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Editorial

Lessons from Extinctions

One hundred one years ago, on 1st September 1914, Martha, the last living specimen of Passenger Pigeon *Ectopistes migratorius* passed away at the zoo of Cincinnati (Ohio, USA). It was certainly one of the most unexpected extinctions of birds, because this most gregarious pigeon in the first decades of 1800 numbered 3-4 billions of individuals between the southern Canada and Virginia. In the first years of 1900 it lived only at the domestic condition; in the Cincinnati zoo there was an aviary with a small flock of these birds, among them George and Martha. Martha was widowed on 10th July 1910, and four years later the species died off forever. This, as well as the sad stories of the Great Auk *Pinguinus impennis* from Iceland and Greenland, the Dodo *Raphus cucullatus* from the island of Mauritius, and other extinct birds, should have been a lesson for us, a sort of ring that should have imposed us to keep watch to the nature around us, but this did not happen. The extinction of the Passenger Pigeon, Great Auk and Dodo happened when they met the man (Hume *et al.* 2006, Avery 2014), and these birds now are icons of the extinction due to the destructive human activity. Many tesseræ of the biodiversity mosaic, birds, insects, plants and other organisms, even if abundant, may vanish in few years, due to human activities, the activities of those 7 billion of people who inhabit this wonderful planet.

The Passenger Pigeon was the commonest bird of the planet, numbered in billions, it was a bird of the eastern forests of USA, nested and roosted in trees, and depended completely on the variations in abundance of the tree mast, that formed a large part of its food throughout the year, as well as the food on which it fed its young. It was a specialized species, it depended to a very large extent on eating beech mast, acorns and chestnuts. It was a nomadic species in winter months. After breeding, flocks of million or billions of birds migrated to southern states of USA to winter there. Its reliance on the above cited trees influenced every aspect of its life, also its nomadic behaviour, that was also determined by the unpredictable abundance of tree mast. Despite the ability of the Passenger Pigeon to adapt to the boom and bust availability of its main food sources, it seems that were not boom and bust years of pigeons productivity, it bred only once per year and reared only one chick.

Seed production by the trees on which the pigeon depended varied from very low in non-mast years to very high in mast years. In mast years, American beech *Fagus grandiflora* produced up to 2,800 kg/ha, Red oak *Quercus rubra* up to 700 and American chestnut *Castanea dentata* up to 400 kg/ha (Avery 2014). Thus, a wide cover of primary forests in the eastern states of USA allowed the existence of the most abundant bird in the world. It was as abundant that in 1703, the Bishop of Montreal excommunicated this bird because of the damage that it did to crops! Nevertheless, between 1850 and 1900 something happened in that country. Human population and food request for people increased, as well as the request for lumber and for land to crop. The last major nesting areas of this bird were in the remote Midwestern parts of the range in Wisconsin and Michigan and in the most mountainous areas of Pennsylvania, where appreciable areas of virgin forests persisted after 1850. From about 1840 to 1900, most of Michigan forests were cut down for farms and to produce lumber for buildings, ships and mines. Between 1850 and 1900, the human population of the USA rose from 23 to 76 million. Wisconsin was one of the last areas of abundance of the Passenger Pigeon. In the same years, in Wisconsin and Michigan the human population increased six-fold, so as the pigeons bred in diminishing numbers they were collected and eaten in increasing numbers. Improvement in the manufacture of guns might have added to this impact (Bucher 1992, Avery 2014).

The combination of human population increase, communication and transport, coupled with the lack of protection for wildlife, allowed pigeon meat to become an industry. Industrialized slaughter of Passenger Pigeons took place in 1871 at Wisconsin Dells and in 1878 at Petoskey. In 1870s and 1880s, thanks to new railways, Passenger Pigeons killed in Wisconsin were eaten 1200-1400 km away (New York, Boston, Philadelphia). The impacts of loss of forests, loss of old trees and fragmentation of forest cover, throughout the range of this bird in summer and winter, was very important. The trapping season lasted for around 40 days, during which time 100-200 barrels daily were transported. Each barrel contained up to 30 dozen pigeon bodies, suggesting a total shipment of around 2 million of individuals. Thousands of squabs died in their nests as one or both parents were killed by trappers (Avery 2014). For decades animal proteins obtained from these pigeons were an extremely economic source for American diet. The human population grew rapidly within the breeding and wintering range of the Passenger Pigeon in the 19th century, and therefore the direct impact of man on this bird increased steadily. Although Passenger Pigeon evolved to avoid the impacts of predators, it was unable to avoid the direct impact of man.

Today there are few remaining areas of original forest surviving in the former range of the Passenger Pigeon. Despite the fact that many of the states where it wintered and nested now are well covered by forests, these are secondary forests, that have regrown after the original trees were fallen for timber for houses, for furniture, for firewood and also to free land for growing crops. If half of the trees on which Passenger Pigeons depended for food were cut down, then food supply for them was also halved. This happened in the wintering range of the Passenger Pigeon in the early 1870s. Three main actions would have saved the Passenger Pigeon: captive breeding, regulating the shooting of birds, and habitat protection. Concerning the habitat protection, the first US National Park was established in 1872, when Theodore Roosevelt was president. Out of the National Parks of the USA, only the Great Smoky Mountains (on the border between Tennessee and North Carolina) would have had relevance to the Passenger Pigeon, but it was established in 1934, and was too late to save this bird! If it is comfort, the Migratory Bird Treaty Act, the law to protect birds in the USA, was inspired by the extinction of the Passenger Pigeon.

It seems a paradox, but a much bigger animal was saved when the Passenger Pigeon became extinct. In fact, the American Bison could have followed a similar fate: in 1884 its population reached the low point of fewer than 1,000 individuals on the plains of North America, where once there had been 30 million! However, it was saved, and now there are ca. 500,000 individuals. The extinction is the failure of a species to maintain itself; it happens when the last reproductive unity of the last population dies, also when some individuals still live, but are unable to reproduce (Frankel & Soulé 1981). Factors that cause species extinction are i) biotic factors (competition, predation, parasitism and disease); ii) isolation; iii) habitat alteration (slow geological changes, climate, disasters, people). Habitat lost and fragmentation are probably the factors that mainly contribute today to the species extinction, but in the case of the Passenger Pigeon the direct impact of man speed the extinction process.

According to Duncan *et al.* (2013), the largest extinction event in the Holocene occurred on Pacific islands, where late Quaternary fossils revealed the loss of thousands of bird populations following human colonization of the region. Two-thirds of the populations on these islands became extinct in the period between first human arrival and European contact, with extinction rates linked to island and species characteristics that increased susceptibility to hunting and habitat destruction. The above cited authors have calculated that human colonization of remote Pacific islands (within the last 1000-4000 years) caused the global extinction of ca. 1,000 species of non passerine, excluding seabirds and passerines, that could be added to the total of extinctions (see also Pimm 1998). Following Butchart *et al.* (2006), 131 birds became extinct since 1500, 15 further species considered critically endangered probably became extinct, and other four species live only in domestic condition and have become extinct in nature. The extinction rate is 0.30 per year, but if we reduce the period since 1900, the total amount of extinct species is 59 and the extinction rate results 0.56 per year. 17 species disappeared in the last forty years and probably further three or four since 2000. 89.3% of them lived on oceanic islands, few were continental species, but they had a restricted range, none had a wide range as that of the Passenger Pigeon, that therefore underwent a very unfortu-

nate fate. The majority of threatened birds or at risk of extinction belong to the groups of parrots, pheasants, albatrosses, petrels, pigeons and rails (Pimm 1998, Bennett & Owens 2002, IUCN 2011). However, also among waders there are birds that become extinct; for example, the Eskimo or Northern Curlew *Numenius borealis* was very abundant in the tundra of western arctic Canada and Alaska. At least 2 million individuals were killed each year in the late 1800s. In 1863 an autumn flock was observed in Nantucket, a small island in Massachusetts; they were thousands of individuals and exhausted the island's ammunition, as 7-8,000 of them were shot from this multitude (Avery 2014). Now this species is considered extinct! Another wader, the Slender-billed Curlew *Numenius tenuirostris*, once common in winter in western Europe, probably is already extinct in the present century. Also the only species of parrot of North America, the Carolina Parakeet *Coccyzus carolinensis* became extinct in the past century. Their ranges, however, were not as wide as that of Passenger Pigeon. A less known case of very high risk of extinction is that of Andalusian Hemipode *Turnix sylvaticus*, widespread in the nineteenth century in different Mediterranean regions, now present only with few pairs in the South Iberian and Morocco areas, where may be considered on verge of extinction; although considered to belong to the same species, clear biometrical differences exist between the Mediterranean population and those living in Asia and in sub-Saharan areas (Violani & Massa 1993). Doubtless, when the Mediterranean population disappear, no specimens for reintroduction projects will be available, being different both Asian and sub-Saharan populations. Thus, we probably will miss forever this Mediterranean endemic taxon, genetically differentiated.

In accordance with the paradox of biodiversity, all species that lived in remote times now are extinct and the number of living species is higher than in the past. Following some estimates, since 3.5 billion of years, 99% of species became extinct; thus, a very high number of chrono-species followed one another to produce the present biodiversity. Of course, the extinction risk is different for each species. The current extinction rate of birds probably is between 100 and 1000 times higher than in natural conditions (Bennett & Owens 2002). Many species in Europe are declining, some were very abundant only a dozen of years ago, as for example the Turtle Dove *Streptopelia turtur*, that now is in moderate decline in Europe (BirdLife International 2004). This consideration reminds us to the sad fate of the Passenger Pigeon; indeed not only endemic taxa restricted to small areas or islands, but also very common and widespread species living in continental regions may meet a fatal destiny, for one of the three reasons above quoted, that is the habitat alteration due to human activities. There is no doubt that humans are now destroying the biological diversity at an alarming rate. A vital question now being tackled is how badly this loss affects ecosystem functioning (Purvis & Hector 2000). Biologists have the duty to give rise to concern the public opinion on this subject.

In February 2015 some Dutch supporters of Feyenoord damaged the lateral decorations of the Barcaccia (Rome, Piazza di Spagna), work of art sculpted by Gian Lorenzo Bernini and his father. This is not the first case of vandalism against pieces of sculpture; certainly many remind that also the "Pietà" of Michelangelo (Rome, basilica San Pietro) was subjected to hammer blows by a madman. Media and press generally comment on these events at considerable length and with words of disdain. It is certainly correct, but a similar indignation is nearly never present when one tessera of natural history of our planet is lost, when a species become extinct. It seems more reasonable to claim that the extinction of one species caused by man has to be considered a worse crime than the destruction of a piece of sculpture, but this may appear as an iconoclastic view to humanistic culture that characterizes our society. People generally consider with deferential consideration works of man talent, more than one piece of nature, and public opinion is much more emotionally involved when works of man talent are damaged in comparison with damages to nature.

According to Avery (2014), as we lose nature from the world around us it is like removing pieces of music from our lives. When a species declines then the volume of that piece is turned down and the sound is distorted. When extinction happens, the music is silenced forever. When in 1858 Charles Darwin and Alfred R. Wallace proposed the theory of natural selection were inspired by Malthus economic prophecy on limited world resources. If we measure our progress only by economic wealth, then we are ignoring much of what

it means to be an inhabitant of this planet¹. Ehrenfeld (1981) defined "arrogance of Humanism" to consider only parameters as gross domestic product, trade balance and competitiveness index, without giving the right value to nature, biodiversity and ecosystem services of our planet, a fine place and worth fighting for (Hemingway 1940).

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