ENVIRONMENTAL FOUNDATIONS:

STUDIES OF CLIMATICAL, GEOLOGICAL, HYDROLOGICAL, AND PHYTOLOGICAL CONDITIONS IN HESBAN AND VICINITY

Contributors

Patricia Crawford
Kevin Ferguson
Dennis Gilliland
Tim Hudson
Øystein Sakala Labianca
Larry Lacelle

Volume Editors
Øystein Sakala Labianca
Larry Lacelle

Associate Editor
Lorita E. Hubbard

Assistant Editors
Lori A. Haynes
Sandra L. Penley

Technical Assistants
James K. Brower
Oscar Canale
Tung Isaiah Duong

published with the financial assistance of the National Endowment for the Humanities and Andrews University
Table of Contents

Chapter One  Introduction
Øystein Sakala Labanca  3

Chapter Two  Climate of Tell Hesban and Area
Kevin Ferguson and Tim Hudson  7

Introduction  9
Aspects of Paleoclimatology in Hesban and Vicinity  9
Introduction to Macroprocesses  11
   Summer Air Masses and Movements  11
   Winter Air Masses and Movements  13
   Transitional Seasons  13
Methodological Approach to Climate Classification for Hesban  15
   Temperatures at Hesban  16
   Precipitation at Hesban  18
   Condensation at Hesban  18
   Climate and Humans at Hesban  21

Chapter Three  Bedrock, Surficial Geology, and Soils
Larry Lacelle  23

Introduction  25
Bedrock Geology  25
   Bedrock Characteristics  28
   Influences of Bedrock Geology on Man  31
   Influences of Man on Bedrock Geology  35
Surficial Geology  35
   Physiographic Subdivisions and Landforms  35
   Geomorphic Processes and Physical Characteristics of the Surficial Materials  38
   Influences of Surficial Geology on Man  45
   Influences of Man on the Surficial Geology  45
Soils  45
   Soil Classification  45
   Soils Genesis  48
   Soils Physical Properties  53
   Soil Chemical Properties  53
   Influences of Soils on Man  57
   Influences of Man on Soils  57

Chapter Four  Surface and Groundwater Resources of Tell Hesban and Area, Jordan
Larry Lacelle  59

Introduction  61
Surface Water  61
   Influences of Surface Water Resources on Man  69
Influences of Man on the Surface Water Resources  69
Groundwater  69
     Influences of the Groundwater Resources on Man  72
     Influences of Man on the Groundwater Resources  72

Chapter Five  Flora of Tell Hesban and Area, Jordan
Patricia Crawford

Introduction  77
Economic Uses of Plants  79
     Plants Utilized as Food  79
     Plants Utilized for Industrial Purposes  80
     Plants Utilized for Domestic Purposes  80
     Plants Utilized for Fodder and Forage  80
Species Descriptions  82
Cultivated Plants of Tell Hesban Area  97
Summary 98

Chapter Six  Ecology of the Flora of Tell Hesban and Area, Jordan
Larry Lecelle

Introduction  101
General Characteristics of the Flora  101
     Vegetation Zonation and Potential Climax Species  101
     Present-day Flora  105
     Environmental Parameters and Their Effects Upon the Flora  105
Ecological Units of the Tell Hesban Area  110
     Dry-Farmed, Cultivated Fields  110
     Dry, Barren Hillsides  113
     Moor Wadi Floors  113
     Irrigated, Cultivated Fields  113
Summary 119

Chapter Seven  Paleoenthnobotany and Paleoenvironment
Dennis R. Gilliland

Introduction 123
Materials and Methods 124
Results 125
Discussion 125
     Comparison with the Previous Study 125
     Ethnobotanical and Paleoenvironmental Interpretations 125
     Paleoenvironment 139
Conclusions 139

Chapter Eight  Conclusion
Øystein Sakala LaBianca and Larry Lecelle

Index  147
FAUNAL REMAINS:

TAPHONOMICAL AND ZOOARCHAEOLOGICAL STUDIES OF THE ANIMAL REMAINS FROM TELL HESBAN AND VICINITY

Edited by
Øystein Sakala LaBianca
Angela von den Driesch

Contributors
Joachim Boessneck †
Angela von den Driesch
Øystein Sakala LaBianca
Johannes Lepiksaar

Managing Editor
Ralph E. Hendrix

Assistant Editor
Lori A. Haynes

HESBAN 13

ANDREWS UNIVERSITY PRESS

in cooperation with the
INSTITUTE OF ARCHAEOLOGY
ANDREWS UNIVERSITY

Published with the financial assistance of the
National Endowment for the Humanities
and Andrews University

ANDREWS UNIVERSITY
ARCHAEOLOGICAL MUSEUM
Illustrations, unless otherwise noted, are from the Horn Archaeological Museum (Heshbon Expedition archive). Cover design by Ralph E. Hendrix. Series cover design by Peter Erhard. Figure 1.1 and Table 1.1 digitized by James Robertson. Dedication drawing and plate 1.9 courtesy of Sven Mathiasson, Naturhistoriska Museet, Goteborg, Sweden. Plates 1.12 and 2.2-36 courtesy of Øystein Sakala LaBianca. Figures 2.1, 3.2 4.2-7, 5.2-10, 5.17, 5.18 digitized by Sharon Prest. Plates 6.1-10, 7.1-7, 8.1-21, and 9.1-95 courtesy of the respective chapter authors. Figures 8.1-55 by Jennifer Johnson after various originals.
Johannes Lepiksaar

Johannes Lepiksaar was born in Rakvere, Estonia, on the 20th of November in 1907. He was educated at the University of Tartu (Dorpat), Estonia, where he received his Mag. scient. in 1930. In 1968, he was awarded a PhD honoris causa at the University of Goteborg, Sweden, and later, at the University of Lund in 1988.

He was first appointed to the Department of Zoology at the University of Tartu in 1929 as an assistant curator. In 1939, he became curator of the Zoological Museum at the same university. During the troublesome years of World War II, Lepiksaar left Estonia for Sweden. He long refused to become a Swedish citizen—hoping for things to change in the east. Although he lost a great deal upon leaving Estonia (especially his library), being a man of principle and determination, he started over again upon arriving in Sweden. Over the years, his entire apartment was turned into a rich library! After some years in Uppsala, he was appointed to the Natural History Museum of Goteborg in 1949, where he was in office until he retired in 1972.

When Johannes Lepiksaar abruptly left Estonia, he was followed by his wife Niina, who never left his side and on whom he depended in every aspect of daily life. Niina was a former student of her husband. She was also a biologist and skilled watercolor painter. Their home was open to scientists from all parts of the world. Niina, born in 1911, died in Goteborg in December 1994.

Lepiksaar is an internationally-recognized vertebrate zoologist—specializing in osteology. His fields of research include domesticated animals, fish osteology, palaeozoology, and systematics. He has also been involved in faunistics and zoogeography—especially faunal history. Johannes Lepiksaar lives in Goteborg.

Sven Mathiasson
Naturhistoriska Museet
Goteborg, Sweden

Oystein S. LaBianca
Institute of Archaeology
Berrien Springs, MI
# Table of Contents

**Foreword**  
*Randall W. Younker*  
xxi

**Preface**  
*Øystein Sakala LaBianca*  
xxiii

## Chapter One  
The Development of the Bone Work on the Heshbon Expedition  
*Øystein Sakala LaBianca*

- Introduction 3  
- Beginnings: The First Field Season 3  
- Development: The Second through Fourth Field Seasons 5  
- The Climax: The Fifth Field Season in 1976 11  
- A Challenge of Integration: The Final Publication Project 12  
- Overview of Volume 13 12  
- References 13

## Chapter Two  
Ethnoarchaeological and Taphonomical Investigations in the Village of Hesban  
*Øystein Sakala LaBianca*

- Introduction 17  
- Objectives, Personnel, and Procedures 18  
- The Hierarchy of Animals in the Village of Hesban (D. Fuller) 19  
- Animal Census of the Village of Hesban (D. Downing, M. Casebolt, T. Fuentes) 22  
- Sheltering of Animals in the Village of Hesban (Ø. LaBianca, A. LaBianca, D. Downing, M. Casebolt, T. Fuentes, P. Butterworth) 23  
- Butchering of Animals in the Village of Hesban (D. Fuller) 25  
- Meals Containing the Flesh of Animals Served in the Village of Hesban (M. Casebolt, T. Fuentes, A. LaBianca) 26  
- Disposal of Animal Wastes by Hesban Villagers (Ø. LaBianca) 27  
- Common Scavengers in the Village of Hesban (Ø. LaBianca) 27  
- Taphonomical Survey in the Village of Hesban (Ø. LaBianca) 29  
- Toward a Firmer Theoretical Rationale for the Study of Animal Bones from Historical Tell Sites 31  
- References 32

## Chapter Three  
The Nature of the Zooarchaeological Record at Tell Hesban  
*Øystein Sakala LaBianca*

- Introduction 35  
- Excavation Areas on Tell Hesban 35  
- The Proportion of the Whole Tell Probed by the Excavations 37  
- Bones Saved and Discarded from Different Excavation Areas 37  
- The Stratigraphical and Chronological Context of Animal Bone Deposit 37  
- The Depositional Context of Bones from the 1976 Season 42  
- Survival Rates of Different Skeletal Parts 42  
- Conclusions: Post-depositional Processes at Tell Hesban 43  
- References 44
Chapter Four  The Effect of Post-depositional Contexts on the Preservation and Interpretation of Bone Samples: A Case Study

Öystein Sakala LaBlanca

Introduction 47
The Two Micro-contexts 47
Evidences of Post-depositional Disturbance 50
Evidence for Cultural Patterning 50
The Ratio of Sheep to Goats 50
The Ratio of Males to Females 54
Percentages of Young and Old Animals 54
Percentages of Butchering Marks 58
Cultural Patterning 58
Conclusions 62
References 62

Chapter Five  Final Report on the Zooarchaeological Investigation of Animal Bone Finds from Tell Hesban, Jordan

Angela von den Driesch and Joachin Boessneck†

Introduction 67
The Finds: A Synopsis 67
Notes on Dating of Finds and Temporal Distribution 70
Archaeoeconomic and Zoological Research Section 71
Domestic Animals 71
Wild Mammals 85
Wild Birds 94
Reptiles and Variegated Toads 97
Fish 98
Conclusions 102
Notes 103
References 103

Chapter Six  Evidence of Deer in the Early Historical Period of Tell Hesban, Jordan

Joachim Boessneck† and Angela von den Driesch

Introduction 111
Pre-historic Findings 111
Historic Findings 111
Examples from Palestine 111
Deer Bones at Tell Hesban 113
Species Comparison from Tell Hesban 113
The Ancient Hesban Habitat 117
Note 117
References 117

Chapter Seven  Bones of the Weasel, Mustela nivalis Linné, 1766, from Tell Hesban, Jordan

Joachim Boessneck†

Introduction 123
Analysis of the Weasel: Bones 123
Material 123
Dating 123
Sex Features 124
Differentiating Weasels 126
Weasels and Polecats 126
Weasel Subspecies 126
Weasels and their Prey 126
Note 126
References 126
Chapter Eight Birds, Reptiles, and Amphibians

Joachim Boessneck†

Introduction 131
Birds 132
Ostrich, Struthio camelus syriacus 132
White Stork, Ciconia ciconia 133
Greater (or Rosate) Flamingo, Phoenicopterus ruber roseus 133
Domestic Goose, Anser anser domesticus 134
Egyptian Vulture, Neophron percnopterus 134
Griffon Vulture, Gyps fulvus 135
Black Vulture, Aegypius monachus 136
Undetermined Eagle 136
European Sparrowhawk, Accipiter nisus or Levant Sparrowhawk, Accipiter brevipes 138
Black Kite, Milvus migrans migrans 138
Great Falcon, Falco Species 139
Old World (Eurasian) Kestrel, Falco tinnunculus 140
Lesser Kestrel, Falco naumanni 140
Chukar Partridge, Alectoris chukar 140
Arabian Sand Partridge, Ammoperdix heyi 143
Common Quail, Coturnix coturnix 143
Common Crane, Grus grus 143
Corn Crane, Grus cherch 144
Coot, Fulica atra 144
Great Bustard, Otis tarda 145
Houbara Bustard, Chlamydotis undulata 145
Cream-colored Courser, Cursorius cursor 146
Stone Curlew, Burhinus oedicnemus 146
Black-bellied Sandgrouse, Pterocles orientalis 147
Domestic Pigeon, Columba livia domesticus and Rock Dove, Columba livia 147
Laughing Dove, Streptopelia senegalensis 149
Barn Owl, Tyto alba 150
Little Owl, Athene noctua lilith 150
Short-toed Lark, Calandrella brachydaictyla or Lesser Short-toed Lark, Calandrella rufescens 151
Woodlark, Lullula arborea 153
Warbler, Hippolais Species 153
Wheatear, Oenanthe Species 154
European Blackbird, Turdus merula 154
Corn Bunting, Emberiza calandra 155
Medium-sized Bunting, Emberiza Species 155
House Sparrow, Passer domesticus 156
Rock Sparrow, Periparus petronia 156
Common Starling, Sturnus vulgaris or Rose-colored Starling, Sturnus roseus 157
Jackdaw, Corvus monedula soemmerringii 157
Brown-necked Raven, Corvus ruficollis 158
Common Raven, Corvus corax subcorax 160
Unidentified Birdhones 160

Reptiles and Amphibians 160
Tortoise, Testudo graeca terrestris 160
Hardoun, Agama stellio 161
Scheltopusik, Ophisaurus apodus 162
Racer, Coluber species 162
Variegated Toad, Bufo viridis 163

Conclusions 164
References 165

Chapter Nine Fish Remains from Tell Hesban, Jordan

Johannes Lepiksaar

Introduction 171
Methodical Remarks 171
Quantitative Analysis 171
Family Cyprinidae, Minnows 173
  Taxonomical Remarks 173
  Dispersal of Finds 174
  Preservation and Its Probable Causes 174
  Zoogeographical Remarks 175
  Ecological Remarks 175
  Economical Remarks 176
  Occurrence at Tell Hesban 176
Family Claridae, Catfish 176
  Taxonomical Remarks 176
  Dispersal of Finds 177
  Preservation 177
  Zoogeographical and Ecological Remarks 177
  Economical Remarks 178
  Occurrence at Tell Hesban 178
Family Mugilidae, Grey Mullet 179
  Taxonomical Remarks 179
  Dispersal of Finds 180
  Preservation 180
  Zoogeographical Remarks 181
  Ecological Remarks 181
  Economical Remarks 181
  Occurrence at Tell Hesban 181
Family Serranidae, Sea Perches or Basses 182
  Taxonomical Remarks 182
  Preservation 182
  Zoogeographical and Ecological Remarks 182
  Economical Remarks 183
  Occurrence at Tell Hesban and Dispersal of Finds 184
  Preservation 184
  Zoogeographical, Ecological, and Economical Remarks 184
  Occurrence at Tell Hesban 184
Family Sciaenidae, Drums and Croakers; Johnius hololepidotus (Lacèpède), Meagars 185
  Taxonomical Remarks 185
  Stratigraphic Survey of Finds 185
  Dispersal of Finds 185
  Preservation 185
  Zoogeographical and Ecological Remarks 185
  Economical Remarks 186
  Occurrence at Tell Hesban 186
Family Sparidae, Sea Breams 186
  Taxonomical Remarks 186
  Dispersal of Finds 186
  Preservation 187
  Zoogeographical Remarks 187
  Ecological and Economical Remarks 187
  Occurrence at Tell Hesban 187
Family Cichlidae, Combs 188
  Taxonomical Remarks 188
  Dispersal of Finds 189
  Preservation 189
  Zoogeographical Remarks 191
  Ecological and Economical Remarks 192
  Occurrence at Tell Hesban 192
Family Scaridae, Parrot Fish 192
  Taxonomical Remarks 192
  Dispersal of Finds 194
  Preservation 195
  Zoogeographical Remarks 196
  Ecological and Economical Remarks 196
  Occurrence at Tell Hesban 196
Family Scombridae, Mackerels and Tunnies 197
   Taxonomical Remarks 197
   Dispersal of Finds 203
   Preservation 207
   Zoogeographical Remarks 209
   Ecological Remarks 209
   Economical Remarks 209
   Occurrence at Tell Elahben 209
   Unidentified Fish Remains 209
   References 210

Chapter Ten Interpretive Conclusions
   Øystein Sakala Lalliaca 211

   Introduction 213
   The Predominance of Sheep and Goats 213
   Mixed Agro-pastoral Dry Farming 213
   Cycles of Sedentarization and Nomadization 214
   Zooarchaeological Correlates of Cycles 215
   Food System Cycles and the Natural Environment 216
   References 216

Indexes
   Ralph E. Hendrix 219

   General Index 219
   Index of Bones and Body Parts 227
   Index of Species, Common Names 230
   Index of Species, Scientific Names 233