

Impacts of agriculture on the proportions of wild and domestic species

Schematically, the expansion and especially the intensification of agriculture can be seen as a reorientation of ecological networks towards the massive production of a few cultivated or domesticated plant and animal species, primarily provided for human consumption. One of the effects of agriculture is then to **reduce the share of wild species** in biodiversity, in biomass.

Estimates of the impact of agriculture on the world's animal and plant biomass are difficult to quantify over long periods of time and on all continents, and **vary greatly** depending on the group considered.



Figure 1. Wheat field. The biomass of cultivated plants is only a tiny fraction (2%) of the total plant biomass, worldwide. [Source: Photo © A. Teyssèdre]

For plants: Erb et al [1] estimate that cereals and other cultivated plants account for 10 Gt C, or about 2% of the current global biomass of land plants (estimated at 450 Gt C); they also estimate the pre-agricultural terrestrial plant biomass at about 900 Gt C. In other words, under the impact of human activities -primarily agriculture, but also forestry and soil artificialisation, see above-, the global biomass of terrestrial plants has decreased by about half since the Neolithic.

For terrestrial mammals and birds, whose biomasses are much lower than those of plants, the picture is different. Overall, on a global scale, the detour of ecological networks towards the production of a minority of 'domesticated' animal and plant species, for food and other human uses, has both:

- **reduced the abundance** (see above) and biomass of wild species, mainly through 'conversion', fragmentation and transformation/pollution of their habitats;
- **increased** -from zero- the **biomass** of **domesticated** mammals and birds, by artificial selection and breeding of 'agricultural' species in modified ecosystems;
- increased the total biomass of **mammals** and **birds**, at the expense of other groups of heterotrophic organisms such as insects, amphibians, annelids and fungi.

Thus, it can be estimated that the loss -in number of individuals- of 30% of land birds (as opposed to seabirds), linked to the expansion and intensification of agriculture since its beginnings [2], **has reduced the total biomass of wild birds by about 20%**, estimated today at two million tons of Carbon (Mt C). During the same period, but especially since the invention of intensive livestock farming in the USA (in the 1930s) and its diffusion in Europe and elsewhere after World War II, the biomass of chickens and other "backyard" birds has increased to reach today 5 Mt C, i.e. nearly 3 times that of wild birds [3].

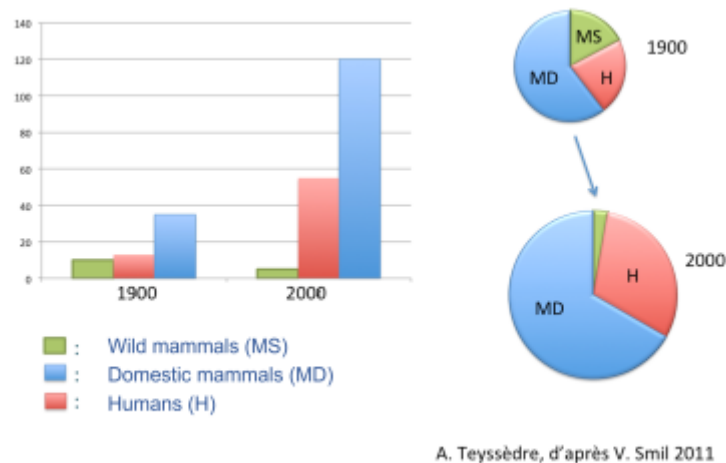


Figure 2. Evolution of mammalian fauna in the 20th century, in biomass. [Source: Scheme A. Teyssèdre, based on data from V. Smil [4]]

For mammals, the dynamics are even more contrasted - even if the different estimates do not exactly overlap. Limiting the period studied to the 20th century, V. Smil [4] estimates that the biomass of wild mammals was halved between 1900 and 2000, dropping from 10 to 5 Mt C, including 3 Mt C for terrestrial mammals (more affected by agriculture). Meanwhile, **the biomass of large domestic mammals and humans both tripled**, reaching 100 Mt C and 50 Mt C respectively in 2000 ([3], [4]). In total, the global biomass of terrestrial mammals almost tripled during the 20th century. It is still growing today, particularly **at the expense of wild mammals** and to the questionable "benefit" (see below) of humans and domestic animals, which in 2018 together constituted 98% of the biomass of terrestrial mammals (and 96% of the global mammalian biomass, [3]).

Agriculture thus has **two opposing effects** on the dynamics of mammals and birds, on a global scale: it **increases their total biomass** while **reducing their diversity in number of species** (and genes). As for the abundance of populations and communities, in number of individuals, it decreases on average for wild species but increases for domestic species, with monospecific agricultural communities.

It should be noted here that the "benefit" of the growth in biomass of domesticated mammals and birds, relative to wild species, is **purely numerical**. It concerns groups of living beings, and can be applied to the productivity of ecosystems, but does not regard individual animals and their well-being. On the contrary! The current practices of intensive breeding that have allowed these increases in biomass have considerably **degraded the living conditions** of chickens, calves, pigs and other domestic animals, confined in so-called "agricultural" buildings from birth to death. (see <https://www.ciwf.fr/ressources/>).

Notes and references

Cover image. From figure 1 cropped, royalty free.

[1] Erb K-H *et al.* 2017. Unexpectedly large impact of forest management and grazing on global vegetation biomass. *Nature* 553:73-76.

[2] Gaston K.J., Tim M. Blackburn & Kees Klein Goldewijk, 2003. Habitat conversion and global avian biodiversity loss. *Proc. R. Soc. Lond. B* 270, 1293-1300. DOI 10.1098/rspb.2002.2303.

[3] Bar-On Y.M., R. Phillips & R. Milo, 2018. The biomass distribution on Earth. *P.N.A.S.* 115: 6506-6511.

[4] Smil V., 2011. Harvesting the Biosphere: The Human Impact. *Pop. Dev. Rev.* 37(4): 613-636.

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