CHAPTER 6

PLANT AND ANIMAL RESOURCES DIVERSITY

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According to the Convention of Biological Diversity (CBD), biological diversity – or biodiversity – means "the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems".

Biodiversity plays a key role in human nutrition by safeguarding the sustainable productivity of soils and providing the genetic resources for all crops and livestock species harvested for food. The diversity of plant and animal resources underpins the wellbeing of society and serves as an important source of food and income, particularly for poor communities living in rural areas. Moreover, plants and animals provide medicine, timber, biomass, energy, fertiliser and transport, as well as other services that people need for their livelihoods and welfare. The loss of biodiversity threatens the sustainable productivity of existing ecosystems and ultimately leads to the waste of natural resources, primarily affecting the livelihood of poor rural communities. According to the FAO (FAO, 2010 and 2015), the serious degradation of agricultural resources has already led to severe losses of crop varieties and 7% of livestock breeds.

The term "genetic diversity" refers to the genetic variability between and within species. It plays an important role in the adaptation of both wild and domestic species to their changing environments, and hence in their survival. Domestic plant and animal species are used for food and agriculture. Following the FAO terminology, these are referred to as plant genetic resources (PGR) and animal genetic resources (AnGR). This chapter assesses the state of plant and animal resources diversity (wild and domestic species) in the Mediterranean region and gives a brief inventory of these genetic resources whilst focusing on crosscutting issues. It highlights their importance, describes the needs for their wise management and identifies

ways to address them. To this end, the authors endeavoured to address the following questions: what are the roles, uses and values of plant and animal genetic resources in the region? What is the current status of these resources? What threatens them? What capacities do the different countries have to manage them? What are the needs for their sustainable management?

These questions constitute the different sections of this chapter and will be addressed at regional level and, where possible, by sub-region rather than by country. For the analyses of AnGR, the data of all Mediterranean countries recorded in the FAO Domestic Animal Diversity Information System (DAD-IS) was used. In addition, country reports submitted by 14 Mediterranean countries[1] in preparation of *The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture* (Scherf and Pilling, 2015) (referred to as 2nd SoW-AnGR) were also used. For these analyses, the Mediterranean countries were divided into three sub-regions, based on their common history and economic and cultural similarities:
– Near East and North Africa (NENA): Algeria, Egypt, Lebanon, Morocco, Libya, Syria, Tunisia;
– The Balkan countries (BC): Albania, Bosnia and Herzegovina, Croatia, Cyprus, Montenegro, Slovenia;
– South West Europe (SWE): France, Greece, Italy, Malta, Portugal, Spain.
Turkey and Israel were grouped with BC and SWE, respectively. Gibraltar, Monaco and the Palestine Territories were not included as there is no available data on them in the DAD-IS database.

Efforts to use uniform terminology between plant and animal genetic resources were made but differences may subsist due to different nomenclature and classification systems.

Roles, uses and values of plant and animal diversity

Contribution to national economies

The contribution of agriculture, including livestock and fishery, to national economies varies greatly across the Mediterranean region. This contribution is highest in NENA and BC countries, with average additions of value to national Gross Domestic Product (GDP) of 10.2% and 9.2%, respectively, and lowest (2.3%) in SWE (FAO, 2015). The agri-food trade balance is favourable to SWE countries. Among the NENA countries, Morocco is the major exporter of all food and live animals to the European Union (EU), followed by Egypt. In the BC region, Croatia is the main exporter of agriculture and food products, while Croatia and Bosnia Herzegovina are the main importers (ARCOTRASS, 2006). According to Spanish data (INE, 2015), there is a clear relationship between exports and employment in the agriculture, forestry and fishery sectors.

1 - Albania, Algeria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Montenegro, Portugal, Slovenia, Spain and Turkey. In addition, Tunisia submitted a report specifically for the purpose of this chapter.

Wild foods of both plant and animal origin are of considerable economic value, but are excluded from official statistics. Apart from the provision of food, wild plant and animal resources provide important ecosystem services that contribute significantly to national and global economies. For example, the economic values of the global herbal medicine market were roughly estimated at USD 43 billion in 2001. Across Europe, crop pollination by insects (including bees) accounted for 14.6 billion euros annually, which equalled 12% of the total economic value of annual crop production. The economic gains attributed to pollination services strongly varied among countries and were highest for Mediterranean EU countries (Leonhardt *et al.*, 2013).

Contribution to human nutrition

PGR and AnGR diversity, key to balanced human nutrition, is only possible through the production of nutritionally diverse food products in diverse food chains. This diversity is mainly observed at species level. However, variety/cultivar/breed-level differences do exist and have begun to attract some attention in recent years. For instance, the FAO/INFOODS Food Composition Database for Biodiversity includes data on the nutritional composition of products from different cattle and pig breeds. In the case of nutritional differences between cultivars, studies show that Mediterranean citrus cultivars vary in organic acids, vitamin C and sugar contents (Bermejo and Cano, 2012). The nutritional properties of extra-virgin olive oil also vary among olive cultivars in terms of oleolic acid and tocopherols content (Tripoli *et al.*, 2009).

The Mediterranean diet is seen as a cultural model for healthy eating (Altomare *et al.*, 2013; Willett *et al.*, 1995). The habit of consuming wild food, of both plant and animal origin (especially plants) is still prevalent in the Mediterranean region, particularly among rural people. Wild plant varieties are richer than the corresponding cultivated ones in micronutrients and secondary metabolites as an adaptation to local environmental conditions. Plant varieties consumed for food or used as food additives (e.g. aromatic herbs such as oregano) constitute 39% of the total taxa identified in the MEDUSA network[2]; 39% are bee-forage plants or plants consumed by animals or invertebrates and contribute indirectly to human nutrition. A total of 2,300 plant and fungal taxa are consumed in the Mediterranean region (Rivera *et al.*, 2006). Animal source foods (mainly meat, milk and eggs) provide essential nutrients for optimal protein, energy and micronutrient nutrition (especially iron, zinc and vitamin B12).

Contributions to poverty alleviation and livelihoods of rural populations

Rural households' income and livelihoods, especially for poor people, are highly dependent on biodiversity. According to the World Resources Institute global report (WRI, 2005), income generated from wild or uncultivated natural ecosystems contributes 15% to 40% of total family income, either cash or in-kind. Thus,

2 - A total number of 1,163 traditionally used native and naturalized taxa were identified in the framework of the MEDUSA network (1996-1998), which is established by CIHEAM and coordinated by its Institute of Chania. The Medusa Database is available at: http://medusa.maich.gr.

the poor are more vulnerable to biodiversity degradation or loss than rich people who can purchase substitutes or shift production and harvesting to other regions (Billé *et al.*, 2012).

Understanding the link between plant and animal diversity, food security and poverty alleviation requires an understanding of their role in the livelihoods of the poor. For instance, livestock do not only provide diverse and critical supplements to staple plant-based diets (Murphy and Allen, 2003), they also provide manure for soil fertilisation and fibre for clothes, produce power and serve as financial instruments and enhance social status. In some communities, livestock-related cultural uses (including gifts and loans of livestock) help to build and maintain social ties. In the NENA region, small ruminants are extremely adaptable and suited to foraging in both semi-arid and arid conditions, providing an important source of meat, milk, wool fibres and skins (Montgomery, 2014).

Ecosystem services and functions

Ecosystem services are essential for human life as they provide food and clean water (provisioning services), regulate floods, drought, land degradation and diseases (regulating services), support soil formation, nutrient cycling and pollination of crops (supporting services), and provide recreational, spiritual and cultural benefits (cultural services). Both crop and livestock productions are interdependent with ecosystem services and thus biodiversity, resulting in both positive and negative impacts. On the one hand, agricultural landscapes that contain significant areas of semi-natural lands are important for wildlife, such as breeding sites for birds. On the other hand, pesticides and habitat loss, degradation and fragmentation threaten natural pollinators. The first assessment from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[3] warns about the decline in the number of pollinating insects and animals, affected by climate change, disease and the use of pesticide.

The Mediterranean region landscape has been shaped over thousands of years by low intensity and localised subsistence farming activities. In this environment, several forms of sustainable agrosilvopastoral farming systems have evolved, making best use of natural resources while creating a complex mosaic of semi-natural habitats rich in wildlife. For instance, Kerstin Sundseth (2009) describes the *dehesas* and *montados* of the Iberian Peninsula as a prime example of a sustainable multifunctional agricultural system. These areas are capable of producing a whole range of different goods and services (e.g. shade and food for livestock, cereal production, timber charcoal and cork) while striking a delicate balance between productivity and wildlife conservation.

The main mechanisms involved in livestock creating or maintaining specific habitats are selective grazing, nutrient redistribution, treading and seed distribution (Wrage *et al.*, 2011). In several cases, their significance has been illustrated by the unexpected and undesirable consequences of the removal of livestock from particular ecosystems,

3 - Nature.com (www.nature.com/news/global-biodiversity-report-warns-pollinators-are-under-threat-1.19456).

such as wildfires that regularly sweep across the Mediterranean region in late summer, causing damage to property and wildlife. Around 600,000 hectares have been estimated to burn every year in the Mediterranean area (Alexandrian, 1999; Morandi, 2002). Grazing by domestic livestock reduces the wildfire risk by limiting the shrub and herbage biomass and maintaining landscape heterogeneity (Ruiz-Mirazo and Robles, 2012). For instance, in agro-pastoral ecosystems in the rural community of Sistelo, in northern Portugal, the association between cattle and the maintenance of pasturelands hinders encroachment caused by natural succession and prevents wildfires (Rodríguez-Ortega *et al.*, 2014). In Croatia, the Slavonian Syrmian Podolian native cattle breed plays an important role in maintaining the grasslands in the Lonjsko Polje Nature Park. In Greece, a project implemented by the Society for the Protection of Prespa in Lake Mikri Prespa has shown that grazing by water buffalos effectively controls the re-growing of reeds and thus plays an important role in the creation of wet meadows. This is beneficial not only for biodiversity since wet meadows are important for the lake ecosystem (spawning grounds for fish, feeding grounds for birds, etc.), but also for the economic activities of local people (fishing, use of reed beds for buffalo food and thatch for barns, etc.).

Status of plant and animal diversity

Species, varieties and breeds diversity

The Mediterranean region is particularly known for its plant diversity, with c. 25,000-35,000 native species (around 10% of the world's vascular plants) of which 13,000 are endemic to the region (Myers *et al.*, 2000). This exceptional concentration of endemic species (see Table 1) is the reason why the Mediterranean region is the third richest hotspot[4] in the world (Mittermeier *et al.*, 2004). The vascular flora of the Mediterranean area is recorded in the online Euro+MedPlantBase. The region also has a high proportion of endemic terrestrial animal species, with 48% of the reptiles, 25% of the mammals and 3% of the birds populations in the world (Cuttelod *et al.*, 2008).

The Mediterranean region is one of the eight centres of cultivated plant origin and diversity, with over 80 plants, the most important of which are cereal crops, pulses, fruit trees, and vegetables. It is also a hotspot for traditional varieties (also known as landraces, local varieties or farmers' varieties) and hosts a large number of Crop Wild Relatives (CWR, i.e. wild plant taxa that have an indirect use derived from their relatively close genetic relationship to crops). According to the European Crop Wild Relative Diversity Assessment and Conservation Forum, approximately 25,000 CWR species are known to exist in Europe and the Mediterranean. They account for almost 80% of the area's flora.

4 - A region is qualified as a "hotspot" if it has at least 1,500 endemic vascular plants and has lost 70% or more of its original vegetation compared to its historical habitat cover.

Table 1 - Wild plant and animal species in the Mediterranean basin

Taxonomic group	Number of species	Number of endemic species	Percentage endemism
Plants	30,000	13,000	43
Mammals	330	87	26
Birds	600	16	3
Reptiles	357	170	48
Amphibians	115	71	62
Freshwater fish	400	253	63

Source: CEPF (2010).

In the livestock sector, more than 36 species of domesticated birds and mammals are used in food production. As of June 2014, the FAO DAD-IS describes 8,127 breeds across the world (both local and transboundary)[5] belonging to 19 mammalian and 17 avian species (Scherf and Pilling, 2015). Cattle, sheep, chickens, goats and pigs are the main livestock species in terms of numbers (the so-called "big five"). For the Mediterranean countries, 1,529 (1,250 local and 292 transboundary) breeds from 24 species have been reported (see Table 2). Among the Mediterranean sub-regions, the largest proportion of local breeds is reported in SWE, followed by BC and NENA. The "big five" species account for 77% (966) of local breeds and 71% (206) of transboundary breeds. The livestock species with the largest number of local breeds are sheep (311 breeds), followed by chicken (260 breeds) and cattle (164 breeds).

Table 2 - Number of local and transboundary livestock breeds in the Mediterranean area

	SWE	BC	NENA	Total Mediterranean area
Local breeds	804	305	141	1,250
Transboundary breeds*	151	143	71	292

* Transboundary breeds are counted once in each sub-region, where they occur. Thus, they are counted more than once.
Source: DAD-IS database.

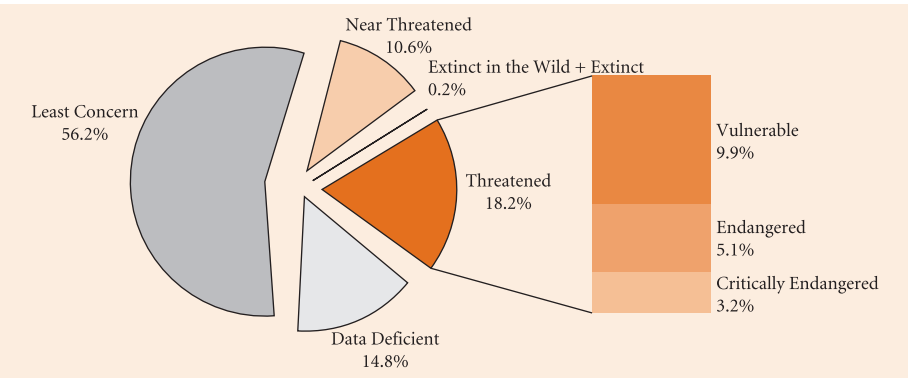
5 - Based on their geographic distribution, livestock breeds are classified into two categories: local and transboundary breeds. Local breeds are breeds that occur only in one country, while transboundary breeds occur in more than one country.

Conservation and risk status of plant and animal resources

Data on the conservation status of wild species in the Mediterranean region is increasing but it is not easily accessible at regional, national or thematic level. Selected key sources of information on biodiversity that include Mediterranean countries are the Biodiversity Data Centre (BDC) and the Red List of Threatened Species elaborated by the International Union for the Conservation of Nature (IUCN). The IUCN Red List classifies the threatened species into three categories (vulnerable, endangered and critically endangered) based on several biological factors such as the rate of decline, population size, area of geographic distribution, and distribution fragmentation. In the Mediterranean region, of the 405 terrestrial and freshwater wild plant species, accounting for 1.6% of the region's flora, that have been assessed using the IUCN Red List criteria, 52 are threatened at the global level (13% of the assessed taxa). However, the number of assessed plants is too low for this percentage to represent the actual pressures on the Mediterranean plant diversity. In fact, the estimated number of Mediterranean plant species to be assessed varies between 3,000 and 4,000. On the other hand, an adequate number of wild animal species (about 3,500 terrestrial animal species, mostly vertebrates) has been assessed for the IUCN Red List (IUCN, 2015). The proportion of threatened terrestrial animal species in the Mediterranean is about one fifth (18.2%) (see Figure 1). Moreover, globally, 20.4% of terrestrial animal populations are decreasing, 3.7% are increasing and 31.2% are stable. These trends should be considered with caution as population data is limited (the trend is unknown for 41% of the assessed taxa).

The high biodiversity in the Mediterranean is also reflected in the c. 18,000 protected areas (terrestrial, freshwater or marine) that are recognised, dedicated and managed through legal or other effective means, covering up to 18% of each country's surface (United Nations Environment Programme – World Conservation Monitoring Centre).

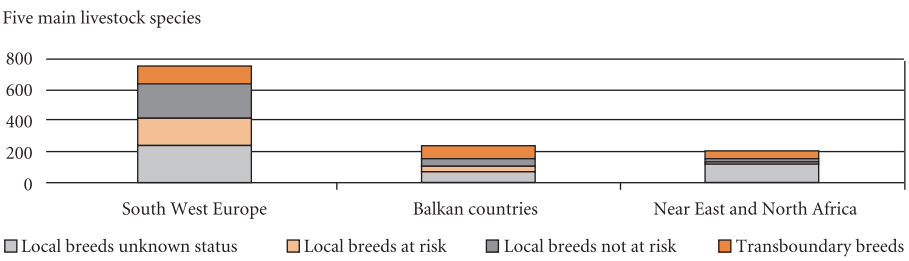
Figure 1 - Conservation status of Mediterranean wild animals assessed for the IUCN Red List of Threatened species



Source: data exported and analysed in July 2015.

Regarding PGR, data on selected crops shows a large rate of extinction in the Mediterranean area. For instance, only 5 to 10 out of 382 almond cultivars remain on the island of Mallorca (Socias, 1990). Information on the status of AnGR also remains far from complete as a large part of Mediterranean local breeds (45%) is classified as being of unknown risk status due to lack of recent population data (see Figure 2). This proportion ranges from 37% in SWE to 45% in BC, and is particularly high in NENA (82%). However, it should be noted that the level of information varies substantially across species. For instance, 83% of local chicken breeds have an unknown status in SWE, a large part of which corresponds to French breeds.

Figure 2 - Breed status of the main livestock species (cattle, sheep, chickens, goats and pigs) according to regions



Countries included: Albania, Algeria, Bosnia Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Portugal, Slovenia, Spain, Tunisia, Turkey.
Source: DAD-IS database.

Threats to plant and animal diversity

Threats to wild plant and animal diversity

The major threats to wild biodiversity include unsustainable agriculture, habitat loss and degradation, invasive alien species, unsustainable hunting and harvesting, wildfires and climate change. Agriculture, including conversion of wild lands and intensification, is a threat for biodiversity worldwide. For the period 2007-2013, the major threats caused to European habitats in the Natura 2000 Network are associated with agriculture (EEA, 2015). Animal production impacts on biodiversity are mostly due to the conversion of natural areas into pastures and forage production areas, as well as overgrazing. In eastern Mediterranean countries (including BC countries), overgrazing of pastoral lands is the most significant threat to Important Plant Areas (IPAs)[6] in more than 50% of the sites, whereas deforestation, tourism, intensification of arable farming and unsustainable collection of plants affect over one third of the IPAs (Radford *et al.* 2011).

A worldwide study on the negative impacts of food wastage on biodiversity (taking into account only mammals, birds and amphibians) has shown that agriculture is responsible for 66% of threats to species, with production of crops to be twice as damaging as livestock production (FAO, 2013). Another study focusing on the Mediterranean region, which took into account vertebrates, has identified the most

6 - Important Plant Areas (IPAs): areas of landscape that have been identified as being of the highest botanical importance.

important threats to Mediterranean species as, by order of importance, habitat loss and degradation, agriculture intensification, overexploitation (unsustainable harvesting, hunting and fishing), natural disasters, invasive alien species[7] (IAS) and human disturbance (Cuttelod *et al.*, 2008).

IAS have significant negative impacts on biodiversity as well as on economic activities (e.g. spreading diseases to domestic plants and animals). In the Mediterranean region, invasive plant species as well as several terrestrial invasive animal species impose an important threat (Vlachogianni *et al.*, 2013). For instance, *Oxalis pes-caprae*, a plant native to southern Africa, and one of Europe's 100 worst invasive species, is now established in Spain, France, Malta, Italy, Greece and Turkey and North Africa.

The region is considered as vulnerable to climate change. The prospects for the climate point towards a general rise in temperature with more and longer periods of higher temperatures and with changes in precipitation and distribution of water (EEA, 2002). The predicted warming and drying of the Mediterranean region, as well as the increase in extreme climatic and fire events, are likely to have a significant effect on the biodiversity. Climate change is expected to result in a shift of a large proportion of Mediterranean basin species (Thuiller *et al.*, 2005) and to facilitate IAS in various ways: 1) new species will enter specific regions and may become invasive; 2) species hierarchies in ecosystems will change, leading to new dominants that may have invasive tendencies; and 3) climate induced stress in an ecosystem will facilitate invasive pathways (Masters and Norgrove, 2010).

Unsustainable harvesting of wild plants and hunting of animals are also important factors threatening biodiversity. Increased demand for North African wild plants coupled with unsustainable collection from the wild (including for firewood) has led a number of important plant species to become scarce in areas where they were previously abundant (Cuttelod *et al.*, 2008). An estimate of 500 million birds are hunted as they migrate through the Mediterranean each year, most of them in North Africa and the Middle East (Project LIFE04 SUSTAINABLE HUNTING).

Global warming and seed germination: the case of *Nepeta sphaciotica*, an alpine Cretan endemic plant

Climate change will particularly affect the geographical distribution and conservation status of narrow endemic species of Mediterranean mountains. *Nepeta sphaciotica* is a critically endangered species of European Community priority with a single population occurring in the Lefká Óri Mountains (Crete), at c. 2,300 m a.s.l. Seed germination of the species occurs in late spring after snowmelt, triggered by a temperature rise above 15 ºC, an adaptation to avoid seedling emergence after seed dispersal, during the fall. The anticipated, warmer autumn temperatures (c. +5 ºC as projected by the rather moderate climatic scenario B2a) will induce untimely seed germination that will undoubtedly result in seedling demise during the prolonged period of snow cover (or by freezing temperatures in case of no snow) thus jeopardising the population regeneration and, in the long run, the species survival itself.

Source: Thanos and Fournaraki (2010).

7 - Alien species (often referred to as non-native, non-indigenous or exotic species) are plants, animals, fungi and microorganisms that have been transported inadvertently or intentionally across ecological barriers and have established themselves in areas outside their natural range.

Threats to domestic plant and animal diversity

The driving forces behind the erosion of PGR and AnGR diversity are diverse and often act in conjunction. At global level, the major ones include the agricultural sector trends, which have been expanding, intensifying and scaling-up. These trends were favoured by enabling policies and legislations. While disasters and emergencies are additional risk factors, climate change will become more relevant in future.

Sector trends. The "Industrialisation" of production systems, resulting in intensification, scaling-up and geographical concentration, has been a response to the increasing demand for food products. This industrialisation was favoured by technological developments that enable production environments to be controlled and genetic material to be transported around the world. The first *Report on the State of the World's Animal Genetic Resources* (SoW-AnGR) noted that the intensification of the livestock sector led to the more widespread use of a narrow range of international transboundary breeds, often exotic to the countries where they were being used (Rischkowsky and Pilling, 2007). Increased use of these exotic breeds and particularly indiscriminate crossbreeding are viewed by the second SoW-AnGR as the main factors driving to the erosion of AnGR along with weak AnGR management policies and programmes, and low competitiveness of local breeds in terms of output levels (Scherf and Pilling, 2015). Obviously, several of these factors are closely related. The Mediterranean region did not derogate from this trend, particularly in the dairy and poultry subsectors. Changes in the farming structure are important, potentially putting at risk locally adapted multipurpose breeds and their small upland and mountain farmers (Montgomery, 2014).

Agricultural intensification also contributes to decreased crop diversity, mainly *via* the introduction of modern cultivars. In Greece, local varieties of cereals were displaced by superior modern varieties, and nowadays account for hardly 1% of the total allocated acreage. An analogous trend is becoming apparent in vegetable crops (FAO, 2010). The use of a small number of highly selected commercial breeds and cultivars to produce food causes a reduction of genetic diversity between and within species and thus the resilience capacities.

Policies and legislations. Sector trends that threaten plant and animal diversity can be favoured by public policy and legislation. This is the case when production systems that harbour diverse plant and animal populations are adversely affected, whether directly or because of competition from other production systems or imported products that benefit disproportionally from such policy and legislation. Therefore, policies that promote the introduction of high external input production systems or the use of exotic animals can pose a threat to locally adapted breeds (Rischkowsky and Pilling, 2007).

Disasters, emergencies and climate change. Catastrophic events such as earthquakes, floods and disease epidemics have the potential to kill large numbers of animals in a short period of time. They are a particular threat to breed populations that are concentrated within a limited geographical area. In addition, the actions taken to deal with such emergencies, such as the restocking of livestock populations using exotic animals, can also be a threat to AnGR.

Climate change will affect the geographic distribution of crops, traditional varieties and CWR. This impact will depend on the sensitivity of traditional varieties to climate variability, the environmental conditions present in their centre of diversity, and the management, preferences and incentives for the farmers who grow them (Bellon and Van Etten, 2014). Some varieties will evolve and adapt to these changes by adjusting their phenological stages to changing growing season and possibly altered yields.

Climate change will ìmpact livestock production systems in many ways. For example, if temperatures increase, heat stress in the animals themselves may become an increasing problem. According to a survey, dairy cows in the hotter southern European countries spent more than half of the day under heat stress, resulting in an estimated milk loss of up to 5.5kg/cow/day (FeedInfo News, 2015). In Italy, M.I. Crescio *et al.* (2010) reported that high temperatures and air humidity during breeding season increased cattle mortality risk by 60%. The availability of feed and feed quality, and the prevalence of diseases and parasites can also be affected by changes in the local ecosystem. These effects have the potential both to kill large numbers of animals in a short period of time and to gradually disrupt livelihoods, which are based on livestock keeping. If changes are rapid, the adaptive link between a breed and the production environment in which it has traditionally been kept may be broken.

Capacities in the management of plant and animal diversity

Legal agreements and institutional capacities

The international legal framework for biodiversity includes several international conventions and agreements. The majority of the Mediterranean countries are signatories to these agreements (see Table 3), which provide the foundation for the establishment of common strategies for biodiversity management in the region. In fact, some regional legally binding agreements exist for the conservation of biodiversity such as the "Habitat" and "Birds" Directives for the countries of the European Union, the African Convention on the Conservation of Nature and Natural Resources (or Algiers Convention) and the Bern Convention for Europe and some African countries.

Biodiversity-related Conventions

– *The Convention on Biological Diversity* (CBD) (UNEP, 1993) is the leading global agreement to address the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources.

– *The Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) (UNEP, 1975) aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

– *The Convention on the Conservation of Migratory Species of Wild Animals* (CMS or Bonn Convention) (UNEP, 1982) aims to conserve terrestrial, marine and avian migratory species and their habitats.

– *The International Treaty* (ITPGRFA) (FAO, 2004) and the Global Plans of Action for Plant (GPA-PGR) (FAO, 2010) and Animal (GPA-AnGR) (Rischkowsky and Pilling, 2007) Genetic Resources for Food and Agriculture promote the conservation and use of PGR and AnGR for sustainable agriculture and food security.

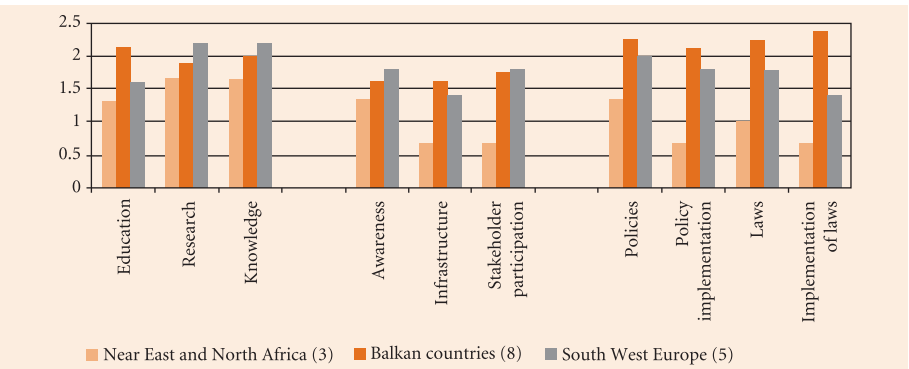
– *The Convention of Wetlands of International Importance* (or Ramsar Convention) (IUCN, 1975) ensures the conservation and wise use of wetlands and their resources.

– *The International Plant Protection Convention* (IPPC) (FAO, 1952) aims to protect domestic and wild plants by preventing the introduction and spread of plant pests.

All Mediterranean countries have signed the CBD, the latest member being the Palestinian Territories in January 2015. To implement the Convention, most countries have developed National Biodiversity Strategies and Action Plans, and/or integrated them into broader national and regional plans for environment and development. For the other agreements, the level of implementation and enforcement varies between sub-regions and among countries within a sub-region, depending on many factors such as institutional and human capacities as well as the level of awareness.

An assessment of the adequacy of legal and policy measures, and institutional and human capacities for the management of AnGR in the Mediterranean countries was conducted using the country reports prepared as part of the 2nd SoW-AnGR process. Six countries indicated having strategies and action plans endorsed by their respective government and five indicated that they are developing such instruments. Overall, countries reported greater capacities for education, research, and policies and legislation and their implementations, compared to their capacities in infrastructure, awareness and stakeholder participation (see Figure 3). NENA countries reported lowest levels of capacities, whereas those reported by BC and SWE countries are almost equivalent.

Figure 3 - State of capacities reported in different area of animal genetic resources management



The countries (Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Portugal, Slovenia, Spain, Tunisia and Turkey) provided a score for the state of capacities in each area, which were converted into numerical values (none = 0; low = 1; medium = 2; high = 3).
Source: Country reports.

Table 3 - Major international and regional conventions, treaties and protocols related to biodiversity governance, and their ratification by the Mediterranean countries

Country	International Conventions										Regional Conventions			
	Convention on Biological Diversity (CBD)			CITES	CMS	Ramsar Convention	WHC	FAO		Algiers Convention	Barcelona Convention	Bern Convention	Habitats & Birds Directive	AEWA
	The Convention	Nagoya Protocol	Cartagena Protocol					ITPGRFA	IPPC					
Albania	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
Algeria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Andorra	✓					✓	✓					✓		
Bosnia and H.	✓		✓	✓		✓	✓		✓		✓	✓		
Croatia	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
Cyprus	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Egypt	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
France	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
FYROM*	✓		✓	✓	✓	✓	✓	✓	✓			✓		✓
Greece	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Israel	✓			✓	✓	✓	✓		✓		✓			✓
Italy	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Lebanon	✓	✓	✓			✓	✓	✓	✓		✓			✓
Libya	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Malta	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Monaco	✓			✓	✓	✓	✓				✓	✓		✓
Montenegro	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
Morocco	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
Portugal	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
San Marino	✓			✓			✓							
Slovenia	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Spain	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Palestian Territories	✓		✓				✓							
Syria	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓
Tunisia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Turkey	✓		✓	✓	✓	✓	✓	✓	✓		✓			

* FYROM: Former Yugoslav Republic of Macedonia.
Source: authors.

National activities for the management of genetic resources

According to country reports prepared as part of the 2nd SoW-AnGR process, AnGR inventory and monitoring activities are low in NENA, intermediate in BC and high in SWE. A similar trend is observed for *in situ* conservation, whereas *ex situ* in vitro conservation activities exist mainly in SWE – 80% of countries in SWE reported having in place in vitro gene banks, compared to 43% in BC and 33% in NENA. The level of implementation of activities contributing to structured livestock breeding programmes (animal identification, pedigree and performance recording, etc.) are reported as high for SWE, intermediate for BC and low for NENA countries. On the other hand, the extent to which the management of AnGR is integrated with the management of plant, forestry and aquatic genetic resources was reported as being none to limited in most of the sub-regions (see Figure 4). However, a few exceptions do exist. For instance, Portugal focuses on the conservation and maintenance of some of its local breeds by supporting agrosilvopastoral ecosystem services, prime examples being the Alentejo and Bísaro pigs, which maintain oak forest as they roam freely feeding on acorns.

Figure 4 - Extent to which the management of animal genetic resources, in the Mediterranean sub-regions, is reported to be integrated with the management of plant, forestry and aquatic genetic resources

	Near East and North Africa (3)	Balkan countries (8)	South West Europe (5)
Development of joint national strategies or action plans	0.3	0.7	0.8
Collaboration in the characterization, surveying or monitring of genetic resources, production environments or ecosystems	1.0	0.5	0.7
Collaboration related to gentic improvement	0.3	0.2	0.5
Collaboration related to product development and/or marketing	0.0	0.5	0.5
Collaboration in conservation strategies, programmes or projects	0.3	0.7	0.5
Collaboration in awareness-raising on the roles and values of genetic resources	1.0	1.0	0.7
Training activities and/or educational curricula that address genetic resources in an integrated manner	0.3	0.7	0.7
Collaboration in the mobilization of resources for the management of genteic resources	0.0	0.5	0.7

None=0, limited=1, extensive=2; number of countries (Albania, Algeria, Bosnia and Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Montenegro, Morocco, Portugal, Slovenia, Spain, Tunisia and Turkey) in parenthesis.
Source: country reports.

Value addition is important for the sustainable use of local genetic resources which are often less productive than commercially bred and intensively raised breeds or varieties. Higher per unit prices of products help compensate for lower quantities. Differences between the sub-regions exist with regards to their efforts to register products and market them with specific quality labels. The EU Database of Origin and Registration (DOOR)[8] shows that five SWE countries (France, Greece, Italy,

8 - European Commission (http://ec.europa.eu/agriculture/quality/index_en.htm).

Portugal and Spain) together have 922 registered labels and 62 submitted ones; they also have 877 entries in the Slowfood Ark of Taste[9]. Among the NENA countries, only Morocco has one DOOR submission. However, Algeria, Egypt, Jordan, Libya, Lebanon, Morocco, the Palestine Territories and Tunisia have 64 entries in the Ark of Taste. These differences indicate cultural differences in the attachment to regional or special foods and a history of labelling local products (which is highest in SWE), but also the technical and financial capacity to engage in registration and compliance procedures related to product differentiation (which may explain the low DOOR registrations from BC and NENA).

Examples of collaborative activities in the Mediterranean region

–*The IUCN Mediterranean Species Programme* encourages the development and availability of scientific data on Mediterranean species and focuses on species' assessments at global and regional level and key biodiversity areas in the Mediterranean.

– *The World Wildlife Fund (WWF) Mediterranean Programme* aims to conserve forest and freshwater ecosystems and to promote sustainable environmentally friendly practices.

– *The European and Mediterranean Plant Protection Organization (EPPO)* develops strategies against the introduction and spread of dangerous pests and to promote safe and effective control methods.

– *The European Cooperative Programme for Plant Genetic Resources (ECPGR)* aims at ensuring the long-term conservation and facilitating the increased utilisation of plant genetic resources in Europe.

– *The European Gene Bank Network for Animal Genetic Resources (EUGENA)*, coordinated by the European Regional Focal Point for Animal Genetic Resources, collaborates with national gene banks for AnGR to develop an integrated regional conservation approach in Europe.

– *The GALIMED project* (*Genetic Adaptation of bovine Livestock and production systems in Mediterranean region)* characterised nineteen cattle breeds from eight Mediterranean countries in order to study the genetic basis of local cattle breed adaptation to local environments.

– *The DoMEsTIc project (MEditerranean bioDiversity as a tool for the sustainable development of the small ruminant sector)* investigates the factors that influence the sustainability of pastoral and rangeland production systems in four Mediterranean countries. It aims also to provide tools for the valorisation of local genetic resources and their access to markets.

– *The International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM)* is an international organisation based in the Mediterranean, actively involved in the fields of agriculture, food, fishery and rural territories, aiming to respond to the needs of the States and of the agro-food actors.

– *The International Centre for Agricultural Research in the Dry Areas (ICARDA)* research and training programme covers most southern countries of the Mediterranean. It focuses on strengthening the sustainable use of sheep and goat genetic resources.

9 - Slow Food Foundation (www.fondazioneslowfood.com/en/what-we-do/the-ark-of-taste/).

Conclusion

The Mediterranean area is undoubtedly a major centre for both wild and domestic biodiversity. This richness plays a key role in food security and nutrition and serves as a source of income and other services that people need for their livelihoods and welfare. The loss of biodiversity, caused by agricultural intensification, tourism, demographic increase and climate change, threatens the sustainability of existing ecosystems and ultimately leads to waste of natural resources, primarily affecting the livelihood of poor rural communities.

The majority of the Mediterranean countries have signed biodiversity related conventions and agreements. These should be translated into national policies and strategic plans for the sustainable management of plant and animal genetic resources promoting the integration of agro-ecosystem approaches. All Mediterranean countries should take more active steps to implement the FAO Global Plans of Action for animal, plant and forest genetic resources for food and agriculture, the Strategic Plan for Biodiversity 2010-2020 and achieve the Aichi Biodiversity Targets adopted by the CBD, many of which promote sustainable food production and decrease of food waste.

The characterisation, inventory and monitoring of status of plant and animal genetic resources should become a priority, particularly for southern Mediterranean countries. They are required for the establishment of early-warning and response systems that can rapidly identify those varieties and breeds at risk, allowing quick and well-defined actions to be taken. The conservation of plant and animal genetic resources in both *ex situ* collections and *in situ*/on-farm should also become a priority. Cross-border cooperation projects and networks are effective tools for knowledge transfer among stakeholders working on biodiversity conservation. Likewise, the establishment of networks for the preservation of traditional knowledge linked to crop and livestock production should be promoted. For plants, the storage of seeds in local farmer driven seed banks is the most effective and low-cost method for their long term-conservation.

Moreover, the promotion of initiatives for adding value to the products of local crops and breeds through commercial differentiation and niche marketing is needed. Different quality schemes can be used (protected designation of origin, protected geographical indication or traditional specialty guarantee). Niche markets, which require a relatively high level of organisation among producers, a reliable marketing chain, well-organised marketing campaigns and an effective policy or legal framework, normally emerge in more affluent economies. However, several success stories in the countries of eastern and southern Mediterranean are also recognized and deserve to be supported.

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