

Contents

Introduction	xiii
Michèle TIXIER-BOICHARD and Georges PELLETIER	
Chapter 1. Thousands of Years of Relationship between Man and Dog Revealed by Genomics	1
Morgane OLLIVIER	
1.1. The history of dog domestication, the subject of much debate.	2
1.1.1. The dog: domesticated since the Paleolithic period	2
1.1.2. The process behind dog domestication	3
1.1.3. The number and location of domestication events: contextualization and the contribution of archaeological and genomic data	5
1.2. Paleogenomics: an essential tool for understanding the evolutionary history of the dog	7
1.2.1. Eurasian origins and diffusion	7
1.2.2. The uniqueness of the Iberian Peninsula	8
1.2.3. Origins of the dog in America	9
1.3. From commensalism to modern breeds: identifying the genomic foundations behind the intensification of the human–dog relationship.	11
1.3.1. Selection and domestication markers	12
1.3.2. Genetic variation and adaptation to a starch-rich diet.	13
1.3.3. The evolution of coat color	14
1.3.4. The question of human–dog co-evolution.	15

1.4. Selection of modern breeds, evolution in an anthropic context	16
1.4.1. Origins and timing of selections	16
1.4.2. Phenotypic and genetic variability	17
1.4.3. Harmful effects and genetic diseases	18
1.5. References	19
Chapter 2. Imprints of Domestication in the Sheep Genome	21
Charlotte HER and François POMPANON	
2.1. The cradle of domestication in the Middle East	21
2.1.1. The beginnings of domestication	21
2.1.2. Genes involved in domestication	24
2.2. Conquering the West	27
2.2.1. Primitive sheep versus more productive breeds	28
2.2.2. The mouflons of the Mediterranean islands, relics of the first wave of domestication	29
2.2.3. Southern Europe, diversity and global influence.	30
2.3. Africa	31
2.3.1. Diffusion	31
2.3.2. North Africa, the impact of the race for productivity	34
2.4. Asia	35
2.4.1. Genetic signatures of origin, expansion and mixes	35
2.5. Conclusion	38
2.6. References	38
Chapter 3. Humans and Pigs: Over Ten Thousand Years of Shared Evolution.	41
Laurent FRANTZ	
3.1. The evolution of <i>Sus scrofa</i> over the last 2 million years	41
3.2. The genomics of adaptation in <i>Sus scrofa</i>	44
3.3. The processes of pig domestication.	46
3.4. Using archaeology and genomics to trace the history of pig domestication	47
3.4.1. Archaeology and history of pig domestication	47
3.4.2. Genomics and the history of pig domestication	49
3.4.3. The first study of mitochondrial DNA.	49
3.5. The 19th century and the advent of the out stud-book.	52

3.6. Before domestication: human-initiated movements of wild and domesticated pigs	53
3.7. Conclusion	54
3.8. References	54

**Chapter 4. The Domestication of the Wild Rabbit: Genetic
and Genomic Elements** 59
Hervé GARREAU and Cécile CALLOU

4.1. Phylogenetic context of the species.	60
4.1.1. Taxonomy	60
4.1.2. Recent genomics tools	62
4.2. Origin and spread of the wild rabbit	63
4.2.1. Hispanic ancestors	63
4.2.2. Crossing the Pyrenees	63
4.3. A recent domestication	64
4.3.1. From leporaria to hutches	64
4.3.2. The molecular marks of domestication	65
4.3.3. Creation of breeds and genes linked to domestication	67
4.4. Back to the wild: an invasive species.	70
4.5. Conclusion	72
4.6. References	72

**Chapter 5. Domesticated Poultry: A History
Illuminated by Genomics** 75
Michèle TIXIER-BOICHARD, Xavier ROGNON and Bertrand BED'HOM

5.1. Introduction.	75
5.2. Domestic birds and their phylogenetic context	76
5.3. Domestication scenarios	81
5.3.1. The chicken	82
5.3.2. Guinea-fowl	84
5.3.3. Turkey	85
5.3.4. Quail	85
5.3.5. Common duck	86
5.3.6. Pigeon.	86
5.4. Genetic mechanisms involved in domestication	87
5.4.1. Setups integrating phenotypic data.	87
5.4.2. A priori molecular signature detection	90
5.4.3. Integrating approaches	93

5.5. Conclusion	98
5.6. References	98
Chapter 6. Genetics of Fish Domestication in Aquaculture	101
Fabrice TELETCHÉA	
6.1. Introduction.	101
6.2. Diverse, complex and poorly understood domestication histories.	103
6.3. Significant performance improvements for domesticated species.	106
6.4. A success story: Atlantic salmon	108
6.5. Conclusion	110
6.6. References	110
Chapter 7. The Domestication of Yeast	113
Jean-Luc LEGRAS, Thibault NIDELET, Virginie GALEOTE and Delphine SICARD	
7.1. The history of fermented products and the domestication of microorganisms	113
7.2. Yeast diversity and the evolutionary origins of fermentation	116
7.3. Population structure of yeast isolated from anthropic niches.	118
7.3.1. No genetic structure	118
7.3.2. Genetic structure associated with anthropic niches	119
7.4. Genetic basis for the evolutionary history of domesticated populations	120
7.4.1. Hybridization and ploidy	120
7.4.2. Horizontal transfers and introgressions	121
7.4.3. Chromosomal rearrangement	123
7.4.4. Duplication.	124
7.4.5. SNP: selection signature a priori	125
7.5. Conclusion	125
7.6. References	127
Chapter 8. The Domestication of <i>Oenococcus oeni</i>: A Bacterium Crafted for Wine Production	131
Jana RUDOLF, Marguerite DOLS-LAFARGUE, Claire LE HENAFF-LE MARREC and Patrick LUCAS	
8.1. Introduction.	131
8.2. <i>Oenococcus oeni</i> , a wine bacterium for MLF.	133

8.2.1. A lactic acid bacterium.	133
8.2.2. The wine bacterium.	133
8.2.3. The MLF bacterium	134
8.2.4. Description of the species <i>O. oeni</i>	134
8.3. Genetic characteristics of <i>O. oeni</i> domestication.	136
8.3.1. Characteristic traits of domesticated microorganisms.	136
8.3.2. Identification of domesticated <i>O. oeni</i> genetic lines.	137
8.3.3. Genetic mechanisms that contribute to the domestication of <i>O. oeni</i>	139
8.3.4. Genetic signatures of domestication	142
8.4. Conclusion	147
8.5. References	149
Chapter 9. Tracing the Origins of Wheat Cultivation	151
Caroline PONT and Jérôme SALSE	
9.1. The different types of wheat, one of the most widely consumed cereals in the world.	151
9.2. A species with ancient origins resulting from multiple hybridizations.	152
9.3. Archaeological evidence of its origins: archaeobotany	154
9.3.1. First traces	154
9.3.2. Domestication center(s)	155
9.3.3. Domestication traits	157
9.4. Genetic evidence of wheat origins: paleogenomics	160
9.4.1. Modern diversity	160
9.4.2. Ancient DNA	162
9.5. Perspectives: studying the origins and spread of wheat cultivation to support the selection of modern varieties	163
9.6. Acknowledgments.	165
9.7. References	165
Chapter 10. A History of Cultivated Rice Genomics	169
Philippe CUBRY, Mathias LORIEUX, François SABOT and Alain GHESQUIÈRE	
10.1. The history of rice: wild rice and cultivated rice	169
10.1.1. The genus <i>Oryza</i>	169
10.1.2. Characteristics of cultivated rice	172

10.2. The beginnings of genomics and the pan-genomic revolution	173
10.2.1. The first genomic sequence	173
10.2.2. Complementary sequencing and 3,000 genomes	173
10.2.3. New reference genomes and the appearance of rice pan-genomes	174
10.2.4. Other rice species	175
10.3. Genomics' contribution to the study of rice domestication	176
10.3.1. Genomics as a tool for studying domestication traits	176
10.3.2. Genomics as a tool for a better understanding of domestication history	178
10.3.3. Domestication of Asian rice	179
10.3.4. Domestication of African rice	180
10.4. Conclusion: the "continuity" of domestication	181
10.5. References.	182
Chapter 11. Grapevine Domestication and Selection	185
Patrice THIS, Thierry LACOMBE and Cécile MARCHAL	
11.1. Introduction	185
11.2. <i>Vitis vinifera</i> L., the main species of the genus <i>Vitis</i> used for the production of table grapes and wine	186
11.2.1. <i>Vitis vinifera</i> L.: biology and genetic diversity	187
11.3. Origin and domestication of <i>Vitis vinifera</i> L.	191
11.3.1. Phylogenetics and biogeography of the genus <i>Vitis</i>	191
11.3.2. Grapevine domestication centers	192
11.4. The main traits that evolved during grapevine domestication	193
11.4.1. Domestication syndrome	193
11.4.2. The presence of male and female organs, a distinctive trait of the wild and cultivated compartments	194
11.4.3. Genetic determinism of flower gender in grapevines	195
11.4.4. Berry color in grapevines: the importance of anthocyanins	196
11.5. From domestication to the present day	198
11.5.1. Ancient grape varieties	198
11.5.2. Relationships between grape varieties	199
11.5.3. Table grapes, wine grapes	200
11.5.4. The phylloxera crisis and its consequences	201
11.6. The grapevine of tomorrow.	202
11.7. References.	203

Chapter 12. Tomato Domestication and Breeding: A Major Contribution from Wild Species	207
Mathilde CAUSSE	
12.1. Introduction	207
12.1.1. Botanical and agronomic description.	208
12.1.2. Etymology and systematics	208
12.2. Origin of the cultivated tomato: wild ancestors and centers of domestication.	209
12.2.1. Indications provided by botany	211
12.2.2. Archaeological and historical evidence	212
12.2.3. Indications provided by linguistics	212
12.3. The origins of cultivated tomatoes: genetic data	213
12.3.1. Indications provided by genetic diversity	213
12.3.2. Genomics and its contribution.	214
12.3.3. Some of the genes responsible for fruit shape diversity.	216
12.4. Post-domestication of the tomato after global expansion	219
12.4.1. Introduction and distribution in Europe and worldwide.	219
12.4.2. Tomato breeding in modern times	222
12.4.3. Using South American resources for multiple breeding objectives.	223
12.5. Conclusion	225
12.6. References.	225
Chapter 13. Mutagenesis and Accelerated Domestication	227
Georges PELLETIER	
13.1. Random mutagenesis and neo-domestication	228
13.1.1. Random mutagenesis	228
13.1.2. The example of <i>Vigna stipulacea</i>	229
13.2. Genome editing and domestication	229
13.2.1. Genome editing	229
13.2.2. De novo tomato domestication	231
13.2.3. Domestication of <i>Physalis pruinosa</i>	232
13.2.4. Domestication of <i>Oryza alta</i>	234
13.2.5. Other candidate species for accelerated domestication	235
13.3. Limits and constraints of neo-domestication	236
13.3.1. In practical terms	236
13.3.2. In terms of health and environmental safety	237

13.3.3. In legal terms	238
13.3.4. In regulatory terms	238
13.4. Conclusion	239
13.5. References.	239
Glossary	243
List of Authors	249
Index	253