas caused yields of natural cereal stands to decrease and under existing territorial restrictions, increased the motivation for intentional cultivation and gave the way to the origination of agriculture in plants. By establishing sedentary communities in the Jordan valley or on lakeshores (like in Aswad) or riverbanks (like in Mureybet), the first farmers gained from using some marginal, flat, alluvial lands as fields. These could have been vegetationally rich areas with high water tables. In the case of the Jordan valley, these localities were hotter and drier than the coastal plain sites. The shift in settlement pattern meant that the main consideration in choosing a location was cereal cultivation and not optimal foraging of vegetal and animal resources as continued to be the case on Mount Carmel, in the Galilee, and in areas in the higher Transjordanian plateau. In many sites the preferred locations were those that had previously served as seasonal sites owing to their rich stands of wild cereals. This shift in settlement pattern created the picture known today, namely, that of early Neolithic sites located in what is now the marginal belt of the Levant. It should be stressed, however, that this Levantine corridor was more fertile during the early Holocene time period. The socioeconomic changes expressed in the very early Neolithic, some 10,000 years ago, led also to major shifts in kind and division of labor, social organization, and exchange patterns. According to the research by Bar Yosef and Meadow, the success of this revolution was supported by the wetter, stable climatic conditions of the PPNA and the survival of farming communities along the Levantine Corridor. The success of these communities led to rapid population increase, as is revealed by the number of PPNB sites and the spread of the suite of cultivated plants into neighboring areas and the rest of the Near East, which until then had been continuously occupied by groups of hunter gatherers (Bar Yosef and Meadow 1993:55-71).

Many scholars and researchers consider the Natufian to represent the culture of sedentary hunter gatherers in the Mediterranean Levant (Perrot, 1968; Braiwood, 1975; Henry, 1985). Radiometric dates indicate that its chronological boundaries should be cautiously placed as 12800/500-10500 B.C. (Valla, 1987 cited in Bar Yosef and Belfer-Cohen 1989:467-490). The definition of the Natufian as an archaeological entity is based only partly on its technotypological properties (Bar-Yosef, 1975, 1981; Henry 1977, 1983). Interassemblage variability among Natufian sites reflects local variation, a limited geographical range, and changes through time. There is a uniformity in the basic technotypological attributes which can be observed at least in the Natufian assemblages in the southern Levant (Henry, 1977; 1983; Valla, 1984). Natufian sites are found throughout the Levant, from the middle Euphrates to the Negev highlands and along the Jordanian plateau. The greatest density to date has been observed in northern and central Israel and northern Jordan.

Natufians appear to have preferred the oak and pistachio belt (Contenson and van Lierre, 1964), which at that time stretched from the Middle Euphrates, through the Damascus basin into the Galilee-Judean Hills, and along the Jordanian plateau as far south as Ras en Naqeb. Thus, the high mountains of Lebanon, the Anti-Lebanon Mountains, the arid areas of the Negev, and the peripheral desertic zone of the Syro-Arabian desert were marginal for the Natufian occupation. The Early Natufians were spread very rarely into the Irano-Turanian zone, and only in Late Natufian times were large settlements established in this belt. Smaller ephemeral sites were found in desertic environments (Belts, 1982; Henry, 1982, 1983; Moore, 1985; Goring-Morris, 1987 cited in Bar Yosef and Belfer-Cohen 1989:467-490).

According to the research cave occupation is an additional interesting aspect of Natufian culture. This type of habitation is rarely encountered during Kebaran and Geometric Kebaran times. The Natufians reoccupied most of the caves and rock shelters that had been inhabited for short time spans during the Upper Paleolithic and were later abandoned. This may indicate that the caves were generally dry and could be used for human occupation and storage (Bar-Yosef and Martin, 1979 cited in Bar Yosef and Belfer-Cohen 1989:467-490).

Natufian sites fall into three size categories: small, 15-100 m^2 (like Sefunim Cave, Hayonim Cave, Erq el Ahmar, Nahal Sekher VI, Site 14/7 in the "Black Desert," J406b); medium, 400-500 m^2 (El Wad Cave and Terrace, Rosh Zin, Salibiya I, Wadi Judayid); and large, more than 1000 m^2 (Mallaha, Hayonim Terrace, Nahal Oren, Hatoula, Rosh Horesha, Wadi Hammeh 27). Intensive construction is observed in the large and medium Natufian sites (Valla, 1987 cited in Bar Yosef and Belfer-Cohen 1989:467-490).

The Natufians placed their base camps in ecotones and turned to exploit a broader spectrum of resources than did their predecessors. Direct evidence for such a strategy is provided by the faunal spectra which include mainly gazelle, with some fallow deer, wild boar, fish (mainly fresh water), reptiles, birds as considerable numbers of water fowl, hardly known from earlier Epi-Paleolithic sites. The abundance of pounding tools might be interpreted as resulting from intensified plant gathering or systematic cultivation of cereals. Direct evidence for intentional cultivation is still lacking but experimental work with sickles, carried out by R. Unger-Hamilton (1989) tends to support earlier contentions that the particular sheen on sickle blades resulted from harvesting cereals (Garrod, 1957 cited in Bar Yosef and Belfer-Cohen 1989:467-490). The consumption of cereals and pulses is indicated by the attrition and caries of Natufian teeth from most of the sites (Smith, 1972 cited in Bar Yosef and Belfer-Cohen 1989:467-490). But when the overall state of the Natufians' health is compared to later populations, the general impression is that they were much healthier than their descendants in the Neolithic and especially the Chalcolithic period (Arensburg, 1985; Smith et al., 1984 cited in Bar Yosef and Belfer-Cohen 1989:467-490). However, a sign of increasing stress, caused by prolonged habitation of a large group in a base camp, is the higher rate of mortality of juveniles and especially of children aged 5-7 years, evidenced in the cemeteries of Hayonim cave and Nahal Oren. An additional view on the changing dietary aspects is provided by Sr/Ca studies. Schoeninger (1981) stated that the Natufians consumed more vegetal material than did the Kebarans, basing her conclusions on comparison between various Natufian populations and a sample of burned human bone from layer C (Kebaran) in Kebara Cave. This comparison was rejected by Sillen (1984), who claimed that burned bones cannot be used for obtaining Sr/Ca ratios due to chemical processes induced by fire. Sillen's conclusions were that the Natufians were more herbivorous in Early and Late Natufian, less in the Final Natufian. Unfortunately only one human skeleton from Nahal Oren represents the Final Natufian. Schoeninger's statement regarding the different trends observed in the Zagros are supported by Solecki's (1983) archaeological analysis. It appears that while the Levantine Natufians ate less meat than the succeeding PPNB people in the Zagros who then had a stock of domesticated animals, the Sr/Ca ratios in human bones indicate a higher level of meat in the human diet before and after the appearance of domesticated animals. (Bar Yosef and Belfer-Cohen 1989:467-490) One way of reducing the threat of overexploiting vegetal resources was probably the use of controlled fire. The Mediterranean park-forest, when burned, enabled a quick regeneration of annuals including cereals and pulses (Naveh, 1984). This activity, although lacking direct archaeological evidence, can be considered as a preadaptation to incipient agriculture which commenced by the end of the eleventh or early tenth millennium B.C. Especially for the Late Natufian and the "Middle Natufian", that Natufian was a society under stress according to the research of Bar Yosef and Belfer-Cohen (Bar Yosef and Belfer-Cohen 1989:467-490).

As an archaeological background, the duration of the Epipalaeolithic, Pre-Pottery Neolithic and Pottery Neolithic cultural entities in the Levant. On the basis of relative and absolute chronologies, techno-typological and geographical classificalions, these have been subdivided into the Kebaran and related (around 20000 - 14500 B.C.), Geometric Kebaran and related (around 14500 - 12800/12500 B.C.), Mushabian (around. 14000 - 11700 B.C.), Natufian (around 12800/12500 - 10500 B.C.), Harifian (around 10700 - 10000 B.C.), Khiamian and related (around 10500 - 10200 B.C.), Sultanian/Pre-Pottery Neolithic A (around. 10200 - 9500/9,300 B.C.), Pre-Pottery Neolithic B (around 9500/9300 - 8000 B.C.), Final Pre-Pottery Neolithic B/Pre-Pottery Neolithic C/early Late Neolithic (around 8000 - 7500 B.C.; the last-named are contemporary archaeological entities in the central and southern, and east-central Levant), and the Pottery Neolithic/later Late Neolithic (around 8000/7500 - 7000/6500 B.C.) complexes. In the following accounts of the archaeological complexes, artefacts associated with the possible procurement and processing of food are described, but other aspects of the material culture are dealt with in less detail (Colledge 2001:2-12).

By the research for the Natufian sites, generally by size, Natufian sites were put into three size categories as small sites of between 15-100 m2 sites like Sefunim Cave, Hayonim Cave, Erq el Ahmar, Nahal Sekher VI, the site named 14/7 in the Black Desert region, the site named J406b, the medium sized Natufian sites are between 400-500m2 like El Wad Cave and Terrace, Rosh Zin, Salibiya I, Wadi Judayid and the large big basecamp sites are more than 1000m2 like Ain Mallaha ("Ein/Ain Mallaha" in Arabic, "Eynan" in Hebrew), Hayonim Terrace, Nahal Oren, Hatoula, Rosh Horesha and Wadi Hammeh 27 (Bar-Yosef and Belfer-Cohen 1989:468).

For the Natufian sites animal data, by looking some principal bigger main basecamp early and late Natufian sites like Hayonim cave and Hayonim Terrace are two parts of the same site. The first was excavated in the late 1960's and 1970's by O. Bar-Yosef, E. Tchernov and B. Arensburg. Most of the things, the bone and stone tools (Bar-Yosef and Goren, 1973 cited in Tchernov, E., 2000: 189-213) have been studied recently by Belfer-Cohen (1989a, b, 1991) and Bar Yosef and Belfer-Cohen (1989a), who presented detailed results concerning the typological and technological dynamics through the Natufian sequence, as well as on the incised limestone slabs.

Some earlier phases of the Natufian are well represented in the cave deposits, and produced a very large sample of animal remains. Six species of reptiles were identified: (Bar-Yosef and Tchernov, 1966 cited in Tchernov, E., 2000: 189-213) Testudo graeca, Ophisaurus apodus; Agama slellio, Chameleo chameleon, Ptyodactylus hasselquisti and a small colubrid snake; and three species of amphibians: Bufo viridis, Hyla arborea and Pelobales svriacus, a plethora of marine fish of relatively small body size, and landsnails (Tchernov, 1992 cited in Tchernov, E., 2000: 189-213). The list of mammals is given of the nine species of ungulates that are represented in the assemblage, Gazella gazella constituted a primary economic importance in term of relative frequencies (Cope, 1992), 45% of the megafaunal collection. A male bias of 80% is present for Gazella based on particularly dimorphic bones; 36% of the gazelle assemblage were immature Ninety-seven species of birds were identified from this site (Bar-Yosef and Tchernov, 1966; Pichon, 1984, 1987), and they were represented (Tchernov, E., 2000: 189-213).

In the Natufian site of Hayonim Terrace, F. Valla, who finished long term excavations at Hayonim terrace, came out with extremely detailed analyses of the remains of houses, tracing hearths, burials and zones (Valla, 1987 cited in Tchernov, E., 2000: 189-213). A large sample of animal remains was uncovered from the Terrace of Hayonim. Most groups are not yet identified, but a preliminary examination of the material (Davis, in Henry et al., 1981 cited in Tchernov, E., 2000: 189-213) showed much the same medium and large size mammals as in the cave deposits. According to Cope (1992), Gazella gazella constituted 64% of all ungulates; 37% of the gazelles were immature. 40% of Dama mesopotamica and 20% of Bos primigenius and Sus scrofa were also found to be immature. A male bias of 76% is present for gazelles (Horwitz et al., 1991 cited in Tchernov, E., 2000: 189-213), while for all other ungulate species sex ratios were close to 1:1. As with Hayonim Cave, Bos primigenius made an important contribution to the economy in terms of meat weight (Tchernov, E., 2000:189-213).

In the Natufian site of El-Wad, a re-examination of the deposits at El-Wad (Valla et al., 1986 cited in Tchernov, E., 2000: 189-213) was carried out in 1980-1981. Layers B2 (Early Natufian) and B.1 (Late Natufian) were found to be closely similar to Garrod's description. The flint industry of the uppermost layer, although disturbed, could have placed it well within the latest (final) Natufian, hence the site represents a long Natufian sequence. A rich malacofaunal assemblage was identified by Tchernov (in Valla et al., 1986), as well as vertebrate remains. The list included fish remains (Sparus auratus) (Valla et al., 1986); amphibians and reptiles (Testudo graeca, Ophisaurus apodits; Agama stellio, Chameleo chameleon, a lacertid and a snake; Pelobates syriacus and other anurans). The birds were not identified. The list of mammals were identified by the research done (Tchernov, E., 2000:189-213).

In the Natufian site of Ain Mallaha (Eynan), a large and well preserved sample of animal remains was unearthed from this site. The list of mammals is given. The gazelle represents again the predominant large mammal throughout the archaeological layers. Bouchud (1987) pointed out the deficit in immature gazelles, and the great increase of 2 to 5 year old males. Hares, tortoises, freshwater birds, fishes and crabs played a dominant part in the diet of the Mallaha community. According to Cope (1992), gazelles remained the economic main-stay with male a bias of 55.4% of the collection. 36% of gazelles were found to be immature although most individuals were between 18 months and five years at the time of death. (Cope, 1992; Horwitz et al., 1991 cited in Tchernov, E., 2000: 189-213). Eight species of ungulates were represented in the assemblage where again Bos primigenius made a significant contribution in terms of meat weight. (Tchernov, E., 2000:189-213) Morphometrics based on gazelles from Mallaha exhibited almost the complete size range for the species, some individuals reaching maximum sizes reminiscent of those for the Aurignacian and Kebaran, while others are smaller than the smallest dwarves from Hayonim Terrace. The V-values that resulted from these extremes (Cope, 1992 cited in Tchernov, E., 2000: 189-213) were among the largest of any site sampled over time and space. The list of birds was known found in the Natufian site of Ain Mallaha (Eynan) (Tchernov, E., 2000: 189-213).

In the Natufian site of Hatoula (Layers 4-5), the site is located on the western flanks of the Judean hills, at present well within the Mediterranean vegetational belt. The faunal remains from Hatoula were only partially identified in a preliminary report by Davis (1985). The list of mammals is represented. A much wider diversity is expected when further analyses will be accomplished. Davis (1985) has also shown that the presence of Mediterranean fish bones may be taken as evidence either of the existence of a trading system with other groups of people, or of fishing expeditions to the coastal area, some 30 km. away. Hatoula offered a relatively large sample of animal remains. Gazella gazella was of primary economic importance: 71% of the ungulate assemblage - the highest figure of any site sampled except layers 2-3 of Hatoula's Khiamian. A relatively large 61% of gazelles were immature at the time of death. Forty-six percent of Sus scrofa were young or neonatal, but only 7 % of Bos prirnigenius were immature. A slight male bias of 60% was evident for gazelles of the late Natufian while mean sizes and most V-values (Cope, 1992 cited in Tchernov, E., 2000: 189-213) are returning to normal (Tchernov, E., 2000: 189-213). Davis (1985) has already shown for the late Natufian of Hatoula, much as in other Natufian sites, that gazelles are the predominant animal and the primary source of large mammal protein. Davis (1985) also agreed that the Hatoula gazelles are smaller than the pre-Natufian populations, but argued that this is due to the Pleistocene to Holocene mammal size decrease resulted from a temperature rise. Cope (1992) has shown that size diminution of gazelles during the Natufian is primarily due to heavy male culling and severe inbreeding of the populations (Tchernov, E., 2000: 189-213).

In the Natufian site of Salibiya I, it is a late Natufian site located in the Lower Jordan Valley, 230 m below sea level and about 17 km north of Jericho surrounded by a post-Pleistocene highly dissected badlands topography, cut by many wadis. During the Natufian period, the site appears to have lain in a low-lying, marshy area fed by a number of springs (Schuldenrein, 1983 cited in Tchernov, E., 2000: 189-213). Pollen analyses (Darmon, 1984, 1987 cited in Tchernov, E., 2000: 189-213) suggest that the surrounding environment supported a steppic vegetation with few trees. The Salibiya I faunal assemblage included some medium and small size mammals, and, in particular, hare (Lepus capensis) and fox Vulpes vulpes. Other carnivores are relatively abundant, and it seems reasonable to suggest that these animals may have been slaughtered for their pelts (Crabtree et al., 1992 cited in Tchernov, E., 2000:189-213) as is suggested by cut marks on the second phalanx of a leopard (Felis pardus) and a radius of a fox. The Salibiya I assemblage, both in its upper and the lower levels, and much like in all other Natufian sites, included substantial numbers of juvenile individuals, especially those between 8 and 18 months of age (Davis, 1983; Henry, 1975, 1989 cited in Tchernov, E., 2000:189-213). Previous analyses of fauna from Natufian sites have focused on the role of animals in the diet. From a dietary perspective, the Salibiya I faunal assemblage provides no surprises. The large mammal remains are predominantly those of gazelles, and the assemblage produced about 50% of immature gazelles, especially those between 8 and 18 months of age, which approaches the present age profile of the local G. gazella in northern Israel (Baharav, 1974 cited in Tchernov, E., 2000:189-213).

According to the research, much like in the PPNA of Gilgal, Jericho, Salibiya IX and Netiv Hagdud, one of the most striking features of the Salibiya I faunal assemblage is the presence of large numbers as 115 identified of phalanges, primarily terminal phalanges, of falconiforms. Crabtree et al., (1992) argued that the distribution of the raptorial bird phalanxes is identical to that of the gazelle fragments, indicating that these bird phalanges entered the faunal assemblage as a result of human activity. It is a distinct possibility that the Natufians collected the talons of raptorial birds and used them for decorative purposes (Tchernov, E., 2000:189-213).

For the Natufian sites plant data, the subsistence economy of the archaeological complexes in the Epipaleolithic Levant's Natufian period, according to the research by the reviews of the plant-based subsistence economies on early sites in the Near East (like Zohary and Hopf 2000; Garrard 1999; Willcox 1999; Butler 1998; Miller 1991, 1992 cited in Colledge 2001: 8) in the Epipalaeolithic period very few sites dated to before around 10000 B.C. have produced remains of plant material (like seeds, fruits and other edible plant parts, rather than wood from trees or shrubs). Evidence from archaeozoological and archaeobotanical studies indicates that for the duration of the Epipalaeolithic period, there was a reliance on wild plant and animal foods andj moreover, that the seasonal availability of these resources dictated the movement of groups between settlements. Wild cereals, fruits and other potentially edible wild plants were found at the Kebaran site of Ohalo II, on the shores of Lake Galilee in Israel, dated to 19000 B.C. (Kislev el al 1992 cited in Colledge 2001: 8). Large numbers of charred grains and rachis internodes of wild barley were recovered from occupation levels at the site. Grains and chaff of wild emmer were also present, together wild lentils.

At a later date, in the Natufian period (or equivalent cultures in the northern Levant), wild barley was found at Hayonim Cave, in Western Galilee (Hopf and Bar Yosef 1987 cited in Colledge 2001: 8) and at Tell Mureybit, in northern Syria (van

Zeist and Bakker-Heeres 1984a cited in Colledge 2001: 8. Finds of wild einkorn have been recorded from Tell Mureybit and Tell Abu Hureyra (in northern Syria; Hillman et al 1989; Hillman in Moore 2000 cited in Colledge 2001: 8), wild rye was also identified at the latter site. At these sites, edible legumes were present in the assemblages of charred remains, including wild lentil (at Mureybit and Abu Hureyra), bitter vetch (at Abu Hureyra) and wild pea (at Mureybit). Wild flax was identified at Mureybit. Based on morphological criteria (the large size of the grains), Hillman has identified a few grains of domestic rye in the Late Epipalaeolithic occupation levels at Abu Hureyra (Hillman in Moore 2000, 379; Hillman et al 2001 cited in Colledge 2001: 8). These finds represent the earliest evidence of domestic crops in the Near East (Colledge 2001: 8).

For the Natufian plants there was a clear separation of three Epipaleolithic sites of Tell Mureybit, Wadi al-Hammeh 27 and Wadi el-Jilat 6. There was a predominance of taxa with catholic or unknown ecological preferences in the Wadi al-Hammeh 27 and Wadi el-Jilal 6 plant samples. Steppe-desert taxa were ubiquitous. Distributions of batha and field taxa corresponded with the samples from Wadi al-Hammeh 27 and Mureybit, and maquis and wet ground taxa corresponded with Mureybit and Wadi el-Jilat 6. The Natufian sites of Tell Mureybit, Wadi el-Jilat 6 and Wadi al-Hammeh 27 are located within, or marginal to, the Irano-Turanian phytogeographical region and the resources of this area would have been exploited for use on the settlements. The representation of arid zone taxa in the samples from the three sites. The presence of taxa common in Mediterranean maquis at Mureybit and Wadi el-Jilat 6, according to the research Pistacia plant species was the dominant component at Mureybit and, in this instance, it could represent steppe forest vegetation rather than Mediterranean maquis. The possibility of a more easterly distribution of the Mediterranean woodland zone, and likewise of the bordering steppe forest at this time. Van Zeist and Bakker-Heeres also commented on the likelihood of the proximity of steppe forest vegetation to Mureybit during the occupation of the site (van Zeist and Bakker-Heeres 1984a, 195; Hillman in Moore 2000, 76-84 cited in Colledge 2001: 8).

Pistacia fruits and other resources would have been exploited if they were accessible from the settlement. Whether or not the steppe forest zone was within reach of the Wadi el-Jilat area during the Epipalaeolithic was unknown, but it was known that there are records of Pistacia trees growing in the vicinity of Wadi el-Jilat today. There may have been some form of plant management of wild cereals at Wadi al-Hammeh 27 and Mureybit, and plants growing alongside the wild crops may have been gathered and brought to the sites with the grain, hence the representation of the field group in the samples at both sites. Wet loving taxa were predominant at Mureybit and Wadi el-Jilat 6, and this is not unexpected. Many of the plants on the banks of the Euphrates River would undoubtedly have been gathered for use. There may have been cultivation of the fertile alluvial soils of the riverbank and the taxa growing in these areas may have been incorporated with the harvests of wild cereals. The presence of local sources of water at the time of occupation of Wadi el-Jilat 6 has been researched and the plentiful resources in the surrounding land would have been available for use. Taxa common in batha are not unexpected at Wadi al-Hammeh 27 because it is located adjacent to an area of Mediterranean woodland. Plants of economic importance in the region would have been gathered and utilised on the settlement. Evidence for these elements of the flora at Tell Mureybit requires explanation. It has been suggested that they may represent an incursion of species from habitats bordering land that was prepared for the cultivation of wild cereals and of their subsequent inclusion with the harvests. (Colledge 2001:184-185)

In Wadi al-Hammeh 27 site of Natufian, a total of nineteen taxa were identified in the plant samples from Wadi al-Hammeh 27 located in Jordan area. The taxa were all representative of wild plants. Wild barley type (Hordeum spontaneum type) grains and rachis internode fragments were identified in three samples. Wadi al-Hammeh 27 lies within the natural distribution range of the wild cereal. Other plant taxa found in the samples at Wadi al-Hammeh 27 were also common in the Mediterranean vegetation zone, Pistacia trees are common components of the woodlands and many Aegilops species grow in degraded batha, along with the small-seeded legumes, and including wild lentils (Lens spp.). Several of the taxa identified in the samples inhabit disturbed ground, including Lolium, Buglossoides arvensis. Malva and Matricaria. The grains and seeds of the wild barley, grasses and small legumes would have been important sources of food. The fruits and resin of Pistacia may have been collected for use. Both the leaves and seeds of Malva are edible and these could have been collected in spring. The fruits of Pistacia would have ripened in early summer. (Colledge 2001:143)

In Iraq ed-Dubb site of Natufian, a total of forty-three taxa were represented in the plant remains from the Iraq ed-Dubb again in Jordan area. These included wild and domestic cereals, fruits and pulses. A wild einkoni type grain (Triticum boeoticum type) was identified in the PPNA pit in structure I. The upper Jordan Valley is beyond the boundaries of the natural distribution of wild einkorn. It must be assumed, therefore, that at Iraq ed-Dubb the cereal was growing in secondary habitats. On a distribution map, Zohary and Hopf show isolated stands of weedy forms of the species as far south as southern Syria and Lebanon (Zohary and Hopf 2000, 37 cited in Colledge 2001: 143). They made the following comments about the occurrences of the wild cereal beyond its natural range. Far away from its distribution centre, wild einkorn is restricted mainly to segetal or secondary habitats, sites which were very probably not available before the opening up of these areas to agricultural activity. (Zohary and Hopf 2000, 36 cited in Colledge 2001: 143)

The excavator mentioned that many of the contexts sampled at Iraq ed-Dubb contained derived material, for example, certain Late Natufian contexts contained PPNA artefacts, and vice versa. The presence of domestic glume wheat chaff in samples dated to the Late Natufian, therefore, must be regarded with extreme caution. Late Natufian contexts underneath structure 1 were below PPNA layers that contained high densities of charred material, and contamination with plant material from above would have been likely. Similarly, in the extramural areas there would also have been mixing of occupation debris. It was not possible to identify the spikelet forks and glume bases of the domestic glume wheats found in the PPNA samples as either einkorn (Triticum monococcum type) or emmer (Triticum dicoccum type). It would seem that domestic einkorn would occur so far south of its possible place of origin at such an early date. Iraq ed-Dubb lies at the centre of the distribution of the wild progenitor of domestic emmer, and so the presence of this cereal, rather than einkorn, would seem more probable. Wild barley type (Hordeum spontaneum type) grains and rachis internode fragments were identified in Late Natufian contexts at Iraq ed-Dubb. The site lies within the natural range of the wild cereal. Domestic barley type (Hordeum sativum type) grains were identified from one Late Natufian context at Iraq ed-Dubb. These must be regarded with the same amount of scepticism as the early finds of domestic wheats. The Late Natufian context in which the domestic barley type grains were found was a burial pit, where the likelihood of mixed deposits would have been great. Grains of both wild and domestic barley types were identified in the later phases of PPNA contexts of the site Iraq ed-Dubb. (Colledge 2001: 143)

Wadi el-Jilat 6 is located in an accumulation at the foot of the hillside on the northern side of the wadi. The surface area of the flint scatter marking the site, is estimated to be c. 19,000m^2. There has been considerable erosion of fine sediments at the site causing vertical compaction of the flint debris and formation of a flint 'tell', A small area, 2 x 2m, was excavated at the centre of the eastern-most concentration of flint debris. Three phases associated with human activity were defined in the small sounding. Phases B and C, the lowest levels, consisted of clayey silts of aeolian origin which had been altered by pedogenic activity and within these deposits, there were lenses of Epipalaeolithic cultural debris, including flint artefacts and bone. Phase A, the latest phase consisted of a 40-60cm thick layer of ashy, sandy silt. The lowest 30cm of this layer has been interpreted as a series of three compressed and trampled occupation surfaces. Two of these surfaces were stained with ochre and there was no doubt, therefore, that they had been deliberately constructed. The surfaces showed signs of being lipped at their edges and were probably floors within a structure. This latest phase at Wadi el-Jilat 6 contained a high density of cultural material (Garrard and Byrd 1992,49-51 cited in Colledge 2001: 28-29). The mixed ashy deposit in Phase A was the only evidence of burning at Wadi el-Jilat 6. Microlithic flint tools were predominant in each of the three phases at the site. The tool kits were distinct for each phase. Fragments of limestone and basalt groundstone artefacts, marine shells and worked bone objects were found in the cultural layers (Garrard and Byrd 1992, 52 cited in Colledge 2001: 28-29). Garrard and Byrd (Garrard and Byrd 1992, 52 cited in Colledge 2001: 28-29) suggested that the two earliest phases at Wadi el-Jilat 6 represented brief, ephemeral human activity, whereas Phase A was indicative of longer term, or repeated occupation at the site. Archaeobotanical samples were taken from cultural layers within Phases A and B at Wadi el-Jilat 6. (Colledge 2001: 28-29)

The archaeobotanical samples from the Syrian Natufian sites were studied by van Zeist and Bakker-Heeres (1982, 1984a, 1984b). The tell Mureybit site of Natufian period is situated on the northern bank of the Euphrates river, in north-western Syria, in the 'elbow' of the river course, before it flows eastwards to join the

Belikh river (van Zeist and Bakker-Heeres 1984a, 171).The site lies on the flat flood plain of the Euphrates. The base of the tell is c. 285m above sea level and the land to the north and north east of the site rises to reach heights of over 500m (van Zeist and Bakker-Heeres 1984a, 171 cited in Colledge 2001: 28-29). The Euphrates valley is cut through Miocene limestones and conglomerates. Alluvial sediments have been deposited in the valley and over the flood plain (van Zeist and Bakker-Heeres 1984a, 171 cited in Colledge 2001: 28-29). A Mediterranean climate prevails in this area of northwestern Syria. The mean annual rainfall is recorded as c. 200mm and winter rains fall between October and April. During April and May the river reaches its maximum height, when it is swollen with the meltwaters from the Anatolian mountains. Temperatures average 7 C in January and rises highly in May (van Zeist and Bakker-Heeres 1984a, 171 cited in Colledge 2001: 28-29). The site lies within the Irano-Turanian phytogeographical region, in an area of steppe and desert vegetation. The natural vegetation cover is denuded because of overgrazing and cultivation. Poplar forest, including poplar (Populus euphratica), ash (Fraximis syriaca), tamarisk (Tamarix sp.), chaste tree (Vitex agnus-castus) and Lycium europaeum, would have grown in the Euphrates valley but, because of overcutting for firewood, there are now no trees bordering the river. The uplands to the north and north-east of the site support an impoverished Artemisia steppe flora. Marshland plants thrive on the fertile soils of the flood plain (van Zeist and Bakker-Heeres 1984a, 173 cited in Colledge 2001: 28-29). Wood charcoal from the site has been identified as poplar (Pinpulus species), confirming the presence of the species in the vicinity during the late Pleistocene/early Holocene (van Zeist and Bakker-Heeres 1984a, 199 cited in Colledge 2001: 28-29). Animal species represented at the site included those that would have inhabited both open country and wooded/waterside landscapes. They included wild ass (Equus asinus), gazelle, wild cattle (Bos taurus), wild sheep (Ovis orientate), Persian fallow deer (Dama mesopolamica) and wild boar. Shell fish, fishes and birds were also exploited at Tell Mureybit (van Zeist and Bakker-Heeres 1984a, 175 cited in Colledge 2001: 28-29). Several C14 dates have been obtained from wood charcoal for all the occupation phases at Mureybit. Phase I at Tell Mureybit has been dated to the Natufian period (12800/12500 - 10500 B.C.). Phase II levels have been assigned to the Khiamian period (10500 - 10200 B.C.). Phase III has been dated to the Pre-Pottery Neolithic

A period (10200-9500/9300 B.C.), and phase IV to the Early Pre-Pottery Neolithic B (9500/9300 - 8000 B.C.). (Colledge 2001: 28-29)

The tell Mureybit is 75m in diameter and it reached a height of 6m, above the flood plain. There have been two series of excavations undertaken at the site, the earlier excavations, were directed by van Loon between 1964 and 1965, and then, later by Cauvin between 1971 and 1974 (van Zeist and Bakker-Heeres 1984a, 173-174 cited in Colledge 2001:34-35). The earlier excavations of a stepped trench and seven 5 x 5m trenches, on the steep south-western side of the tell, revealed seventeen levels of prehistoric occupation. During the later excavations, two trenches were opened on the eastern side of the tell and nine 4 x 4m trenches were dug on the west, bedrock was reached in four of these. A simpler four-fold phasing of the occupation was devised by Cauvin. In the earliest occupation levels, sub-phase IA dated to the Natufian period, several hearths were uncovered. During IB, dated the Epinatufian, one round structure was excavated. Seven round structures, which had wall foundations of clay, stone and limestone slabs and floors constructed from compacted clay and limestone paving, were dated to phase II, the Khiamian period. Microlithic flint artefacts were dominant in this phase. Groundstone querns and mortars were also common. Round structures divided into compartments were characteristic of phase III, which was dated to the Pre-Pottery Neolithic A period. The structures in phase IV were rectilinear. The flint implements found in this phase, dated to the Pre-Pottery Neolithic B period, were made on long blades as opposed to bladelets, typical of the previous periods, and common types found in these levels included Byblos points and denticulates. Polished stone axes were also found in deposits dating to this latest phase. Two series of samples, taken at regular intervals from exposed sections in the trenches, were collected for the purpose of archaeobotanical analyses. The samples were representative of all phases of occupation at the site (van Zeist and Bakker-Heeres 1984a 175-177 cited in Colledge 2001:34-35).

There is another food economy shift evidence of dietary change in the Late Natufian compared to Early Natufian analyzed by Sillen and Lee-Thorp (Sillen and Lee-Thorp 1989:399-411). There was a sharp decline analyzed and shown in Sr/Ca ratios of Late Natufian human skeletons compared to Sr/Ca ratios of Early Natufian human skeletons, so that means plants were decreased by the Younger Dryas and plants (high Sr) were being less eaten in the Late Natufian and meat (animals – high Ca) were being more eaten in the Late Natufian differing from Early Natufians diet. (Sillen and Lee-Thorp 1989:399-411)

Table 6. Sr/Ca ratios in cereals, herbivores and in carnivores (Created by using Sillen and Lee-Thorp 1989:399-411)

Species	Location	Sr/Ca
Cereals		
Triticum Dicoccoides (wild emmer)	Amiad, .East Galileei, Israel	7,90
Triticum Dicoccoides (wild emmer)	Amiad, East Galilee, Israel	3,19
Triticum Dicoccoides (wild emmer)	Jordan Reserve, North Galilee	1,72
Triticum Dicoccoides (wild emmer)	Rosh Pinna, East Galilee	3,00
Avena sterilis (wild oat)	Jordan Reserve, North Galilee	7,43
Herbivores		
Gazella gazella (gazelle)	K. Maayan	0,45
Gazella gazella (gazelle)	K. Maayan	0,40
Carnivores		
Martes folina (marten)	Rosh Pina	0,27
Martes foina (marten)	Shaar HaGai	0,17

Table 7. Change (decrease) in **Strontium/Calcium (Sr/Ca) ratio** in the **Late Natufian human skeletons** as adjusted percentage of mean of herbivors and carnivores at each site during the Epi-Paleolithic and Neolithic of the Levant. (Created by using Sillen 1984 cited in Sillen and Lee-Thorp 1989:399-411 – **C14 B.P.to B.C. conversions done by Oxcal C14 calibration software version 4.1, 2009**)

Adjusted Sr/Ca %	Kebaran		Early/Late Natufian		PPNA
110			Mallaha		Nahal Oren
100			ElWad,HayonimB		
90	Kebara C		Kebara B		
80					
70					Nahal Oren
60					Mallaha
	18028 B.C.	**16136 B.C.**	**13153 B.C.**	**10932 B.C.**	**8233 B.C.**

In order to look for other kinds of evidence for the Late Natufian's social and economic crisis connected with the high decrease of animal and plant food sources in the Late Natufian compared to Early Natufian times and the possible food crisis-food shortage started in the Late Natufian during the abrupt, harsh and long Younger

Dryas climatic event, the Late Natufian humans' social/economic stress indicators are present in the Late Natufian human bone remains. Many sources and research done about the Natufian human remains and human bone anthropological studies mention about the evidence for social/economic stress for humans in the Late Natufian differring from Early Natufian.

The decorated burials are found only in the Early Natufian, and skull separation is clearly an only Late Natufian ritual. There is extended burial position in Early Natufian. The only consistent observation concerning the decorated burials is that they all belong to the Early Natufian, even though less ornaments were recovered also from Late Natufian sites. (Belfer-Cohen, A. Hovers1992: 463-471).

There are clear differences in the burial practices (decorations, ritualistic ceremonies, burial methods, etc...) of Early and Late Natufian. There are more primary burials (all main body and parts togetherly found as buried) in the Early Natufian and more secondary burials (not all main body and parts togetherly found, they are found as seperate pieces as arms, legs, skull are in buried or found in different places seperated) in the Late Natufian. Also in the Early Natufian there are more single burials as each individual buried seperately in the family or in the community but in the Late Natufian there are more multiple burials as many people were buried togetherly in a family. (Edwards P.C., Webb S.G.:2002:103 - 123). Another thing is in the Late Natufian there is evidence for making less or no ritualistic/religious ceremonies and less or no decorations and lessor no ornaments in the burials compared to Early Natufian. There are more more number of decorated/ornamented burials and generally in the Late Natufian society there are less ritualistic/or religious decorations/ornaments and arts found in bone objects and bone tools.

So impossibilities to do arts and ceremonies/ornaments can be caused by an economic problem, economic food stress, food shortage, they might have been thinking of finding/or producing food, economics and trying to find out some food subsistance mechanisms to survive in the time of Late Natufian, and these can show a sociocultural/economic stress in the Late Natufian compared to Early Natufian. Also acording to human bone evidence, there is no people in the Natufian older than 45 years old and the average death age was around 31-32-36 years old. There is a high percentage of young people and a low percentage of old people in the Natufian generally in 14,3 % old people in Eynan and 11,1 % old people in Nahal Oren, 16 % old people in Hayonim. It was found out that there was a sexual selection/discrimination in burying individuals in the Natufian. There is less number of females and high number of males in the Natufian society and there is high importance given in females' burials compared to males' burials and females were buried in single burials and by using decoration and ornaments. In 2008 there was a 45 year old (very old) Natufian female religious person found in a burial with many ornaments and some ritualistic ceremonial objects, bones, many shells and turtle shells. So this female can show something about the importance of religion/ritualistic/ceremonial sociocultural activities and the importance of females/women in the Natufian culture, even the number of women is very low compared to men. There is no dental disease in the Natufian dental remains but there is evidence for dental attrition. (Byrd, Brian, F., Monakan, Christopher M. 1991: 571-580, Grossman, Leore, D. 2003 and Karasik, Baruch, Arensburg, O. M. Pavlovsky 2000) and Lahr, M. Mirazon, Haydenblit, R., and Smith 1991).

Other research evidence of the Late Natufian human dental evidence shows that tooth sizes and dental disease patterns in the Late Natufians are intermediate shift-transition stage between the tooth of hunter-gatherers and agriculturalists and Late Natufian human dental evidence shows some changes/shifts were taking place in the dietary habits and food processing/producing techniques. (Smith 1991 cited in Bar Yosef, O. and Valla, F.(eds) 1991:425-432.) In the 10% of adults there is ante-mortem teeth loss, agriculture was asociated with a decrease in health and nutritional status, according to Belfer-Cohen and Smith, there are stress indicators among late Natufian skeletal and dental samples. According to the research when agriculture starts there is reduction in dental sizes, reduction in teeths, food processing techniques caused softer diets and softer/weaker/smaller teeths. So it was seen that Late Natufian human dental structure was closer to Neolithic's agrcultural societies human dental structure but Earl Natufian human teeths were closer to Epipaleolithic's / Late Paleolithic's human dental structure.

The extended burials were in the Early Natufian but new skull removal and flexed/semi-flexed burials were in the Late Natufian, and there was a high population of children in the Late Natufian. This can show that people are dying young in the Late Natufian. The children's average last milk age was around 3-5, 5-7 years old, as it was critical, there were less females but the males were living much more older than females. The females were dying young maybe while giving birth to children. (Belfer Cohen, A.1988:297-308.) There is evidence for that, there was social statification and class society and females were important in the Natufian and ceremonies were made for the most of the females but less of some important males in the Natufian. (Sillen, Andrew 1981:131 and Belfer-Cohen A.1988:297-308 and Haydenblit R., Lahr, M. Mirazón 1995:97-111).

So till this point of evidence, again my idea about Late Natufian period sites human evidence is: the impossibilities to do arts and ceremonies/ornaments in the Late Natufian compared to Early Natufian can be caused by an economic problem, economic food stress, food shortage, they might have been thinking of finding/or producing food, economics and trying to find out some food subsistance mechanisms to survive in the time of Late Natufian, and these can show a sociocultural/economic stress in the Late Natufian compared to Early Natufian.

Another evidence is present for social stress and food crisis in the Late Natufian can be agenesis and underdevelopment, possible malnutrition in the Late Natufians' climatic crisis and food crisis times and a decrease in human growth/development and in the health of people living in the Late Natufian compared to Early Natufian as referred in the sources. This Natufian human bones data was collected from the primary studies of skeletal material recovered from the big and scientifically famous Natufian sites of Hayonim Cave, the studies on El-Wad, Shukba and Kebara collections present at Peabody Museum in Harvard University and also some of this data was published as the Natufian cultural evolution subject by Keith:1931, McCown in Garrod and Bate 1937, McCown 1939, Smith 1970 (cited in A Belfer Cohen, L. A. and Schepartz B. Arensburg 1991:411-424, 413, 417) and in addition to this data, a detailed report on the skeletons from the important Natufian site of Eynan (Mallaha) was published (Perrot et. al.1988 (cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417) included in this data. There is also human bone data from the Nahal Oren humans described by Crognier and Dupouy-Madre:1974 (cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417) and all these Natufian human bone data was interpreted and Early and Late Natufian humans were compared among each other by A. Belfer Cohen, L. A. Schepartz B. Arensburg 1991:411-424, 413, 417).

In this study, most of the Natufian individuals were recovered from the basecamp sites of Natufian and 4 individuals remains recovered from the Natufian site of Rakefet (T. Noy, personal communication of A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991 cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417) and 3 individuals remains from the Natufian site of Hatoula, (Arensburg:1985a, Smith:1985 cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417), 9 individuals bones from the Hayonim Terrace and (Valla and Le Mort, personal communication of A Belfer Cohen, L. A. Schepartz and B. Arensburg, cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417), and at least 3 individuals from Wadi Hammeh 27 in Jordan, (Edwards et al:1988 cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417) and 11 individuals recovered from Azraq 18 in the Azraq basin of Jordan (Garrard et al 1987 and present volume cited in A Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417). Totally all recovered Natufian human skeletons in this study from the core basecamp Natufian sites area was 407 individuals. Out of these, 21.4 % of the total human remains was from Early Natufian sites and the 3 % of the whole individuals were from middle (intermediate) Natufian sites and the 47 % of the whole number of human bones were from the Late (or Final) Natufian sites. (A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417) The remaining individuals' human bones were %26 of the total human remains from El-wad site and human remains from El-Wad site cannot be divided and identified into Early, Late (or final) and middle (intermediate) Natufian periods. Eynan and Hayonim cave has individuals from each Early and Late Natufian archaeological phase.

Table 8. Number of Natufian human individuals. ***by Perrot et al:1988, **by Keith:1931, ***by Crognier and Dupouy-Madre:1974, (table created by using and cited in A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Site	Early Natufian	MiddleIntermediate N.	Late Natufian	Undivided	Total
Kebara	31			1	31
Eynan*****	28	8	68	9	105
Hayonim	20	3	16		48
Shukba******			45		45
NahalOren*******			45		45
El-Wad				96	96
Total	79	11	174	206	370

Table 9. Changes in the proportions of children and adults in the Early and Late Natufian phases. **(part of the table created by using A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Combined by Phase within the site	N Children	N Adults	**% Children**
Early Eynan	7	21	**25.0 %**
Middle Eynan	0	8	-
Late Eynan	11	58	**15.9 %**
Early Hayonim Cave	6	14	**30.0 %**
Middle Hayonim Cave	1	2	-
Late Hayonim Cave	2	14	**12.5 %**
Combined by cultural phase			
Early Natufian	23	56	**29.1 %**
Middle Natufian	1	10	9.0 %
Late Natufian	40	134	**23 %**
Total Samples	85	284	23.0 %

We can see that in the table 9, the % percentage ratios of the children are changing from Early to Late periods. The % percentage ratios of the children in the Early and Late Natufian sites are shown with BOLD in the "% Children" coloumn and in the Early Natufian the children percentages are higher but in the Late Natufian children percentages are decreasing and they are lower in value.

Table 10. Humerus minimum shaft circumference comparison in the Early and the Late Natufian human bones. **(part of the table created by using A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Humerus	Males				Females			
By Phase	N	X	SD	Range	N	X	SD	Range
Early Natufian	14	60.5	3.66	50.0-66.0	3	56.3	5.28	48.8-60.0
Late Natufian	13	58.3	2.89	53.5-62.5	7	53.3	2.1	50.0-56.0

We can see that in the table 10, the humerus circumference dimension values and ratios are higher, longer and wider in the Early Natufian human but shorter, thinner and lower in the Late Natufian human. This can show an underdevelopment and malnutrition of humans in the Late Natufian climatic crisis and food crisis times.

Table 11. Mandibular Body Length comparison in the Early and the Late Natufian human bones. **(part of the table created by using A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Mandibular Body Length	Males				Females			
By Phase	N	X	SD	Range	N	X	SD	Range
Early Natufian	4	91.4	2.7	88.0-95.5	3	89.5	5.61	83.5-97.0
Early period and El-Wad site	15	87.1	6.70	75.0-97.0	6	84.3	6.61	78.0-97.0
Late Natufian	7	81.1	6.33	72.0-90.0	4	78.3	7.29	70.0-86.0
By Phase and site								
Early Eynan	3	92.5	2.16	90.5-95.5	3	89.5	5.61	83.5-97.0
Middle Eynan	3	97.5	2.27	95.0-100.5	-	-	-	-
Late Eynan	1	89.5	-	-	2	85.5	0.5	85.0-86.0

Table 12. Mandibular Ramus Breadth comparison in the Early and the Late Natufian human bones **(part of the table created by using A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Mandibular Ramus Breadth	Males				Females				Percent Dimorphism %
By Phase	**N**	**X**	**SD**	**Range**	**N**	**X**	**SD**	**Range**	**% (male/female) x 100**
Early Natufian	**13**	**37.8**	**2.95**	**33.5-44.0**	**6**	**34.6**	**2.49**	**32.0-38.0**	**109.2**
Early period and El-Wad site	**31**	**38.1**	**2.72**	**33.0-44.0**	**11**	**34.3**	**2.51**	**30.0-38.0**	**111.1**
Late Natufian	**6**	**34.8**	**1.77**	**33.0-38.0**	**5**	**34.4**	**2.50**	**32.0-39.0**	**101.2**
By Phase and site									
Early Eynan	**2**	**37.3**	**1.75**	**35.5-39.0**	**3**	**34.5**	**2.48**	**32.5-38.0**	**108.1**
Middle Eynan	**2**	**37.0**	**6.0**	**31.0-43.0**	**-**	**-**	**-**	**-**	**-**
Late Eynan	**-**	**-**	**-**	**-**	**1**	**33.0**	**-**	**-**	**-**
Early Hayonim	**8**	**38.0**	**3.18**	**33.5-44.0**	**1**	**34.0**	**-**	**-**	**-**
Late Hayonim	**1**	**38.0**	**-**	**-**	**1**	**39.0**	**-**	**-**	**-**

We can see that in the table 11, the Mandibular Body Length values and ratios are higher, longer and wider in the Early Natufian human but shorter, thinner and lower in the Late Natufian human. This can again show an underdevelopment and malnutrition of humans in the Late Natufian climatic crisis and food crisis times.

We can see that in the table 12, the Mandibular Ramus Breadth values and ratios are higher, longer and wider in the Early Natufian human but shorter, thinner and lower in the Late Natufian human. This can again show an underdevelopment and malnutrition of humans in the Late Natufian climatic crisis and food crisis times.

Table 13. Mandibular Height at M1-M2 comparison in the Early and the Late Natufian human bones **(part of the table created by using A. Belfer Cohen, L. A. Schepartz and B. Arensburg 1991:411-424, 413, 417)**

Mandibular Height at M1-M2	**Males**				**Females**			
By Phase	**N**	**X**	**SD**	**Range**	**N**	**X**	**SD**	**Range**
Early Natufian	**14**	**29.3**	**2.33**	**25.5-34.0**	**5**	**28.2**	**3.33**	**24.5-34.0**
Early period and El-Wad site	**37**	**29.9**	**2.41**	**25.5-35.0**	**12**	**27.0**	**2.92**	**22.0-34.0**
Late Natufian	**14**	**29.6**	**1.66**	**26.5-33.5**	**10**	**27.6**	**1.73**	**25.0-30.0**
By Phase and site								
Early Eynan	**2**	**30.3**	**2.25**	**28.0-32.5**	**2**	**29.3**	**4.75**	**24.5-34.0**
Middle Eynan	**3**	**33.7**	**1.55**	**31.5-35.5**	**-**	**-**	**-**	**-**
Late Eynan	**1**	**33.5**	**-**	**-**	**5**	**27.5**	**1.44**	**26.0-30.0**
Early Hayonim	**9**	**28.8**	**2.04**	**25.5-31.0**	**1**	**25.5**	**-**	**-**
Late Hayonim	**5**	**28.6**	**1.16**	**26.5-30.0**	**1**	**30.0**	**-**	**-**

We can see that in the table 13 the Mandibular Height at M1-M2 values and ratios are higher, longer and wider in the Early Natufian human but shorter, thinner and lower in the Late Natufian human. This can again show an underdevelopment and malnutrition of humans in the Late Natufian climatic crisis and food crisis times.

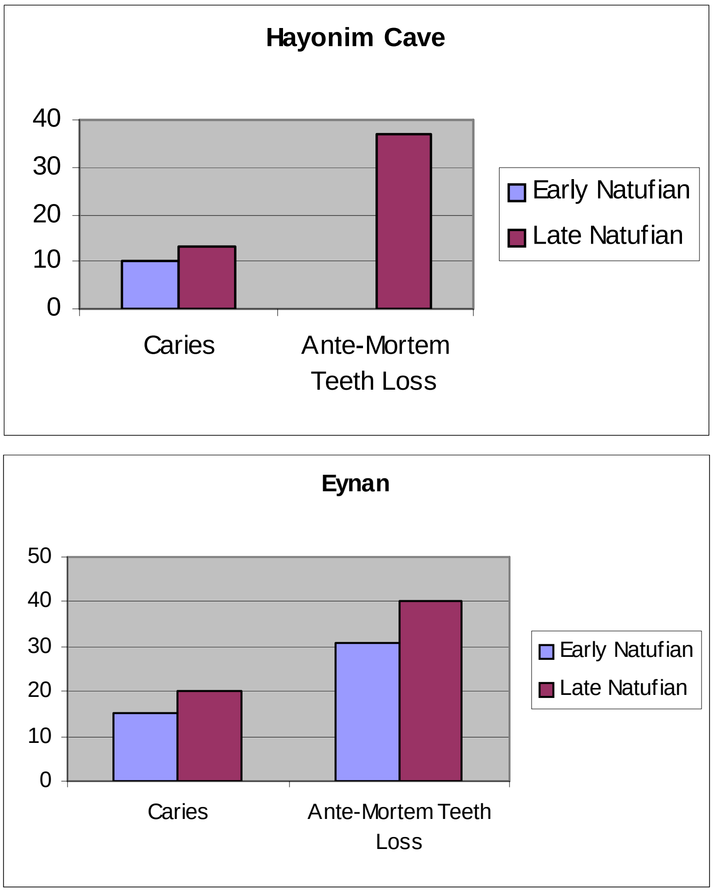

Figure 6. Caries and Ante-mortem tooth loss by percent, the comparison of Early and Late Natufian phases at the sites of Eynan and Hayonim. **(part of the chart figure created by using Smith 1991 cited in Bar Yosef, O. and Valla, F. (eds) 1991:425-432).**

We can see that in the chart figure 6 Caries and Ante-mortem tooth loss by percentage values and ratios are higher in the Early Natufian human but lower in the Late Natufian human. These high percentage of caries of weak teeth and teeth loss in the Late Natufian human can again show an underdevelopment and malnutrition of humans in the Late Natufian climatic crisis and food crisis times.

According to the Late Natufian sites human bones research evidence, the mandibular body length decreases for both Late Natufian males and females (Smith: 1973 cited in A Belfer Cohen, L. A. Schepartz B. Arensburg: 1991, 411-424, 413, 417). Sizes (length) of humerus (humeri) and femora bones decreases, Late Natufian people are shorter than the Early Natufian people in average. Decrease in body length and bone sizes can be an indicator of underdevelopment, food stress and social crisis and social stress in the Late Natufian. When finding food is harder and health conditions decline the social stress will increase. Another evidence is there were highly possibly some disease like Malaria, Tuberculosis and Syphilis in the

Late Natufian understood from the Late Natufian human bone analysis evidence. These can be also social/economic stress indicators. There 68.6 percent males in the Natufian population and less and some sites very few females. There are many big Late Natufian sites with low number of children but there are many small Late Natufian sites with high number of children but general Late Natufian sites male children average is high, higher than male adults and male old people. But the total number of children is low in the Late Natufian sites compared to Early Natufian sites. The birth rate of human is lower by the females in the Late Natufian compared to Early Natufian according to the research. In the Late Natufian there are more more 62,5 percent adults compared to Early Natufians adults as 20 percent. So in the Early Natufian there are more number of old people and in the Late Natufian less old people so this can show a food and social stress in the Late Natufian.

The researchers clearly indicate that late Natufian human skeletal remains indicate all type of stress conditions in general. Another thing was in the Late Natufian there was more endogamy used differing from Early Natufian (internal marriage, sexual relationship with the relatives) in the Late Natufian society. This can be a sociocultural change or might be another social stress indicator in the Late Natufian in order to reproduce and make more human to give birth. (A. Belfer Cohen, L. A. Schepartz B. Arensburg: 1991 cited in Bar Yosef, O. and Valla, F.(eds): 1991, Natufian Culture in the Levant, 411-424, 413, 417).

As a summary of this part, the Younger Dryas was a shift of the postglacial climatic trend, which was limited to the period corresponding with the Late Natufian. It is not still so clear that the long, controversial ideas about the role of climate change in the origins of cereal domestication (Wright 1971; Cohen 1977; Rindos 1984; Henry 1989 cited in Sillen and Lee-Thorp 1989:399-411), it requires further examination in the new, more highly resolved climatic and dietary data. The thing that makes the Younger Dryas cold period special is that it occurred at a time when Late Natufians had already concentrated to some extent in harvesting, storing, and consuming wild cereals. The exact mechanism by which the shrinking/decreasing/shortage of these food resources in the Late Natufian may have resulted in primitive agriculture and pre-domestication, but it can be possible that the dietary/food resource which was first cultivated wild cereals was the one which may have been most effected by this climatic episode of Younger Dryas.

CHAPTER 4

METHODOLOGY

I began this research by reading, understanding and analyzing the background of the previous archaeological, anthropological, sociocultural, archaeozoological and archaebotanical research about Natufian cultures, and the related paleoenvironmental considerations and related surrounding catchment area occupations and other geographically and chronologically related cultures. I was fundamentally interested in climate change theory related to the early and late Natufian cultures. Previous research suggests a possible food crisis resulting from climate change during the Younger Dryas, which may have been a necessary pre-condition for the origins of agriculture in the Epipaleolithic period. My aim of the thesis is to demonstrate this through mathematical percentage frequency based comparison methods. This can be achieved by comparing the faunal and botanical evidence between Early and Late Natufian cultures through statistical analysis.

The second step of this research is necessarily the data collection. I collected all published faunal and botanical data and interpretations related to the subsistence strategies of Late Natufian sites, and compared them with similar data from Early Natufian sites that were presumably effected by the Younger Dryas paleo-climatic event. All the faunal and botanical reports and the references used for developing the tables throughout this research are numbered systematically and available in the **Appendix C** section of the thesis. In the data collection process I observed a great number of sites for both the Early and Late Natufian periods. However, for this research I have confined the study to sites that according to my research I decided were the most important Early and Late Natufian occupation sites in their respective periods, in terms of size and population and geography/climate/regional conditions.

In addition to importance measured in size and population, I am also considering geography, in particular evidence that demonstrates that some Late Natufian sites were more successful in coping with the possible food crisis during the

Younger Dryas because of their geographical conditions. The success of a settlement was also related to its location, for example on the coastal plains and forested areas (e.g. the coastal region of contemporary Israel), which was more favorable than the inland steppic and desertic zones. This geographical variance meant that Natufian sites coped differently during the Younger Dryas, which was directly related to the availability of local food supplies. Another variable that influenced my choice of sites for the study is whether they were only occupied in the Early or in the Late Natufian period.

The very last and crucial theory concerning the Natufian sites relates to the social-cultural and economic structure of the Natufian people, which allowed them to shift to a less mobile and more settled condition after the Younger Dryas. This possibly gave way to the origins of agriculture in the Epipaleolithic period in the Levant.

After the data collection and having been through these basic aspects of the Natufian sites, the third step of the research is the statistical analysis of all the data collected. In the process of analysis, I have found that all past research has been extremely partial. Previous research has taken into account only faunal or botanical remains mostly from larger sized Natufian camps. Some faunal and botanical reports include complete lists of animal or plant species and corresponding frequencies while others do not. Moreover, some animal remains were studied more than once by different researchers and the outcomes of their respective research were not the same, due to different chronological sub periods, or the different use of statistical methods, or differing methods of excavation.

Therefore there is no complete data relating to all the Natufian sites concerning the all faunal and botanical remains and these can said to be the most important limitation to my thesis work. I am necessarily studying the faunal and botanical assemblages from every site that I have chosen for the thesis, analyzing them separately and comparing them. The analysis and comparison is designed to the highlight the fluctuation of the total quantities of faunal and botanical remains between the Early and Late Natufian periods.

The limitations of the current data set require that I assess the reports of the faunal remains, recognizing that these have been studied only from larger Natufian camps, the excavation periods (season after season in the same period), and taking into account that previous research (despite being conducted by different researchers) that are using the same statistical methods of counting calculation (NISP and MNI). So this study is an attempt to unite a variety of data collected and analyzed through different methodological approaches. The tables in the **Appendix C section** show the outcomes of previous research; these constitute the data foundation for my study. Most faunal and botanical analyses use different types of calculation and counting methods for animal and plant species. The numbers and frequencies of animal and plant species found in each site are mainly calculated through NISP, MNI and the corresponding percentage only (%) frequency calculations that represent ratios of the percentage frequencies out of 100, showing the ratio of that species to the total of all species found on that site. The NISP method (Number of Identified Specimens method) is an animal bone counting method that shows the total counting number of pieces and parts of identified species found. The MNI method (Minimum Number of Individuals) is another different animal bone counting method that counts the total number of pieces and parts of bones of identified species found. The MNI method identifies and counts the bones of different species. By using known anatomic body parts/pieces information from each identified species, and by mathematically calculating the possible logical minimum number of complete individual animal species, archaeozoological researchers attempt to form and identify complete individual animals from the fragments found on that site.

The % percentage method of comparison of animal and plant species shows the changes and differences between the sites of early and late periods, and the comparison of forestal and coastal with inland steppic or desertic sites. Because the extent to which an individual archaeologist, archaebotanist or archaeozoologist studied a site varied (i.e. some studied the whole site while others studied only parts of the site), the quantites of fuanal and botanical assemblages will differ accordingly. By using percentage values I thought logically and mathematically that comparing percentage values, regardless of the size of the area excavated and the quantities of faunal and botanical remains recovered, the whole site can be represented. The ratio of species among the total representation of species can then be compared among each site.

If I had the chance to trip and go to the Natufian region and see the Natufian sites itself and gather each whole sites' equally calculated NISP or MNI frequencies numbers of total animals and plants of whole region of that site and if I had the chance of creating my own data by physically collecting and counting animals and plants for all comparable sites than I would be able to compare the frequencies of NISP's and MNI's real amount of total animal and plant species values to make early/late period, forestal-coastal/inland-steppic-desertic comparisons, but this was impossible for me. So I need and I must have used and regulated/equalized someonelse's, the Natufian archaebotanists' or archaeozoologists' published animal and plant frequency data.

I also use comparative methods for the calculation of economic price/cost-benefit/food value analysis of Natufian foods, to understand differences between Early and Late Natufian economies. This includes calculating and comparing economic food value totals of Early and Late Natufian; and comparing the ratio of total benefit (input energy by meat weight) to total cost of consumption (output energy by catching, hunting, domesticating, feeding the animal) between the Early and Late Natufian. Such an approach can assess whether catching and eating the same food animal group (example:gazelle) was more beneficial or more costful for the Late Natufian people compared with Early Natufian people. This should enable me to test the hypothesis of a possible food shortage/food crisis in the Late Natufian economy during the Younger Dryas period.

By observing the higher economic "price" values of animals and consumable plants that were rarely found, and which necessarily require more labour to collect/hunt/domesticate or cultivate in the Late Natufian food crisis times, this Younger Dryas period of food crisis appears to have lasted an extensive period of at least 800 years of the Late Natufian. The Late Natufian subsistence strategy probably demanded that less food be eaten, and necessarily demanded more developed planning and organization of food consumption compared with the Early Natufian. These strategies in the Late Natufian may have required some degree of specialization in a labor share/labor organisation and food collection and/or production.

An input/output ratio comparison that assesses food **input** (food energy input, calorie input from eating animals and plants) and the food **output** (the energy output, the calorie output in the physical labor involved in hunting/collecting/producing/cultivating or domesticating animals and plants) should produce different values between Early and Late Natufian societies under climatic food stress. The economic ratio of **input to output (input/output) energy ratio** should be higher for the Early Natufian period than for the Late Natufian. The **input** from food should be higher in the Early Natufian compared to the Late Natufian, but the required labor and food stress and the energy **output** should be so much lower in the Early Natufian than in the Late Natufian. This should be because of subsistence strategies were under increased pressure from population increases and the climatic stress of the Younger Dryas, resulting in the shortage of available food sources. The Late Natufian crisis economy theoretically required more **output** energy. More labor was required for finding/producing less volumes of food (i.e. less meat weight – less **input**) compared with earlier periods. During the Late Natufian **input** of food energy was lower than during the Early Natufian, so the Late Natufian economic ratio of the **input to output (input/output) energy ratio** should be lower than during the Early Natufian.

During the process of formation and development of my animal frequency analysis calculations **(mostly my Economic Value (EV) ranking and parameter (factor) multiplications calculations methodology)** and for the other parts-aspects of my calculation methodology, I got technical-academic-zooarchaeological assistance (help-support) and control from my supervisor (my thesis advisor) Assist. Prof. Dr. Evangelia Pişkin from the Graduate Department of Settlement Archaeology (SA) from the Middle East Technical University (M.E.T.U.) (Her contact web pages are:http://209.85.129.132/search?q=cache:FD95pZfNu8sJ:https://catalog.metu.edu.tr /acad_pers.php%3Fpers_id%3DMjAxMDg3+evangelia+piskin&cd=1&hl=tr&ct=cln k&gl=tr and http://www.sa.metu.edu.tr/index.php@option=com_content&task=view &id=20).

Again I got technical-academic-mathematical assistance (help-support) and control from Prof. Dr. Münevver Tezer from the Department of Mathematics (MATH) from the Middle East Technical University (M.E.T.U.) (Her contact web pages are: http://www.math.metu.edu.tr/people/munevver_tezer.shtml and http://arf.math. metu.edu.tr/~mtezer/).

The **economic value (EV)** and **input/output ratio** analysis of **Natufian animals** by giving values for each 3 factor for each Natufian animal species, and for example there can be calculated when we take first:

1- Mobility (LABOUR/ENERGY/CALORIE OUTPUT FROM THE CONSUMER) as an indicator/parameter coefficient (or multiplier) with a value scale that **ranges from 1 to 5** (**1 = fast movement**, **difficult to catch** to **5= slow movement**, **easy to catch**), and a similar mobility parameter coefficient as **M value (1 to 5)**

2- Group (in flocks) or **individuality parameter** (ranging from **1= animal moving individually to 5= animal moving in groups in flocks**) as **IG (individuality/group (in flock) parameter)** and its **values (1 to 5) (LABOUR/ENERGY/CALORIE OUTPUT FROM THE CONSUMER)**

3- Meat weight (**again ranging from the kgs of species with low meat weight, low food value return to kg of the species with high meat weight, highest kg, best food value return, the highest energy/calorie or best fruits/nuts for food value)** as **MW (meat weight parameter) and its values are were "NOT ranked from 1 to 5 like other 2 previous parameter factors". Meat weight factors were calculated in terms of "kgs" (their real kilograms) ((INPUT ENERGY/CALORIE TO THE CONSUMER). Meat weight was used/calculated as directly in terms of kgs (their real kilograms) because it cannot be not ranked 1 to 5 or 1 to 50, or 1 to 74 or 1 to 25, because, in my analysis data, the animals' meat weight kg values are changing from 0,1-0,2-0,3 kgs values to 300-500 kgs values. So, it cannot be ranked mathematically logically with significant representation of ranking if 1 to 5 or even 1 to 20 or etc..., it would have been really mathematically insignificant to rank 0,1 to 500 kg values in the 1 to 5 ranking system and actually if the meat weight was ranked, then it should have been ranked with the same ranking system as the Mobility and Group (in flocks)** or **individuality parameter as they are also 1 to 5 ranking system.** These **2 variables of mobility and individuality/flock is** then multiplied with **the "labor output"** involved in gathering and consuming the food.

The **energy/calorie/"food input" to human is the 1 factor of meat weight/food/calorie value. Using "Multiplication" operation in calculating "Economic Food Value" of each animal is logical mathematically because multiplying each hunted animals' "meat weight" kgs with its "mobility", then with its "individuality/group" and then with its "percentage frequency values of NISP/MNI frequencies" factor parameter is logical in this operation. To**

multiply the effect of a parameter's factor over other parameter factors to obtain one overall (the mathematical impacts of all factors included in one EV factor) multiplied parameter factor value as it is the EV value that I calculated in the Analysis chapter. It is also logical to compare the results of multiplication operations of these factors for each hunted and eaten animal to compare the EV animal totals of animals in each Early and Late Natufian coastal/forestal or inland/steppic/desertic sites and also logical to compare the overall sites' EV animal totals of Early Natufian periods with Late Natufian periods.

The parameters should be multiplied to create the multiplication effect of a kind of parameter over another parameter, that means, for instance, a 230 kg of an animal with a Mobility (human benefit side) parameter coefficient of 1 (most mobile-low benefit value-hardest to catch-least benefit to human) will be 230kg * 1=230, but if this 230 kg of an animal's Mobility parameter coefficient (human benefit side) becomes 5 (least mobile-high benefit value-easiest to catch-most benefit to human) than it will be 230kg * 5=1150, that means that human have 5 TIMES (x5) higher chance to catch an animal with the M value=5 compared to an animal that has a M value=1", AND ALSO that means that human have 5 TIMES (x5) higher chance to catch an animal with the IG value=5 compared to an animal that has a IG value=1, BUT NOT PLUS 5 or MINUS 5 higher chance to catch or lose an animal with M=5 (human benefit side) compared to M=1 (human benefit side). It is the same logic for again for the Individuality/Group parameter coefficient. So this operation should be multiplication, not addition.

As I said before in the quantitative/mathematical logic part of Economics science also, it is always used multiplication in cases like to measure income effect or inflation effect/price effect over something, "income multiplier", "inflation multiplier" as a term are used, actually i think that even taking power or simple multiplication can be used optionally, because the Mobility and Individuality/Group parameters are so much important and effective over the meat weight that will be caught and eaten that it makes a total overall effect over the total amount of weight of meat that human catched/ate/consumed per a specific time period. So I am measuring the impact of IG and M parameters over the human's total overall benefit (M and IG effect over the total weight of meat that was eaten/consumed/catched). By using exactly the same operation, same mathematica tool for both sides for both

Early and Late Natufian animals, than it is correct and I think MW*IG*M is the formula to measure it and to test the Late Natufians' food crisis hypothesis. By using this formula, that means a human have 5 TIMES (x5) higher chance to catch an animal with the M value=5 compared to an animal that has a M value=1, AND ALSO that means again OVER THIS THING the same human have "5 TIMES 5" = 25 TIMES (5x5 times = 25 times) higher chance to catch an animal with the IG value=5 compared to an animal that has a IG value=1. So finally I mean and with my formula I think that for the same human being (homo sapiens sapiens) in the overall (in total) there is (5x5=) 25x times higher chance to catch an animal with the IG value=5 and M value=5 compared to another animal that has a IG value=1 and M value=1. So the formula makes **the human's benefit/cost ratio difference** between hunting the animal with the IG value=5 and M value=5 and hunting the another animal that has a IG value=1 and M value=1 so much higher like 25 times bigger.

Then I multiplied these parameters with their corresponding animal species frequencies by using the formula of **(EV) economic value (frequency based) = M*IG*MW*frequency value** of that animal species (NISP or MNI); and then I multiplied with the corresponding animal species percentages as **(EV) economic value (percentage ratio based) = M*IG*MW*percentage animal value of NISP or MNI or normal % values** given by the researcher (for example, of course "% 34" form of percentages is used in the form of "0.34" mathematically for coefficient multiplying). By adding/summing all these values seperately as economic value sums and comparing these **EV sums for Early compared to Late periods, forest coastal/inland compared with steppic desertic sites, this methodology will analyze and test the shift of EV (economic value) from site to site. Input/output ratios can also be calculated and compared between the sites of early/late periods, and forest coastal/inland steppic desertic. I can then analyze the change of input/output ratios from site to site**.

A similar approach can be applied for **Natufian plant species.** For example estimations of the plant's value might be assessed in its level of anvailability in specific climatic conditions. In other words, these values might be directly connected to percentage/or NISP, MNI frequencies. Similar scales can be used: 1 to 5 as 1=plant rarely found to 5=plant commonly found (LABOUR/ENERGY/CALORIE **OUTPUT** FROM THE CONSUMER) as **1-**

Availability as **A value.** After we find the plant, the **2- collecting/gathering** as **C value** as for each plant species, again can be scaled from 1 to 5 as 1=plant hardly collected/consumed to 5=plant easily collected/consumed (LABOUR/ENERGY/CALORIE **OUTPUT** FROM THE CONSUMER). Similarly we can equate **plant food value** as **FV value**, energy value/calorie of that plant (ENERGY/CALORIE **INPUT** TO THE CONSUMER) **(plant "food" (fruits, nuts, etc...) weight referring to the plant "meat" weight parameter)**. This can similarly be scaled from 1 to 5 as 1=plant/plant parts contain low food/energy/calorie level to 5= plant/plant parts has high/best food/energy/calorie level return. This FV (food value) can include the factors like: Is the plant large or small in volume? Is the plant's food/the eaten parts/or fruit large or small in volume? Is the plant's consumable part rich or poor in calorie/energy/food return? Colledge's Natufian plant analysis tables mention which parts of these plants were eaten, how they were used and consumed in the Natufian diet. (Colledge, S., 2001, 152-155)

For calculating economic food value for plants, **(EV) the economic value (frequency based) = A*C*FV*frequency/number value of that plant** and by also multiplying with their corresponding animal species percentages as **(EV) economic value (percentage ratio based) = A*C*FV*percentage value of that plant species' number/frequency % values calculated.** By adding/summing all these values seperately as economic value sums and comparing these **EV sums** for **early and late periods**, and **forest coastal/inland and steppic desertic sites**, I can assess the change and/or shift of **EV (economic value)** from **site to site**. Also this **input/output ratios** can be calculated and compared between the sites of **early and late periods**, and **forest coastal/inland and steppic desertic sites**. I can then analyze the change/shift of **input/output ratios** from **site to site**. Generally however it is difficult to compare the percentages for plants because of the different plant species studied for different periods. The avaliable published plant data is necessarily inconsistent, insignificant and unequal to make plant comparisons between Early and Late Natufian sites in terms of the changes of percentage between species. It is then not possible **to engage in an Economic Food Value analysis and comparison for plants using this kind of "unequal" data for the early and late period Natufian sites.** We can however observe the **plant totals** for comparison of some **percentage changes of plant species found in total plant**

numbers/frequencies between Early and Late Natufian sites. Again to add finally, during the process of formation-development of **my EV animal ranking value decisions and parameter (factor) multiplication calculations methodology)**, I got technical-academic-zooarchaeological-mathematical helpsupport from my supervisor (my thesis advisor) Assist. Prof. Dr. Evangelia Pişkin (from SA) and from Prof. Dr. Münevver Tezer (from the Department of Mathematics) from the Middle East Technical University (M.E.T.U.) (Their contact web pages were given previously).

CHAPTER 5

THE ARCHAEOZOOLOGICAL AND ARCHAEOBOTANICAL ANALYSIS OF THE NATUFIAN CULTURE AND THE NATUFIAN ECONOMY

Numerous research studies, articles, books and publications around the field of this research that I could have reached and found including zooarchaeological (animal) and archaebotanical (plant) remains analysis tables, data evidence and interpretations of many main base camp sites of Early and Late Natufian periods tables that represents the frequencies of all available plant and animal species. The frequency tables for all the faunal and botanical assemblages of the study are in **APPENDIX C part** that I collected, analyzed and summed up together and formed from different published sources. They were calculated by different counting/calculation methods, including first NISP (Number of Identified Species) and then MNI (Minimum Number of Individuals), which allowed me to assess frequencies for Early and late Natufian sites separately, and then comparatively.

As I mentioned before in the **APPENDIX C** part of this study, there can be found the real clear sources of the complete Natufian animals and plants tables that I could find and used for this study. I used them first to complete the total data summary tables. The detailed presentation and summation of them include values of each animal and plant from each specific source. I then analyzed these values from every site species by species, comparing early period with early period, late period with late period, early period with late period sites, coastal sites with coastal sites, inland sites with inland sites, and coastal sites with inland sites. The analysis compared the faunal and botanical assemblages of early and late Natufian cultures, to test the previous research that suggests that there is a relationship between food crisis/food shortage and a change in subsistence strategies. The origins of agriculture in the late Epipaleolithic period in the Levant region may be found in the adapting subsistence strategies of Late Natufian societies during the abrupt and hard paleoclimatic event of the Younger Dryas.

The probable main sources of Natufian foods are likely the highest plant and animal frequencies in the tables. Also, information provided by the change in Sr/Ca ratios in human teeth of the Early and Late Natufian and changes in diet (Sillen, A. and Lee-Thorp, J. A., 1989: 399-411) compliment general research on the faunal/botanical assemblages from Natufian sites in the Levant corridor. In the **APPENDIX A** section of the thesis, all Natufian occupation sites list includes all known Early and Late Natufian occupation sites and including all sites that have archaeological layer(s) corresponding to or related with Natufian culture.

The regions with Natufian occuaption that were most affected by climatic change during the Younger Dyas are: 1- The Ghab region in the Syrio-African rift system, in NW Syria, close to the Turkish border near Antakya, 2- The Hula region in northern Israel in the Palestine-Levant region. (Bar Yosef and Valla 1991, Baruch and Bottema 1991)

The absolute chronology of the whole Natufian period (also known as the Late Epipaleolithic period of the Levant region) is between around 12500 and 10200 B.C. (or as late as 9500 B.C.). The absolute chronology of the Early Natufian period is between around 12500 and 11000 B.C. The absolute chronology of the Late Natufian period is between around 11000 and 10200 B.C. (or till around 9500 B.C.) (Grosman 2003). The absolute chronology of the late Pleistocene Younger Dryas climatic event (the abrupt change/decrease in the precipitation, moisture and temperature levels in the Levant area) happened between 10700 and 9500 B.C. So the Younger Dryas climatic event roughly belongs to the timeline of the entire Late Natufian period [11000-10200 B.C. (or as late as around 9500 B.C.)].

Previous research on Natufian communities has determined that the paleoclimatic change of the Younger Dryas event (increased aridity and cold) during the Late Natufian period was a probable cause of a possible food shortage and food crisis. In order to answer the question of how the Natufian subsistence strategies developed during the Younger Dryas climatic period, which may have given way to the origins of agriculture in the later PPNA period, we should analyze and try to understand how during the Natufian period, the choices of hunters changed, what Early and Late Natufian people were eating, and what was the change, decrease or increase in their natural food supplies. Lastly, what changed in the subsistence economy patterns during the Younger Dryas, or during the Late Natufian period?

In the **Appendix C,** I listed the species that constitute the highest frequencies and were likely the main sources of Natufian animal diet foods. References for these Natufian animal diet foods below were: Richerson, P. J., Boyd R., and Bettinger R. L, 2001: 1-50., Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62., Moore, A. M. T. and Hillman, G. C., 1992: 482-494., Bar Yosef, O. and Valla, F. (eds) 1991: 11-19, Colledge, S. 2001: 3-4., Munro, N. D., 2003: 47-71., Tchernov, E. 1993: 218-233, Noy, T, Legge, A. J. and Higgs, E. S. 1973: 75-99, Valla, F. R., Bar Yosef, O., Smith, P., Tchernov, E., and Desse, J. 1985: 21-38, Davis, S. J. M. 1982: 5-15, Byrd, B. F. 1989: 176, Bouchud, J. 1987: 14-17, Cope, C., 1992: 341-358, Munro, N. D. 2003: 12:47, Sillen, A. and Lee-Thorp, J. A. 1989: 399-411.

The primary sources of animal food in all other Natufians' coastal/inland range sites are the ungulates: **(generally high frequency as a food animal family in the tables),** gazelles mainly (gazella gazella), dorcas gazelle (gazelle dorcas) (main source of meat) **(high frequency as a food animal family in the tables),** red deer (Cervus elaphus) (**middle frequency**)**,** fallow deer (**high frequency**)**,** wild cattle (Bos primigenus) (**high frequency**)**,** wild boar (sus scofa), (**middle frequency**)**,** equids, equus (horse, donkey family) (**low frequency**)**,** ibex, goat (capra, caprine, Capra aegagrus) (**high frequency),** persian fallow deer (dama dama mesopotamica) **(high frequency),** Cervidae (deer) **(high frequency),** Sheep (Ovis aries) (**middle frequency**)**,** roe deer, deer (Capreolus capreolus) (**high frequency**)**,** caprine (**high frequency**)**,** Oiseaux (birds) **(high frequency),** Alectoris chukar **(high frequency),** Lepus capensis **(high frequency).** For example in Abu Hureyra, gazella subgutturosa (Persian gazelle) was probably the main source of meat (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62).

For the food animal group of Pisces (Poissons) (fish) **(middle frequency),** Testudo graeca **(high frequency),** other Testudo sp. **(middle frequency),** Medium sized Aves (birds) **(middle frequency),** Large sized Aves (birds) **(low frequency),** Ophisaurus apodus **(middle frequency),** Ophidia **(low frequency),** Squamata **(low frequency),** Anatidae (ducks) **(middle frequency),** Rodentia **(low frequency)**. In Beidha, nubian ibex (capra nubiana), wild goat (capra aegagros), water fowl, ducks, seasonal fresh water food, seasonal fresh water fish, marine fish, local common food sources for all Natufian sites are rabbits, wild sheep (ovis), birds, Equus asinus (wild donkey), shell fish, legless lizards (ophisaurus apodus) (Lacertilia group), lizard, snakes, hares (Lepus capensis, Lagomorpha), tortoises, land tortoise, turtles, crabs, Sparus auratus (fish), terrestrial molluscs, reptiles (Ophisaurus, chameleon), Alectoris chukar (Phasianidae group), hartebeest (Alcelaphus), possible bird foods were are patrigde, sand grouses were usually being coursed and eaten, and chukar, bustard, ostrich, ducks, and they were not eating micromammals and the passeriform birds, Lepus capensis (hare), vulpes vulpes (fox) were being cut for their pelts (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62).

For the Natufian possible food plants: (Colledge, S., 2001: 152-155, Davis, S. J. M. 1982: 5-15) in Abu Hureyra: (Early period: 1A: 11500 B.C.-11000 B.C.), Charred seeds and fruits, fruit stones, seeds of hackberry tree (celtis tournefortis), plum, pear, medlar, seeds of white flowered asphodel (Asphodelus microcarpus) (for food or medicine), pistacia fruitlet remains, in Abu Hureyra: (Late period:1B: 11000 B.C.-10400 B.C.), wild cereals:grains of feather grass species (stipa spp.), domestication of wheat (triticum vulgare, triticum monococcum, triticum dicoccum, triticum boeoncum etc..) and barley (genus hordeum, etc…), harvesting of wild cereals, nuts, legumes, wild barley/domestic barley (?), wild emmer (triticum dicoccoides), marten (martes follina), wild einkorn wheat, edible legumes, edible wild pulses as wild lentil, bitter vetch, wild pea, wild flax, wild rye/domestic rye, leaves of malva, Cruciferae (for salads), Linum (for oil), perennials, oil plants, fruit plants, lupines, wild almond nuts, wild grasses, fruits of trees and shrubs of Mediterranean forest zone trees, almonds, acorns, Hordeum cf. Spontaneum (rachis intermode fragments) middle frequency as a food plant in the tables. Cf. Pistacia sp. has **high frequency**, Leguminosae **low frequency**, Cereal indeterminate (grains) **low frequency**, Culm nodes **low frequency**, Phalaris sp. **low frequency**, Gramineae **low frequency**, Leguminosae **low frequency**, Pistacia sp. **high frequency**, Geraniaceae (twists) **low frequency**, Ficus sp. (nutlets) **middle frequency**, Amygdalus sp. (fruit stones) **low frequency**, Artiplex sp. **low frequency**, Chenopodiaceae/Caryophyllaceae **middle frequency**, single loop Chenopodiaceae/Crucifer **middle frequency**, cf. single loop Chenopodiaceae/Crucifer **middle frequency**, Cruciferae (type a) **low frequency**, Schoenus nigricons low frequency, Verbascum sp. were in **low frequency** shown in the tables.

Also according to the Natufian plant diet research (Colledge 2001:84-91)**,** Natufians were eating **cf. Aegilops sp., Aegilops sp., Avena sp., cf. Bromus sp., Bromus sp., Bromus sterilis, Echinochloa crus-galli, cf.Echinochloa/Setaria type, stipa sp., Setaria sp./type, Pictasia terebinthus, pictasia sp., gypsophila sp., capparis, atriplex, atriplex type, atriplex bracts, Chenopodium album type, Chenopodium sp., Suaeda sp., Chenopodiaceae/Capparis sp. (spiral embryos), cruciferae, single loop chenopod/incumbent crucifer, camphorosoma type food plants consumed more in spring and summer, consumed less in autumn and winter seasons and centaurea sp. (small, medium and large sizes), cf. Centaurea sp., cornus mas, cruciferae (type a, type c, and indetermined types), carex cf. divisa, Eleocharis sp., schoenus nigricans, scirpus martimus, scirpus tabernaemontani type, scirpus sp. type a and type b, Cyperaceae type c, type d, type x, indetermined types, Erodium (large, small and indetermined sizes), cf. Cicer sp., Lathyrus cf. cicera, Lathyrus sativa/cicera, Lens sp., pisum sp., vicia ervilia, cf. vicia faba, cf. vicia lathyrus sp., astragalus sp., coronilla sp., medicago sp., melilotus sp. food plants were consumed mostly all seasons and trifolium sp. type, trigonella sp. type, leguminosae indetermined small types, asparagus sp., asphodelus sp., cf. Ornithogalum, malva sp., ficus sp., olea sp., polygonum venentianum type, rumex sp., portulaca sp., potamogeton sp., amygdalus sp., crataegus sp., cf. Prunus sp., Pyrus sp., Rubus sp., vitis vinifera and vitis species food plants** were consumed mostly in summer and spring times and relatively less consumed in winter and autumn times. (Colledge 2001:84-91)

We can make the following observations on Natufian diets. My idea in this aspect is; the food supplies of Natufian societies were either processed (by the possible start of semi-agriculture/ pre-agriculture and semi-domestication/pre-domestication) or not processed (continued hunting and gathering). The whole ungulate family including mainly gazella gazella, or all kinds/species of gazelle, gazella subgutturosa (Persian gazelle), dorcas gazelle (gazelle dorcas, etc...) have the highest frequency as the main food animal, main food supply and the main source of meat for the Natufians in both the Early period, and the Late period during the

Younger Dryas when there was significant subsistence stress. (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62)

Research on the diet/food supply of Early Natufian societies (Moore, A. M. T. and Hillman, G. C. 1992: 482-494) demonstrate that plants were the majority of their diet. Edible plants were much easier found before the Younger Dryas climatic event. With the start of the Younger Dryas cooling period the Late Natufian diet/food supplies changed/shifted abruptly from mostly plants to mostly animals. This switch has been supported by research that has calculated the shift in the Sr/Ca ratios (Sr - Strontium – found more in plants, Ca - Calcium – found more in animals) in human teeth. Comparison of teeth between Early and Late Natufian people shows that plants were eaten less during the Late Natufian (Sr decreases, Ca increases) and animals (probably mostly gazelles) were eaten more (Sillen, A. and Lee-Thorp, J. A. 1989: 399-411). Plant species probably decreased during the Younger Dryas climatic event in the Late Natufian period.

Neverhteless some other animals like Mesocricetus auratus survived and adapted to arid climatic conditions. The presence of Mesocricetus auratus in the Late Natufian shows there was a huge climatic change/shift and aridifaction period of Younger Dryas fits completely and perfectly into the Late Natufians' time period. Gazelle is also known to have adapted well to high aridity in open, arid places during Younger Dryas conditions. Gazelles continued to reproduce but the percentage frequency of gazelle decreased in the Late Natufian compared with the Early Natufian.

Though the percentage frequency of gazelle was reduced in the Late Natufian, more cut marks and animal food/cooking fire marks/remains have been identified on gazelles from Late Natufian contexts compared with the early Natufian periods sites (Stahl 1984). Additoinal changes can also be observed in the Sr/Ca ratio analysis, in particular related to the type of Calcium (Ca) (Sillen, A. and Lee-Thorp, J. A., 1989, 399-411). A comparison of C3 and C4 types of plants and the comparison of the levels of different types of Calcium (Ca) found in the teeth of Early and Late Natufian people, shows also diet differences in the choice between marine animals and land animals. During the whole of the Early and Late Natufian periods land animals were eaten more than animals from fresh or salt water.

The research shows that the Late Natufian culture was a society under stress, as food stress, subsistence/economic stress and environmental stress (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62). Social stress probably also accompanied the decrease of natural food resources in the Late Natufian period as populations also increased. This may have led Natufian societies to create subsistence economics that involved food production and/or food storage for survival, and provided the initiative to begin agricultural and semi-domestication techniques to cope with Younger Dryas.

There is evidence (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62) and also I have an idea of a close relationship between gazelles and Late Natufian people as gazelles and some other ungulates were possibly being fed, and that possibly living within the human culture of Natufian sites. This relationship with gazelle can be defined as one of pre-domestication, and in some seasons gazelle would have increased food supply and storage as other Late Natufian subsistence strategies had become stressed. Dogs (wolfs, etc…) were also close to human culture. Wild dogs (grey wolf that derived to domestic dog or feral dogs that are domestic dogs that escaped to wilderness) may have been fully or semi-domesicated and were possibly also being fed and protected inside the Natufian zone of human culture. Dogs were buried together with humans in secondary human burials in the Late Natufian (a burial over another burial practices spread highly in the Late Natufian) (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62).

By the Younger Dryas in the Late Natufian large animals decreased but small animals and small game increased. The size of mammals also decreased with the fall of temperature in the cooling period of the Younger Dryas. Also, a greater frequency of young gazelles has been identified found and male gazelles were decreasing and male gazelles were mostly hunted in the Late Natufian sites. (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62) Male gazelles were mostly being eaten and female were not. Perhaps female gazelles were being fed and somewhat domesticated for the reproduction and birth of new gazelles. This effort to protect a source of food may have also resulted from climatic pressure during the Late Natufian period.

Another important Late Natufian subsistence strategy included an increase in gazelle hunting and a decrease in fallow deer hunting. Water fowl and nesting ducks were also eaten mostly in times of food stress during the Late Natufian (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62).

By the Younger Dryas there was a decrease in the total number of plant species and in the Natufian food plants. The most signficant reduction of plant species was in the wild cereals. The cultivation/domestication of wild cereals was one response in Late Natufian subsistence strategy (Colledge, S. 2001: 152-155). The asphodel seeds (used as food and medicine), and a few of the feather grass species decreased by the Younger Dryas/Late Natufian. The consumption of foods like the small seeded legumes increased during the Late Natufian but the availability of previously preferred/eaten plants from the Early Natufian decreased in the Late Natufian (Colledge, S. 2001: 152-155).

Some of the most important and developed, big, populated and base camp characteristic Natufian sites that were most highly effected by the Younger Dryas aridity and cooling period, and which most successfully adapted the Late Natufian subsistence techniques during the possible food crisis include: Mugharet El Wad (by Garrod in 1957), Ain/Ein Mallaha (by Perrot in 1966), Wadi Hammeh 27 (by Edwards in 1988). Later agriculturally suitable Natufian sites that were also settled/occupied in the early Neolithic period were Abu Hureyra, Jericho and Beidha. An origin for the domestication of wheat and barley and the harvesting of cereals is observed in the Late Natufian. (Colledge, S., 2001: 152-155 and Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62) (References for Natufians possible food animals: Richerson, P. J., Boyd R., and Bettinger R. L. 2001: 1-50., Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62., Moore, A. M. T. and Hillman, G. C. 1992: 482-494., Bar Yosef, O. and Valla, F. (eds) 1991: 11-19, Colledge, S. 2001: 3-4, Munro, N. D. 2003: 47-71., Tchernov, E. 1993: 218-233, Noy, T, Legge, A. J. and Higgs, E. S. 1973: 75-99, Valla, F. R., Bar Yosef, O., Smith, P., Tchernov, E., and Desse, J. 1985, 21-38, Davis, S. J. M. 1982, 5-15, Byrd, B. F. 1989: 176, Bouchud, J. 1987: 14-17, Cope, C. 1992: 341-358, Munro, N. D. 2003: 12: 47, Sillen, A. and Lee-Thorp, J. A. 1989: 399-411 and References for Natufian plant food sources: Colledge, S. 2001: 152-155, Davis, S. J. M. 1982: 5-15)

The comparison within Early and Late Natufian periods of the same sites, same locations for the Natufian sites that had both early and later Natufian periods' occupations together and display of some animal and plant species' frequency and percentage changes and differences from different locations of Early and Late Natufian sites, attained by using site comparison within NISP and MNI counting methods and percentage frequencies are **in the tables in the Appendix C part** respectively. In the beginning part of these animal tables **(Tables 17-29 in the Appendix part C)** and in also plant tables section **(Tables 30-34 and 35-38 in the Appendix C),** and in the "within periods" and "between sites analyses" we can see the comparisons within inside Early Natufian sites to all other Early Natufian sites and the comparison of Late Natufian sites to all other Late Natufian sites.

We can also see these in "between periods analysis" animal tables **(Tables 17-29 in the Appendix C part)** when comparing the food animals totals of some known bigger base camp sites from Early Natufian with food animals totals of some sites from the known bigger base camp sites from the Late Natufian, and also in "within same sites analysis" when making comparisons of the same sites within different earlier or later Natufian periods'situation.

Considering the locational, geographical, vegetational and paleoclimatic, environmental local animal and plant food potential differences and similarities in between the sites and the different periods as if they are forestal and coastal or inland and desertic or steppic sites of earlier and later periods, there is a decrease in percentage of animal remains and decrease in percentage of animal food sources, in addition to the decrease in the environmental plant food sources in the Late Natufian. Again evidence shows that, possible animal and food animal shortage may have happened for some animal species, almost a decrease for many food animal species is seen during the climatic shift and change from Early to Late Natufian by the Younger Dryas.

Natufian food animals with highest frequencies from the animal tables: (Tables 17-29 in the Appendix C part)

These are ungulates family, gazelles mainly (gazella gazella), dorcas gazelle (gazelle dorcas) (main source of meat and **highest frequency as a food animal family in the tables, gazelle decreased in Late Natufian, gazelle was being eaten much more and/or preferred much more in the Late Natufian),** red deer (Cervus elaphus) has **middle frequency,** fallow deer has **high frequency,** wild cattle (Bos primigenus) has **high frequency,** wild boar (sus scofa) **middle frequency,** equids, equus (horse, donkey family) **low frequency,** ibex (capra) **high frequency,** persian fallow deer (dama dama mesopotamica) **high,** Cervidae (deer) **high frequency,** Capra aegagros, Goat, Sheep (Ovis aries) **high frequency,** roe deer, deer (Capreolus capreolus) **high**

frequency, caprine **high frequency,** Oiseaux (birds) **high frequency,** Alectoris chukar **high frequency,** Lepus capensis **high frequency,** Pisces (Poissons) (fish) **middle frequency,** Testudo graeca **high frequency,** other Testudo sp. **middle frequency,** Medium sized Aves (birds) **middle frequency,** Large sized Aves (birds) **low frequency,** Ophisaurus apodus **middle frequency,** Ophidia **low frequency,** Squamata has **low frequency,** Anatidae (ducks) has **middle frequency,** Rodentia has **low frequency**.

Natufian food plants with highest frequencies from the plant tables (Tables 30-34 and 35-38 in the Appendix C part):

Hordeum cf. Spontaneum (rachis intermode fragments) **has middle frequency** as a food plant in the tables, cf. Pistacia sp. has **high frequency**, Leguminosae has **low frequency,** Cereal indeterminate (grains) **low frequency**, Culm nodes **low frequency**, Phalaris sp. **low frequency**, Gramineae **low frequency**, Leguminosae **low frequency**, Pistacia sp. **High frequency**, Geraniaceae (twists) **low frequency**, Ficus sp. (nutlets) **middle frequency**, Amygdalus sp. (fruit stones) **low frequency**, Atriplex sp. **low frequency**, Chenopodiaceae/Caryophyllaceae **middle frequency**, single loop Chenopodiaceae/Crucifer **middle freq**uency, cf. single loop, Chenopodiaceae/Crucifer **middle frequency**, Cruciferae (type a) has **low frequency**, Schoenus nigricons has **low frequency**, **Verbascum sp.** has **low frequency.**

5.1. NISP values and NISP comparisons

We can reach some main outcomes by looking at all these Natufian sites' detailed animal and plant data tables **(tables from 39 to 49 in the Appendix C part)** of the comparisons of NISP, MNI and % percentage calculation frequencies, and also by using the Natufian plant diet research evidence, (Colledge 2001:84-91) in the Natufian plants and food plants. **(tables 30-34, 35-38 and 43-44 in the Appendix C part)** We can see that by number and by percentage, under the pressure of Younger Dryas conditions in the Late Natufian period some plant decreased more, relatively compared to Early Natufian period. From the cereals as the focal plants and mostly food plants (the plants mostly consumed as food), as Hordeum spontaneum (grains), Hordeum cf. Spontaneum (rachis intermode fragments), Cereal (grains), from

Grasses, cf. Aegilops sp., cf. Bromus sp., Lolium sp., cf. Stipa sp., Gramineae (grains), the Species "X" defined by Colledge (Colledge 2001:84-91), Buglossoides arvensis, Chenopodiaceae/Capparis sp. (spiral embryos), Matricaria, Lens sp., Leguminosae, Liliaceae, Malva sp., and some unidentified taxa by Colledge (Colledge 2001:84-91) were decreased. From the grasses, Echinaria sp., cf. Stipa sp., Graminae (type 2), Gramineae, Atriplex sp., cf. Atriplex sp., Chenopodiaceae/Caryophyllaceae, single loop Chenopodiaceae/Crucifer, cf. single loop Cbenopodiaceae/Crucifer, Camphorosma type, Compositae (kernals), cf. Compositae (kernals), Cruciferae (type a), Schoenus nigricons, Cyperaceae (type c), Cyperaceae (type x), cf. Sophora sp., Verbascum sp., and again and some unidentified taxa by Colledge (Colledge 2001:84-91) were relatively decreased in the Late Natufian of Younger Drays, compared to the Early Natufian period. But as again food plants as Hordeum cf. Spontaneum (grains), Hordeum cf. Spontaneum (rachis intermode fragments), cf. Pistacia sp., Vicia/Lathyrus spp., Leguminosae, Pistacia sp., Chenopodiaceae/Copparij sp. (spiral embryos), Geraniaceae ("twists"), cf. Colutea sp., Liliaceae (type x), Linum sp., Ficus sp. (nutlets), Amygdalus sp. (fruit stones), Galium sp., "Lupin"type, "XXX" type defined by Colledge (Colledge 2001:84-91) and some again unidentified taxa by Colledge (Colledge 2001:84-91) relatively increased in the Late Natufian of Younger Drays compared to the Early Natufian period.

We can look and analyze the changes in the percentages of the plants and food plants **(tables 30-34, 35-38 and 43-44 in the Appendix C part)** in the Natufian plant tables that I calculated by considering the given frequency amounts and ratios of the plant species out of 100 given in the plant tables. As we can see that there was a general decrease in the total amounts of plants and percentage levels of the plants in the Late Natufian compared to the Early Natufian period. As again it was known by the past research that in the Late Natufian there was a high shift and high preference to food animals as food source instead of food plants. So Late Natufian subsistence strategy diet under the pressure of Younger Dryas cooling and drying was mainly on animal meat, on animal foods products, but not on plant foods and yet in fact plants and plant foods decreased in the Younger Dryas.

When we look again at the plant percentage levels from the food plants **(tables 30-34, 35-38 and 43-44 in the Appendix C part)**, the percentages of cereals (grains), cf. Bromus sp., Species "X" (by Colledge), Leguminosae, Unidentified taxa by Colledge relatively decreases, grass species as Echinaria sp., cf. Stipa sp., Gramineae**,** Atriplex sp., cf. Atriplex sp., Chenopodiaceae/Caryophyllaceae, single loop Chenopodiaceae/Crucifer, Camphorosma type, Cruciferae, Compositae (kernals), cf. Compositae (kernals), Cruciferae (type a), Schoenus nigricons, Cyperaceae (type c and type x), cf. Sophora sp., Verbascum sp. and some other unidentified taxa by Colledge decreased in percentage, while cf. Pistacia sp, Liliaceae plant species increased in percentage. If we look inside Early Natufian period for the plant species tables, as an example, the Early Natufian site of Wadi Hammeh 27 has much more plant remains found in total and in percentage compared to the Early Natufian site of Wadi Jilat 6. Additionally the Late Natufian site of Iraq ed Dubb has less plants in total and in percentage than the Early Natufian site of Wadi Hammeh 27.

It can be seen from these plants tables that Natufian sites' plant studies, which give ancient plant data separately divided as showing Early and Late Natufian periods' are so less studied and hardly found as a resource. But fortunately by the Early and Late Natufian sites' plant study of Colledge, Natufian plants and food plants in the diet was so widely studied. But some plant species were studied more thoroughly at some Early Natufian sites, while different plant species were studied more thoroughly at the Late Natufian sites. But also there are some common same plant species studied for both Early and Late Natufian periods to compare and to see the change or the shift or the decrease in each plant frequencies and percentage values **(tables 30-34, 35-38 and 43-44 in the Appendix C part)** from Early to Late periods.

As I said before, in total as we look, generally we cannot so easily compare the percentages for plants because of the different plant species studied for different periods, so the available published plant data are inconsistent, insignificant and unequal to make plant comparisons between Early and Late Natufian sites in terms of the percentage changes via species by species comparison. **So it is impossible and insignificant to make an Economic Food Value analysis and comparison for plants using this kind of "unequal" data for the early and late period Natufian sites.** But we can look at the **totals** and **compare not all but some of the percentage changes of same plant species found in total plant numbers/frequencies** in the

Early and Late Natufian sites and **we can see a total decrease** and **a percentage decrease** in some plant species in the total plants of the Late Natufian sites compared to the Early Natufian sites.

When total frequency of plants, food plants level and variety of the plants level are taken into comparison, as we can see the plant totals and percentages comparison in the Early and Late Natufian periods in the plant comparison tables, and according to the research evidence from the Hulah and Ghab lake regions core pollens analyzed by Baruch and Bottema also; Late Natufian sites were under the pressure of Younger Dryas. This logically and naturally caused to form less vegetation area and less vegetation growth, as well as decreasing in forest areas, declining of vegetation line, and decreasing in the variety of the plants. Also according to the tables, the Late Natufian sites have less number and variety of edible food plants to eat, that means less amount of plant food supplies, less suitable climate conditions, less food/edible plants diversity, mostly seen in less number of food plants and their availability in nature compared to the plants and food plants of Early Natufian sites.

Again in all these Natufian sites by looking at the detailed animal data and the comparisons of NISP, MNI and % percentage calculation frequencies in the animal tables, and by using the Natufian animal meat diet research evidences, again we can drive some major conclusions **(all tables from 17 to 49 in the Appendix C part).** We can see that by number and by percentage, under the pressure of Younger Dryas conditions in the Late Natufian period, relatively compared to Early Natufian period, generally the total frequency for the most animals and food animals like Capra aegagrus, Goat, Sheep, Ovis are approximately equal or some decreased in the Late Natufian.

But these species' percentage ratios in the total of all animals and food animals decreased. We can possibly say that they were becoming fewer in the Late Natufian periods because of the environmental and vegetational impact of Younger Dryas and/or hunters' or consumers', peoples' choice might have changed or they might have been preferred less be eaten in the Late Natufian people compared to Early Natufian, though it is still questionable.

The total number of gazella gazella increased since gazelle species are good at adaptation to aridification and cooling of the climate in the Late Natufian. Gazelle has the highest frequency of all food animals and all animals for both Early and Late Natufian as we can see from the animal tables. Gazelle is the main food/meat supply as gazella species can be the main support of the subsistence strategy of the Late Natufians.

The creating of a strong relationship with gazelle and also with dogs for protection, it can be interpreted as a semi domestication of gazelle in the Late Natufian. The percentage number of gazelle also increased in number of frequencies as it can be seen from the animal tables **(Tables 9 and 11)** as more animals and less plants were consumed, mostly ungulates from animals and from those mostly gazelles were being eaten considerably more in the total of Late Natufan sites as a food compared to Early Natufian.

The total number of Bos primigenius (cattle), Sus scrofa (wild boar-wild pig-pig), Equus spp. (wild donkey), Cervidae (deer), Alcelaphus buselaphus, Cervus elaphus (red deer), Capreolus capreolus (roe deer) increases in the Late Natufian, but Dama dama mesopotamica (fallow deer) decreased in the Late Natufian and its percentage as a food source increased; Anas sp. (ducks) (birds) as food source decreased in percentages in the Late Natufian.

As non food animals Rhinoceros, Hippopotamus, Camelus, Vulpes sp. (fox), Canis sp. (dog), Erinaceus europaeus (hedgehog) , Rongeurs, Small carnivores, Serpents, Potamion sp., Poissons, decreased in Late Natufian in terms of percentage of all total of animals found in that period. Furthermore, as non food animals Felis sp. (cat), cf . Vormella peregusna (pole cat) (carnivora), Insectivores, Molluscs, Falconiformes (hawk) (birds), Phasianidae (birds), decreased in Late Natufian in terms of percentage of all total of animals found. The total number of frequencies of Vulpes sp. (fox), Canis sp. (dog), increased in the Late Natufian, and Felis sp., Vormella peregusna (pole cat) (carnivora) (cat), Erinaceus europaeus (hedgehog), Rongeurs, Small carnivores, Serpents, Potamion sp., Poissons decreased in the Late Natufian. **(tables 17-29 in the Appendix C part)**

As again food animals of Oiseaux (birds) decreased, Alectoris chukar decreased, Coturnix coturnix increased, Anatidae (duck) (birds) increased, Anas sp. (ducks) (birds) increased, Aves sp. (birds) increased, Falconiformes (hawk) (birds), Lepus sp. increased but Lepus capensis as a food decreased. Lepus europaeus increased, fish sp. decreased but Testudo graeca which has one of the highest frequency food animals highly increased and some other testudo sp. decreased, but generally in total medium sized aves (birds), large sized aves (birds), and huge sized aves (birds) decreased, Ophisaurus apodus increased, Agama stellio, Ophidia and Squamata as food animals increased in terms of number/frequency in the Late Natufian. **(tables 17-29 in the Appendix C part)**

In the NISP percentages changes calculated for Natufian animals **(tables 17-29 in the Appendix C part)**, we see that there is a general trend that, as the first frequent preferred food animal, gazelle is always present with high frequency values for all Natufian sites of Early and Late periods of Natufian. In the site of Ein Mallaha, the gazelle is much more abundant in percentage and has a greater number as in NISP frequency in Early Natufian than in Late Natufian. But generally more gazelle and more animal meat was being eaten in the Late Natufian subsistence diet compared to Early Natufian diet. The secondly frequent preferred food animal is the dama species, as dama dama mesopotamica. The Hayonim Terrace and Hayonim cave is also having the highest recovered percentage of deer, as Dama species in Early Natufian and Cervus species in the Late Natufian is frequent. Mainly gazelle as food animal, but also dama, other ungulates/large mammals as deer (red, roe, fallow), cattle, sheep and pig has high meat capacity than other small food animals like legless lizzards, lizard species, and birds and ducks and fish. Late Natufian subsistence was possibly mainly on large mammals/ungulates and gazelles as we know.

The NISP percentage changes calculated for Natufian animals **(tables 17-29 in the Appendix C part)** indicate that, as the food animals, the percentages of Gazella gazella, Ovicaprids, Bos primigenius, Sus scrofa, Equus sp., Alcelaphus buselaphus, Cervidae, Capreolus capreolus, Dama mesopotamica, Lepus sp., Huge Aves generally decreased in the Late Natufian compared to the Early Natufian period. Testudo sp., Alectoris chukar, Anatidae (ducks), Ophisaurus apodus and mainly Cervus elaphus food animal species generally increases in the Late Natufian period.

When we look at Early Natufian sites of Ain Mallaha, Hayonim Cave and El Wad layer B2 as they are the best represented assemblages for having the most number of animal species variety calculated, compared to other sites of Early Natufian as we have a high number of gazella, lepus, testudo, alectoris chukar, anas (ducks) and medium sized aves (birds) in the Hayonim cave of early Natufian that has the maximum number of animals present and calculated among the Early Natufian sites. In El Wad B2 of early Natufian there is secondly high amount of Lepus and testudo species and medium sized aves (birds), and in Ain Mallaha of Early Natufian there is high gazelle and high testudo species with the cervidae species.

In the Late Natufian sites, in the Hayonim cave there is the maximum frequency of the total of animals that is calculated among the late Natufian sites, and Hayonim terrace of late Natufian has high amounts of Testudo and Anatidae (ducks) species. In Hatoula layers 4-5 of late Natufian and in late Natufian Mureybit (Mureybet), the Anatidae (ducks) are high in frequency and it is known by the research that ducks were gathered and consumed throughout food stress/food shortage conditions during the Late Natufian in the Younger Drays. (Bar Yosef, O. and Belfer-Cohen, A. 1999: 55-62) The Hayonim terrace and cave and El Wad B1 layers of late Natufian and the El Wad A of final Natufian periods are the sites that have the strongest assemblages of animal remains that has the most frequent animal measurements of most animal species.

The maximum gazelle frequency numbers seen in Hatoula, also intensely in Hayonim terrace, Nahal Oren, Ain Mallaha, El Wad B1 and A, the late and final layers and has high gazelle frequencies respectively and other late Natufian sites have high gazelle percentages as the highest percentages are gazelles for the all Late Natufian sites generally as we see from the animal tables. Highest large mammal and ungulate numbers are from Hayonim cave of Early Natufian and secondly in Ain Mallaha layers of Early Natufian. Largest assemblage of large ungulate mammal numbers are from the Hatoula layers 4-5 of the Late Natufian, and secondly highest large mammal frequencies are from Hayonim terrace, Nahal Oren and Ein Mallaha and El Wad and Salibiya in decreasing order respectively. Hence from large mammals the gazelles decreased in the Late Natufian compared to early Natufian by percentage and by number as it can be seen from the NISP percentage comparison animal tables by the help of probably semi domestication strategy of Natufians on gazelle and even against the gazelles' dry places adaptation. The other large mammals totally decreased generally in the Late Natufian compared to early Natufian. **(tables 17-29 in the Appendix C part)**

5.2. MNI values and MNI comparisons

The MNI percentages changes calculated for Natufian animals **(tables 23, 24 and 25 in the Appendix C part)** indicate that El Wad B2 site of Early Natufian has the most strongest assemblage to compare as it has the most animal species measured which has less ungulate frequency. Considering the ungulate results but Hayonim Cave of Early Natufian has higher number of ungulates, mainly with the high amount of gazelles and high cervidae. In the Late Natufian MNI animal results, again El wad B1 site of Late Natufian has most strongest assemblage to compare that has the most animal species measured, and again Hayonim terrace of Late Natufian and Hatoula layers 4-5 of Late Natufian has high ungulate values as the highest ones are again gazelle and secondly cervidae species. In MNI percentages shows that in general sus scofa and bos primigenus increases in the Late Natufian, but while species including gazelle decreases and also other ungulates, as main food animals, decreases in terms of MNI percentages in the Late Natufian compared to Early Natufian. But in general the amount of gazelle and its food animal percentage decreased in the Late Natufian compared to Early Natufian as can be seen generally comparison in only percentage showing tables and in NISP percentage showing tables values. **(tables 17-29 in the Appendix C part)**

It can be seen that Natufian people targeted especially on gazelle for animal domestication and main food supply, and frequently deer species from the large mammals and occasionally less catch up or hunt a lesser amount of the other large animals/ungulates also such as pig, sheep, equus (donkey). This can be an interesting outcome, because the origination of animal domestication and start of the production of food in the PPNA, PPNB, PPNC periods in the Early Neolithic times chose a completely different group of animals like cattle, sheep, goat, pig differing from the Natufian culture. There is an increase in small mammals in the Late Natufian but small mammals are also high enough in some sites of the Early Natufian like in example Hayonim Cave.

As it is clear from all animal data that the Natufians exploit mostly gazelle, as Natufians seem to be a semi-domestication society and economy and a specialized/organized culture in the hunting and somehow partly domesticating of this animal (gazelle). But at the same time Natufians collected around their site what is easy to catch, but having less meat weight (having less food energy, less input value for people), like lizards and tortoises as small mammals and also hares, might be because they were able to easily captured or perhaps they used traps or other easy catching methods. Also the increase of some animals and decrease of others can be affected from the adaptation of some animals (and also plants) like gazelles for drier conditions. Drier and colder conditions that may also have benefitted tortoises and (while) reduced(ing) the number of hares in/during the Late Natufian of Younger Dryas.

When we look at the NISP percentages table data **(table 39 in the Appendix C part)**, the comparison of the highest frequency animal sites of Ein Mallaha, Hayonim, El Wad B2 (Mugharet El Wad) of Early Natufian and the lowest frequency animal sites of Nahal Ein Gev, Fazael IV and El Wad layer A of the Late/Final Natufian shows that gazelle decreased highly in food animal percentage in the Late Natufian, compared to Early Natufian. but lepus and testudo species decrease together with some other animal species but Ophisaurus apodus increases in the Late Natufian.

In the intra-site comparisons of the same sites within different periods' animal frequency and percentage comparisons which were done for the bigger Early and Late Natufian basecamp sites of Hayonim; in the shift to El wad B1 to B2 to A, Fazael, Ain Mallaha sites' comparisons between the Early and Late Natufian periods, revealed that the most of the animals and main food animals as ungulates and other like ungulates, birds and fish species decreased in the Late Natufian mainly. Again in the intra-site comparisons the percentage comparisons done in the same site but the same periods as in Nahal Oren layers and El wad layers mostly the percentage of animals do not change so much for each animal, and for main food animals like gazelle, deer, ovis, capra, sheep, etc…and other ungulates and for other birds and fish species that are food animals.

But if we compare all Early and Late Natufian sites in terms of animal percentages and food animal percentages, for example for other ungulates and especially for gazelle, there is a high decrease in the percentages of gazelle and gazelle eating in the Late Natufian, but the highest frequency of animals found as in some Late Natufian sites like Hatoula 4 and Hatoula 5. The percentage of gazelle finding and possibly gazelle eating is around high 98-99 percent inside all totally found animal and food animal species measured for these sites.

5.3. Percentage only (%) values and percentage comparisons

In the percentage only values comparisons **(tables from 39 to 46 in the Appendix C part)**, of Ain Mallaha of Early Natufian to Ain Mallaha I of Late Natufian, the capra, gazelle, bos, sus, and the type of deers as cervus, capreolus and dama species also highly increases in terms of food animal percentages (being more eaten, more consumed by the Late Natufians) in the Late Natufian compared to Early Natufians.

In the site of Fazael between layer VI of Early Natufian transition to the shift to Fazael layer IV of Late Natufian, the Capra, Bos, Sus, Cervidae, Dama species decreased in percentages but Gazella gazella increased in percentages. In Hayonim cave there is very high level of gazella in the Early Natufian phase, and in Hayonim cave Alectoris chukar decreases in percentage in the Late Natufian. Lepus decreases in percentage and Testudo graeca increases in percentage in the Late Natufian Hayonim cave. Medium aves (birds) also decrease in percentage in the Late Natufian. In the shift from the El wad B2 to El wad A of Late Natufian, there is again a high increase in the percentages of Gazelles and an increase in the percentage of Testudo graeca, Ophisaurus apodus, Ophidia increased in the Late Natufian. In Ain Mallaha, Capra, Bos, Sus, Equus (donkey), deer species as Cervus, Capreolus and Dama were collectively increased in percentage total in the Late Natufian but gazelle was decreasing in percentage in the Late Natufian. In the site of El Wad B2 (early layer) to B1 (late layer) shift shown in MNI percentage tables, gazelle is increasing in percentage and with high frequency in this site as Calaxis hierosolymarum, Microtus guentheri are decreasing in the Late Natufian.

5.4. Intra-site, same sites and forestal-coastal to inland/steppic-desertic Natufian sites comparisons

For looking the percentage of change and frequencies of animal species in the comparison of forest & coastal to inland, steppic or desertic sites of Early and Late Natufian, the Capra aegagros, Goat, Sheep, Ovis species in number are high in the inland, steppic or desertic Early and Late Natufian sites compared to the forestal and coastal Early and Late Natufian sites. In the animal comparison tables we can see that the gazelle as the main high frequency food animal is higher in the forest & coastal Early and Late sites than the steppic or desertic inland Early and Late Natufian sites. Cattle, wild pig, donkey, goat, red deer, roe deer, fallow deer and also other animals of all kinds of birds and others animals in the forestal and coastal places are more abundant compared to inland steppic or desertic places in both Early and Late Natufian sites. When we look at the animal percentages of the coastal and forestal Early and Late Natufian sites we have again more percentage of food animals and other animals compared to the inland, desertic and steppic sites in both periods. More to the point, the total number of both plants and animals forestal and coastal Early and Late Natufian sites demonstrates greater food supply compared to the inner steppic or desertic sites of Early and Late Natufian generally.

In the inland sites of Fazael VI, Ain Mallaha 3 and Ein Mallaha 4 of Early Natufian, the percentages of gazelle is almost close or similar in value, and also other ungulates percentages are slightly fluctuating or close to each other in those 3 Early Natufian inland sites. But Hayonim cave has the highest animal frequency for forestal and coastal Early Natufian sites.

In comparison between inland Early Natufian Fazael VI and Early Natufian forestal and coastal Hayonim Cave, percentages of gazelles, bos and sus are less in Hayonim, but the total frequency amounts of animals and their variety are greater in forest coastal Hayonim site compared to inland sites. Gazella in Hayonim terrace as a forestal and coastal site of Late Natufian is very high in number and as also the cervidae is high in number in Hayonim. But in food animal percentage, gazelle is low in Hayonim terrace of Late Natufian compared to the Late Natufian inland sites of Nahal Ein Gev II, Fazael IV and Ain Mallaha I (Eynan) gazelles, however

Testudo graeca is very high also in forest and coastal Hayonim terrace site of Late Natufian.

Hayonim Cave generally has highest animal value in total among the forestal and coastal sites of Late Natufian. In the comparison of forestal and coastal Late Natufian sites of El Wad B1 and again forestal and coastal Late Natufian site of Nahal Oren (Layers V and VI), gazelle increases in percentage, dama dama species decreases in percentage. The percentage comparison of forestal and coastal site of Hayonim Cave of Early Natufian and again the forestal and coastal sites of Hatoula (Layers 4-5), El Wad B1 and Hayonim Cave of Late Natufian sites, there is increase in the percentage of gazella, capra, bos, sus and alcelaphus increases in percentage in the Late Natufian, and the alectoris chukar decreases in number in Hayonim in the Late Natufian period.

Medium, large and huge aves (birds) decrease in percentage in the Late Natufian of Hayonim cave. Lepus capensis decreases as a food animal in Hayonim of Late period, but Testudo graeca increases in late period of Hayonim. In inland site of Ain Mallaha of Early Natufian compared to inland Late Natufian sites of Mureybet, Nahal Ein Gev II and Ain Mallaha I, the percentage of Gazelle increases as in Nahal Ein Gev II, but Ain Mallaha 1 Gazelle percentage decreases, Capra, Bos, Sus, Cervidae, Cervus, Capreolus percentage increases and Molluscs decrease in the Ain Mallaha I of Late Natufian.

When some forestal & coastal and some inlands of both Early and Late Natufian sites compared together, the percentages of gazelles are lower in forestall & coastal and furthermore in the Late Natufian subsistence times, again the percentages of gazelle, as important food animals, are getting higher in inland and forests coastal sites of Late Natufian. Capra, Bos, Sus, Cervus, Capreolus and dama are also increasing in percentage in the Late Natufian period inland and forests coastal sites. Testudo sp. and Testudo graeca is decreasing in percentage in the Late Natufian, and while Ophisaurus apodus, Ophidia increases in the Late Natufian periods inland and forests coastal sites.

When we look at all the sites in the Early and Late Natufian as both coastal and inland sites, the frequencies and percentages of animals are changing and fluctuating from sites to sites and some sites are not indicating a decrease on animal remains but showing some increase in the number of animals and percentages.

Maybe these "animal increasing" sites were more successful in semi animal domestication (?) pre-domestication (?) or somewhat more successful in methods of Late Natufian subsistence/survival or food storage methods. It is certainly positively known by the evidence that (Baruch and Bottema 1991, 11-20) climate change of Younger Dryas effected the Levant region's whole vegetation, forest line and environmental food resources very wildly and badly. Some late Natufian sites are showing a decrease in animals and maybe these "animals decreasing" sites were less successful in animal domestication(?) or less successful in somewhat methods of Late Natufian subsistence/survival or food storage methods than other sites. So these sites are indicators of this Early and Late Natufian shift at the start of Younger Dryas period by showing the decrease of animals and also some sites are indicators of the change in the food animals and the dietary change in the Late Natufian. More gazelles and more other ungulates were being eaten in the Late Natufian according to their subsistence strategies shaped by the Younger Drays climate change differing than the Early Natufian sites as shown in changes percentages.

So intra site animal data comparisons in the tables are better as comparing same sites in the different periods. Also the certain evidences of plant species and vegetational decrease evidence caused by Younger Dryas started at the beginning of Late Natufian period may better be seen in the environmental animal/plant food resources abrupt decrease pressure over the Late Natufian subsistence techniques and also over the growing population pressure in the Late Natufian.

It can be seen from the animal tables that some Early and Late Natufian sites has more animal data gathered and/or more number or variety of animal remains; however, some Early and Late Natufian sites have not so much animal data analyzed or less amount of animal remains found compared to other sites. As a case point, Mugharet El Wad layers of B1, B2, and A have many more animal data measurements than the Fazael layers of early and late which is one of the Natufian sites of minimum number of animal data measured.

So we can say also that the famous bigger basecamp Natufian sites have more animals and plants collected and also more animal and plant analysis and excavations/surveys done there. We know that more Early Natufian sites were excavated/surveyed and analyzed in total compared to the excavated/surveyed/analyzed Late Natufian sites. Natufian culture archaeologists and zooarchaeologist and archaebotanists hope to find and excavate more Late Natufian sites for the need to gather more archaeological and floral & faunal data to understand Late Natufian economy and subsistence strategies better in the way of origination of agriculture and domestication.

The environment around the Late Natufian sites under the pressure of Younger Dryas had logically and naturally caused to form less vegetational area, as seen in decreasing forest areas, declining of vegetation line, and decreasing the variety of the plants. Also according to the tables, the Late Natufian sites have less number and variety of plants, mostly less food plants and less plant food supplies compared to the plants and food plants of Early Natufian sites. We can logically and truly say that frequency and presence/absence ratios of the variety and the number of Natufian plants found in the Early and in the Late Natufian periods will directly effect the levels of frequencies and varieties of animal species in the Early and Late Natufian phases. Totally generally plants will inevitably effect all the animal and plant food supplies of the Natufian. Possibly also the number of animals had affected the number of plants during the Younger Dryas subsistence period for all animal (including human) and plant species. So logically in the wild non domestication or non agricultural life in the nature, when the flora decreased in some areas by the climatic shift, then the plant eating animals (herbivores) and the meat eating (carnivors) or both animal and plant eating animals (omnivors) will also decrease in the order of the food chain.

But human's possible agriculture and domestication techniques can change/shift the food chain and the survival and feeding system for plants and animals. During the Younger Dryas, the Late Natufian people subsistence may have formed a possible system like semi-domestication or pre-domestication of animals and plant/cereal cultivation or agriculture that the natural link of food chain between the food sources of plants (water and minerals) and plants as the foods of the wild animals became more separated by the human subsistence methods of agriculture and domestication. Because humans were taking care of feeding the animals and growth of plants separately. So the survival of animals and survival of plants may have become more dependent to human feeding and protection. The link of natural-organic food chain between animals and plants could have been separated by human by plant agriculture and animal domestication again made by human.

As I think about the idea, of which some refers to as co-evolution hypothesis of agricultural origins, this hypothesis refers to the organic relation between the subsistence of plants and animals which is counting human as animals (Homosapiens sapiens), it should be counted that the impacts of human at the category of co-evolutionary impacts on animals (also on human), on plants and plants on animals (also human) is also natural.

So again in all these Natufian sites' detailed animal and plant data above and the comparisons of NISP, MNI and % percentage calculation frequencies in the animal tables (tables from 17 to 29 and tables from 43 to 49 in the Appendix C part), we can understand the change, and in some sites the abrupt and harsh shift in the number of animal remains. The main change is the decrease in the food animals and the main decrease in the amount of plant remains and food plants; the decrease in the amount of food supplies in the Late Natufian can be counted as a possible food crisis or food shortage in the shift of Early Natufian to Late Natufian periods during the Younger Dryas.

In this aspect, the Natufian's economic subsistence systems changed during the shift from Earlier to Later periods in the Natufian and also connected with the economics of Late Natufian subsistence. If we assume and accept that Late Natufians had a food crisis and the Late Natufian society were under economic food supply stress/under food shortage then it is clear that there is the minimum amount of choice or preference in the type of food consumption and storage of food, that hunter's choice of food had only the criteria of collecting/hunting the maximum calorie foods to survive and make storage for possible future worser climatic conditions.

Table 8. Early and Late Natufian sites average percentages of animal species group by group. **EN = Early Natufian, LN = Late Natufian, TN = Total number (NISP), AVG % = Average Percentages**

Animal Species	EN		LN	
NISP	TN	AVG %	TN	AVG%
Ovicaprids	71,00	2,48	71,00	0,70
Gazella gazella	2880,00	75,75	7259,00	61,74
Bos primigenius	57,00	2,70	262,00	1,83
Sus scrofa	77,00	3,51	259,00	2,42
Alcelaphus buselaphus	3,00	0,02	16,00	0,05
Cervidae	145,00	4,86	1037,00	5,24
Cervus elaphus	55,00	1,95	69,00	0,93
Capreolus capreolus	78,00	3,44	100,00	1,74
Dama mesopotamica	319,00	5,29	181,00	2,27
TOTAL	3685,00		9254,00	
Lepus sp.	2134,00	31,49	1272,00	14,50
Testudo sp.	2249,00	33,19	6950,00	79,26
PISCES	64,00	0,94	26,00	0,29
Molluscs	19,00	0,28		0,00
Alectoris chukar	657,00	9,69	327,00	3,72
Coturnix coturnix	21,00	0,30	8,00	0,09
Anas sp.	785,00	11,58	2,00	0,02
Falconiformes	81,00	1,19	72,00	0,82
Medium Aves	623,00	9,19	71,00	0,80
Large Aves	142,00	2,09	40,00	0,45
SITES TOTALS	6775,00		8768,00	

So probably they were eating mostly what they could find, hunt and gather or collect and in addition to this maybe they were in a position of thinking to start food production by storing animals by domesticating them and/or storing plants or cultivating wild plants by agriculture. Also probably they were beginning to store food and trying to produce and collect more food, and consume less food economically.

In the animal tables Early/Late Natufian periods comparison of percentage ratios, group by group from the table **(Table 8),** as ungulates large mammamls family taken as a group, we see that inside this group gazelle gazelle, that is always the highest frequency food animal, is decreasing in percentage ratio in the Late Natufian compared to Early Natufian. Also Bos, Sus, Cervus, Capreolus, Dama dama decreases in terms of the percentage of whole found ungulate bones in the Late Natufian. When we come to small game, small animals whole as a group, Pisces, Molluscs, Alectoris chukar, Coturnix coturnix, Anas, Falconiformes groups, they are also changing in percentage in the Late Natufian as Pisces decrease, Alectoris increase, Anas decrease, Falconiformes increase in the Late Natufian period. The group of medium aves decrease and the group of large aves increase in the Late Natufian compared to Early Natufian according to the percentages of the animal bones of different groups of species found. **Testudo species (turtle) seems as a small game animal, they were highly increased in frequency total NISP number and also increased in percentage frequencies in the Late Natufian compared to Early Natufian. This can show both a percentage increase and a total frequency number of increase in the small animals (the small game) in the Late Natufian differing from Early Natufian period, but the large mammals-ungulates are lower and decreases during the Late Natufian food crisis period again differing from Early Natufian times.**

We can see that Late Natufian economy is different in subsistence techniques by looking at that animal remains. The decrease and the change in the food animal and food plant consumption-preference levels in Late Natufian period are differing from Early Natufians. In the Late Natufian times the society was under a food crisis and an economic stress and we can assume that more physical and economic labor was required to hunt and gather-collect and/or to produce-cultivate-domesticate animal and plant foods. Because of the decrease in the plants and animals during the Younger Dryas in the Late Natufian times, the food may have been the most important and valuable, also possibly the most expensive economic meta.

Economic consumption of food was high and the supply of food was low and hard and the demand for food was high. Food resources were scarce in the time of crisis in terms of economic value or exchange value (logically by not including social/cultural (socio-cultural) or cultic/religious value of food animals and food plants in the food crisis times – seteris paribus (means all other effective variables/parameters are assumed to be constant)); food has a higher value (higher price) in the Late Natufian compared to Early Natufian times. So the economic price value in the Late Natufian times (food value of each animal and plant species collected to be consumed as food supply or food storage which were hardly found during the Younger Dryas) was higher than Early Natufian times. The price exception can be for only some plant and animal species (like gazelles) that were more able or adaptable to live and adapt drier and cooler conditions of Younger Dryas, they were consumed and supplied and demanded more and, could sometimes less and sometimes more difficultly be found and be collected from the nature. These palnt and animal species were logically and economically less valuable than valuable high meat weight ungulates (like gazelles), as their demand was higher but their supply (frequency) was also higher in the wild nature, compared to other animals, and we can say their required labour to gather and hunt.

So economic prices of highest frequency of gazelles (as an example) may be lower compared to other hardly found highly-laborious to catch and high calory requiring food animals and food plant species in the Late Natufian times, but other low supply-high demand food animal and plant prices should be so much higher priced in the Late Natufian economics food market.

5.5. The Economic Food Value Comparison Analysis for the Early and Late Natufian Economy

The economic price values of food animals and food plants possibly increased as they were hardly found, because that possibly required more labour to collect/hunt in the Late Natufian food crisis times. This Younger Dryas period of food crisis lasted around a hugely long time of at least 800 years of the Late Natufians. The required Late Natufian subsistence method can probably be an economical critically planned food consumption and maybe again a planned and economically organized food collection/production technique practiced in the Late Natufian differing from the Early Natufian. This may have probably required a labor share or labor organization and a food collection or food production specialization in Late Natufians.

So we can say as an input/output ratio comparison, economically the food **input** (food energy input, calorie input to Natufian people when they eat food animals and food plants) and the **output** for food (the energy output, the calorie output from Natufian people, the physical labor work done by Natufian people for hunting, collecting, producing, cultivating and/or domesticating food animals and food plants) values are different for the Early and Late Natufian societies under climatic food stress. So the Early Natufian economic ratio of **input to output (input/output)** energy is higher and this ratio is different in the Late Natufian compared to Early Natufian. The **input** from food is high in Early Natufian but the required labor and food stress and the energy **output** is so much lower in the Early Natufian compared to Late Natufian. But in the Late Natufian subsistence periods, under pressure of the increasing population and under the pressure of Younger Dryas' food stress, shortage in the available food resources, the food **input** to human is less and the labor **output** from human is higher in the Late Natufian compared to Early Natufian. With the Late Natufian, crisis economy needs more **output** energy from the late Natufian people, and as more labor force is required for finding/producing food and less amount of food was found compared to earlier periods, so **input** of food energy to late Natufian people was lower than the Early Natufian times. Hence, the Late Natufian economic ratio of the **input to output (input/output)** energy is lower than the Early Natufian times.

For the economic value (EV), food value (FV) and input/output ratio comparison analysis of Natufian animals parameters, formulas and calculations you can look at the methodology chapter's economic value analysis part (pages 91-96). In general, among the Natufian animals**, Lepus animal species is individual and fast moving as IG value is 2 and M value is 2, Testudo is also individual and slow moving as IG value is 2 and M value is 5, Birds are fast and some live in flocks but some are not as IG values change. Birds can be given an IG=4 value for individual or flocks and an M=2 value for mobility value (fast-slow values) as they can be caught with nets and in many cases we don't see the actual bird but they are aves species. (If 1 = is low in return difficult to catch and 5= is the best). For the large mammals, mainly as ungulates, pig is individual as IG=2, fast moving as M=3 difficult to catch. Cattle can be in flocks, IG=4, fast moving as M=4 and difficult to catch. Acelaphus, Gazelle are in flocks, IG=4, M=5 but deer (are seen) less in flocks as IG=3 and more difficult to catch than gazelle as M=4. Especially gazelle can be driven into traps. But in fact the same can be done with cattle. The gazelle and acelaphus, as ovicaprids have similar difficulties to catch, as IG=4, M=5 and deers another group a bit more difficult as IG=3, M=4 and the most difficult to catch it can be put pig as IG=2, M=3.**

Again to add, during the process of formation and development of my animal frequency analysis calculations **(MY ECONOMIC VALUE (EV) RANKING VALUE DECISIONS AND PARAMETER (FACTOR) MULTIPLICATIONS**

CALCULATIONS METHODOLOGY) and for the other parts-aspects of my calculation methodology, I got technical-academic-zooarchaeological and mathematical assistance (help-support) and control from my supervisor (my thesis advisor) Assist. Prof. Dr. Evangelia Pişkin (from SA) and from Prof. Dr. Münevver Tezer (from the Department of Mathematics) from the Middle East Technical University (M.E.T.U.) (Their contact web pages were given previously).

Table 9. EN and LN Ungulates family NISP values and NISP Average % percentages comparison **(% ratio to total number of all animals of all E.N. and L.N. sites seperately), E.N.:Early Natufian, L.N.:Late Natufian, NISP: Number of Identified Specimens for each animal species**

	E.N. Large Mam.	E.N. Large Mam. Avg %	L.N. Large Mam.	L.N. Large Mam. Avg %
	NISP	%	NISP	%
Ovicaprids	71	2,87	71	1,17
Gazella gazella	**2863**	**78,22**	**7199**	**71,79**
Bos primigenius	57	2,99	262	3,03
Sus scrofa	77	4,13	259	4,00
Alcelaphus buselaphus	3	0,02	29	0,99
Cervidae	145	5,72	16	0,09
Cervus elaphus	55	2,31	1037	8,64
Capreolus capreolus	78	4,05	69	1,52
Dama mesopotamica	319	6,17	98	2,35
Totals	3669		9040	

Table 10. EN and LN Ungulates family Average % percentages of each animal species found comparison **(% ratio to total number of all animals of all E.N. and L.N. sites seperately), E.N.:Early Natufian, L.N.:Late Natufian**

Ungulates	Early Natufian Avg %	L. N. + Final N. Avg %
	%	%
Ovicaprids	20,91	7,53
Gazella gazella	**64,62**	**52,15**
Bos primigenius	11,69	3,47
Sus scrofa	1,96	2,15
Equus spp.	7,57	1,98
Cervidae		18,80
Alcelaphus buselaphus		0,00
Cervus elaphus	0,59	0,02
Capreolus capreolus	0,35	0,45
Dama dama mesopotamica	2,94	3,29

Table 11. E. N. and L. N. Ungulates family MNI values and MNI Average % percentages comparison **(% ratio to total number of all animals of all E.N. and L.N. sites seperately), E.N.:Early Natufian, L.N.:Late Natufian, MNI: Minimum Number of Individuals for each animal species**

	E. N. Sites Total	E.N. MNI Avg %	L. N. Sites Total	L.N. + Final N. MNI Avg %
	MNI	%	MNI	%
Ovicaprids	6	3	7	2,54
Gazella gazella	**63**	**79,2**	**175**	**70,59**
Bos primigenius	5	2,5	14	3,00
Sus scrofa	3	1,45	12	5,67
Equus sp.	1	0,5	1	0,20
Cervidae	26	12,85	46	9,49
Alcelaphus buselaphus	1	0	1	0,50
Cervus elaphus	0	0	0	0,00
Capreolus capreolus	0	0	3	11,90
Dama mesopotamica	0	0	2	4,76
Large M. MNI SUMS=>	E. N. MNI Total		L. N. MNI Total	
	105		261	

Table 12. Table for Economic food value comparison between Early and Late Natufian, **E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, NISP: Number of Identified Specimens for each animal species, for the description of formulas in the tables look at the Methodology part and the Economic Food Value Analysis part (Methodology part pages 91-96, EV analysis page 122-123 respectively)**

E.N. Economic food value => EV=>IG*M*MW	**E. N. INPUT/OUTPUT ratio NISP value EV=> frequency (NISP number)**	**E. N. INPUT/OUTPUT ratio % NISP EV=>percentage frequency (% NISP)**
22027	4124704,52	**132840,64**
L.N. Economic food value => EV=>IG*M*MW	**L. N. INPUT/OUTPUT ratio NISP value= EV=>frequency (NISP number)**	**L. N. INPUT/OUTPUT ratio % NISP = EV=>percentage frequency (% NISP)**
22027	11880780	**122045,27**

Table 13. (a part of Tables 50-51, see Tables 50-51 in the Appendix C for the complete table) Table for Economic food value comparison between Early and Late Natufian, E. N. Sites and Gazelle NISP EV Totals, **E.N.:Early Natufian, EV:Economic Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, NISP: Number of Identified Specimens for each animal species, for the description of formulas in the tables look at Methodology part and the Economic Food Value Analysis part (Methodology part pages 92-96, EV analysis page 122-123 respectively)**

E.N.	**TN**	**AVG%**	**EV=> IG*M*MW* frequency (NISP)**	IG*M*MW	% (IG*M*MW)	**EV (NISP)**	EV %	**EV (%NISP)**	EV%
Gazella gazella	2863	**78,22**	4*5*44 kg	880,00	4,00	2519440	**61,09**	**68833,6**	49,66

Table 14. (a part of Tables 52-53, see Tables 52-53 in the Appendix C for the complete table) Tables for Economic food value comparison for total frequency of gazelles between Early and Late Natufian**,** L.N. Sites and Gazelle NISP EV Totals**, L.N.:Late Natufian, EV:Economic Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, NISP: Number of Identified Specimens for each animal species, for the description of formulas in the tables look at Methodology part and the Economic Food Value Analysis part (Methodology part pages 91-96, EV analysis page 122-123 respectively)**

L.N.	**TN**	**AVG%**	**EV=> IG*M*MW*frequency (NISP)**	IG*M*MW	**EV (NISP)**	EV %	**EV (%NISP)**	EV%
Gazella gazella	7199	**71,79**	4*5*44 kg	880,00	6335120	**53,31**	**63175,2**	53,90

Table 15. (a part of Tables 59-60, see Tables 59-60 in the Appendix C for the complete table) E. N. and L. N. Sites and Gazelle MNI EV Totals**, E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, MNI: Minimum Number of Individuals for each animal species, for the description of formulas in the tables look at Methodology part and the Economic Food Value Analysis part (Methodology part pages 91-96, EV analysis page 122-123 respectively)**

Sites Totals	**E.N. MNI Avg %**	**Food Value (FV)**	**EV**	**INPUT/ OUTPUT ratio MNI**	**INPUT/ OUTPUT ratio % MNI**	**L. N. Total**	**L.N. + Final N. MNI Avg %**	**Food Value (FV) =IG *M* MW**	**EV**	**INPUT/ OUTPUT ratio MNI**	**INPUT/ OUTPUT ratio % MNI**
MNI	**%**					**MNI**	**%**				
Gazelle =>63	**79,2**	4*5*21 kg	880,00	55440	**69696**	**175**	**70,59**	4*5*21 kg	880,00	154000	**62119,2**
108			20444	E.N. EV => 190548	**E.N. % EV => 136390**	269			20444	L.N. EV => 441624	**L.N % EV=> 134121**

Table 16. (a part of Tables 63-64, see Tables 63-64 in the Appendix C for the complete table) Gazelle and Total Economic Value (EV) calculations of EN and LN periods by using only single Percentage % frequency values, Average % percentages of each animal species found comparison**, E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, for the description of formulas in the tables look at Methodology part and the Economic Food Value Analysis part (Methodology part pages 91-96, EV analysis page 122-123 respectively)**

Ungulates	**E. N. Avg %**	**Food Value (FV)**	**Food Value (FV)**	**INPUT/OUTPUT ratio EV**	**L. N. + Final N. Avg %**	**Food Value (FV)**	**Food Value (FV)**	**INPUT/OUTPUT ratio EV**
	%				**%**			
Gazella gazella	**64,62**	4*5*21 kg	880	**56865,6**	**52,15**	4*5*21 kg	880	**45892**
Economic Food Value SUMS			20444	**EN % EV=>213766,6**			20444	**LN % EV=>149721,48**

First of all before looking to the piechart and frequency histogram graphs below **(from Figure 6 to Figure 23)**, they require some detailed explanations.

The legends of the frequency histograms and the percentage showing piecharts are showing the different tones of colours used in the graphs and piecharts. Colours labels of very much small frequency values compared to other big-middle range values are not so clearly inside the graph, they were presented and they seem so small in the printed graph histogram but they are clearly shown in the legend (from top to bottom) in the graph's label colour order of left to right.

Again for the piecharts also, colour labels of very much small frequency percentage values compared to other big-middle range percentage values are not so clearly shown inside the graph, they were presented and they seem so small in the printed graph histogram but they are clearly shown in the legend (from top to bottom) in the graph's label colour order of left to right.

The corresponding % percentage value showing piecharts and the corresponding total number (NISP or MNI) showing piecharts do not show/present/represent the same values or the same things for the same early/late period or the same animal species groups. The piechars and frequency histograms show /present different things different numbers and values to be comparable.

The frequency histograms show the frequency distribution and the total species by species or period by period economic value numbers (NISP EV, MNI EV and also in % values based EV) calculated and the total numbers of animals/different animal species in E.N and L.N. periods seperately in NISP, MNI and also in % methods frequencies showing in percentage.

The piecharts show both the presentation of the percentage values ratio of NISP, MNI and percentage animal values and the total species by species or period by period economic value percentages calculated (NISP EV, MNI EV and also in % values based % EV) ratio in the total economic value, also it shows the percentage values and percentage value based % ratio Economic values in the whole EV total comparison Early to Late Natufian (percentages initially given by the archaezoologist researcher but not the percentages calculated by using NISP,MNI total row number values).

In the very last frequency histogram chart **(Figure 23)** at the end of the analyses that shows the E.N. and L.N. Total Economic Value comparison in Percentage and in total numbers, it presents there is a difference between percentage EV values between and EN and LN. It shows total of LN period sites has a lower "percentage values based calculated total EV value" compared to % based total EV of total of EN period sites. This last results summarizing graph also shows and presents there is a total frequency number based total EV difference as in the LN, the total number based EV is around 1 and a half million but in the EN, the total number based EV is around 4 and a half million.

Actually by excluding "the total sum of EV total number based table sum value in the EN and LN periods", the most important thing to compare is the comparison of the "the EN and LN periods % based total EV values calculated", and the result is as shown in the very last frequency histogram summarizing figure "the % based total EV value" of LN calculated value is lower than "the same % based total EV values" of EN period calculated value.

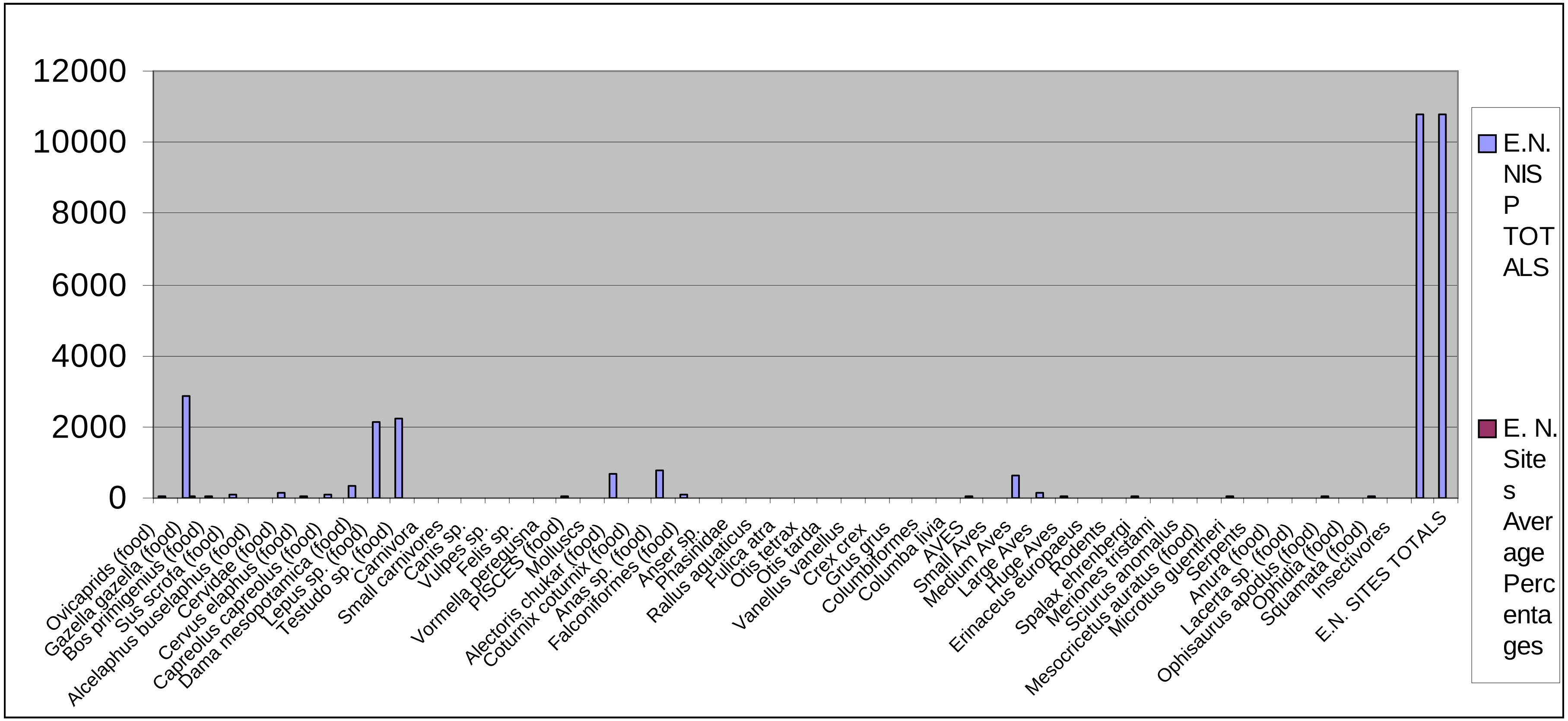

Figure 6. EN sites NISP animal species Total frequencies, E.N.:Early Natufian, L.N.:Late Natufian

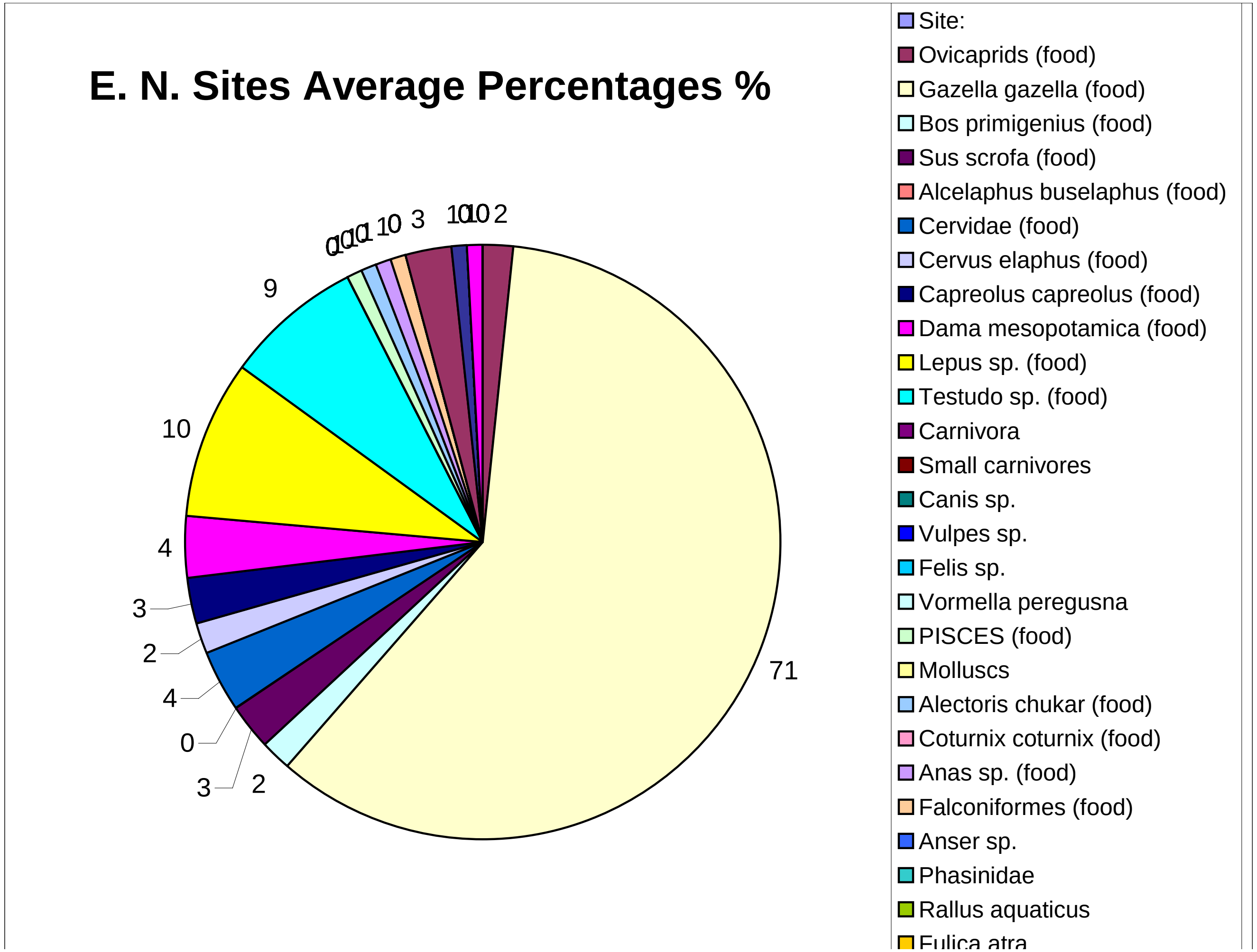

Figure 7. Pie chart showing EN sites animal species average percentages, E.N.:Early Natufian, L.N.:Late Natufian

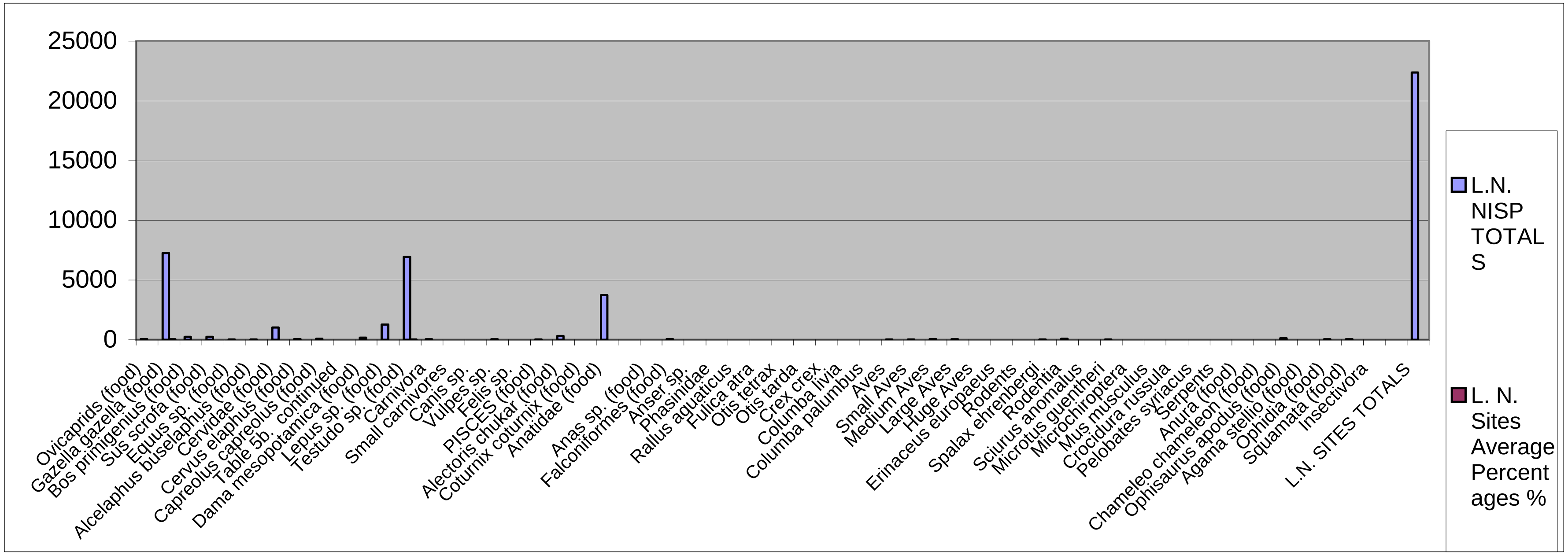

Figure 8. LN sites NISP animal species Total frequencies, E.N.:Early Natufian, L.N.:Late Natufian

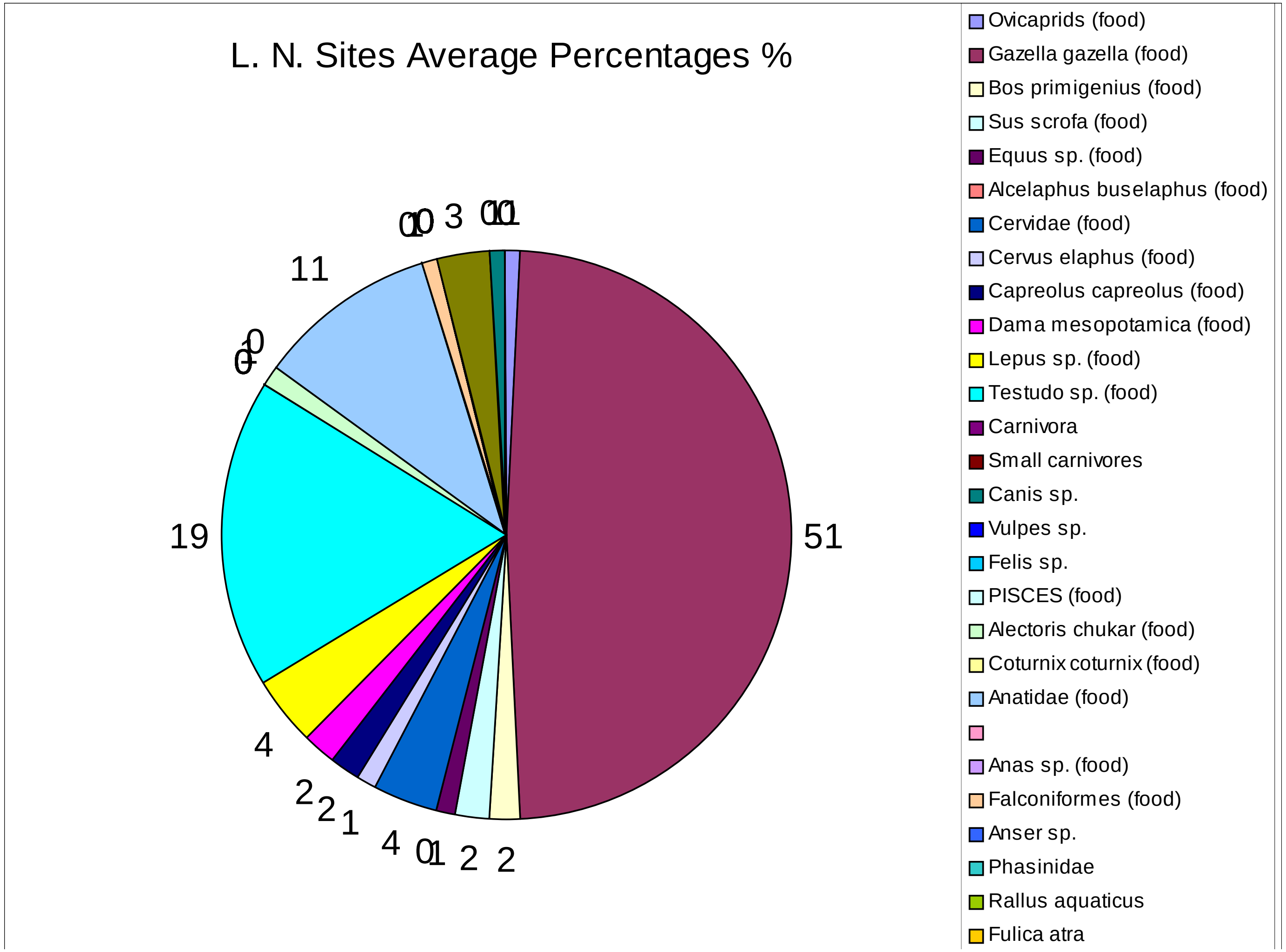

Figure 9. Pie chart showing LN sites animal species average percentages, E.N.:Early Natufian, L.N.:Late Natufian

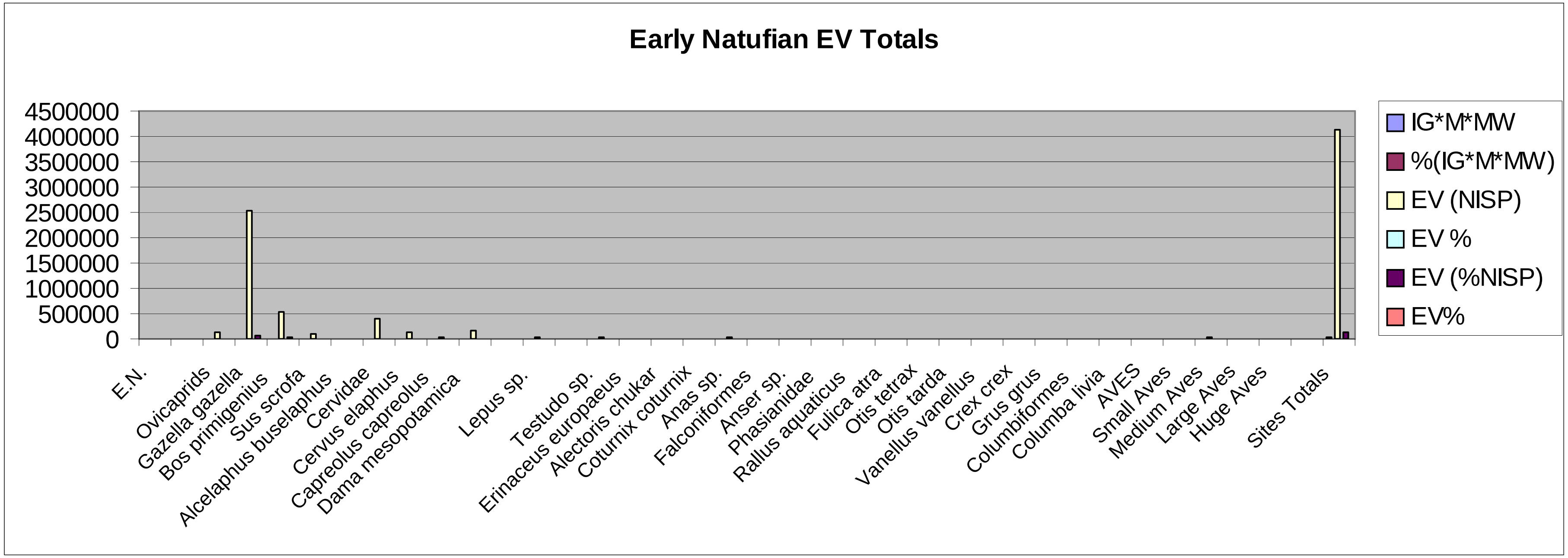

Figure 10. Early Natufian Economic Value (EV) Totals, E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value**, for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively)**

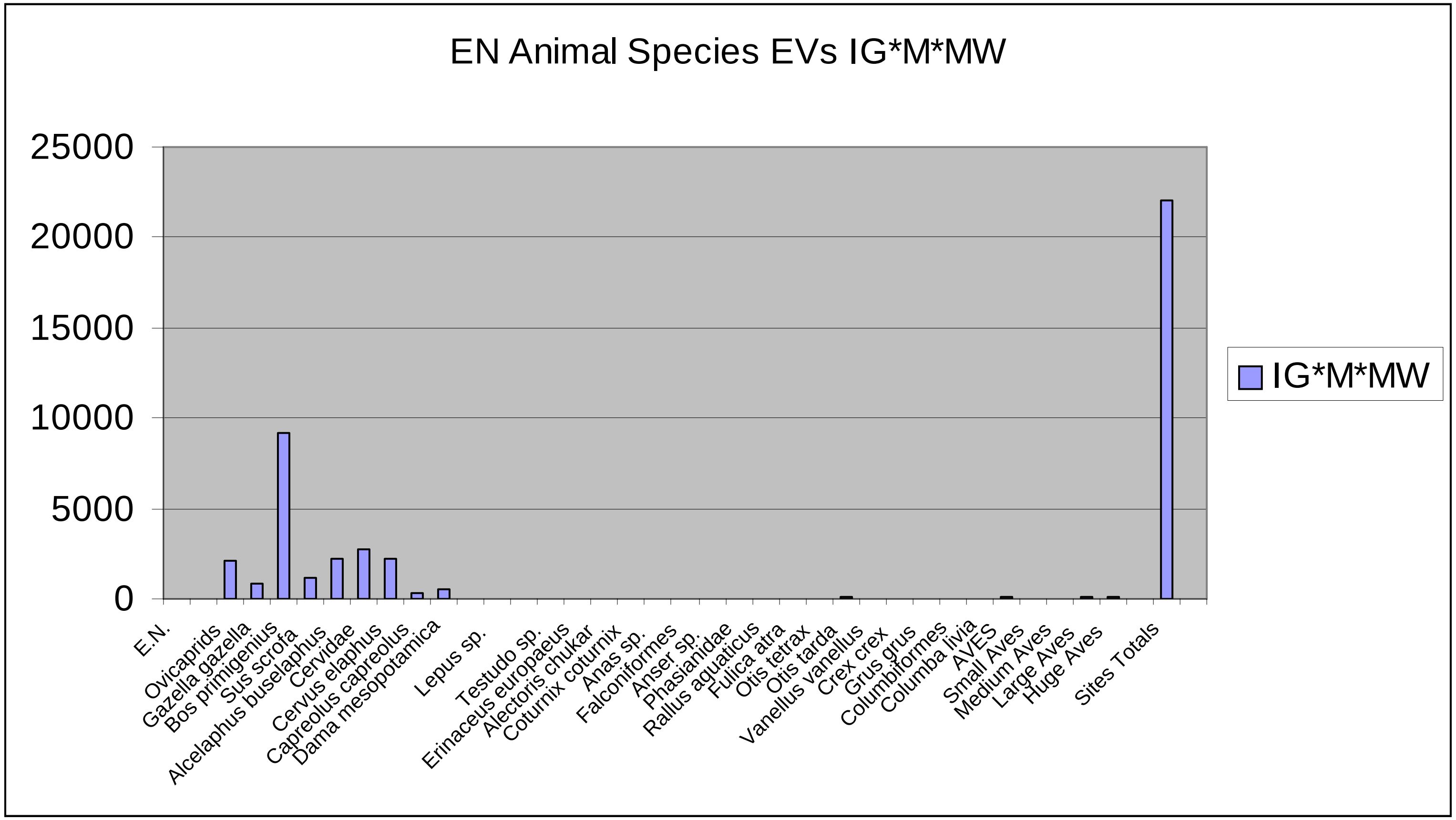

Figure 11. Total Food values (FV) (multiplied IG*M*MW parameter values) assigned for each animal species found in both EN and LN sites, E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

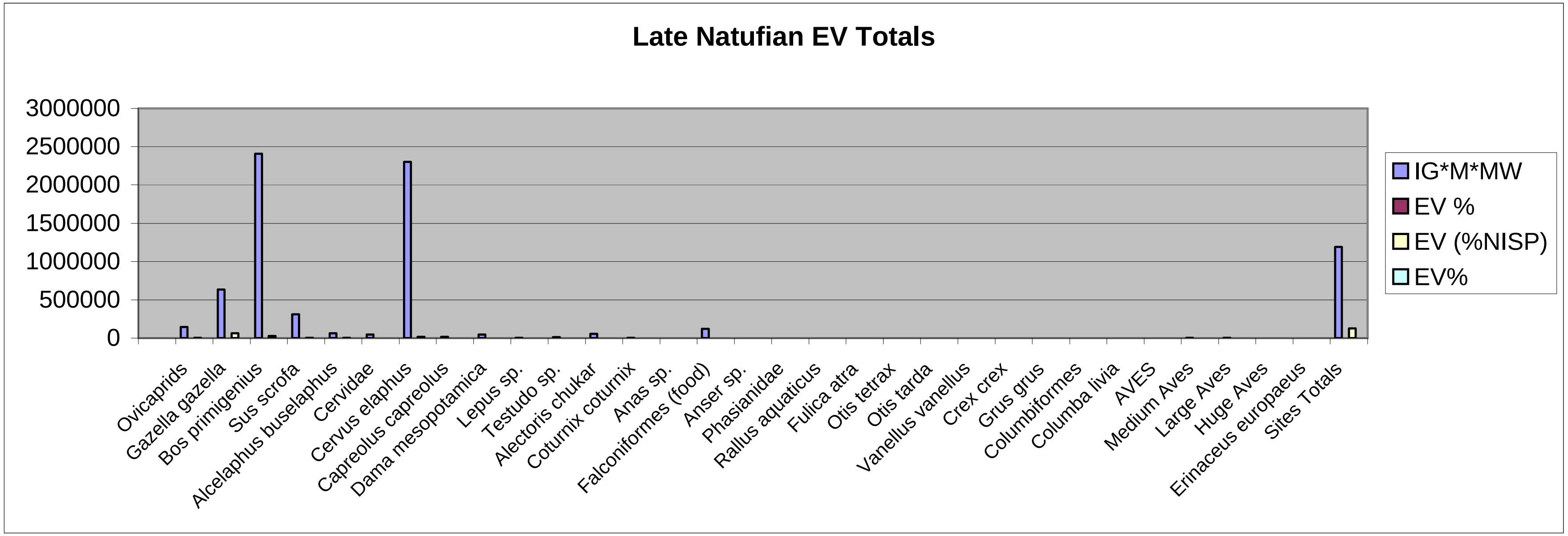

Figure 12. Late Natufian EV Totals, E.N.:Early Natufian, L.N.:Late Natufian, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

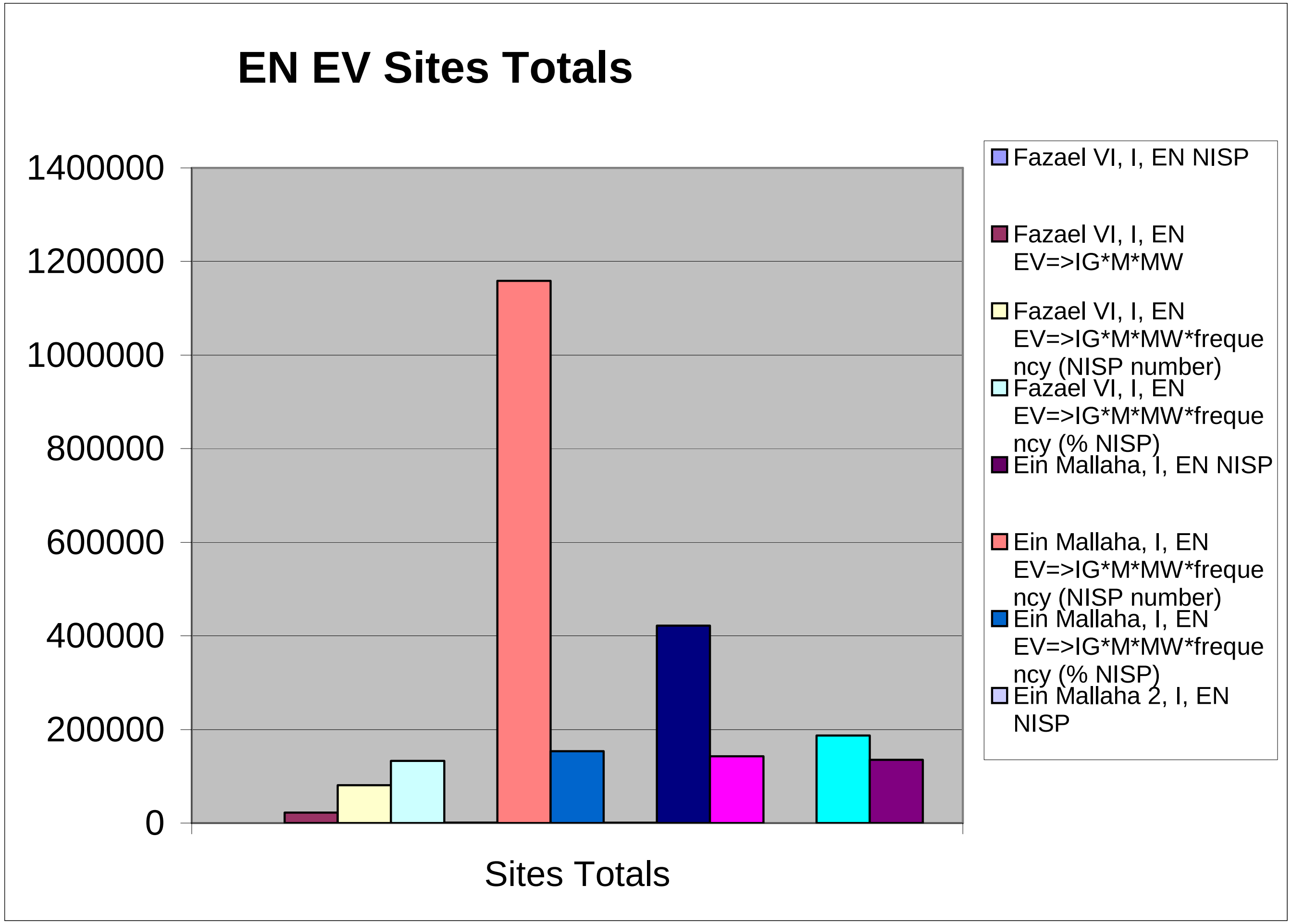

Figure 13. EN Sites EV frequencies Totals, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

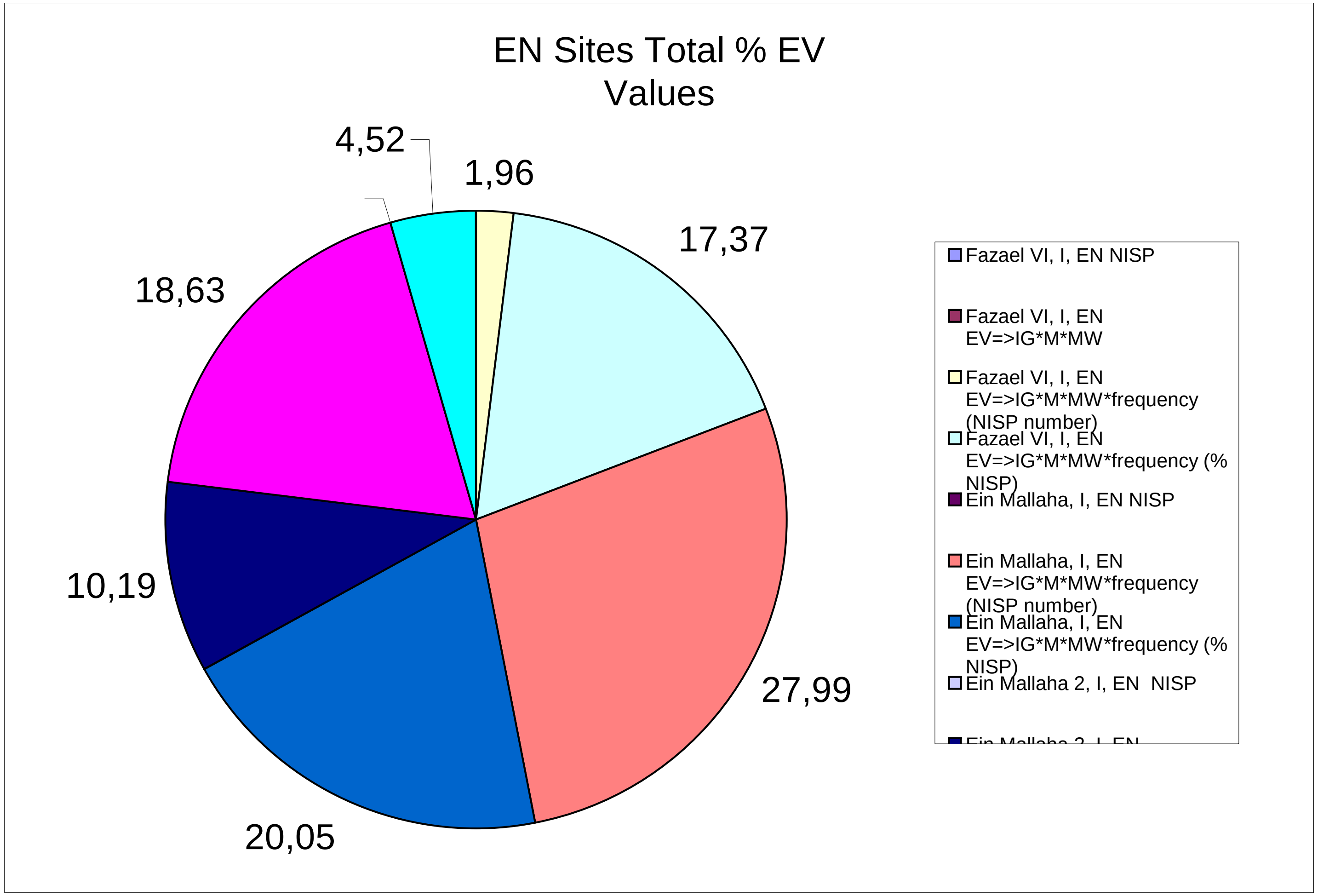

Figure 14. Pie chart showing EN Sites EV percentages, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value**, for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

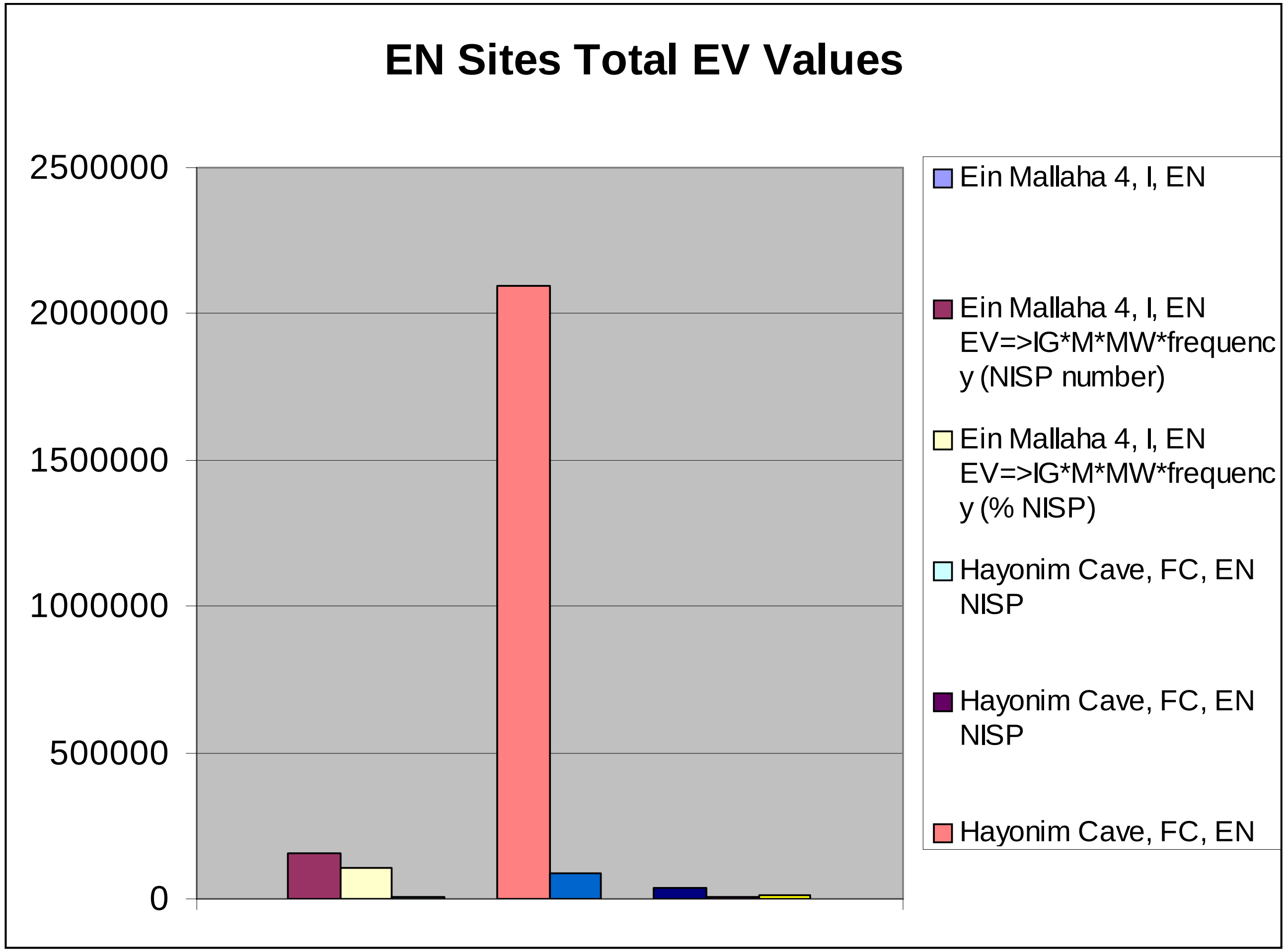

Figure 15. EN Sites EV frequencies Totals, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

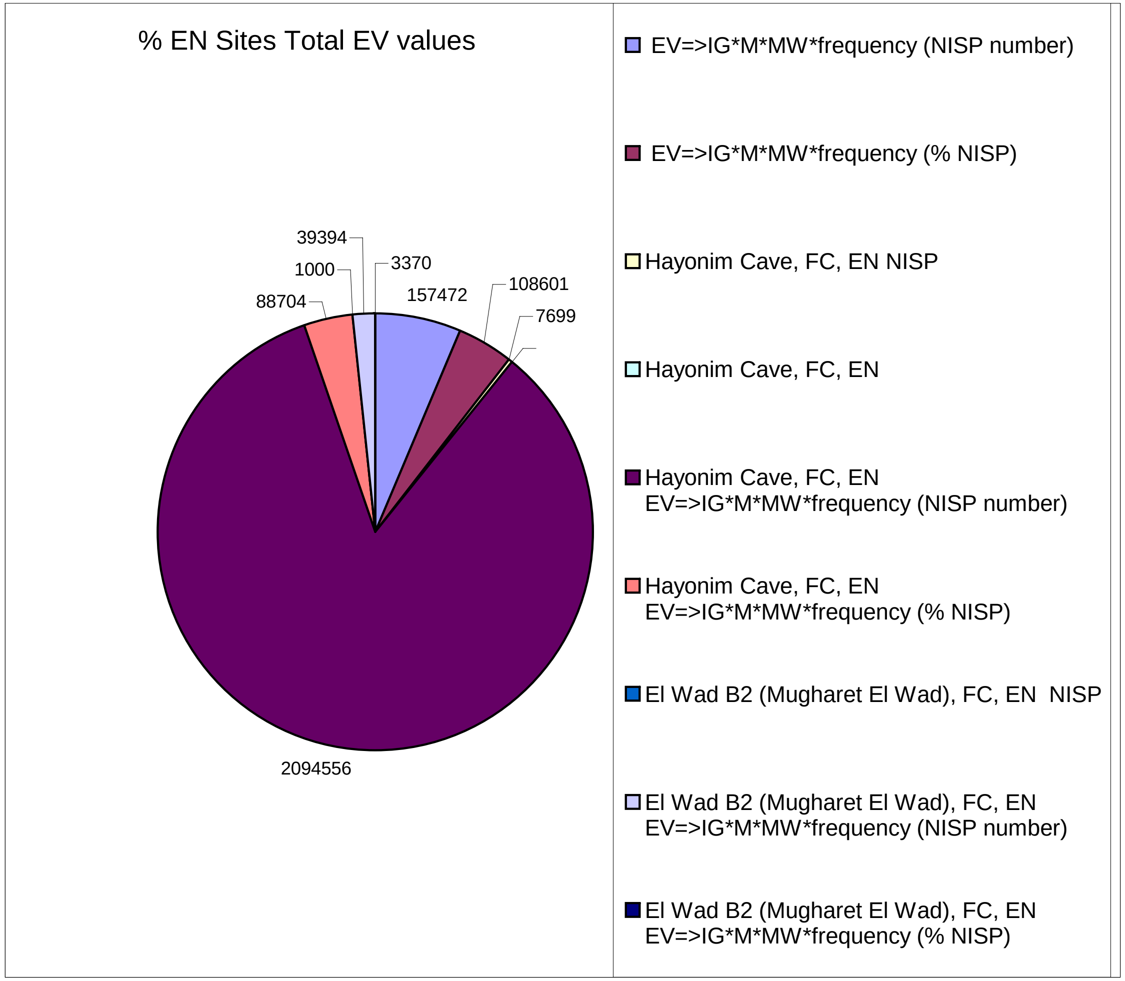

Figure 16. Pie chart showing EN Sites EV percentages, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

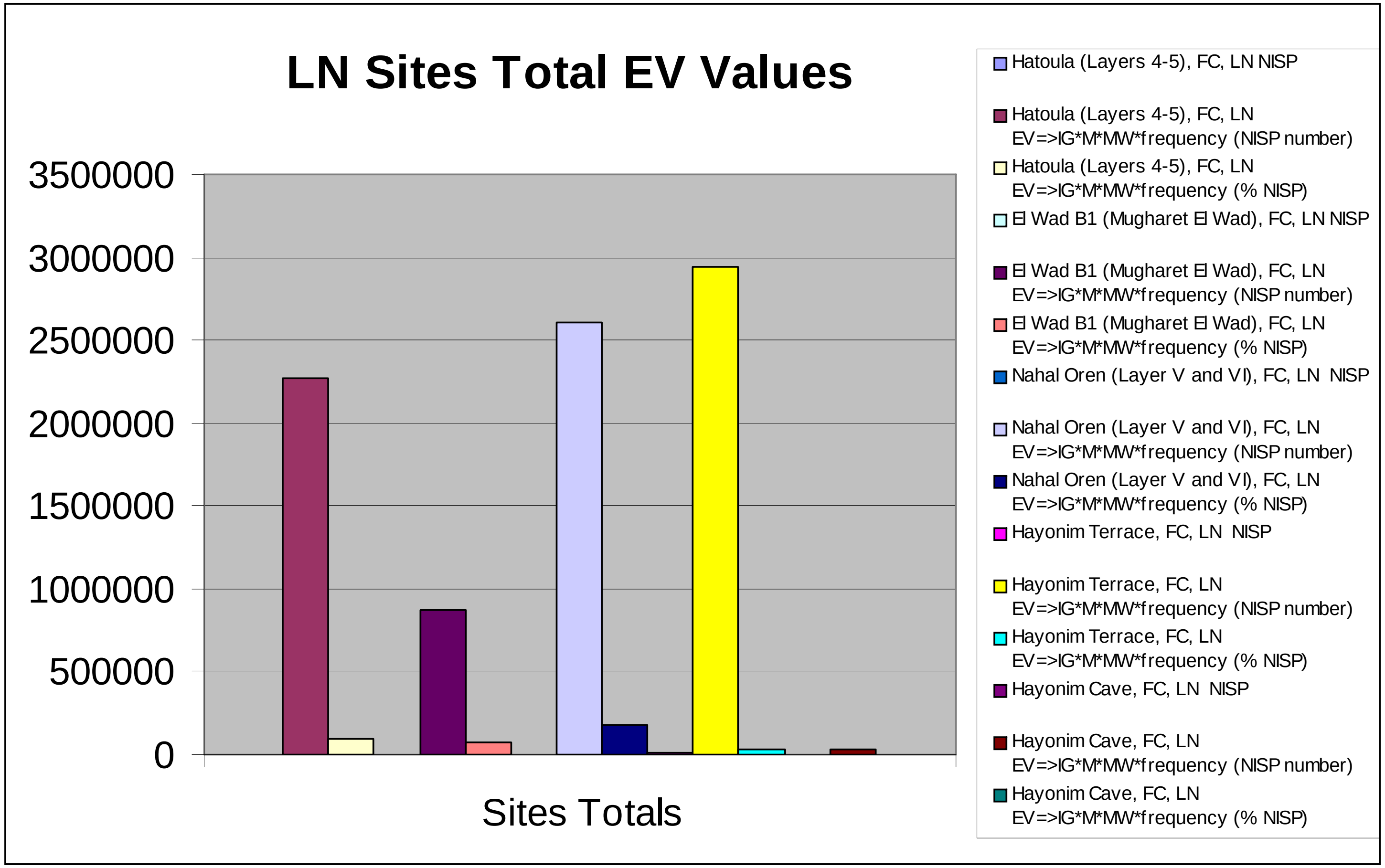

Figure 17. LN Sites EV frequencies Totals, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

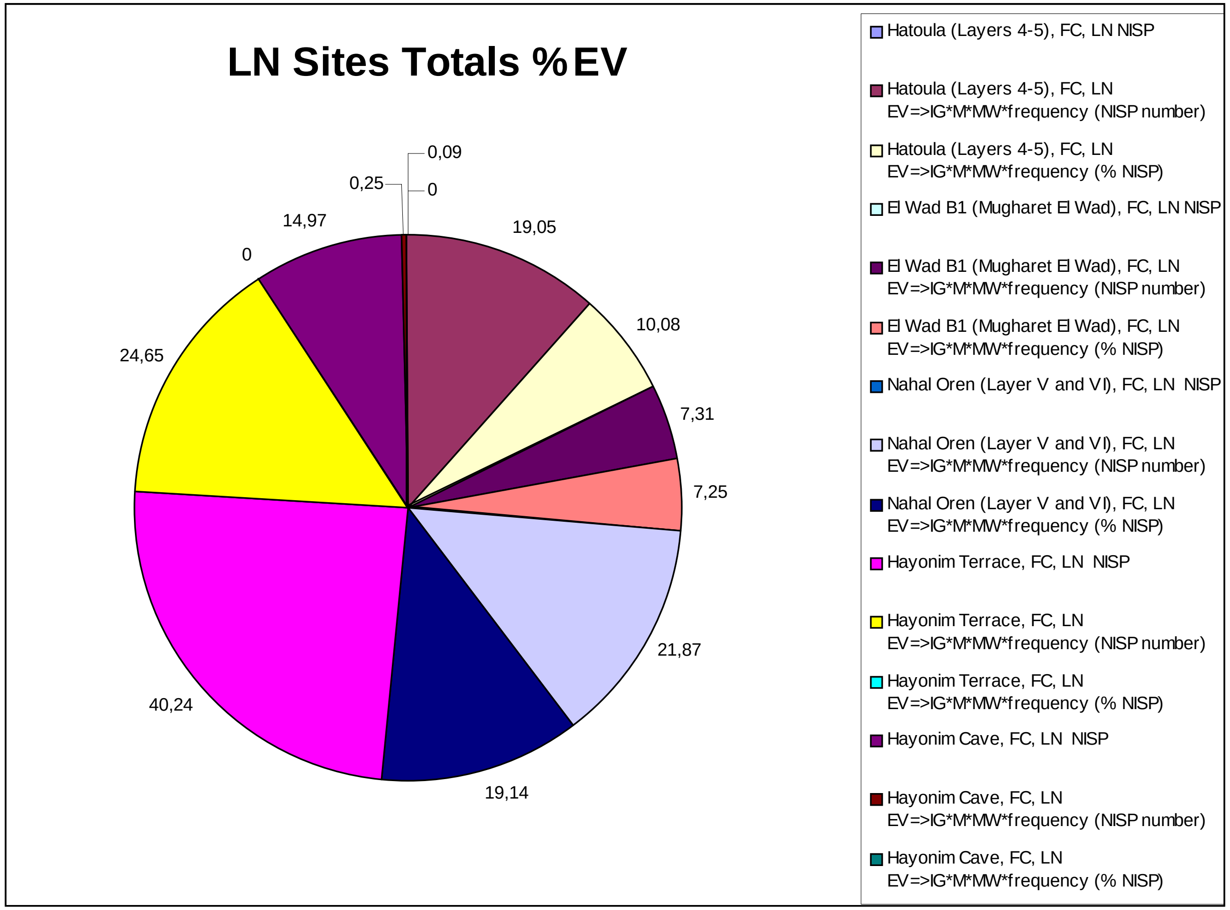

Figure 18. Pie chart showing LN Sites EV percentages, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

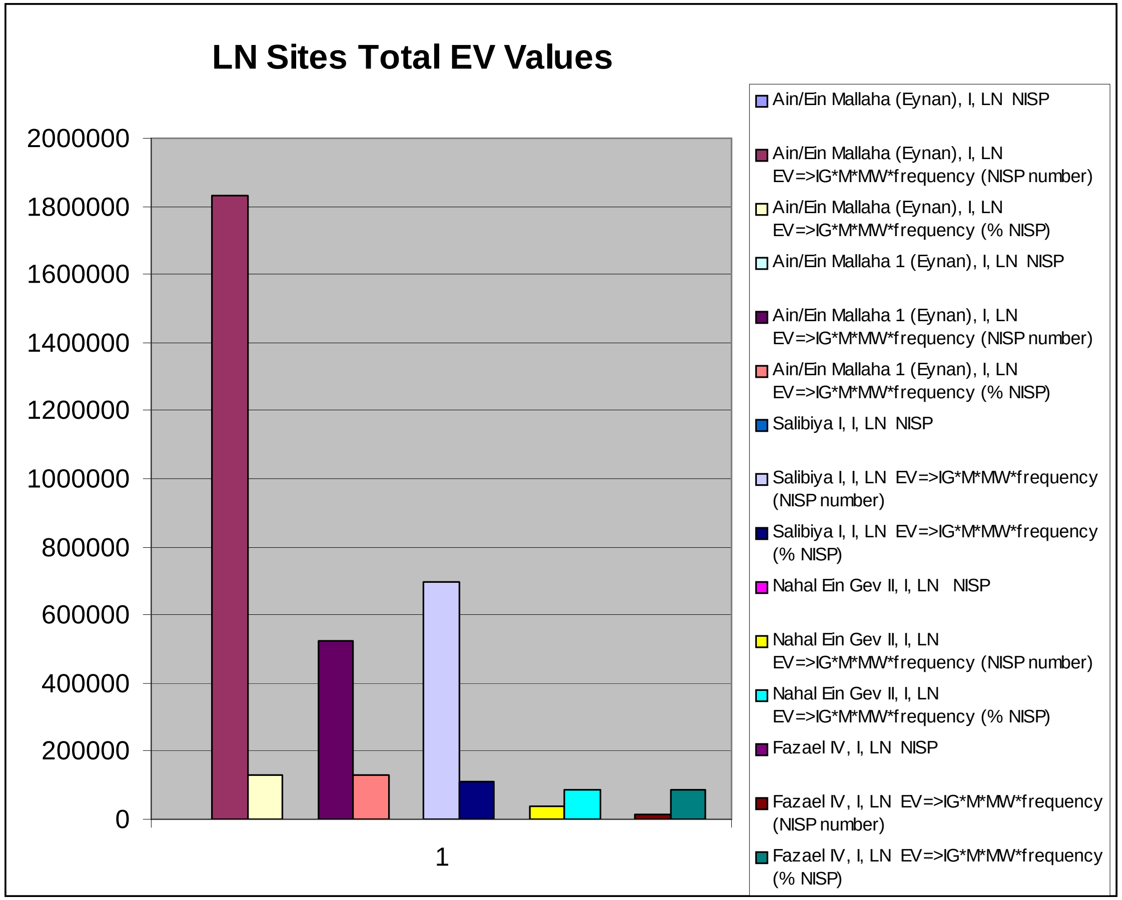

Figure 19. LN Sites EV frequencies Totals, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

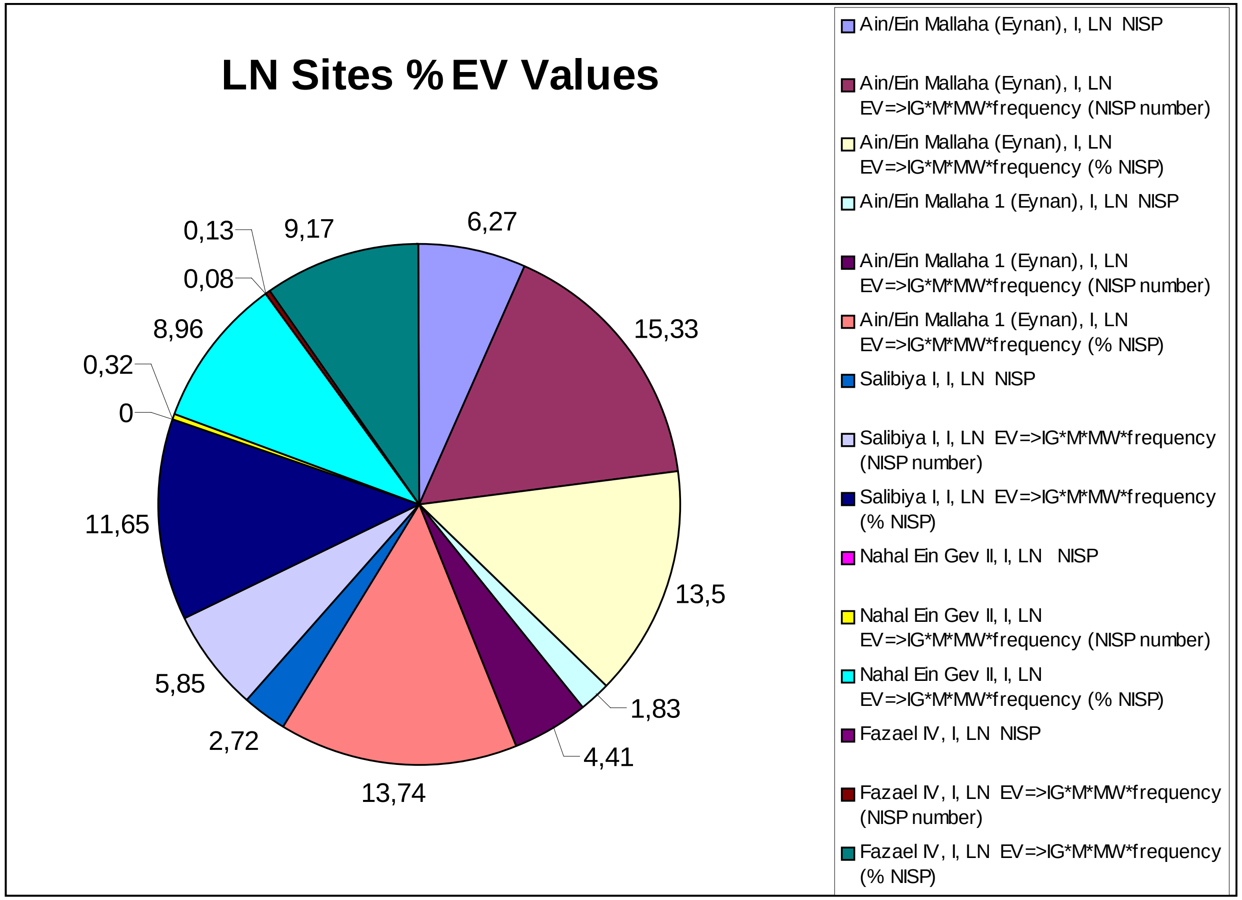

Figure 20. Pie chart showing LN Sites EV percentages**,** E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

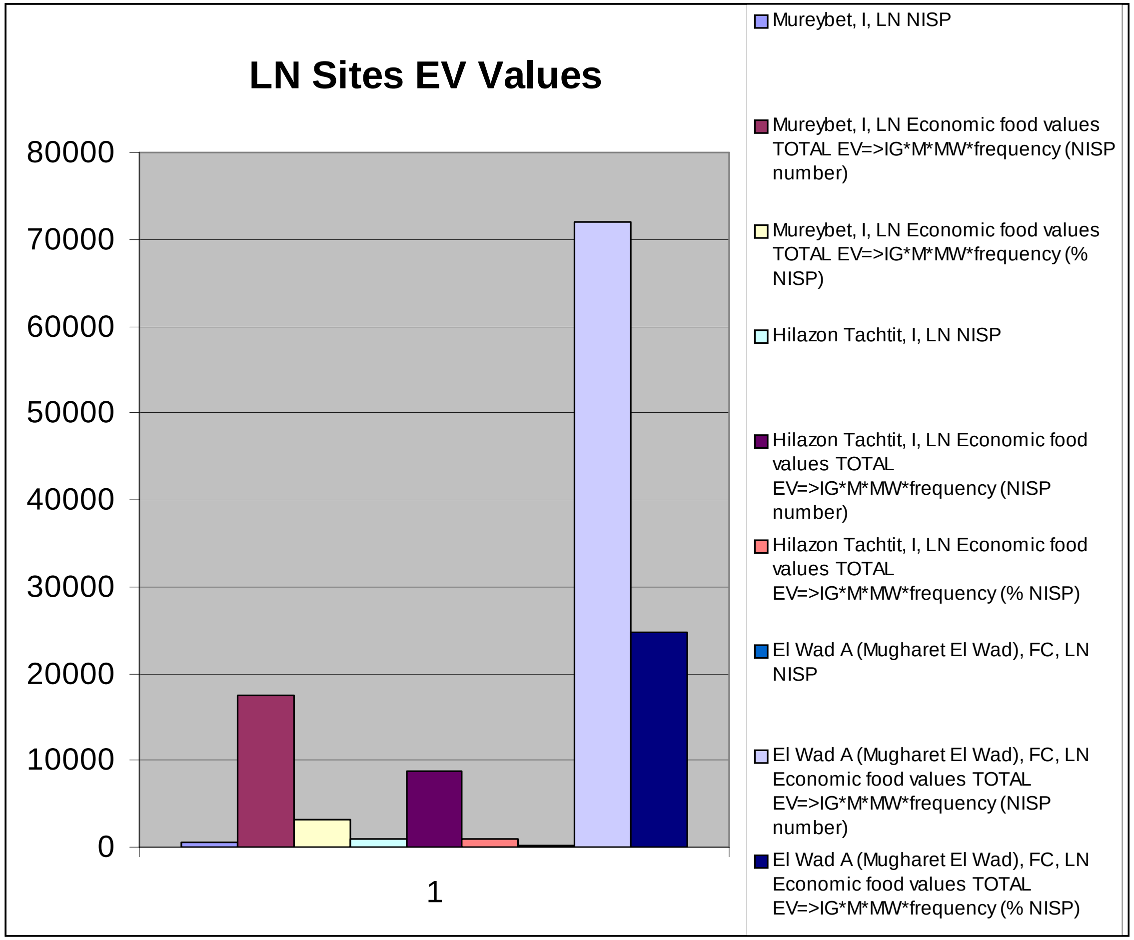

Figure 21. LN Sites EV frequencies Totals, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

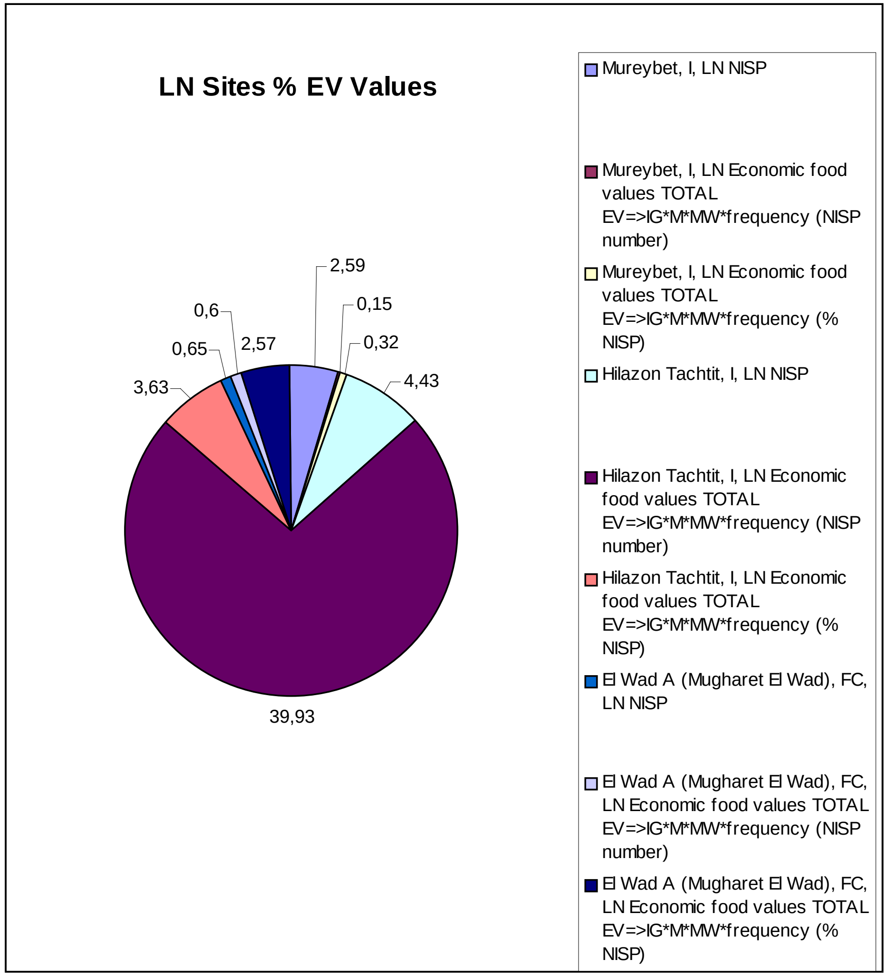

Figure 22. Pie chart showing LN Sites EV percentages, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

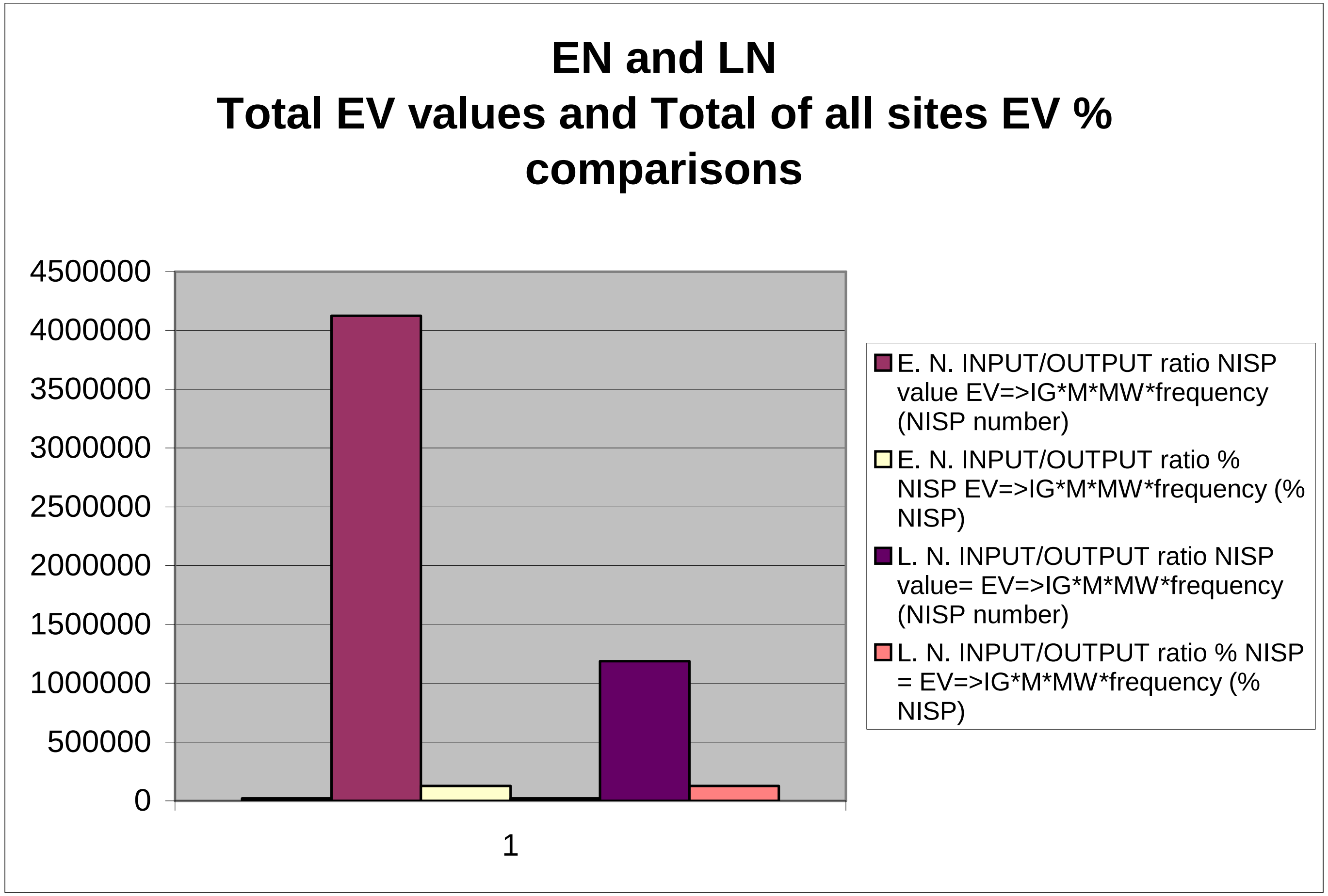

Figure 23. EN and LN Sites EV frequencies Totals Comparison, E.N.:Early Natufian, L.N.:Late Natufian, I: Inland, steppic and/or desertic site, FC: Forestal and Coastal site, EV:Economic Value, **for the description of formulas in the chart's legend look at Methodology part pages 91-96, EV analysis page 122-123 respectively**

If we look the NISP EV calculations above **(tables from 50 to 55 in the Appendix D part),** gazelle has the maximum NISP Economic Value (EV value) in the Early Natufian. As gazelle has the highest INPUT/OUTPUT ratio then cervidae, which had second high EV value in the EN and Bos primigenus and Sus scrofa follow respectively for the total of Early Natufian period sites.

In the Late Natufian again gazelle has a high value of NISP Economic Value (EV value), but gazelle frequency decreased in percentage in the Late Natufian, so Bos primigenus has the maximum EV value in the Late Natufian considering its high weight and Cervus elaphus has high NISP EV values.

Gazelle NISP EV value increases both in NISP EV number value and in NISP EV percentage value, but the species of Cervidae, Capra, Dama., Lepus, Anas, Testudo (turtle) decrease in NISP EV number value and they decrease in NISP EV percentage value in the Late Natufian compared to Early Natufian. Hayonim site has the maximum level of NISP EV value in total of all animals and Ein Mallaha is the second highest level NISP EV value for the Early Natufian.

Hilazon Tachtit has the maximum percentage EV NISP and Hatoula, Salibiya, Nahal Oren, Ein Mallaha have the second highest NISP EV number values and Hayonim terrace has the highest maximum NISP EV number value for all the sites of Late Natufian and Nahal Oren and Hatoula have high NISP EV values respectively but as percentage NISP EV value, Nahal Oren and Ain Mallaha have high NISP EV percentage values among the Late Natufian sites. Maximum NISP EV value and in percentage NISP EV inland site in Early Natufian is Ein Mallaha and the maximum NISP EV number and EV percentage coastal and forestal Early Natufian site is Hayonim Cave. In the Late Natufian sites, Hayonim terrace forest coastal site has the maximum EV value and the EV percentage, Ain Mallaha inland site has the maximum EV value and but Hilazon Tachtit has the maximum EV percentage.

Forest and coastal sites have more total EV values and EV percentages, compared to inland sites, in the Early Natufian; and again the Late Natufian forest and coastal sites have more total EV values and EV percentages compared to inland sites. In total, in the NISP EV percentages to be compare and in the EV values in the comparison of Early Natufian to Late Ntufian sites, EV number and EV percentage values, some sites in the Early Natufian have higher EV percentage and number values than the Late Natufian sites % EV and number EV values but still some Late Natufian have very low EV percentage and EV number value compared to other Early Natufian sites. From the both Early and Late Natufian periods, showing multilayered sites, in Ein Mallaha and Hayonim terrace and caves there can be clearly seen NISP EV percentage value and EV total number value decreases in the Late Natufian, compared to Early Natufian, but in the shift from El Wad B2 to El Wad B1 that is the shift from the Early period to Late Natufian period, there is an increase in the NISP EV percentage value and EV total number value in the Late Natufian compared to Early Natufian. In the MNI EV values and percentages **(tables 59, 60, 61 and 62 in the Appendix D part)** Hayonim terrace and Hayonim caves has the maximum MNI EV values and EV percentages among the Early and Late Natufian sites together and Hayonim Cave/Terrace has a decrease in MNI EV percentages and MNI EV values in the Late Natufian compared to Early Natufian. In MNI EV percentages gazelle has the maximum EV number value and Cervide and Bos has the secondly high EV values. Gazella increases in EV number value but decreases in the EV percentage value in the Late Natufian compared to Early Natuafian and cervidae species decreases and sus increases, Bos increases and Lepus decreases in the Late Natufian in terms of EV percentage comparison.

If we look at the total overall successes or failures of the continuity of economic subsistence mechanism regimes applied in the shift from Early to Late Natufian transition period of Younger Dryas climatic food crisis in the sites of both Early and Late Natufian; Fazael VI has a very low animal based Economic Food value (EV value) in the Early Natufian period andalso in Late Natufian peirod. Ein Mallaha and Hayonim Cave in the Early Natufian period layers, economic values are the highest and in the Hayonim Cave and Hayonim Terrace and in Ein Mallaha there is again the highest percentage of Economic Value of food animals in the LN. So we can conclude that in the Late Natufian the food subsistance techniques and survival mechanisms like primitive agriculture/domesitcation or kinds of storage methods were probably successfully used and continued in these both Early and Late Natufian period sites of Hayonim Cave and Terrace and Ain/Ein Mallaha. Hayonim Terrace has the highest EV value in the Late Natufian and then the highest EV is Nahal Oren layers V and VI, then the highest EV site is the Hatoula layers 4-5 in the Late Natufian. Mugharet El wad B2 is the lowest EV in the Early Natufian and El Wad layer B1 is also the lowest EV in the Late Natufian but El wad A becomes the highest EV in the Final Natufian subsistance, so we can conclude that in the Late/Final Natufian also in the El wad A, the food subsistance techniques and survival mechanisms like primitive agriculture/domesitcation or kinds of storage methods were probably successfully used and continued in also both Early and Late Natufian period sites of El Wad. Mureybit (Mureybet) and Hilazon Tachtic are the highest EV sites in the Late Natufian.

In the percentage (%) only based EV calculations **(tables 63, 64, 65 and 66 in the Appendix D part)** gazelle has the main highest frequency again in both Early and Late Natufian periods and Dama, Capreolus, Gazelle and Sus increase in percentage in the Late Natufian compared to Early Natufian. Capra, bos, cervus and lepus species decreases in the Late Natufian compared to Early Natufian. In the percentage value, EV sum’s comparison of the Early Natufian percentage based EV sum is greater than the Late Natufian percentage based EV sum. Ain al Saratan has the highest percentage EV value and then El Wad B2 and Beidha have the secondly highest frequency among the Early Natufian sites and among the Late Natufian sites of Nahal Oren, El Wad A (Final Natufian), Hayonim, have the highest EV percentage values and Shukbah B. Khallat Anaza sites have higher EV percentage values. In the percentage tables of the EV percentages shown, inland steppic or desertic sites of Early Natufian have more animal percentage total EV values than the forestall and coastal sites of Early Natufian but percentage EV values fluctuate again in the Late Natufian sites but in general in overall and in average the EV percentage values are higher in forestal and coastal sites, compared to inland and desertic or steppic sites of Late Natufian. But in total, the inland steppic or desertic Late Natufian sites has less animal percentage EV value compared to inland steppic or desertic Early Natufian sites and again for forestal and coastal Late Natufian sites has less animal percentage EV value compared to forestal and coastal Early Natufian sites.

CHAPTER 6

CONCLUSIONS

All these data and comparison of MNIs, NISPs, percentages and finally EV (Economic value) number and EV percentages/percentage average calculations and EV totals comparisons shows us that **(tables from 50 to 67 in the Appendix D part)**; there was a clearly seen shift/change in animal and plant amounts and ratios.

In some Late Natufian period sites animal ratios and amounts totally decreased in terms of some animals and in large mammals/ungulates and mainly gazelles (as the main meat supplies found in highest frequencies in every Natufian site). The percentage and number of animals increased in some sites, so there was a clear fluctuation in the animal and plant food resources during the Younger Dryas period of Late Natufian. As I think, as a result of my analysis, there is a possibility that some Late Natufian sites were better able to cope with food crisis/food shortage, more successfully than other Late Natufian sites during the Younger Dryas climatic event period.

So because of that I think mainly the animals, and also plants are decreasing though lesser, in some Later sites or increasing in some Later sites or generally fluctuating in terms of number, (in) frequency ratio or in terms of the range of variety of animal and plant species sites. We have evidence and we know that Younger Dryas thoroughly affected whole Levant area including all Early and Late Natufian occupation sites. So for the Late Natufian people their main diet changed. Their main food sources changed and their economy changed into another form in the direction of the process of change from animal hunting/plant gathering economy to animal domestication and plant cultivation/primitive agriculture as food production economy during the shift from Early to Late Natufian, by the impact of population increase pressure and by the strong impact of Younger Dryas paleoclimatic event in the Levant.

When we look at Economic food value comparison calculations summary table as seen on the **tables 54 and 55** and as also seen in percentage EV calculation comparison tables total as in **tables 63 and 64 (in the Appendix D part)** as Economic food value benefit totals' comparison tables between Early and Late Natufian economies, and which also can be seen from the sites and species, and finally Early and Late period sites NISP and EV totals comparison of **percentage pie charts and frequency histogram diagrams and graphs in figures from 6 to 23**; we can see that Early Natufian's total economic benefit number from the animal foods are bigger than the total economic benefit number of the Late Natufians. This means in the Late Natufian economy under the effect of Younger Dryas climatic change, the cost of the production/supply (cost of living for human and cost of food animals) (hunting & gathering) of the same food animal in the Late Natufian was higher than in the Early Natufian economy for the same food animals and so the economic benefit was higher in the Early Natufian compared to Early Natufian.

It should be added that each Early and Late Natufian sites' animal and plant reports are not always giving a constant pattern of an increase of total number of animals and plants in frequency and in percentage in the Early Natufian or a regular pattern of a decrease of total number of animals and plants in frequency and in percentage in the Late Natufian. So when we randomly select a site from Late Natufian to test mostly the animal decrease during the Late Natufian by selecting and comparing it to a later period site with another Early Natufian period site, we can sometimes see a shift but not always because the animal data tables shows us some inconsistency, which is constant for some animal species' percentage and frequency comparative and relatively decreases in some Late Natufian sites, compared to Early Natufian sites but we cannot always see the shift of animal decrease constantly or consistently.

So this seems to be caused by the analysis methodology but mostly caused from the irregularity and inequality of the amount of data for each early and late Natufian site. That means as I mentioned above, there are different number of species studied/counted by using different methods by different people, mostly in each different archaeozoological study of separate early and late Natufian sites. Because of that it became so much harder sometimes to make comparisons between the different types and different amounts of data of the different sites.

By interpreting all these Natufian animal and plant data, again I think that there is a possibility that some Late Natufian sites that has low fluctuating in high number of animals were better able to cope with food crisis/food shortage and more successfully than other Late Natufian sites; and the Late Natufian sites with highly fluctuating and less animal frequencies had less successful coping mechanisms during the Younger Dryas climatic period. So in order to prove this idea, again as an example of sites, Fazael VI has a very low animal based Economic Food value (EV value) in the Early Natufian period and also in Late Natufian peirod. Ein Mallaha and Hayonim Cave in the Early Natufian period layers, economic values are the highest and in the Hayonim Cave and Hayonim Terrace and in Ein Mallaha there is again the highest percentage of Economic Value of food animals in the LN. So we can conclude that in the Late Natufian the food subsistance techniques and survival mechanisms like primitive agriculture/domesitcation or kinds of storage methods were probably successfully used and continued in these both Early and Late Natufian period sites of Hayonim Cave and Terrace and Ain/Ein Mallaha. Hayonim Terrace has the highest EV value in the Late Natufian and then the highest EV is Nahal Oren layers V and VI, then the highest EV site is the Hatoula layers 4-5 in the Late Natufian. Mugharet El wad B2 is the lowest EV in the Early Natufian and Mureybit (Mureybet) and Hilazon Tachtic are the highest EV sites in the Late Natufian. But, El Wad layer B1 is also the lowest EV in the Late Natufian but El wad A becomes the highest EV in the Final Natufian subsistence.

So we can conclude that in the Late/Final Natufian Hayonim Cave and Hayonim Terrace and in Ein Mallaha, also in the site of Mugharet El Wad, somekind of food subsistance techniques and survival mechanisms were used. There might be a possibility that at that time of Late Natufians the primitive agriculture/domestication or kinds of storage methods were probably invented and/or taught from somewhere else and successfully used and continued in the Late Natufian period sites of Hayonim Cave and Hayonim Terrace and in Ein Mallaha and the site of Mugharet El Wad.

Many sources and research done about the Early and Late Natufian human remains and human bone anthropological studies also mention and support the climatic food stress evidence and climate change based social/economic pressure hypothesis by giving the evidence for social/economic stress for humans in the Late

Natufian differring from the Early Natufian times. The extended burials were in the Early Natufian but new skull removal and flexed/semi-flexed burials were in the Late Natufian, and there was a high population of children in the Late Natufian highly differing from Early Natufian societies and social-cultic-religious-social and physical burial habits. This can show that people are dying young in the Late Natufian. So, the burial practices and rituals/cultic-religious ceremonies highly changed in the Late Natufian. So my idea about Natufian human evidence is: the impossibilities to do arts and ceremonies/ornaments in the Late Natufian compared to Early Natufian can be caused by an economic problem, economic food stress, food shortage, they might have been thinking of finding/or producing food, economics and trying to find out some food subsistance mechanisms to survive in the time of Late Natufian, and these can show a sociocultural/economic stress in the Late Natufian compared to Early Natufian. Other research evidence of the Late Natufian human dental evidence shows that tooth sizes and dental disease patterns in the Late Natufians are intermediate shift-transition stage between the tooth of hunter-gatherers and agriculturalists and Late Natufian human dental evidence shows some changes/shifts were taking place in the dietary habits and food processing/producing techniques. Another evidence is present for social stress and food crisis in the Late Natufian human can be agenesis and underdevelopment, possible malnutrition in the Late Natufians' climatic crisis and food crisis times and a decrease in human growth/development and in the health of people living in the Late Natufian compared to Early Natufian as referred in the sources.

According to the Late Natufian sites human bones research evidence, the mandibular body length decreases for both Late Natufian males and females. Sizes (length) of humerus (humeri) and femora bones decreases, Late Natufian people are shorter than the Early Natufian people in average. Decrease in body length and bone sizes can be an indicator of underdevelopment, food stress and social crisis and social stress in the Late Natufian. When finding food is harder and health conditions decline the social stress will increase. Another evidence is there were highly possibly some disease like Malaria, Tuberculosis and Syphilis in the Late Natufian understood from the Late Natufian human bone analysis evidence. These can be also social/economic stress indicators. The researchers clearly indicate that late Natufian human skeletal remains indicate all type of stress conditions in general. Another thing was in the Late Natufian there was more endogamy used differing from Early Natufian (internal marriage, sexual relationship with the relatives) in the Late Natufian society. This can be a sociocultural change or might be another social stress indicator in the Late Natufian in order to reproduce and make more human (children) to give birth.

So finally and generally we can conclude that, by interpreting all these Natufian animal, plant and human data, evidence, analyses and comparisons, I think that generally a huge food crisis was highly possible and Late Natufian society highly possibly lived an economic (food supply) crisis and an highly connected-related social-cultural-political-religious-cultic crisis and related to this there might be a probability that Late Natufians naturally invented agricultural and/or animal domestication types of subsistence mechanisms to cope with the food crisis during the Younger Dryas in the Late Natufian times human societies ancient occupation sites in the Levantine region.

CHAPTER 7

LIMITATIONS AND FURTHER RESEARCH

At the beginning of the process of this research, I collected all these analyzed and published animal and plant reports and all the zooarchaeological and archaeobotanical data and interpretations about the early and late Natufian periods in the Levant, in many number of archaeological ancient occupation sites, related with the early and late Natufian periods sites separately. By looking only the animal and plant data of the Natufian culture, excluding economic interpretations, at first I found out that for all each early and late Natufian site there was no complete animal and plant remains' tables that includes all animal and plant species which was totally studied and published that I could find or reached. But there were many number of animal and plant reports partially analyzing the Natufian sites or some reports partially analying the animal and plant species. Some reports were analyzing only Natufian plants and some were analyzing only Natufian animals in only some important bigger base camp Natufian sites (or academically more famous Natufian sites). But some smaller less important (or academically less famous) Natufian sites' animals and plants were not analyzed and/or not published that I could not find out and reached them.

Some animal and plant reports that I found, despite the fact that they all give the complete animal or plant species list and the corresponding frequencies; they had some problems for my research aim. My main research aim was to find out and collect these animal and plant reports separately and/or to separate the frequencies of Early and Late Natufian sites' animals and plants, in order to separately individually analyze them and compare the change and the difference/fluctuation of the total amounts of animals and plants between the Early and Late Natufian periods. But in some animal and plant tables about Natufian sites, they were analyzing and taking the complete Natufian period as a whole, by not separating the frequencies of animals and plants in each early and late Natufian layers.

Some animal reports were researched and prepared twice or three, four times by different archaeozoologists and researchers. Some reports were giving different frequencies and calculations for the same site and for the same period of Natufian culture, for each same species. But this was probably caused by the animal bone counting of the data of different but very close chronological sub periods inside its main early or late Natufian level. Another explanation is that this may have been caused by making different calculations or different statistical processes and analysis in calculating frequencies, and/or using different counting techniques in the same site and in the same or closer periods, or calculating animals in different excavation or survey times of that site by different zooarchaeologist researchers. Probably they have been working on the same site in different seasons/times and taking animal remains' data each following season/year during the past excavations through this Natufian of the Levant area. This may have been caused by also taking and calculating, counting and including different species inside the same group or counting, analyzing and identifying body parts of the species differently by creating different numbers and frequencies.

I tried to solve this problem by sometimes summing up the animal reports results if they were continuously taken season after season in the same period, the same site and for each same species done by same or different researchers, if they were done with the same calculation and counting methods (NISP and MNI). If the animal results are again taken from the same site and the same period than I tried to take averages of the results again if they were done with the same calculation and counting methods (NISP and MNI). This was problematic for me to analyze and separate them and I excluded all these above mentioned type of incomplete (or useless for the aim of my research) animal and plant data in this research. So, to form the animal and plant tables for all calculated species, frequencies and calculations, summations in the tables, I used only the animal and plant data which were from many different references which shows the animal and plant frequencies of each Early and Late Natufian chronological layers and periods clearly mentioned separately (as separate archaeological cultural layers).

Most animal and plant analysis uses different type of calculation and counting methods for animals and plants. These methods used to represent numbers and frequencies of animals and plants found in each site are mainly NISP, MNI and the corresponding % (percentage) calculations, showing the ratio of that species to the total of all species found on that site.

The % percentage method of comparison of animal and plant species used between the sites of Early and Late periods and the comparison of forestal and coastal with inland, steppic or desertic sites were used. Each excavator or surveyor or archaebotanist or archaeozoologist of each site worked on an area of the whole site or she/he did partially of the whole site. So the animal bones and plant pieces and glumes counting are done for an area that cannot be comparably similar for all sites studied. So by using percentage values, this part of area worked for animal and plant remains by the researchers, it should be assumed that representing the whole site as randomly sampled statistically. So in order to make site by site and early and late periods comparisons equally, that means using the same denominator for all sites (This out of 100, %, percentage measure) to compare the numerators (found animal/plant frequency percentages on each site, on each period) between the sites and early/late periods. Percentage animal and plant values gives the ratio of species in the total number of all species found, so each animal and plant species' percentage values became comparable to represent the each whole sites and early/late periods equally.

So, the sites examined here have not been excavated to their full extend nor the specialists appear to have always studied the whole of the materials available. In order to make such studies comparable, we use percentage calculations and assume that the recovered and studied animal and plant remains represent the site as if they were a statistically random sample.

If I had the chance to gather total of each site's equally calculated NISP or MNI frequencies numbers of total animals and plants of whole region of that site or if I had the chance of creating my own data by physically collecting and counting animals and plants for all comparable sites, than I would be able to compare the frequencies of NISP's and MNI's real amount of total animal and plant species values to make early and late period, forestall-coastal and inland-steppic-desertic comparisons more significantly.

Also another important analysis and comparison limitation is that all each early and late Natufian sites' animal and plant reports are not always giving a constant pattern of increase of total number of animals and plants in frequency and in percentage, in the Early Natufian or decrease of total number of animals and plants in frequency and in percentage in the Late Natufian. So when we randomly select a site from Late Natufian to test mostly the animal decrease during the Late Natufian by selecting and comparing it to the compatible later period site, and with another early Natufian period site, we can sometimes see (the animal data tables shows us some inconsistency, which is constant a comparative or relatively some animal species' percentage and frequency decreases in some Late Natusian sites compared to Early Natufian sites. But we cannot always see the shift or the animal decrease constantly or consistently.

Nevertheless, this does not seem to represent a real irregularity in the Natufian economy. It appears rather that it is the result of different methodologies used by different researchers as well as the fact that recovery methods differ between the sites. This last has resulted in having an unequal number of species represented in different sites. Because of that it became so much harder sometimes to make comparisons between the different types and different amounts of "unequal" data of the different sites and different periods to compare.

There can be a further wide socio-cultural agricultural origins research that could be done about this economic and social labor organization for the origination of agriculture or systematic cultivation and domestication. This also requires a social cultural political or a system of labor or some mechanism of governance/government for organizing people at that time, which would have been necessarily developed. Such as the feasting hypothesis or a feeding organization where some societies/some group of people who would feed others or they would sold readily produced and processed food to others or they could sold their agricultural methods to others in terms of an economic exchange meta or they could have taught agricultural methods to others. The technological change probably came by diffusion or the agricultural methods developed separately on each area for human cultures of each separate geographical area.

The way for the formation of the initiation of social, economic, religious, cultural, ethnic and political human groups inside the ancient cultures, probably also as the origination and spread of economic and social class or social-socioeconomic power, and the formation of political or religious or socio-cultural-economic organization holding power in some groups of people and the formation of socioeconomic-religious-cultural or ethnic-political based/rooted class societies probably comes from the agricultural origins and the first agricultural organizations (feasting theory of agricultural origins and example of the known change/shift in the burial practices might be results of probable animal domesticating and plant cultivating in Late Natufian culture, differing from Early Natufian culture).

Other starter agricultural cultures may have probably continued to agricultural economy, social diffusion and its social impacts and which probably gave way to the systematic agricultural and animal domestication origins, and may have shaped the agricultural economy (food production) based socio-cultural life style after Late and Final Natufian cultures. After the Final Natufians periods ended, the Harifian culture continued in the Sina peninsula (near Egypt, Alexandria, Cairo) region and during the agricultural and domestication based economies and probably continued to develop widely and deeply in some primitive agricultural/domestication societies of PPNA and PPNB cultures of such as Hallançemi, Göbeklitepe, and Çayönü sites of the Southeastern Anatolia in Turkey and these areas and surrounding ancient sites should be further researched for the social-economic-cultic-religious-political structures of first PPN's agriculturalist and animal domesticating societies.

As a further research that may fill the academic gaps about the field of Natufians; if more Late Natufian sites were surveyed, excavated and analyzed; the more animal and plant remains based food data, the Natufian economic data and also socio-cultural and religious-cultic data and interpretations from the burials and human skeletons will be gathered. This agricultural and pre-domestication-originitation processes and the subsistance mechanisms of the Natufian culture (mostly the Late Natufian) will probably be more clearly understood; and the transformation/shift from the Early period to Late period of Natufians will be more significantly comparable in terms of socio-cultural and economic aspects. Furthermore, in the future, for more significant and clearer answers for this research question of this study; if the animal and plant data could be equally collected in terms of collection area, animal/plant counting methods would follow similar systems, and the number, type and variety of animal and plant species could be measured, counted and analyzed from all the sites of the same and different periods, then the impacts of abrupt Younger Dryas, the food crisis, the hard stressful conditions over the Late Natufians again will be more clearly understood. Early period and Late period of Natufians will be more significantly comparable in terms of food economy aspects.

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APPENDICES

APPENDIX A: LIST AND SHORT DESCRIPTIONS OF ALL EARLY AND LATE NATUFIAN SITES AND LAYERS

Alphabetical and numbered list of the names and properties of all known Early and Late Natufian culture occupation sites and including the other earlier period (pre-Natufian, Kebaran, etc...) or later period (post-Natufian, Harifian, early PPNA, PPNA, etc...) sites that also have archaeological layer(s) corresponding to or related with the whole Natufian cultural periods: (Moore, Hillman and Legge 2000, Pomerantz 1979, Bar Yosef and Valla (eds) 1991, the article: Natufian sites in Lebanon, Schroeder, B. Natufian sites in Central Beqaa Valley. In: Bar Yosef and Valla (eds), 1991, Egan and Bikai, 1998)

1-Abu Hureyra (may be the earliest, first farming), Northern Levant, central NW Syria, near east of Aleppo, western Mesopotamia, south of Euphrates river, near lake Assad, near to Antakya/ Hatay province /Turkey border, Early Natufian, 11500-9500 B.C., inland, finds on the site were the skeletal remains of about 162 individuals

2-Abu Usba, Cave in Mt. Carmel range, south of wadi Fallah, Both, Late Natufian/Early Natufian coastal, cave

3-Ain Chaub, Lebanon, Late Natufian, Early Kebaran, coastal ?

4-Ain Ghazal (Azraq), NE Jordan, near Amma, Late Natufian, inland, 15 hectares

5-Ain Mallaha (Eynan) (Ein Mallaha), In Israel, on the Hills of Naphtali, Hula Basin (Natufian heartland), Early Natufian, inland, Big settlement, base camp, around 2,000 square meters

6-Amiq II, Lebanon, Both, Late Natufian/Early Natufian, coastal, ?

7-Antelias Cave, 13 km from Beirut ?, coastal, cave

8-Azraq 18, 31, (Ain Ghazal (Ein Ghazal)) (may be first goat/sheep domestication), Eastern Jordan (Trans-Jordan), Late Natufian, inland

9-Basta(m), Near as-Sadaqa, 25km south of Petra, Late Natufian, PPNB, inland ?

10-Bawwab al Ghazal, Azraq basin region, Jordan, Late Natufian, early PPNB

11-Beidha, Next to Siq al-Barid, outside of north Petra, southern Jordan (Trans-Jordan) Late Natufian, early Neolithic, around 8000 B.C. inland ?

12-Beisamun, Western margins of Hula basin, south of Qiryat Shemana, moderate mediterrenean climate, Late Natufian, PPNA/B inland 40m/40m2

13-Borj el/al Barajne, West of Beirut, Lebanon, ?, coastal ?

14-Buqras, ?, ?, ?, ?

15-Dederiyeh, cave

16-Dibsi Faraj East (may be the earliest, first farming), In Ar-Raqqah, northern Syria, Early Natufian, inland

17-Ein Gev, Israel

18-Ein Shakri, South of wadi Khareitoun, Both, Late Natufian/Early Natufian, inland

19-El Wad (B1), In mount Carmel, site in Israel coastal, near Nahal Oren, Both, Late Natufian/Early Natufian coastal cave"

20-El Wad (B2), South of wadi Mughara, 5km SE of Atlit, Early Natufian, coastal, cave

21-El-Khiam 15,16,17,18 South of Ein Shakri, west of wadi Khareitoun, Both (?), Late Natufian/Early Natufian (?), inland ?

22-Erq el Ahmar, East of wadi Khareitoun, Jordan Valley, Israel Both, Late Natufian/Early Natufian inland ?

23-Fazael IV, North of town of Jericho, Late Natufian, final Natufian site, inland ?

24-Haela Cave (Hula Cave(?)), On the Northern slope of Nahal Bezet (Western Galilee), Early Natufian

25-Hatoula, Near Latroun, Israel, in Central Beqaa Valley, Late Natufian, Khamian, PPNA site inland ?

26-Hayonim Cave, Hayonim terrace (climate effect), Mediterrenean coast of Israel, Both, Late Natufian/Early Natufian, Semi- coastal/semi-inland

27-Hayonim Terrace, In Western Gallilee, 13 km east of Acco, Israel Early Natufian semi-inland/semi-coastal, cave

28-Hilazon Tachtit Cave, Early Natufian, cave

29-Iraq el Baroud, Mediterranean coast of Israel, north of Nahal Oren and Abu Usba, Both, Late Natufian/Early Natufian, coastal

30-Iraq el Hamra

31-Jebal Saaide (Saaide I, II), Baalbek Hermel, central Beqaa valley, Lebanon, Late Natufian (9th mill. B.C. or later settlements), coastal, 0.25 ha (hectar)

32-Jericho, in north of modern town of Jericho, in Jordan valley, Early Natufian inland, big settlement, base camp, The oval tell has between 8 and 12 meters of occupation fill, and it covers an area of about 2.5 hectares.

33-Jiita II, III (East), Lebanon, Both (?), Late Natufian/Early Natufian, Late Natufian (?), coastal, ?

34-Jilat 13,25, In Wadi al jilat at central Jordan, Early Natufian, inland ?

35-Karain Cave in Turkey, in the province boundries of the modern city of Antalya, Early Natufian layer, cave

36-Kebara Cave, Kebara region, Early Natufian, coastal cave

37-Khirbat el Khan, Late Natufian

38-Khirbat el Mite

39-Mt. Carmel occupation sites, west of Gallilee and Judea, Coastal mountain range, in northern Israel, towards coasts to southeast, west of Gallilee and Judea, ?, coastal

40-Tell Aswad, 30 km SE of Damas, east of village of Jdeidet el Khass,
30 km east by southeast of Damas, Late Natufian/PPNA 250m*250m=62500m2

41-Mugharet el Wad (B2) (El wad (B2)), In Syria, South of wadi Mughara, 5km SE of the town Atlit (Natufian heartland), Early Natufian, inland Mugharet El-Wad means 'cave of the valley.' It is the largest cave found on Mt. Carmel

42-Munhatta, West of Jordan valley, inland ?

43-Mureybit 1A (may be the earliest, first farming), Middle Euphrates part, northern Syria, near to Antakya/ Hatay province /Turkey border, Early Natufian, inland

44-Nachcharini Cave, Northern anti-Lebanon mountains, Late Natufian, coastal, cave

45-Nahal Bezet, Western Galliee in Israel

46-Nahal Oren 5,6 (Wadi Fallah), 10 km south of Haifa, Israel, wadi Fallah, Both, Late Natufian/Early Natufian, coastal

47-Netiv Haghdut, Jordan, inland

48-Öküzini Cave, in Turkey, in Antalya, Early Natufian layer, cave

49-P508, NE of Beer Sheva, Late Natufian, inland ?

50-Pella (Tabaqat Fahl), In Jordan, 78 miles north of Amman, in Central Beqaa Valley Late Natufian/Early Neolithic, inland ?

51-Poleg 18M, Coastal strip, north of Nahal Poles, Late Natufian coastal ?

52-Rakefet Cave, Eastern slopes of Carmel range, Jezrell valley, Both, Late Natufian/Early Natufian coastal, cave

53-Ras Shamra VC, in Syria, Near Latakia (Laskiya/Laskiye in Turkish), close to the city of Antakya, Samandağ/Yayladağ district region, in the mediterranean coast of north western Syria, ancient port city, Late Natufian coastal, ?

54-Rosh Horesha (G7), in west central Negev, Har mountains, Harif area, 24 km west-southwest of town Mitzpe-Rimon, Israel, Late Natufian, inland

55-Rosh Zin (interior and exterior), In Nahal, 5 km south of Kibbutz, 1,5 km north to Avdat, Israel, Late Natufian, inland, the Negev highlands settlements are similar to those within the core area, but Rosh Zin is smaller, only becoming larger in later phases, at Rosh Zin between five and six oval structures, measuring between 2.5-3m diameter were semi-subterranean with a drystone lining

56-Rujm as Suwwan, Late Natufian

57-Salibiya I, Lower Jordan valley, in Central Beqaa Valley, Both (?), Late Natufian/Early Natufian (?), Early Natufian (around 12300-10800 B.C.), inland ?

58-Sha'ar Ephraim South, Late Natufian/Final Natufian, coastal

59-Shukbah Cave, East of Iod, Israel,above the Wadi-en-Natuf,Late Natufian,inland

60-Skhul Cave, In Israel, in the slopes of Mt. Carmel in Nahal Meant canyon, very near to ancient site Tabun, Early Natufian, Neandarthal site, very early site, around 80.000-100.000 B.C. inland cave

61-Tabaqa, Early Natufian

62-Tor Abu Sif, SouthofUmm ezZuwetina,on the wadi Abu-Sif,Late Natufian,inland

63-Tor at-Tariq/WHS 1065, In Israel, Early Natufian

64-Umm ez Zuwetina (Uum Zoueitina), SW of Ein Shakri, Early Natufian ?

65-Umm Qalaa, Inland of Israel, near Dead sea, near Ein Shakri and Erq el Ahmar, Both, Late Natufian/Early Natufian, inland

66-Upper Besor 6, Early Natufian

67-Wadi abu el Loz

68-Wadi al Aijb 18, 24, Late Natufian

69-Wadi Arawa, Petra area, Jordan

70-Wadi az Zarga, Late Natufian

71-Wadi Hammeh 27, In Jordan, small tell where Zarga river opens to Jordan valley (Natufian heartland) Late Natufian, inland, Big settlement, base camp

72-Wadi Hisban 6, NE of Dead Sea in Jordan (Pella Region excavations, Jordan)

73-Wadi Judayid, Israel, near Beidha, near dead sea (Trans-Jordan),

Late Natufian, PPNA inland ?

74-Wadi Mataha 2, Petra area, Jordan

75-Yabrud III (Jabrud III), Israel, inland

76-Yutil al-Hasa/WHS 784, In Jordan, Early Natufian

APPENDIX B: NUMBERED REFERENCES OF ALL ANIMAL AND PLANT TABLES RESPECTIVELY

(Tables are in the Appendix C in the order of NISP, MNI and then single % percentage frequency tables)

References for the tables 17, 18, 19, 23:

*Ref 1: -Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry et al., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

-Davis 1982:5-15

*Ref 2: -Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry et al., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

-Cope 1992, and personal communication of Tchernov with Cope, gazella gazella (by counting of total skeletal elements found), Bouchud 1987, Davis 1985 cited in Tchernov 1993:218-233

-Bouchud 1987:14-17, some other animals

*Ref 3: -Munro 2003:47, some other animals

-Davis 1982:5-15, ungulates

-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17, ungulates

*Ref 4: -Munro 2003:47, some other animals

-Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38, Mammalia (Mammals - number of body parts) (by counting of total skeletal elements found)

-Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38, some species of Amphibians, Reptiles and Birds found (number of body parts) (by counting of total skeletal elements found)

*Ref 5: -Bouchud 1987:14-17, ungulates calculated in 1955-56 and 1959-61 seasons

-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17, ungulates

-Bouchud 1987:14-17, ungulates calculated in 1971-76 seasons

*Ref 6: Same as ***Ref 5**

*Ref 7: Same as ***Ref 5**

*Ref 8:-Munro 2003:47, some other animals

-Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233)

-Horwitz and Tchernov, unpublished data, Crabtree et al in press, Davis 1986, Bouchud 1987 cited in Tchernov 1993:218-233, micromammal species (small mammals)

-Davis 1982:5-15, ungulates

-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14017, ungulates

*Ref 9:-Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

-Horwitz and Tchernov, unpublished data, Crabtree et al in press, Davis 1986, Bouchud 1987 cited in Tchernov 1993:218-233, micromammal species (small mammals)

-Bouchud 1987:14-17, some other animals

*Ref 10:-Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

*Ref 11:- Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

-Horwitz and Tchernov, unpublished data, Crabtree et al in press, Davis 1986, Bouchud 1987 cited in Tchernov 1993:218-233, micromammal species (small mammals)

-Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

-Davis 1982:5-15, ungulates

*Ref 12:-Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38, mammalia (mammals - number of body parts) (by counting of total skeletal elements found

-Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38, some species of Amphibians, Reptiles and Birds found (number of body parts) (by counting of total skeletal elements found)

-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17, El Wad layer B 1(Mugharet El Wad / El Quad (El Ouad) (in French sources)) (Late Natufian), ungulates

*Ref 13:-Davis 1982:5-15, ungulates

-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17, ungulates

*Ref 14:-Davis 1982:5-15, ungulates

*Ref 15:-Bouchud 1987:14-17, ungulates in 1955-56 and 1959-61

-Bouchud 1987:14-17, ungulates in 1955-59

-Bouchud 1987:14-17, ungulates in 1971-76

*Ref 16:-Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17, ungulates

*Ref 17:-Pichon 1984, 1987 cited in Tchernov 1993:218-233, after Pichon 1984, 1987 cited in Tchernov 1993:218-233, Pichon 1984, 1987 cited in Tchernov 1993:218-233, Falconiformes (birds) (by counting of total skeletal elements found) (based on species of buteo spp., aquila spp., falco spp., and Phasianidae (birds) (by counting of total skeletal elements found) (and Anatidae (birds) (by counting of total skeletal elements found)

*Ref 18:-Munro 2003:47, some other animals

*Ref 19: Same as ***Ref 18**

*Ref 20: -Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38, mammalia (mammals - number of body parts) (by counting of total skeletal elements found)

-Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38), some species of Amphibians, Reptiles and Birds found (number of body parts) (by counting of total skeletal elements found))

*Ref 22: -Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry et. al. 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233)

*Ref 23: -Full Mammals - number of full individuals) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

-Mollusca Gastropoda (Terrestrial gastropods) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

*Ref 24: -Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233)

*Ref 25: Same as ***Ref 24**

*Ref 26: -Full Mammals - number of full individuals (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

-Mollusca Gastropoda (Terrestrial gastropods) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

*Ref 27: -El Wad A (Mugharet El Wad) (Final Natufian) Mammalia (Full Mammals - number of full individuals) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

-El Wad A (Mugharet El Wad) (Final Natufian) Mollusca Gastropoda (Terrestrial gastropods) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38))

References for frequencies by Single Percentage % calculations of animal species tables (tables 26, 28) (Tables are in the Appendix C in order):

*1: Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*2: Nahal Oren (Layer VI) (Early Natufian) Percentages of the species found (Noy, Legge and Higgs 1973:75-99)

*3: El Wad B2 (Mugharet El Wad) (Early Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*4: Mollusca Gastropoda (Terrestrial gastropods) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

*5: Mammalia (Full Mammals - number of full individuals) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)

*6: Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176

*7: Wadi Hammeh 27 (Early Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*8: Beidha (Early Natufian) (steppe and desert area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*9: Wadi Judayid 2 (Early Natufian) (steppe and desert area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*10: Ain al Saratan (Early Natufian) (steppe and desert area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*11: Hayonim Terrace (Later Natufian) Ungulates (Davis 1982:5-15)

*12: Hayonim Terrace B (Later Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*13: Horwitz and Tchernov, unpublished data, Bouchud, 1987, Cope, 1992, total number of specimens not available, Tchernov in Valla et al., 1986, Davis, in Henry etal., 1981, Crabtree et al., 1992, Legge, 1972, Noy et al., 1973, Davis, 1985, Cope, 1992, Davis, 1986 cited in Tchernov 1993:218-233

*14: Nahal Oren (Layer V) (Late Natufian) Percentages of the species found (Noy, Legge and Higgs 1973:75-99)

*15: Nahal Oren (Layer V) (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)

*16: El Wad B1 (Mugharet El Wad) (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69, references cited in Byrd 1989:176)

*17: Mollusca Gastropoda (Terrestrial gastropods) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)
*18: Mammalia (Full Mammals - number of full individuals) (Valla, Bar Yosef, Smith, Tchernov and Desse 1985:21-38)
*19: Fazael IV (Late Natufian) Ungulates (Davis 1982:5-15)
*20: Shukbah B (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*21: Nahal Oren (Layer VI) (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*22: Hatoula 4 (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*23: Hatoula 5 (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*24: Rakefet (Late Natufian) (forest and coastal area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*25: Rosh Horesha (Late Natufian) (steppe and desert area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*26: Abu Hureyra (Late Natufian) (steppe and desert area) Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*27: Large Mammals (Byrd 1987, table 69 references cited in Byrd 1989:176)
*28: El Wad A (Mugharet El Wad) (Final Natufian) Ungulates (Bouchud, J. with Garrod, D. and Bate D. M. A. cited in Bouchud 1987:14-17)

APPENDIX C: THE ANIMAL AND PLANT TABLES OF EARLY AND LATE NATUFIAN SITES' NISP, MNI, % FREQUENCY OF ANIMAL AND PLANT SPECIES RESPECTIVELY

Table 17. Early Natufian sites animal species list – NISP (Number of Identified Species) frequencies, NISP % percentage values ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	E a r l y N a t u f i a n S i t e s															
Site:	Fazael VI		Ain Mallaha		Ain Mallaha 2		Ain Mallaha 3		Ain Mallaha 4		Hayonim Cave		El Wad B2		Totals	Av%
Type:	*I		*I		*I		*I		*I		*FC		*FC			
References:	*Ref 1		*Ref 2		*Ref 5		*Ref 6		*Ref 7		*Ref 3		*Ref 4			
NISP	N	%	N	%	N	%	N	%	N	%	N	%	N	%		%
Ovicaprids	3	5	23	2	21	7	1	0	1	1	23	0		0	71	2
Gazella gazella	43	70	491	39	183	62	104	75	107	74	1936	28	17	1	2880	71
Bos primigenius	1	1	24	2	16	5	8	6	4	3	5	0		0	57	2
Sus scrofa	4	7	27	2	22	7	8	6	1	1	16	0		0	77	3
Alcelaphus bus.	0	0		0	0	0	0	0	0	0	3	0		0	3	0
Cervidae	10	16	135	11	0	0		0	0	0		0		0	145	4
Cervus elaphus	0	0	17	1	13	4	4	3	5	4	16	0		0	55	2
Capreolus capreolus	0	0	12	1	24	8	7	5	12	8	23	0		0	78	3
Dama mesopotamica	1	2	26	2	18	6	7	5	14	10	253	4		0	319	4
Lepus sp.		0	33	3	0	0		0	0	0	1559	22	542	46	2134	10
Testudo sp.		0	344	27	0	0		0	0	0	1777	25	128	11	2249	9
Carnivora	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Small carnivores		0	2	0	0	0		0	0	0		0		0	2	0
Canis sp.		0	5	0	0	0		0	0	0		0		0	5	0
Vulpes sp.		0	13	1	0	0		0	0	0		0	2	0	15	0
Felis sp.		0	3	0	0	0		0	0	0		0		0	3	0
Vormella peregusna		0		0	0	0		0	0	0		0	1	0	1	0
PISCES		0	41	3	0	0		0	0	0	23	0	0	0	64	1
Molluscs		0	19	1	0	0		0	0	0		0		0	19	0
Alectoris chukar	0	0	0	0	0	0	0	0	0	0	657	9	0	0	657	1
Coturnix coturnix		0		0	0	0		0	0	0	21	0	0	0	21	0
Anas sp.		0		0	0	0		0	0	0	785	10	0	0	785	1
Falconiformes											81	1			81	1
Anser sp.		0		0	0	0		0	0	0	1	0	0	0	1	0
Phasinidae		0		0	0	0		0	0	0	4	0	0	0	4	0
Rallus aquaticus		0		0	0	0		0	0	0	2	0	0	0	2	0
Fulica atra		0		0	0	0		0	0	0	8	0	0	0	8	0
Otis tarda		0		0	0	0		0	0	0	9	0	0	0	9	0
Vanellus vanellus		0		0	0	0		0	0	0	1	0	0	0	1	0
Crex crex		0		0	0	0		0	0	0	2	0	0	0	2	0
Grus grus		0		0	0	0		0	0	0	3	0	0	0	3	0
Columbiformes		0		0	0	0		0	0	0	1	0	0	0	1	0
Columba livia		0		0	0	0		0	0	0	5	0	0	0	5	0

Table 18. **(Table 17 (continued))** Early Natufian sites animal species list – NISP (Number of Identified Species) frequencies, NISP % percentage values ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian Sites															
Site:	Fazael VI		Ain Mallaha		Ain Mallaha 2		Ain Mallaha 3		Ain Mallaha 4		Hayonim Cave		El Wad B2		Totals	Avg %
Type:	*I		*I		*I		*I		*I		*FC		*FC			
References:	*Ref 1		*Ref 2		*Ref 5		*Ref 6		*Ref 7		*Ref 3		*Ref 4			
NISP	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
AVES		0	30	2	0	0		0	0	0		0	3	0	33	0
Small Aves		0		0	0	0		0	0	0	14	0	8	1	22	0
Medium Aves		0		0	0	0		0	0	0	408	6	215	18	623	3
Large Aves		0		0	0	0		0	0	0	72	1	70	6	142	1
Huge Aves		0		0	0	0		0	0	0	15	0	16	1	31	0
Erinaceus europaeus		0		0	0	0		0	0	0		0	1	0	1	0
Rodents		0	1	0	0	0		0	0	0		0		0	1	0
Spalax ehrenbergi		0		0	0	0		0	0	0		0	25	2	25	0
Meriones tristami		0		0	0	0		0	0	0		0	4	0	4	0
Sciurus anomalus		0		0	0	0		0	0	0		0	1	0	1	0
Mesocricetus auratus		0		0	0	0		0	0	0		0	1	0	1	0
Microtus guentheri		0		0	0	0		0	0	0		0	55	5	55	1
Serpents		0	23	2	0	0		0	0	0		0		0	23	0
Anura		0		0	0	0		0	0	0		0	3	0	3	0
Lacerta sp.		0		0	0	0		0	0	0		0	1	0	1	0
Ophisaurus apodus		0		0	0	0		0	0	0		0	29	2	29	0
Ophidia		0		0	0	0		0	0	0		0	17	1	17	0
Squamata		0		0	0	0		0	0	0		0	29	2	29	0
Insectivores		0	2	0	0	0		0	0	0		0		0	2	0
E.N. SITES TOTALS	61		1270		296		138		145		7003		1169		10801	

Table 19. Late and Final Natufian sites animal species list – NISP frequencies, NISP % percentage values
***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian Sites																								Final N.			
Site:	*1		*2		*3		*4		*5		*6		*7		*8		*9		*10		*11		*12		*13		Totals	Avg %
Type:	*FC		*FC		*FC		*FC		*FC		*I		*I		*I		*I		*I		*I		*I		*FC			
References:	*Ref 10		*Ref 12		*Ref 16		*Ref 8		*Ref 19		*Ref 9		*Ref 15		*Ref 11		*Ref 13		*Ref 14		*Ref 17		*Ref 18		*Ref 20			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		%
Ovicaprids	8	0,34	0	0	1	0	13	0		0	30	2	14	4	4	1	0	0	0	0		0		0	1	0	71	1
Gazella gazella	2288	97,66	989	79	1159	82	1388	21		0	693	49	175	44	431	69	42	95	18	100		0		0	77	26	7259	51
Bos primigenius	17	0,72	0	0	165	12	3	0		0	44	3	20	5	13	2	0	0	0	0		0		0		0	262	2
Sus scrofa	14	0,60	1	0	54	4	14	0		0	103	7	54	14	19	3	0	0	0	0		0		0		0	259	2
Equus sp.				0		0	0	0		0		0	29	7	0	0	0	0	0	0		0		0		0	29	1
Alcelaphus buselaphus	16	0,68	0	0	0	0	0	0		0		0	0	0	0	0	0	0	0	0		0		0		0	16	0
Cervidae				0		0	690	11		0	270	19		0	77	12		0		0		0		0		0	1037	4
Cervus elaphus			0	0	0	0	4	0		0	30	2	35	9	0	0	0	0	0	0		0		0		0	69	1
Capreolus capreolus			1	0	12	1	3	0		0	40	3	38	10	1	0	2	5	0	0		0		0	3	1	100	2
Dama mesopotamica			56	4	31	2	10	0		0	42	3	34	9	0	0	0	0	0	0		0		0	8	3	181	2
Lepus sp.			7	1		0	656	10	417	13	85	6		0	50	8		0		0		0	44	5	13	4	1272	4
Testudo sp.			19	2		0	3483	54	2542	78	22	2		0		0		0		0		0	848	87	36	12	6950	19
Carnivora	0	0	1	0	0	0	10	0	0	0	11	1	0	0	16	3	0	0	0	0	0	0	0	0	1	0	39	0
Small carnivores				0		0		0		0	5	0		0		0		0		0		0		0		0	5	0
Canis sp.				0		0	1	0		0	7	0		0		0		0		0		0		0		0	8	0
Vulpes sp.			1	0		0	12	0		0	17	1		0	6	1		0		0		0		0	4	1	40	0
Felis sp.				0		0		0		0	1	0		0		0		0		0		0		0		0	1	0

Sites: *1. Hatoula 4-5, *2- El Wad B1, *3- Nahal Oren V-VI, *4- Hayonim Terrace, *5-Hayonim Cave, *6- Ain Mallaha, *7- Ain Mallaha 1, *8-Salibiya I, *9-Nahal Ein Gev II, *10-Fazael IV, *11- Mureybet, *12- Hilazon Tachtit, *13-El Wad A (Final Natufian)

Table 20. (Table 19 (continued)) Late and Final Natufian sites animal species list – NISP frequencies, NISP % percentage values
***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	L a t e N a t u f i a n S i t e s																								Final N.			
Site:	*1		*2		*3		*4		*5		*6		*7		*8		*9		*10		*11		*12		*13		Totals	Avg %
Type:	*FC		*FC		*FC		*FC		*FC		*I		*I		*I		*I		*I		*I		*I		*FC			
	N	%		%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		%	N	%	N	%		%
PISCES				0		0	10	0	8	0		0		0		0		0		0		0	8	1		0	26	0
Alectoris chukar	0	0	0	0	0	0	53	1	231	7	0	0	0	0	0	0	0	0	0	0	2	0	41	4	0	0	327	1
Coturnix coturnix				0		0	0	0	7	0		0		0		0		0		0		0	1	0		0	8	0
Anatidae	834	26,25		0		0	2427	27		0		0		0		0		0		0	493	87		0		0	3754	11
Anas sp.				0		0	0	0	1	0		0		0		0		0		0		0	1	0		0	2	0
Falconiformes				0		0		0		0		0		0		0		0		0	72	13		0		0	72	1
Anser sp.				0		0	0	0	1	0		0		0		0		0		0		0	0	0		0	1	0
Phasinidae				0		0	0	0	2	0		0		0		0		0		0		0	0	0		0	2	0
Rallus aquaticus				0		0	0	0	1	0		0		0		0		0		0		0	0	0		0	1	0
Fulica atra				0		0	0	0	1	0		0		0		0		0		0		0	0	0		0	1	0
Otis tetrax				0		0	0	0	1	0		0		0		0		0		0		0	0	0		0	1	0
Otis tarda				0		0	0	0	5	0		0		0		0		0		0		0	0	0		0	5	0
Crex crex				0		0	0	0	2	0		0		0		0		0		0		0	0	0		0	2	0
Columba livia				0		0	0	0	7	0		0		0		0		0		0		0	2	0		0	9	0
Columba palumbus				0		0	0	0	1	0		0		0		0		0		0		0	0	0		0	1	0
Aves			12	1		0		0		0	12	1		0		0		0		0		0		0	3	1	27	0
Small Aves				0		0	0	0	12	0		0		0		0		0		0		0	0	0		0	12	0

Sites: *1. Hatoula 4-5, *2- El Wad B1, *3- Nahal Oren V-VI, *4- Hayonim Terrace, *5-Hayonim Cave, *6- Ain Mallaha, *7- Ain Mallaha 1, *8- Salibiya I, *9-Nahal Ein Gev II, *10-Fazael IV, *11- Mureybet, *12- Hilazon Tachtit, *13-El Wad A (Final Natufian)

Table 21. (Table 20 (continued)) Late and Final Natufian sites animal species list – NISP frequencies, NISP % percentage values
***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian Sites																								Final N.			
Site:	*1		*2		*3		*4		*5		*6		*7		*8		*9		*10		*11		*12		*13		Totals	Avg %
Type:	*FC		*FC		*FC		*FC		*FC		*I		*I		*I		*I		*I		*I		*I		*FC			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		%
Medium Aves				0		0	43	1	1	0		0		0		0		0		0		0	27	3		0	71	0
Large Aves				0		0	7	0	30	1		0		0		0		0		0		0	3	0		0	40	0
Huge Aves				0		0	0	0	9	0		0		0		0		0		0		0	0	0		0	9	0
Erinaceus europaeus			2	0		0		0		0		0		0		0		0		0		0		0	1	0	3	0
Rodents				0		0		0		0	1	0		0		0		0		0		0		0		0	1	0
Spalax ehrenbergi			20	2		0		0		0		0		0		0		0		0		0		0	11	4	31	0
Rodentia				0		0	89	1		0	0	0		0		0		0		0		0		0		0	89	0
Sciurus anomalus				0		0		0		0		0		0		0		0		0		0		0	2	1	2	0
Microtus guentheri			16	1		0		0		0		0		0		0		0		0		0		0	11	4	27	0
Microchiroptera			1	0		0		0		0		0		0		0		0		0		0		0	3	1	4	0
Mus musculus			1	0		0		0		0		0		0		0		0		0		0		0		0	1	0
Crocidura russula				0		0		0		0		0		0		0		0		0		0		0	1	0	1	0
Pelobates syriacus			0	0		0		0		0		0		0		0		0		0		0		0	1	0	1	0
Serpents				0		0		0		0	1	0		0		0		0		0		0		0		0	1	0
Anura			1	0		0		0		0		0		0		0		0		0		0		0	0	0	1	0
Chameleo chameleon			1	0		0		0		0		0		0		0		0		0		0		0	1	0	2	0

Sites: *1. Hatoula 4-5, *2- El Wad B1, *3- Nahal Oren V-VI, *4- Hayonim Terrace, *5-Hayonim Cave, *6- Ain Mallaha, *7- Ain Mallaha 1, *8-Salibiya I, *9-Nahal Ein Gev II, *10-Fazael IV, *11- Mureybet, *12- Hilazon Tachtit, *13-El Wad A (Final Natufian)

Table 22. (Table 21 (continued)) Late and Final Natufian sites animal species list – NISP frequencies, NISP % percentage values
***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian Sites																										Final N.			
Site:	*1		*2		*3		*4		*5		*6		*7		*8		*9		*10		*11		*12		*13		Totals	Avg %
Type:	*FC		*FC		*FC		*FC		*FC		*I		*I		*I		*I		*I		*I		*I		*FC			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		%
Ophisaurus apodus			60	5		0		0		0		0		0		0		0		0		0		0	80	27	140	3
Agama stellio			4	0		0		0		0		0		0		0		0		0		0		0	1	0	5	0
Ophidia			26	2		0		0		0		0		0		0		0		0		0		0	28	10	54	1
Squamata			37	3		0		0		0		0		0		0		0		0		0		0	6	2	43	0
Insectivora				0		0	0	0		0	0	0		0	9	1		0		0		0		0		0	9	0
L.N. SITES TOTALS	2343		1255		1422		6488		3279		1413		399		625		44		18		567		975		292		22382	

Sites: *1. Hatoula 4-5, *2- El Wad B1, *3- Nahal Oren V-VI, *4- Hayonim Terrace, *5-Hayonim Cave, *6- Ain Mallaha, *7- Ain Mallaha 1, *8-Salibiya I, *9-Nahal Ein Gev II, *10-Fazael IV, *11- Mureybet, *12- Hilazon Tachtit, *13-El Wad A (Final Natufian)

Table 23. Early and Late Natufian sites animal species list - MNI and % MNI percentages ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natufian						Final Natufian			
Site:	Hayonim Cave		El Wad B2		E.N. MNI TOTALS	E.N. MNI Avg %	Hayonim Terrace		Hatoula 4-5		El Wad B1		El Wad A		L.N. MNI TOTALS	L.N. + Final N. MNI Avg %
Type:	*FC		*FC				*FC		*FC		*FC		*FC			
References:	*Ref 22:		*Ref 23				*Ref 24:		*Ref 25:		*Ref 26		*Ref 27			
	MNI	%	MNI	%		%	MNI	%	MNI	%	MNI	%	MNI	%		%
Ovicaprids	6	6	0	0	6	3	4	2,4	2	3	0	0	1	0,19	7	1
Gazella gazella	59	58,4	4	5	63	37	107	64	47	71	5	9	16	3,01	175	32
Bos primigenius	5	5		0	5	3	10	6	4	6		0		0,00	14	3
Sus scrofa	3	2,9	0	0	3	1	9	5,4	2	3	1	2	0	0,00	12	3
Equus sp.	1	1		0	1	1	1	0,6				0		0,00	1	0
Cervidae	26	25,7		0	26	13	35	21,2	11	17		0		0,00	46	9
Alcelaphus buselaphus	1			0	1	0			1	1,5		0		0,00	1	1
Cervus elaphus				0	0	0						0		0,00	0	0
Capreolus capreolus			0	0	0	0					1	2	2	0,38	3	1
Dama mesopotamica			0	0	0	0					0	0	2	0,38	2	0
Lepus sp.			2	3	2	3					2	4	5	0,94	7	2
Carnivora	0	0	1	1	1	1	0	0	0	0	1	2	1	0,19	2	1
Vulpes sp.			1	1	1	1					1	2	2	0,38	3	1
Felis sp.				0	0	0						0		0,00	0	0
Vormella peregusna			1	1	1	1					0	0	0	0,00	0	0
Erinaceus europaeus			1	1	1	1					1	2	1	0,19	2	1
SNAILS				0	0	0						0		0,00	0	0
Pomatias glaucus			1	1	1	1					0	0	19	3,58	19	2
Euchondrus saulcyi			5	6	5	6					4	7	61	11,49	65	9
Euchondrus Septeradentatus			1	1	1	1					4	7	172	32,39	176	20

Table 24. (Table 23 (continued)) Early and Late Natufian sites animal species list - MNI and % MNI percentages ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natufian						Final Natufian			
Site:	Hayonim Cave		El Wad B2		E.N. MNI TOTALS	E.N. MNI Avg %	Hayonim Terrace		Hatoula 4-5		El Wad B1		El Wad A		L.N. MNI TOTALS	L.N. + Final N. MNI Avg %
Type:	*FC		*FC				*FC		*FC		*FC		*FC			
	MNI	%	MNI	%		%	MNI	%	MNI	%	MNI	%	MNI	%		%
Zonitidae				0	0	0						0		0,00	0	0
Vitrea contracta			0	0	0	0					0	0	4	0,75	4	0
Eopolita protensa			0	0	0	0						0	3	0,56	3	0
Calaxis hierosolymarum			31	40	31	40					16	29	12	2,26	28	16
cf. Popoides coenopictus			1	1	1	1					0	0	0	0,00	0	0
Helicellidae				0	0	0						0		0,00	0	0
Xeropicta vestalis			7	9	7	9					4	7	104	19,59	108	13
Monacha haifensis			5	6	5	6						0	100	18,83	100	9
Sphincterochilidae				0	0	0						0		0,00	0	0
Sphincterochila cariosa			0	0	0	0					0	0	1	0,19	1	0
Helicidae				0	0	0						0		0,00	0	0
Helix engaddensis			0	0	0	0						0	10	1,88	10	1
Rodentia				0	0	0						0		0,00	0	0
Sciurus anomalus			1	1	1	1					0	0	2	0,38	2	0

Table 25. (Table 24 (continued)) Early and Late Natufian sites animal species list - MNI and % MNI percentages ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natufian						Final Natufian			
Site:	Hayonim Cave		El Wad B2		E.N. MNI TOTALS	E.N. MNI Avg %	Hayonim Terrace		Hatoula 4-5		El Wad B1		El Wad A		L.N. MNI TOTALS	L.N. + Final N. MNI Avg %
Type:	*FC		*FC				*FC		*FC		*FC		*FC			
	MNI	%	MNI	%		%	MNI	%	MNI	%	MNI	%	MNI	%		%
Mesocricetus auratus			1	1	1	1					0	0	0	0,00	0	0
Microtus guentheri			9	12	9	12					7	13	2	0,38	9	7
Spalax ehrenbergi			4	5	4	5					6	11	7	1,32	13	6
Meriones tristami			1	1	1	1					0	0	0	0,00	0	0
Mus musculus			0	0	0	0					1	2	0	0,00	1	1
Crocidura russula				0	0	0						0	1	0,19	1	0
Microchiroptera			0	0	0	0					1	2	3	0,56	4	1
SITES MNI SUMS=>	MNI		MNI		E. N. MNI TOTAL		MNI		MNI		MNI		MNI		L. N. MNI TOTAL	
	101		77		178		166		67		55		531		819	

Table 26. Early Natufian sites animal species list – Frequency by single percentage calculations ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian									
Site:	Hayonim Cave	El Wad B2	Kebarah			Wadi Hammeh 27	Beidha	Wadi Judayid 2	Ain al Saratan	
Type:	*FC	*FC	*FC			*FC	*ISD	*ISD	*ISD	
References:	*1	*3	*4	*5	*6	*7	*8	*9	*10	E. N. sites Avg %
Ungulates										
	%	%	%	%	%	%	%	%	%	%
Ovicaprids	3,60	0,20			0,00	8,00	69,90	64,70	0,00	20,91
Gazella gazella	86,80	85,20		15,38	50,70	83,60	22,10	18,50	24,50	64,62
Bos primigenius	1,10	3,30			32,90	0,40	5,90	6,50	38,00	11,69
Sus scrofa	0,80	0,90			6,60	5,30	0,00	0,00	0,00	1,96
Equus spp.	0,00	0,10			1,90	0,90	2,20	10,30	37,60	7,57
Cervus elaphus	2,20	0,20			1,90	0,40	0,00	0,00	0,00	0,59
Capreolus capreolus	1,40	0,10			0,90	0,40	0,00	0,00	0,00	0,35
Dama dama mesopotamica	3,90	3,60			5,20	0,90	0,00	0,00	0,00	2,94
Vulpes sp.				3,85						3,85
cf . Vormella peregusna				3,85						3,85
Erinaceus europaeus				3,85						3,85
Lepus europaeus				7,70						7,70
Pomatias glaucus			1,95							1,95
Euchondrus saulcyi			9,80							9,80
Euchondrus Septeradentatus			1,95							1,95
Calaxis hierosolymarum			60,78							60,78
cf. Popoides coenopictus			1,95							1,95
Xeropicta vestalis			13,70							13,70
Monacha haifensis			9,80							9,80
Carnivora				3,85						3,85

Table 27. (Table 26 (continued)) Early Natufian sites animal species list – Frequency by single percentage calculations ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

Site:	Hayonim Cave	El Wad B2	Kebarah		Wadi Hammeh 27	Beidha	Wadi Judayid 2	Ain al Saratan	E. N. sites Avg %
Type:	*FC	*FC	*FC		*FC	*ISD	*ISD	*ISD	
Spalax ehrenbergi				15,38					15,38
Meriones tristami				3,85					3,85
Sciurus anomalus				3,85					3,85
Mesocricetus auratus				3,85					3,85
Microtus guentheri				34,61					34,61

Table 28. Late and Final Natufian sites animal species list – Frequency by percentage calculations ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian																	Final Natufian	
Site:	Hayonim Terrace			Nahal Oren	El Wad B1		Nahal Ein Gev II		Fazael IV	Shukbah B	Nahal Oren VI	Hatoula 4	Hatoula 5	Rakefet	Rosh Horesha	Abu Hureyra	Khallat Anaza	El Wad A	
Type:	*FC			*FC	*FC				*I	*FC	*FC	*FC	*FC	*FC	*ISD	*ISD	*ISD	*FC	
References:	*11	*12	*13	*14	*15	*16	*17	*18	*19	*20	*21	*22	*23	*24	*25	*26	*27	*28	L.N. + Final N. sites Avg %
Ungulates	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ovicaprids	0,00	0,50	2,50	0,10	0,10	0,20			0,00	0,00	0,00	0,30	0,40	0,00	37,40	12,10	66,70	0,10	7,53
Gazella gazella	0,00	83,30	65,50	81,50	81,50	85,20		18,520	0,00	85,10	82,70	98,20	99,60	77,90	60,70	71,40	25,90	81,50	52,15
Bos primigenius	0,00	0,00	3,70	11,60	11,60	3,30	0,00	0,00	0,00	11,20	5,40	0,80	0,00	3,20	0,10	0,00	0,00	11,60	3,47
Sus scrofa	0,00	0,90	9,50	3,80	3,80	0,90		3,705	0,00	0,00	2,10	0,70	0,00	7,40	0,00	0,00	0,00	3,80	2,15
Equus spp.	0,00	0,00			0,00	0,10			0,00	0,00	0,00	0,00	0,00	0,00	1,80	16,40	7,40		1,98

Table 29. (Table 28 (continued)) Late and Final Natufian sites animal species list – Frequency by percentage calculations ***Ref: References are in Appendix B, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian																		Final Natuf.	L.N. + F. N. Avg %
Site:	Hayonim Terrace			Nahal Oren V	El Wad B1		Nahal Ein Gev II		Fazael IV	Shukbah B	Nahal Oren VI	Hatoula 4	Hatoula 5	Rakefet	Rosh Horesha	Abu Hureyra	Khallat Anaza	El Wad A	
Cervidae			18,80																18,80
Cervus elaphus	0,00	0,00		0,00	0,00	0,00			0,00	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,30
Capreolus capreolus	0,00	1,10		0,80	0,80	0,00		3,705	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,80	0,45
Dama dama mesopotamica	0,00	14,20		2,20	2,20	3,60			0,00	3,40	9,90	0,00	0,00	11,60	0,00	0,00	0,00	2,20	3,29
Vulpes sp.								3,705											3,71
Erinaceus europ.								3,705											3,71
Lepus europaeus								7,410											7,41
Euchondrus saulcyi							14,26												14,26
Euchondrus Septeradentatus							14,26												14,26
Calaxis hierosolymarum							57,10												57,10
Xeropicta vestalis							14,26												14,26
Carnivora								3,705											3,71
Spalax ehrenbergi								22,220											22,22
Microtus guentheri								25,925											25,93
Microchiroptera								3,705											3,71
Mus musculus								3,705											3,71

Table 30. Early and Late Natufian sites plant species list – Frequencies by number of found plants, ***Ref A: Colledge 2001:152-155, *I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natuf.	
Site:	Wadi Hammeh 27		Wadi Jilat 6		E. N. TOTAL	E.N. Avg %	Iraq ed Dubb	L.N. Avg %
Type:	*FC		*I				*I	
References:	***Ref A**		***Ref A**				***Ref A**	
Cereals	N	%	N	%	N	%	N	%
Hordeum spontaneum	3,00	0,09		0,00	3	0,04	1,00	0,15
Hordeum cf. Spontaneum	1,00	0,03		0,00	1	0,01	6,00	0,88
Hordeum cf. Spontaneum (rachis intermode fragments)	2,00	0,06		0,00	2	0,03	13,00	1,91
Cereal (grains)	1,00	0,03		0,00	1	0,01		0,00
Grasses		0,00		0,00	0	0,00		0,00
cf. Aegilops sp.	1,00	0,03		0,00	1	0,01		0,00
cf. Bromus sp.	1,00	0,03	1,00	0,28	2	0,16	1,00	0,15
Lolium sp.	1,00	0,03		0,00	1	0,01		0,00
cf. Stipa sp.	2,00	0,06		0,00	2	0,03		0,00
Gramineae (grains)	2,00	0,06		0,00	2	0,03		0,00
Species "X"	175,00	5,11		0,00	175	2,56		0,00
Other Wild taxa Table 5f. continued		0,00		0,00	0	0,00		0,00
cf. Pistacia sp.	3,00	0,09		0,00	3	0,04	101,00	14,81
Buglossoides arvensis	1,00	0,03		0,00	1	0,01		0,00
Chenopodiaceae/Capparis sp. (spiral embryos)	2,00	0,06		0,00	2	0,03		0,00
Matricaria	1,00	0,03		0,00	1	0,01		0,00
Lens sp.	1,00	0,03		0,00	1	0,01		0,00
Leguminosae	12,00	0,35		0,00	12	0,15		0,00
Liliaceae	6,00	0,18		0,00	6	0,09	1,00	0,15

Table 31. (Table 30 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants, ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natuf	
Site:	Wadi Hammeh 27		Wadi Jilat 6		E. N. TOTAL	E.N. Avg %	Iraq ed Dubb	L.N. Avg %
Type:	*FC		*I				*I	
Cereals	N	%	N	%	N	%	N	%
Triticum cf. monococcum/dicoccum (glume bases)		0,00		0,00	0	0,00	8,00	1,17
Triticum cf. monococcam/dicoccum (spikelet forks)		0,00		0,00	0	0,00	2,00	0,29
Hordeum spontaneum (rachis int. frags)		0,00		0,00	0	0,00	8,00	1,17
Hordeum sativum (grains)		0,00		0,00	0	0,00	4,00	0,59
Cereal indeterminate (grains)		0,00		0,00	0	0,00	10,00	1,47
Culm nodes		0,00		0,00	0	0,00	12,00	1,76
GRASSES								
cf.Aegilops sp.		0,00		0,00	0	0,00	4,00	0,59
Phalaris sp.(type a)		0,00		0,00	0	0,00	8,00	1,17
Phalaris sp.(type c)		0,00		0,00	0	0,00	17,00	2,49
Gramineae		0,00		0,00	0	0,00	18,00	2,64
PULSES								
Lens sp.		0,00		0,00	0	0,00	6,00	0,88
Vicia/Lathyrus spp.		0,00		0,00	0	0,00	3,00	0,44

Table 32. (Table 31 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants, ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natuf	
Site:	Wadi Hammeh 27		Wadi Jilat 6		E. N. TOTAL	E.N. Avg %	Iraq ed Dubb	L.N. Avg %
Type:	*FC		*I				*I	
	N	%	N	%	N	%	N	%
Leguminosae		0,00		0,00	0	0,00	13,00	1,91
WILD/"WEED" TAXA								
Pistacia sp.		0,00		0,00	0	0,00	38,00	5,57
Chenopodiaceae/Caryophyllaceae		0,00		0,00	0	0,00	7,00	1,03
Geraniaceae ("twists")		0,00		0,00	0	0,00	19,00	2,79
cf. Colutea sp.		0,00		0,00	0	0,00	1,00	0,15
Liliaceae (type x)		0,00		0,00	0	0,00	1,00	0,15
Linum sp.		0,00		0,00	0	0,00	2,00	0,29
Ficus sp. (nutlets)		0,00		0,00	0	0,00	103,00	15,10
Amygdalus sp. (fruit stones)		0,00		0,00	0	0,00	11,00	1,61
Galium sp.		0,00		0,00	0	0,00	1,00	0,15
"Lupin" type		0,00		0,00	0	0,00	2,00	0,29
"XXX" type		0,00	2,00	0,57	2	0,28	16,00	2,35

Table 33. (Table 32 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants, ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natuf.	
Site:	Wadi Hammeh 27		Wadi Jilat 6		E. N. TOTAL	E.N. Avg %	Iraq ed Dubb	L.N. Avg %
Type:	*FC		*I				*I	
	N	%	N	%	N	%	N	%
Unidentified taxa		0,00		0,00	0	0,00	245,00	35,92
GRASSES								
Echinaria sp.		0,00	1,00	0,28	1	0,14		0,00
cf. Stipa sp.		0,00	1,00	0,28	1	0,14		0,00
Graminae (type 2)		0,00	6,00	1,71	6	0,85		0,00
Gramineae		0,00	2,00	0,57	2	0,28		0,00
OTHER TAXA								
Atriplex sp.		0,00	22,00	6,27	22	3,13		0,00
cf. Atriplex sp.		0,00	2,00	0,57	2	0,28		0,00
Chenopodiaceae/Caryophyllaceae		0,00	81,00	23,08	81	11,54		0,00
single loop Chenopodiaceae/Crucifer		0,00	50,00	14,25	50	7,12		0,00
cf. single loop Cbenopodiaceae/Crucifer		0,00	61,00	17,38	61	8,69		0,00
Camphorosma type		0,00	10,00	2,85	10	1,42		0,00
Compositae (kernals)		0,00	2,00	0,57	2	0,28		0,00
cf. Compositae (kernals)		0,00	7,00	1,99	7	1,00		0,00
Cruciferae (type a)		0,00	8,00	2,28	8	1,14		0,00

Table 34. (Table 33 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants, ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natuf.	
Site:	Wadi Hammeh 27		Wadi Jilat 6		E. N. TOTAL	E.N. Avg %	Iraq ed Dubb	L.N. Avg %
Type:	*FC		*I				*I	
	N	%	N	%	N	%	N	%
Schoenus nigricons		0,00	18,00	5,13	18	2,56		0,00
Cyperaceae (type c)		0,00	1,00	0,28	1	0,14		0,00
Cyperaceae (type x)		0,00	1,00	0,28	1	0,14		0,00
cf. Sophora sp.		0,00	1,00	0,28	1	0,14		0,00
Verbascum sp.		0,00	10,00	2,85	10	1,42		0,00
Unidentified taxa		0,00	64,00	18,23	64	9,12		0,00
	N		N		**E. N. SITES PLANT TOTAL**		**L. N. SITES PLANT TOTAL**	
	3423,00		351,00		**3774**		**682**	

Table 35. Early and Late Natufian sites plant species list – Frequencies by number of found plants – group by group

	Early Natufian				Late N.	
Site:	Wadi al Hammeh 27		Wadi Jilat 6		Iraq ed Dubb	
Type:	*FC		*I		*I	
	N	%	N	%	N	%
CEREALS						
Hordeum spontaneum (grains)	3,00	0,09		0,00	1,00	0,15
Hordeum cf. Spont. (grains)	1,00	0,03		0,00	6,00	0,88
Hordeum cf. Spont. (rachis)	2,00	0,06		0,00	13,00	1,91
Cereal (grains)	1,00	0,03		0,00		0,00
cf. Aegilops sp.	1,00	0,03		0,00		0,00
cf. Bromus sp.	1,00	0,03	1,00	0,28	1,00	0,15
Lolium sp.	1,00	0,03		0,00		0,00
cf. Stipa sp.	2,00	0,06		0,00		0,00
Gramineae (grains)	2,00	0,06		0,00		0,00
Triticum m/d (glume bases)		0,00		0,00	8,00	1,17
Triticum m/d (spikelet forks)		0,00		0,00	2,00	0,29
Hordeum spontaneum (rachis)		0,00		0,00	8,00	1,17
Hordeum sativum (grains)		0,00		0,00	4,00	0,59
Cereal indeterminate (grains)		0,00		0,00	10,00	1,47
Culm nodes		0,00		0,00	12,00	1,76
OTHER GRASSES						
cf.Aegilops sp.		0,00		0,00	4,00	0,59
Phalaris sp.(type a)		0,00		0,00	8,00	1,17
Phalaris sp.(type c)		0,00		0,00	17,00	2,49

Table 36. (Table 35 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants – group by group

	Early Natufian				Late N.	
Site:	Wadi al Hammeh 27		Wadi Jilat 6		Iraq ed Dubb	
Type:	*FC		*I		*I	
	N	%	N	%	N	%
Gramineae		0,00		0,00	18,00	2,64
Echinaria sp.		0,00	1,00	0,28		0,00
cf. Stipa sp.		0,00	1,00	0,28		0,00
Graminae (type 2)		0,00	6,00	1,71		0,00
Gramineae		0,00	2,00	0,57		0,00
PULSES						
Lens sp.	1,00	0,03		0,00		0,00
Leguminosae	12,00	0,35		0,00		0,00
Lens sp.		0,00		0,00	6,00	0,88
Vicia/Lathyrus spp.		0,00		0,00	3,00	0,44
Leguminosae		0,00		0,00	13,00	1,91
"Lupin" type not sure		0,00		0,00	2,00	0,29
cf. Colutea sp. Tree not sure		0,00		0,00	1,00	0,15
cf. Sophora sp. Tree not sure		0,00	1,00	0,28		0,00
FRUITS - NUTS						
cf. Pistacia sp.	3,00	0,09		0,00	101,00	14,81
Pistacia sp.		0,00		0,00	38,00	5,57
Ficus sp. (nutlets)		0,00		0,00	103,00	15,10
Amygdalus sp. (fruit stones)		0,00		0,00	11,00	1,61
OILS - FOOD						
Linum sp.		0,00		0,00	2,00	0,29
MEDICAL - PIGMENT						
Buglossoides arvensis (red pigment from roots)	1,00	0,03		0,00		0,00

Table 37. (Table 36 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants – group by group

	Early Natufian				Late N.	
Site:	Wadi al Hammeh 27		Wadi Jilat 6		Iraq ed Dubb	
Type:	*FC		*I		*I	
	N	%	N	%	N	%
Matricaria (chamomile)	1,00	0,03		0,00		0,00
Verbascum sp.		0,00	10,00	2,85		0,00
VEGETABLE						
Chenopodiaceae/Capparis sp. (spiral emb.)	2,00	0,06		0,00		0,00
Malva sp.	5,00	0,15		0,00		0,00
Chenopodiaceae/Caryophyllaceae		0,00		0,00	7,00	1,03
Chenopodiaceae/Caryophyllaceae		0,00	81,00	23,08		0,00
s.l. Chenopodiaceae/Crucifer		0,00	50,00	14,25		0,00
cf. s. l. Cbenopodiaceae/Crucifer		0,00	61,00	17,38		0,00
Atriplex sp.		0,00	22,00	6,27		0,00
cf. Atriplex sp.		0,00	2,00	0,57		0,00
Cruciferae (type a)		0,00	8,00	2,28		0,00
Cyperaceae (type c)		0,00	1,00	0,28		0,00
Cyperaceae (type x)		0,00	1,00	0,28		0,00
Schoenus nigricons		0,00	18,00	5,13		0,00
Compositae (kernals)		0,00	2,00	0,57		0,00
cf. Compositae (kernals)		0,00	7,00	1,99		0,00
Liliaceae (eaten or medical use - poisonous depending on species)	6,00	0,18		0,00	1,00	0,15
Liliaceae (type x)		0,00		0,00	1,00	0,15
Galium sp		0,00		0,00	1,00	0,15
TOTAL IDENTIFIED						
All species	45	1,34	275	78,33	402	58,96

Table 38. (Table 37 (continued)) Early and Late Natufian sites plant species list – Frequencies by number of found plants – group by group

	Early Natufian				Late N.	
Site:	Wadi al Hammeh 27		Wadi Jilat 6		Iraq ed Dubb	
Type:	*FC		*I		*I	
	N	%	N	%	N	%
UNKNOWN TYPES						
Species "X"	175,00	5,11		0,00		0,00
Unidentified taxa	3203,00	93,57		0,00		0,00
Geraniaceae ("twists")		0,00		0,00	19,00	2,79
"XXX" type		0,00	2,00	0,57	16,00	2,35
Unidentified taxa		0,00		0,00	245,00	35,92
Camphorosma type		0,00	10,00	2,85		0,00
Unidentified taxa		0,00	64,00	18,23		0,00
Totals	3423,00		351,00		682,00	

Table 39. Change in the percentage frequencies of the each food animal species' diet ratios during the Younger Drays climatic shift from the Early Natufian times to the Late Natufian times animal diet.

	E. N. Avg %	L. N. + Final N. Avg %
Ungulates		
	%	%
Ovicaprids	**20,91**	**7,53**
Gazella gazella	**64,62**	**52,15**
Bos primigenius	**11,69**	**3,47**
Sus scrofa	**1,96**	**2,15**
Equus spp.	**7,57**	**1,98**
Cervidae		**18,80**
Cervus elaphus	**0,59**	**0,02**
Capreolus capreolus	**0,35**	**0,45**
Dama dama mesopotamica	**2,94**	**3,29**
Rhinoceros	**3,85**	**3,71**
Hippopotamus	**3,85**	
Camelus	**3,85**	**3,71**
Vulpes sp.	**7,70**	**7,41**
Canis sp.	**1,95**	**0,00**
Fenis sp.	**9,80**	**14,26**
cf . Vormella peregusna	**1,95**	**14,26**
Erinaceus europaeus (hedgehog)	**60,78**	**57,10**
Rongeurs	**1,95**	**0,00**
Insectivores	**13,70**	**14,26**
Small carnivores	**9,80**	
Serpents	**3,85**	**3,71**
Molluscs	**15,38**	**22,22**
Potamion sp.	**3,85**	
Poissons	**3,85**	
Oiseaux	**3,85**	
Anas sp.	**34,61**	**25,93**
Falconiformes		**3,71**
Phasianidae (birds)		**3,71**

Table 40. Changes in percentages and frequencies of animals in the Early (E.N.) and the Late Natufian (L.N.) periods.

Animal Species:	E.N. NISP TOTALS	E. N. Sites NISP Avg %	Animal Species:	L.N. NISP TOTALS	L. N. Sites NISP Avg %
Ovicaprids	70,67	2,19	Ovicaprids	71,23	0,55
Gazella gazella	2880,25	50,50	Gazella gazella	7258,73	49,35
Bos primigenius	56,92	2,36	Bos primigenius	261,95	1,74
Sus scrofa	77,33	3,26	Sus scrofa	258,83	2,19
Alcelaphus buselaphus	3,00	0,01	Equus sp.	29,00	0,61
Cervidae	145,00	3,86	Alcelaphus buselaphus	16,33	0,05
Cervus elaphus	55,42	1,78	Cervidae	1037,33	3,27
Capreolus capreolus	78,33	3,27	Cervus elaphus	68,60	0,90
Dama mesopotamica	318,67	3,96	Capreolus capreolus	100,15	1,64

Table 41. (Table 40 (continued)) Changes in percentages and frequencies of animals in the Early (E.N.) and the Late Natufian (L.N.) periods.

Animal Species:	E.N. NISP TOTALS	Avg %	Animal Species:	L.N. NISP TOTALS	Avg %
		%			%
Lepus sp.	2134,00	9,88	Dama mesopotamica	180,50	1,75
Testudo sp.	2249,00	8,72	Lepus sp.	1271,50	3,63
Carnivora	1,00	0,01	Testudo sp.	6950,00	18,25
Small carnivores	2,00	0,02	Carnivora	39,00	0,30
Canis sp.	5,00	0,06	Small carnivores	5,00	0,03
Vulpes sp.	15,00	0,17	Canis sp.	7,50	0,04
Felis sp.	3,00	0,03	Vulpes sp.	39,50	0,31
Vormella peregusna	1,00	0,01	Felis sp.	1,00	0,01
PISCES	64,00	0,50	PISCES	26,00	0,10
Molluscs	19,00	0,21	Alectoris chukar	327,00	0,94
Alectoris chukar	656,50	1,21	Coturnix coturnix	8,00	0,03
Coturnix coturnix	20,50	0,04	Anatidae	3754,00	10,80
Anas sp.	785,00	1,45	Anas sp.	2,00	0,01
Falconiformes	81,00	1,05	Falconiformes	72,00	1,06
Anser sp.	1,00	0,00	Anser sp.	1,00	0,00
Phasinidae	4,00	0,01	Phasinidae	2,00	0,01
Rallus aquaticus	2,00	0,00	Rallus aquaticus	1,00	0,00
Fulica atra	8,00	0,01	Fulica atra	1,00	0,00
Otis tetrax	0,00	0,00	Otis tetrax	1,00	0,00
Otis tarda	9,00	0,02	Otis tarda	5,00	0,01
Vanellus vanellus	1,00	0,00	Crex crex	2,00	0,01
Crex crex	5,00	0,00	Columba livia	9,00	0,03
Grus grus			Columba palumbus	1,00	0,00
Columbiformes	33,00	0,00	Aves	27,00	0,24
Columba livia	22,00	0,01	Small Aves	12,00	0,03
AVES	623,00	3,38	Medium Aves	71,00	0,27
Small Aves	142,00	1,00	Large Aves	40,00	0,11
Medium Aves	31,00	0,00	Huge Aves	9,00	0,02
Large Aves	1,00	0,00	Erinaceus europ.	3,00	0,04
Huge Aves	1,00	0,00	Rodents	1,00	0,01
Erinaceus europ.	25,00	0,01	Spalax ehrenbergi	31,00	0,45
Rodents	1,00	0,00	Rodentia	89,00	0,08
Spalax ehrenbergi	1,00	0,01	Sciurus anomalus	2,00	0,06
Meriones tristami	55,00	0,67	Microtus guentheri	27,00	0,42
Sciurus anomalus	1,00	0,01	Microchiroptera	4,00	0,09
Mesocricetus auratus	1,00	0,01	Mus musculus	1,00	0,01
Microtus guentheri			Crocidura russula	1,00	0,03
Serpents			Pelobates syriacus	1,00	0,03
Anura	23,00	0,26	Serpents	1,00	0,01
Lacerta sp.	3,00	0,04	Anura	1,00	0,01
Ophisaurus apodus	29,00	0,35	Chameleo chameleon	2,00	0,04
Ophidia	17,00	0,21	Ophisaurus apodus	140,00	2,68
Squamata	29,00	0,35	Agama stellio	5,00	0,06
Insectivores	2,00	0,02	Ophidia	54,00	0,97

Table 42. (Table 41 (continued)) Changes in percentages and frequencies of animals in the Early (E.N.) and the Late Natufian (L.N.) periods

E.N. Animal Species:	E.N. NISP TOTALS	E. N. Sites NISP Avg %	L.N. Animal Species:	L.N. NISP TOTALS	L. N. Sites NISP Avg %
			Squamata	43,00	0,42
			Insectivora	9,00	0,12
E.N. SITES TOTALS	10800,58		L.N. SITES TOTALS	22382,16	

Table 43. Changes in percentages and frequencies of plants in the Early (E.N.) and the Late Natufian (L.N.) periods

	E. N. Plant Totals	E.N. plants avg %	L. N. Plant Totals	L.N. plants avg %
Cereals	N	%	N	%
Hordeum spontaneum (grains)	3,00	0,08	1,00	0,15
Hordeum cf. Spontaneum (grains	1,00	0,03	6,00	0,88
Hordeum cf. Spontaneum (rachis intermode fragments)	2,00	0,05	13,00	1,91
Cereal (grains)	1,00	0,03		0,00
Grasses	0,00	0,00		0,00
cf. Aegilops sp.	1,00	0,03		0,00
cf. Bromus sp.	2,00	0,05	1,00	0,15
Lolium sp.	1,00	0,03		0,00
cf. Stipa sp.	2,00	0,05		0,00
Gramineae (grains)	2,00	0,05		0,00
Species "X"	175,00	4,64		0,00
Other Wild taxa				
cf. Pistacia sp.	3,00	0,08	101,00	14,81
Buglossoides arvensis	1,00	0,03		0,00
Chenopodiaceae/Capparis sp. (spiral embryos)	2,00	0,05		0,00
Matricaria	1,00	0,03		0,00
Lens sp.	1,00	0,03		0,00
Leguminosae	10,00	0,26		0,00
Leguminosae	2,00	0,05		0,00
Liliaceae	6,00	0,16	1,00	0,15
Malva sp.	5,00	0,13		0,00
Unidentified taxa	3203,00	84,87		0,00
CEREALS				
cf. Triticum boeoncum/Secale montanum (grains)	0,00	0,00		0,00
Triticum cf. monococcum/dicoccum (glume bases)	0,00	0,00	8,00	1,17
Triticum cf. monococcam/dicoccum (spikelet forks)	0,00	0,00	2,00	0,29
Triticum spp. glumed wheat (grains)	0,00	0,00	-	0,00
Hordeum spontaneum (rachis int. frags)	0,00	0,00	8,00	1,17
Hordeum sativum (grains)	0,00	0,00	4,00	0,59
Hordeum/Elymus type	0,00	0,00	-	0,00
Cereal indeterminate (grains)	0,00	0,00	10,00	1,47
Culm nodes	0,00	0,00	12,00	1,76

Table 44. (Table 43 (continued)) Changes in percentages and frequencies of plants in the Early (E.N.) and the Late Natufian (L.N.) periods

	E. N. Plant Totals	E.N. plants avg %	L. N. Plant Totals	L.N. plants avg %
GRASSES				
cf.Aegilops sp.	0,00	0,00	4,00	0,59
Phalaris sp.(type a)	0,00	0,00	8,00	1,17
Phalaris sp.(type c)	0,00	0,00	17,00	2,49
Gramineae	0,00	0,00	18,00	2,64
PULSES	0,00	0,00		0,00
Lens sp.	0,00	0,00	6,00	0,88
Vicia/Lathyrus spp.	0,00	0,00	3,00	0,44
Leguminosae	0,00	0,00	13,00	1,91
WILD/"WEED" TAXA	0,00	0,00		0,00
Pistacia sp.	0,00	0,00	38,00	5,57
Chenopodiaceae/Caryophyllaceae	0,00	0,00	7,00	1,03
Chenopodiaceae/Copparij sp. (spiral embr)	0,00	0,00	-	0,00
Cruciferae	0,00	0,00	-	0,00
Geraniaceae ("twists")	0,00	0,00	19,00	2,79
cf. Colutea sp.	0,00	0,00	1,00	0,15
Liliaceae (type x)	0,00	0,00	1,00	0,15
Linum sp.	0,00	0,00	2,00	0,29
Ficus sp. (nutlets)	0,00	0,00	103,00	15,10
Amygdalus sp. (fruit stones)	0,00	0,00	11,00	1,61
Galium sp.	0,00	0,00	1,00	0,15
"Lupin" type	0,00	0,00	2,00	0,29
"XXX" type	2,00	0,05	16,00	2,35
Unidentified taxa	0,00	0,00	245,00	35,92
GRASSES	0,00	0,00		0,00
Echinaria sp.	1,00	0,03		0,00
cf. Stipa sp.	1,00	0,03		0,00
Graminae (type 2)	6,00	0,16		0,00
Gramineae	2,00	0,05		0,00
OTHER TAXA	0,00	0,00		0,00
Atriplex sp.	22,00	0,58		0,00
cf. Atriplex sp.	2,00	0,05		0,00
Chenopodiaceae/Caryophyllaceae	81,00	2,15		0,00
single loop Chenopodiaceae/Crucifer	50,00	1,32		0,00
cf. single loop Cbenopodiaceae/Crucifer	61,00	1,62		0,00
Camphorosma type	10,00	0,26		0,00
Compositae (kernals)	2,00	0,05		0,00
cf. Compositae (kernals)	7,00	0,19		0,00
Cruciferae (type a)	8,00	0,21		0,00
Schoenus nigricons	18,00	0,48		0,00
Cyperaceae (type c)	1,00	0,03		0,00
Cyperaceae (type x)	1,00	0,03		0,00

Table 45. (Table 44 (continued)) Changes in percentages and frequencies of plants in the Early (E.N.) and the Late Natufian (L.N.) periods

	E. N. Plant Totals	E.N. plants avg %	L. N. Plant Totals	L.N. plants avg %
cf. Sophora sp.	1,00	0,03		0,00
Verbascum sp.	10,00	0,26		0,00
Unidentified taxa	64,00	1,70		0,00
	Early Natufian Plant Totals		Late Natufian Plant Totals	
	3774,00		682,00	

Table 46. NISP Percentages and frequencies of Large Mammals in the Early Natufian, tables and comparison analysis for only large mammals/ungulates as main Natufian animal food resources. ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian Sites													
Site:	Fazael VI		Ein Mallaha		Ein Mallaha 2		Ein Mallaha 3		Ein Mallaha 4		Hayonim Cave		E.N. Large Mammals Totals	E.N. Large Mammals Avg %
Type:	*I		*I		*I		*I		*I		*FC			
References:	*Ref 1		*Ref 2		*Ref 5		*Ref 6		*Ref 7		*Ref 3			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%		
Ovicaprids	3	5	23	3	21	7	1	0	1	1	23	1	71	3
Gazella gazella	43	70	491	65	183	62	104	75	107	74	1936	85	2863	78,22
Bos primigenius	1	1	24	3	16	5	8	6	4	3	5	0	57	3
Sus scrofa	4	7	27	4	22	7	8	6	1	1	16	1	77	4
Alcelaphus buselaphus	0	0		0	0	0	0	0	0	0	3	0	3	0
Cervidae	10	16	135	18	0	0		0	0	0		0	145	6
Cervus elaphus	0	0	17	2	13	4	4	3	5	4	16	1	55	2
Capreolus capreolus	0	0	12	2	24	8	7	5	12	8	23	1	78	4
Dama mesopotamica	1	2	26	3	18	6	7	5	14	10	253	11	319	6
Sites Totals	61		754		296		138		145		2275		3669	

Table 47. NISP Percentages and frequencies of Large Mammals in the Late Natufian, tables and comparison analysis for only large mammals/ungulates as main Natufian animal food resources. ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian Sites																	
Site:	Hatoula 4-5		El Wad B1		Nahal Oren V and VI		El Wad A		Hayonim Terrace		Ein Mallaha		Ein Mallaha 1		Salibiya I		L.N. Large Mammals Totals	L.N. Large Mammals Avg %
Type:	*FC		*FC		*FC		*FC		*FC		*I		*I		*I			
References:	*Ref 10		*Ref 12		*Ref 16		*Ref 20		*Ref 8		*Ref 9		*Ref 15		*Ref 11			
	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%		%
Ovicaprids	8	0,34	0	0	1	0	1	1	13	0,6	30	3	14	4	4	1	71	1,17
Gazella gazella	2288	97,65	989	100	1159	83	77	95	1388	65,6	693	57	175	48	431	79	7199	72
Bos primigenius	17	0,73	0	0	165	12		0	3	0,1	44	4	20	6	13	2	262	3,03
Sus scrofa	14	0,60	1	0	54	4		0	14	0,7	103	9	54	15	19	3	259	4,00
Alcelaphus buselaphus	0	0,00		0		0		0	0	0,0		0	29	8	0	0	29	0,99
Cervidae	16	0,68	0	0	0	0		0	0	0,0		0	0	0	0	0	16	0,09
Cervus elaphus	0	0,00		0		0		0	690	32,6	270	22		0	77	14	1037	8,64
Capreolus capreolus		0,00	0	0	0	0		0	4	0,2	30	2	35	9	0	0	69	1,52
Dama mesopotamica		0	1	0	12	1	3	4	3	0,1	40	3	38	11	1	0	98	2,35
Sites Totals	2343		990		1391		81		2115		1211		365		544		9040	

Table 48. MNI Percentages and frequencies of Large Mammals in the Early and the Late Natufian, tables and comparison analysis for only large mammals/ungulates as main Natufian animal food resources. ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian						Late Natufian						Final Natufian			
Site:	Hayonim Cave		El Wad B2		E.N. MNI TOTALS	E.N. MNI avg %	Hayonim Terrace		Hatoula 4-5		El Wad B1		El Wad A		L.N. MNI TOTALS	L.N. + Final N. MNI Avg %
Type:	*FC		*FC				*FC		*FC		*FC		*FC			
References:	*Ref 22:		*Ref 23				*Ref 24:		*Ref 25:		*Ref 26		*Ref 27			
	MNI	%	MNI	%		%	MNI	%	MNI	%	MNI	%	MNI	%		%
Ovicaprids	6	6	0	0	6	3	4	2,4	2	3	0	0	1	4,76	7	3
Gazella gazella	59	58,4	4	100	63	79	107	64	47	71	5	71	16	76,19	175	71
Bos primigenius	5	5		0	5	3	10	6	4	6		0		0,00	14	3
Sus scrofa	3	2,9	0	0	3	1	9	5,4	2	3	1	14	0	0,00	12	6
Equus sp.	1	1		0	1	1	1	0,6				0		0,00	1	0
Cervidae	26	25,7		0	26	13	35	21,2	11	17		0		0,00	46	9
Alcelaphus buselaphus	1			0	1	0			1	1,5		0		0,00	1	1
Cervus elaphus				0	0	0						0		0,00	0	0
Capreolus capreolus			0	0	0	0					1	14	2	9,52	3	12
Dama mesopotamica			0	0	0	0					0	0	2	9,52	2	5
SITES MNI SUMS=>	101		4		105		166		67		7		21		261	

Table 49. Percentage % only frequencies of Large Mammals in the Early Natufian, tables and comparison analysis for only large mammals/ungulates as main Natufian animal food resources. ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Early Natufian										
Site:	Hayonim Cave	Nahal Oren VI	El Wad B2	Kebarah			Wadi Hammeh 27	Beidha	Wadi Judayid 2	Ain al Saratan	
Type:	*FC	*FC	*FC	*FC			*FC	*ISD	*ISD	*ISD	
Ungulates											
	%	%	%	%	%	%	%	%	%	%	%
Ovicaprids	3,60		0,20			0,00	8,00	69,90	64,70	0,00	20,91
Gazella gazella	86,80	82,60	85,20		15,38	50,70	83,60	22,10	18,50	24,50	64,62
Bos primigenius	1,10	5,40	3,30			32,90	0,40	5,90	6,50	38,00	11,69
Sus scrofa	0,80	2,10	0,90			6,60	5,30	0,00	0,00	0,00	1,96
Equus spp.	0,00		0,10			1,90	0,90	2,20	10,30	37,60	7,57
Cervus elaphus	2,20	0,00	0,20			1,90	0,40	0,00	0,00	0,00	0,59
Capreolus capreolus	1,40	0,00	0,10			0,90	0,40	0,00	0,00	0,00	0,35
Dama dama mesopotamica	3,90	9,90	3,60			5,20	0,90	0,00	0,00	0,00	2,94

Table 50. Percentage % only frequencies of Large Mammals in the Late Natufian, tables and comparison analysis for only large mammals/ungulates as main Natufian animal food resources. ***I: inland site, *FC: Forestal and coastal site, *ISD: Inland, steppic and/or desertic site**

	Late Natufian																		Final N.	
Site:	Hayonim Terrace			Nahal Oren V	El Wad B1		Nahal Ein Gev II		Fazael IV	Shukbah B	Nahal Oren VI	Hatoula 4	Hatoula 5	Rakefet	Rosh Horesha	Abu Hureyra	Khallat Anaza	El Wad A	L.N. + Final N. sites Avg %
Type:	*FC			*FC	*FC				*I	*FC	*FC	*FC	*FC	*FC	*ISD	*ISD	*ISD	*FC	
Ungulates																			
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Ovicaprids	0,00	0,50	2,50	0,10	0,10	0,20			0,00	0,00	0,00	0,30	0,40	0,00	37,40	12,10	66,70	0,10	7,53
Gazella gazella	0,00	83,30	65,50	81,50	81,50	85,20		18,520	0,00	85,10	82,70	98,20	99,60	77,90	60,70	71,40	25,90	81,50	52,15
Bos primigenius	0,00	0,00	3,70	11,60	11,60	3,30	0,00	0,00	0,00	11,20	5,40	0,80	0,00	3,20	0,10	0,00	0,00	11,60	3,47
Sus scrofa	0,00	0,90	9,50	3,80	3,80	0,90		3,705	0,00	0,00	2,10	0,70	0,00	7,40	0,00	0,00	0,00	3,80	2,15
Equus spp.	0,00	0,00			0,00	0,10			0,00	0,00	0,00	0,00	0,00	0,00	1,80	16,40	7,40		1,98
Cervidae			18,80																18,80
Cervus elaphus	0,00	0,00		0,00	0,00	0,00			0,00	0,30	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02
Capreolus capreolus	0,00	1,10		0,80	0,80	0,00		3,705	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,80	0,45
Dama dama mesopotamica	0,00	14,20		2,20	2,20	3,60			0,00	3,40	9,90	0,00	0,00	11,60	0,00	0,00	0,00	2,20	3,29

APPENDIX D: ECONOMIC VALUE (EV) AND FOOD VALUE (FV) CALCULATION AND COMPARISON TABLES IN ORDER

Table 51. Early Natufian Animals Economic Values**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

	TN	AVG%	EV (NISP value or % NISP)	FV	% FV	EV (NISP)	EV %	EV (%NISP)	EV%
Large mammals									
Ovicaprids	71	2,87	4*5*103 kg	2060,00	9,35	146260	3,53	5912,2	4,65
Gazella gazella	2863	78,22	4*5*44 kg	880,00	4,00	2519440	61,09	68833,6	49,66
Bos primigenius	57	2,99	4*4*575 kg	9200,00	41,77	524400	12,70	27508	21,65
Sus scrofa	77	4,13	2*3*200 kg	1200,00	5,45	92400	2,25	4956	3,89
Alcelaphus buselaphus	3	0,02	4*5*110 kg	2200,00	9,99	6600	0,16	44	0,04
Cervidae	145	5,72	3*4*230 kg	2760,00	12,53	400200	9,70	15787,2	12,40
Cervus elaphus	55	2,31	3*4*185 kg	2220,00	10,08	122100	2,98	5128,2	4,03
Capreolus capreolus	78	4,05	3*4*23 kg	276,00	1,25	21528	0,52	1117,8	0,88
Dama mesopotamica	319	6,17	3*4*40 kg	480,00	2,18	153120	3,71	2961,6	2,33
Lepus sp.	2134	9,88	2*2*5 kg	20,00	0,09	42680	1,03	197,6	0,16
Testudo sp.	2249	8,72	2*5*1 kg	10,00	0,05	22490	0,55	87,2	0,07
Erinaceus europaeus	1	0,01	4*2*1 kg	8,00	0,04	8	0,00	0,08	0,00
Birds									
Alectoris chukar	657	1,21	4*2*1 kg	8,00	0,04	5256	0,13	9,68	0,01
Coturnix coturnix	21	0,04	4*2*1 kg	8,00	0,04	168	0,00	0,32	0,00
Anas sp.	785	1,45	4*2*5 kg ordek	40,00	0,18	31400	0,76	58	0,05
Falconiformes	81	1,05	4*2*4 kg	32,00	0,15	2592	0,06	33,6	0,03
Anser sp.	1	0,00	4*2*2,65 kg	21,20	0,10	21,20	0,00	0	0,00
Phasianidae	4	0,01	4*2*3,02 kg	24,16	0,11	96,64	0,00	0,24	0,00
Rallus aquaticus	2	0,00	4*2*1 kg	8,00	0,04	16	0,00	0	0,00
Fulica atra	8	0,01	4*2*5 kg	40,00	0,18	320	0,01	0,4	0,00
Otis tetrax	0	0,00	4*2*6 kg	48,00	0,22	0	0,00	0	0,00

Table 52. (Table 51 (continued)) Early Natufian Animals Economic Values**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

	TN	AVG%	EV (NISP value or % NISP)	FV	% FV	EV (NISP)	EV %	EV (%NISP)	EV%
Otis tarda	9	0,02	4*2*12,25 kg	98,00	0,44	882	0,02	1,96	0,00
Vanellus vanellus	1	0,00	4*2*4 kg	32,00	0,15	32	0,00	0	0,00
Crex crex	2	0,00	4*2*0,1675 kg	1,34	0,01	2,68	0,00	0	0,00
Grus grus	3	0,01	4*2*5,25 kg	42,00	0,19	126	0,00	0,42	0,00
Columbiformes	1	0,00	4*2*5 kg	40,00	0,18	40	0,00	0	0,00
Columba livia	5	0,01	4*2*5 kg	40,00	0,18	200	0,00	0,4	0,00
AVES	33	0,37	4*2*6,75 kg	54,00	0,25	1782	0,04	19,98	0,02
Small Aves	22	0,12	4*2*1 kg	8,00	0,04	176	0,00	0,96	0,00
Medium Aves	623	3,38	4*2*4 kg	32,00	0,15	19936	0,48	108,16	0,09
Large Aves	142	0,99	4*2*7 kg	56,00	0,25	7952	0,19	55,44	0,04
Huge Aves	31	0,22	4*2*10 kg	80,00	0,36	2480	0,06	17,6	0,01
E.N. Sites EV Totals	**10483**			**22027**		**4124704,52**		**132840,64**	

General Legend for the Economic Value Tables: For the tables 50-67, E. N. (EN): Early Natufian, L. N. (LN): Late Natufian, *I: inland site, *FC: Forestal and coastal site, AVG: Average, %: Percentage, TN: Total Number, NISP: "Number of Identified Specimens" animal counting method, MNI: "Minimum Number of Individuals" animal counting method, *ISD: Inland, steppic and/or desertic site, EV: Economic Value, FV: Food Value, IG: Individuality or Group (Flock) Parameter, M: Mobility parameter, MW: Meat weight parameter, FV (Food Value) =IG*M*MW , INPUT/OUTPUT RATIO = EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP), for the description of formulas in the tables look at Methodology part and the Economic Food Value Analysis part (Methodology part pages 88-96; 91-96, EV analysis page 122-123 respectively)

Table 53. Late Natufian Animals Economic Values, **FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

	TN	AVG%	EV (NISP value or % NISP)	Food Value (FV)	EV (NISP)	EV %	EV (%NISP)	EV%
Ovicaprids	71	1,17	4*5*103 kg	2060,00	146260	1,23	2410,2	1,89
Gazella gazella	7199	71,79	4*5*44 kg	880,00	6335120	53,31	63175,2	53,90
Bos primigenius	262	3,03	4*4*575 kg	9200,00	2410400	20,28	27876	21,83
Sus scrofa	259	4,00	2*3*200 kg	1200,00	310800	2,61	4800	3,76
Alcelaphus buselaphus	29	0,99	4*5*110 kg	2200,00	63800	0,54	2178	1,71
Cervidae	16	0,09	3*4*230 kg	2760,00	44160	0,38	248,4	0,19
Cervus elaphus	1037	8,64	3*4*185 kg	2220,00	2302140	19,38	19180,8	15,02
Capreolus capreolus	69	1,52	3*4*23 kg	276,00	19044	0,16	419,52	0,33
Dama mesopotamica	98	2,35	3*4*40 kg	480,00	47040	0,40	1128	0,88
Lepus sp.	181	1,75	2*2*5 kg	20,00	3620	0,03	35	0,03
Testudo sp.	1272	3,63	2*5*1 kg	10,00	12720	0,11	36,3	0,03
Alectoris chukar	6950	18,25	4*2*1 kg	8,00	55600	0,47	146	0,11
Coturnix coturnix	327	0,94	4*2*1 kg	8,00	2616	0,02	7,52	0,01
Anas sp.	8	0,03	4*2*5 kg	40,00	320	0,00	1,2	0,00
Falconiformes (food)	3754	10,80	4*2*4 kg	32,00	120128	1,01	345,6	0,27
Anser sp.	2	0,01	4*2*2,65 kg	21,20	42,4	0,00	0,21	0,00
Phasianidae	72	1,06	4*2*3,02 kg	24,16	1739,52	0,01	25,61	0,02
Rallus aquaticus	1	0,00	4*2*1 kg	8,00	8	0,00	0	0,00

Table 54. (Table 53 (continued)) Late Natufian Animals Economic Values, **FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

	TN	AVG%	EV (NISP value or % NISP)	FV	EV (NISP)	EV %	EV (%NISP)	EV%
Fulica atra	2	0,01	4*2*5 kg	40,00	80	0,00	0,4	0,00
Otis tetrax	1	0,00	4*2*6 kg	48,00	48	0,00	0	0,00
Otis tarda	1	0,00	4*2*12,25 kg	98,00	98	0,00	0	0,00
Vanellus vanellus	1	0,00	4*2*4 kg	32,00	32	0,00	0	0,00
Crex crex	5	0,01	4*2*0,1675 kg	1,34	6,7	0,00	0,0134	0,00
Grus grus	2	0,01	4*2*5,25 kg	42,00	84	0,00	0,42	0,00
Columbiformes	9	0,03	4*2*5 kg	40,00	360	0,00	1,2	0,00
Columba livia	1	0,00	4*2*5 kg	40,00	40	0,00	0	0,00
AVES	27	0,24	4*2*6,75 kg	54,00	1458	0,01	12,96	0,01
Medium Aves	71	0,27	4*2*4 kg	32,00	2272	0,02	8,64	0,01
Large Aves	40	0,11	4*2*7 kg	56,00	2240	0,02	6,16	0,00
Huge Aves	9	0,02	4*2*10 kg	80,00	720	0,01	1,6	0,00
Erinaceus europaeus	3	0,04	4*2*1 kg	8,00	24	0,00	0,32	0,00
L.N. Sites EV Totals	**21790**			**22027**	**11880780**		**122045,27**	

Table 55. Early Natufian sites Economic Values

Sites:	Fazael VI, **E. N., I**				Ein Mallaha, **E. N., I**			Ein Mallaha 2, **E. N., I**			Ein Mallaha 3, **E. N., I**		
	NISP	**Total of Food Values=FV**	**EV (NISP)**	**EV (% NISP)**	NISP	**EV (NISP)**	**EV (% NISP)**	NISP	**EV (NISP)**	**EV (% NISP)**	NISP	**EV (NISP)**	**EV (% NISP)**
Sites Totals	**61**	**22027**	**81060**	**132885**	**1161**	**1158502**	**153339**	**296**	**421699**	**142466**	**138**	**186997**	**135505**
%			1,96	17,37		27,99	20,05		10,19	18,63		4,52	

Table 56. (Table 55 (continued)) Early Natufian sites Economic Values

Ein Mallaha 4			Hayonim Cave			El Wad B2			**E.N. Large Mammals EV Totals**	
*I	E. N.		*FC	E. N.		*FC	E. N.			
	EV (NISP)	**EV (% NISP)**	NISP	**EV (NISP)**	**EV (% NISP)**	NISP	**EV (NISP)**	**EV (%NISP)**	**EV (NISP)**	**EV (% NISP)**
145	**157472**	**108601**	**7699**	**2094556**	**88704**	**1000**	**39394**	**3370**	**4124704,52**	**132840,64**
%	3,80	14,20		50,60	11,60		0,95	0,44		

Table 57. Late Natufian sites Economic Values

Sites:	Hatoula 4-5			El Wad B1			Nahal Oren V and VI			Hayonim Terrace			Hayonim Cave		
Type:	*FC	L. N.		*FC	L. N.		*FC	L. N.		*FC	L. N.		*FC	L. N.	
	NISP	EV (NISP)	EV (% NISP)	NISP	EV (NISP)	EV (% NISP)	NISP	EV (NISP)	EV (% NISP)	NISP	EV (NISP)	EV (%NISP)	NISP	EV (NISP)	EV (% NISP)
Sites Totals	3177	2273968	96702	1086	872966	69559	1422	2611160	183626	8793	2942221	33002	3271	29860	911
	%	19,05	10,08		7,31	7,25		21,87	19,14	40,24	24,65	0,00	14,97	0,25	0,09

Table 58. (Table 57 (continued)) Late Natufian sites Economic Values

Ain Mallaha			Ain Mallaha 1			Salibiya I			Nahal Ein Gev II			Fazael IV		
*I	L. N.		*I	L. N.		*I	L. N.		*I	L. N.		*I	L. N.	
NISP	EV NISP	EV (% NISP)	NISP	EV NISP	EV (% NISP)	NISP	EV NISP	EV (% NISP)	NISP	EV (NISP)	EV (% NISP)	NISP	EV (NISP)	EV (% NISP)
1371	1830409	129525	399	526414	131867	594	698920	111790	44	38040	85966	18	15840	88000
6,27	15,33	13,50	1,83	4,41	13,74	2,72	5,85	11,65	0,00	0,32	8,96	0,08	0,13	9,17

Table 59. (Table 58 (continued)) Late Natufian sites Economic Values

Mureybet			Hilazon Tachtit			El Wad A			L.N. Large Mammals EV Totals	
***I**	L. N.		***I**	L. N.		***FC**	L. N.			
NISP	**Economic food values TOTAL EV**	**Economic food values TOTAL EV %**	**NISP**	**Economic food values TOTAL EV**	**Economic food values TOTAL EV%**	**NISP**	**Economic food values TOTAL EV**	**Economic food values TOTAL EV %**	**Economic food values TOTAL EV**	**Economic food values TOTAL EV %**
567	**17532**	**3092**	**967**	**8725**	**895**	**142**	**72008**	**24660**	**11880780**	**122045,27**
2,59	0,15	0,32	4,43	39,93	3,63	0,65	0,60	2,57		

Table 60. Early Natufian Animals MNI EV Totals**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

E. N. Sites Totals	**E.N. MNI Avg %**	**Food Value (FV)**	**EV**	**INPUT/OUTPUT ratio MNI= EV**	**INPUT/OUTPUT ratio % MNI= EV**	**L. N.+ Final N. Sites Total**	**L.N. + Final N. MNI Average percentages**	**Food Value (FV)**	**EV**	**INPUT/OUTPUT ratio MNI EV**	**INPUT/OUTPUT ratio % MNI EV**
MNI	**%**					**MNI**	**%**				
Ovicaprids =>6	**3**	4*5*103 kg	2060,00	12360	6180	**7**	**2,54**	4*5*103 kg	2060,00	14420	5232,4
Gazelle=>63	**79,2**	4*5*21 kg	880,00	55440	69696	**175**	**70,59**	4*5*21 kg	880,00	154000	62119,2
Bos=>5	**2,5**	4*4*575 kg	9200,00	46000	23000	**14**	**3,00**	4*4*575 kg	9200,00	128800	27600
Sus=>3	**1,45**	2*3*200 kg	1200,00	3600	1740	**12**	**5,67**	2*3*200 kg	1200,00	14400	6804
Cervidae=>26	**12,85**	3*4*230 kg	2760,00	71760	35466	**46**	**9,49**	3*4*230 kg	2760,00	126960	26192,4
Alcelaphus=>1	**0**	4*5*110 kg	1100,00	1100	0	**1**	**0,50**	4*5*110 kg	1100,00	1100	550
Cervus=>0	**0**	3*4*185 kg	2220,00	0	0	**0**	**0,00**	3*4*185 kg	2220,00	0	0
Capreolus=>0	**0**	3*4*23 kg	276,00	0	0	**3**	**11,90**	3*4*23 kg	276,00	828	3284,4
Dama dama=>0	**0**	3*4*40 kg	480,00	0	0	**2**	**4,76**	3*4*40 kg	480,00	960	2284,8
Lepus=>2	**3**	2*2*5 kg	20,00	40	60	**7**	**2,29**	2*2*5 kg	20,00	140	45,8
cf. Vormella=>1	**1**	4*2*30 kg	240,00	240	240	**0**	**0,00**	4*2*30 kg	240,00	0	0
Erinaceus=>1	**1**	4*2*1 kg	8,00	8	8	**2**	**1,00**	4*2*1 kg	8,00	16	8

Table 61. (Table 60 (continued)) Early Natufian Animals MNI EV Totals**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

E. N. Sites Totals	E.N. MNI Avg %	Food Value (FV)	EV	INPUT/ OUTPUT ratio MNI= EV	INPUT/OUTPUT ratio % MNI= EV	L. N. Sites Total	L.N. + Final N. MNI Avg %	Food Value (FV:)	EV	INPUT/ OUTPUT ratio MNI EV	INPUT/ OUTPUT ratio % MNI EV
MNI						MNI					
E. N. MNI large mammals TOTALS						L. N. MNI large mammals TOTALS					
108			20444	190548	E.N.=> (% EV) 136390	269			20444	441624	L.N.=> (% EV) 134121

Table 62. Early Natufian Sites MNI EV Totals

	Early Natufian									
Site:	Hayonim Cave					El Wad B2			E.N. MNI EV TOTALS	
Type:	*FC					*FC				
SITES MNI SUMS=>	MNI		EV=>IG*M*MW	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	MNI	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	E. N. MNI TOTAL EV	E. N. MNI TOTALs % EV
	100		20444	186740	184164	8		3808	190548	136390

Table 63. (Table 62 (continued)) Late Natufian Sites MNI EV Totals, **FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

L a t e N a t u f i a n										Final Natufian				
Hayonim Terrace				Hatoula 4-5			El Wad B1			El Wad A				
*FC				*FC			*FC			*FC				
MNI	EV	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	MNI	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	MNI	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	MNI	INPUT/OUTPUT ratio MNI EV	INPUT/OUTPUT ratio % MNI EV	L.N. + Final N. MNI TOTAL EV	L.N. + Final N. MNI TOTAL EV %
165	20444	301800	181456	67	116140	175120	10	5924	58847	27	17760	65398	441624	134121

Table 64. Ungulates Economic Value (EV) calculations by using only Percentage % frequency values**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

Ungulates	**Early Natufian sites Avg %**	**EV (% value)**	**Food Value (FV)**	**INPUT/OUTPUT ratio EV (% value)**	**L.N. + Final N. sites Avg %**	**EV (% value)**	**FV**	**INPUT/OUTPUT ratio (% value EV (% value)**
	%				**%**			
Ovicaprids	**20,91**	4*5*103 kg	2060	43074,6	**7,53**	4*5*103 kg	2060	15511,8
Gazella gazella	**64,62**	4*5*21 kg	880	56865,6	**52,15**	4*5*21 kg	880	45892
Bos primigenius	**11,69**	4*4*575 kg	9200	107548	**3,47**	4*4*575 kg	9200	31924
Sus scrofa	**1,96**	2*3*200 kg	1200	2352	**2,15**	2*3*200 kg	1200	2580
Cervidae		3*4*230 kg	2760	0	**18,80**	3*4*230 kg	2760	51888
Alcelaphus buselaphus		4*5*110 kg	1100	0	**0,00**	4*5*110 kg	1100	0

Table 65. (Table 64 (continued)) Ungulates Economic Value (EV) calculations by using only single Percentage % frequency values**, FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

Ungulates	**Early Natufian sites Avg %**	**EV (% value)**	**Food Value (FV)**	**INPUT/OUTPUT ratio=EV (% value)**	**L. N. + Final N. sites Avg %**	**EV=> (% value)**	**FV=>IG* M*MW**	**INPUT/OUTPUT ratio =EV (% value)**
Cervus elaphus	**0,59**	3*4*185 kg	2220	1309,8	**0,02**	3*4*185 kg	2220	44,4
Capreolus capreolus	**0,35**	3*4*23 kg	276	96,6	**0,45**	3*4*23 kg	276	124,2
Dama dama mesopotamica	**2,94**	3*4*40 kg	480	1411,2	**3,29**	3*4*40 kg	480	1579,2
Lepus europaeus	**7,70**	2*2*5 kg	20	154	**7,41**	2*2*5 kg	20	148,2
cf . Vormella peregusna	**3,85**	4*2*30 kg	240	924	**0,00**	4*2*30 kg	240	0
Erinaceus europaeus	**3,85**	4*2*1 kg	8	30,8	**3,71**	4*2*1 kg	8	29,68
Economic Food Value SUMS			**20444**	**EN=>213766,6**			**20444**	**LN=>149721,48**

Table 66. Economic Value (EV) calculations by using only single Percentage % frequency values, **FV (Food Value) =IG*M*MW , EV (Economic Value) =IG*M*MW*frequency (NISP value or % NISP)**

Site:	Hayonim Cave			Nahal Oren VI	El Wad B2	Wadi Hammeh 27	Beidha	Wadi Judayid 2	Ain al Saratan	
Date/Period:	EN			EN	EN	EN	EN	EN	EN	
Type:	FC			FC	FC	FC	ISD	ISD	ISD	
INPUT/ OUTPUT ratio= EV %=>	**FV**	**20444**	**102022**	**129640**	**109028**	**14643**	**362178**	**101518**	**217722**	**209362**

Table 67. Economic Value (EV) calculations by using only single Percentage % frequency values

Site:	Hayonim Terrace			Nahal Oren V			Nahal Ein Gev II	Fazael IV	Shukbah B	Nahal Oren VI
Date/Period:	LN			LN			LN	LN	LN	LN
Type:	FC			FC				I	FC	FC
INPUT/ OUTPUT ratio EV %	**0**	**82534**	**160118**	**184483**	**184483**	**108556**	**21944**	**0**	**180226**	**129728**

Table 68. (Table 67 (continued)) Economic Value (EV) calculations by using only single Percentage % frequency values

Site:	Hatoula 4	Hatoula 5	Rakefet	Rosh Horesha	Abu Hureyra	Khallat Anaza	El Wad A (Final N.)
Date/Period:	L. N.	L. N.	L. N.	L. N.	L. N.	L. N.	Final N.
Type:	FC	FC	FC	ISD	ISD	ISD	FC
INPUT/ OUTPUT ratio EV %	**95234**	**88472**	**112440**	**131380**	**87758**	**160194**	**184483**

APPENDIX E: CURRICULUM VITAE (C.V.)

PERSONAL INFORMATION

Surname, Name: Ferah, Egemen

Nationality: Turkish (T.C.)

Date and Place of Birth: 31 October 1984 , Adana/TURKEY

Marital Status: Single

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EDUCATION

Degree	Institution	Year of Graduation
Ph.D.	METU ISS (SBE) Settlement Archaeology, Ankara	Continuing Ph.D. (Doctorate) Student, 2010 (till 2014)
M.S.	METU ISS (SBE) Settlement Archaeology, Ankara	2009
B.S.	Bilkent University FEASS (IISBF) Economics, Ankara	2007
High School	TED Ankara Colledge High School, Ankara	2001

WORK EXPERIENCE

Year	Place	Enrollment
2009 March-June	British Institute of Archaeology Anthropological Archaeology - Bone and Pollen Analysis Laboratory (B.I.A.A/Çankaya/Ankara/Turkey)	Anthropology Laboratory bone database assistant, Archaeology M.S.-Ph.D. Student
2009 July-September	Tell Atchana/Alalakh mound excavation project –Tayfur Sökmen village (Reyhanlı/Antakya/Hatay/Turkey)	Intern Archaeology Student, excavation trench assistant
2008 August	Tell Atchana/Alalakh mound excavation project –Tayfur Sökmen village (Reyhanlı/Antakya/Hatay/ Turkey)	Intern Archaeology Student, excavation trench assistant
2008 July-August	M.E.T.U. T.A.Ç.D.A.M. and Graduate Department of Settlement Archaeology Datça Burgaz (Old Knidos) excavation project (Datça/ Muğla/ Turkey)	Intern Archaeology Student, excavation trench assistant
2006 September-2007 September	Bilkent University – FEASS (IISBF) Department of History - Work together with my professor (Bilkent University Main Campus FEASS Building/ Bilkent/ Çankaya/ Ankara/ Turkey)	Database-computer work, accounting, programming, web design-graphic design-video-photo recording-editing, Assistance for my professor, as an Economics Bachealor graduate
2003 July-August	Dışbank (Türk Dış Ticaret Bankası – nowadays "Fortis Bank") İç Anadolu Bölge Müdürlüğü (Central Anatolian Regional Management) (Ankara/ Turkey)	Intern Economics Student
2003 June-July	Garanti Bank, Ege Kurumsal (Institutional) Branch (İzmir/ Turkey)	Intern Economics Student

FOREIGN LANGUAGES

Advanced English, Intermediate German, Basic French, Basic Spanish, Basic Italian and Basic Russian.

HOBBIES

Voluntary activities, active membership in non-governmetal organisations' voluntary social responsibility projects (TOG – Toplum Gönüllüleri Vakfı – Society Volunteers Community, active participation to voluntary groups, coordination and organisation in social projects for voluntary educating and helping poor working homeless children studying, living and working in the streets and helping blind/or physically and/or mentally obstacled children and people), traveling and hitchiking in Turkey and in different foreign neighbourhood countries in the borders, hiking, bicycle, photography, thinking, analyzing, philosophy, computer technologies, reading books, watching documentary films and documentary series, foreign and Turkish series and movies, video montage-digital/analog video editing, short amateur film making, web design, programming, statistics, probability, mathematics, physics, mechanics, quantum philosophy/physics/mechanics, sociology, social/psychology.