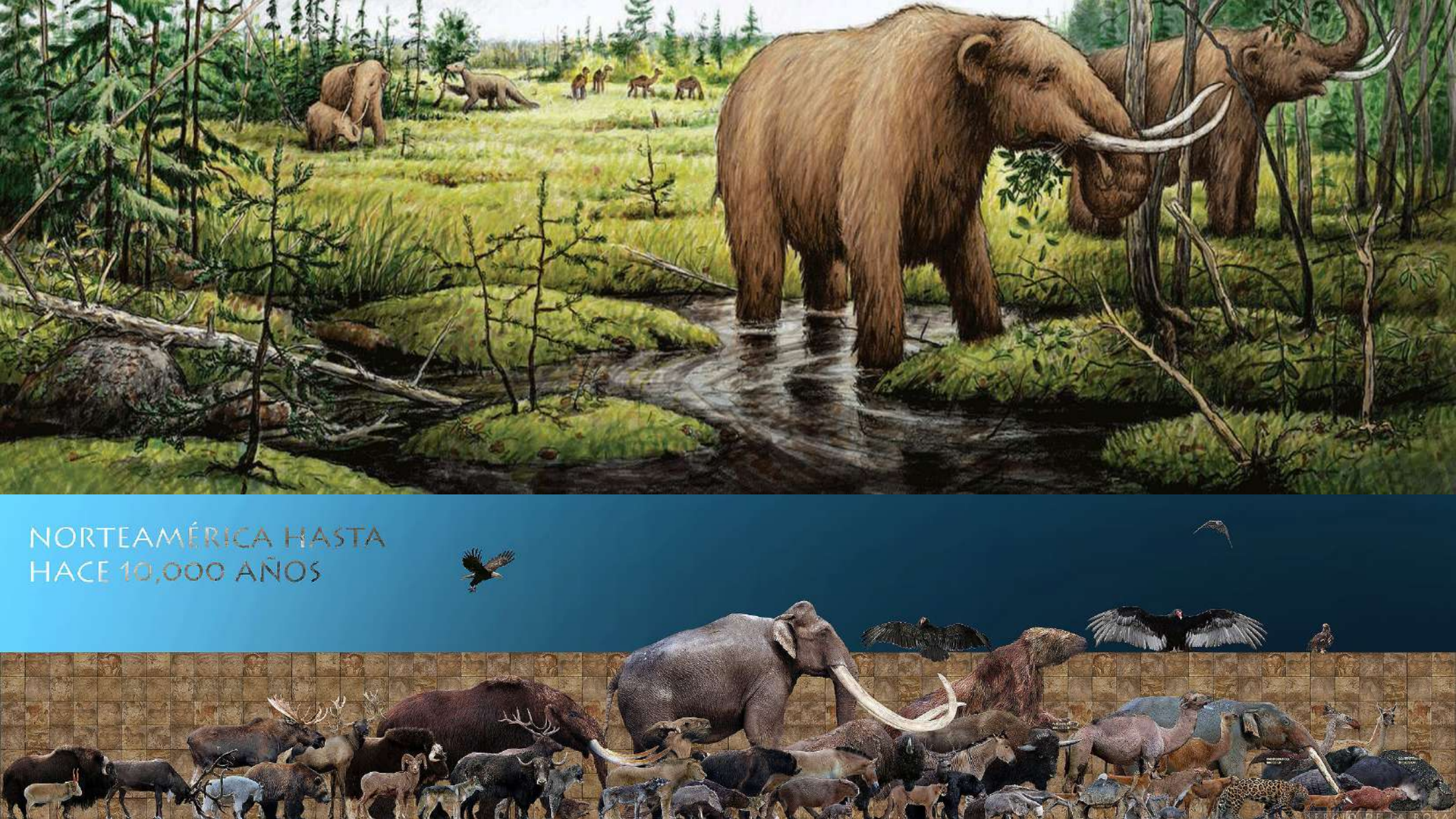
Maclura pomifera (Osage Orange)


NORTEAMÉRICA HASTA
HACE 10,000 AÑOS

Megafauna Fruits

How do plants with large fruits disperse their seeds?

Fruits Adapted to Now-Extinct frugivores
→ ecological anachronism

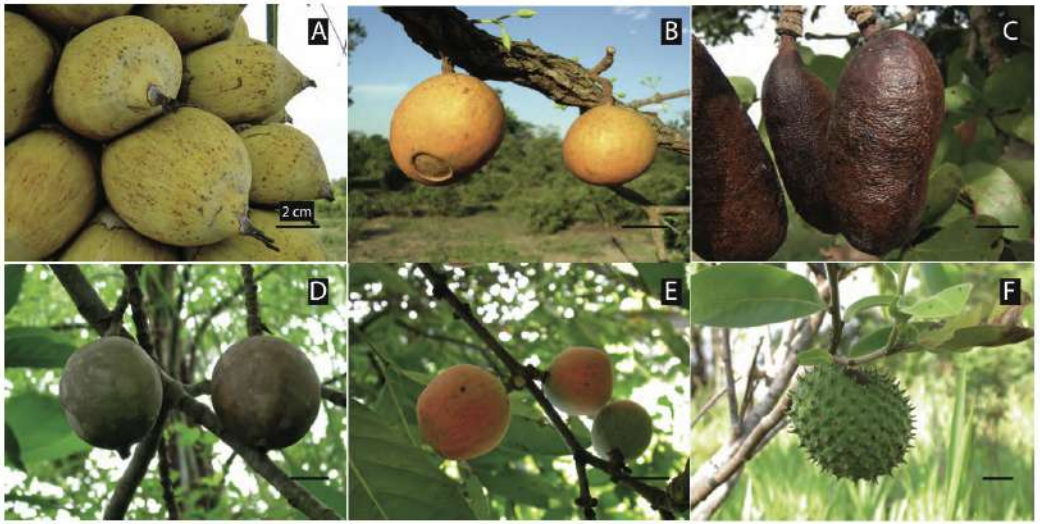
Janzen & Martin (1982); Guimarães et al. (2008)

Megafauna Fruits

- Trade-off between seed size and dispersal

→ unless you rely on large herbivores

- Large animals consume larger seeds and distribute seeds over larger distances

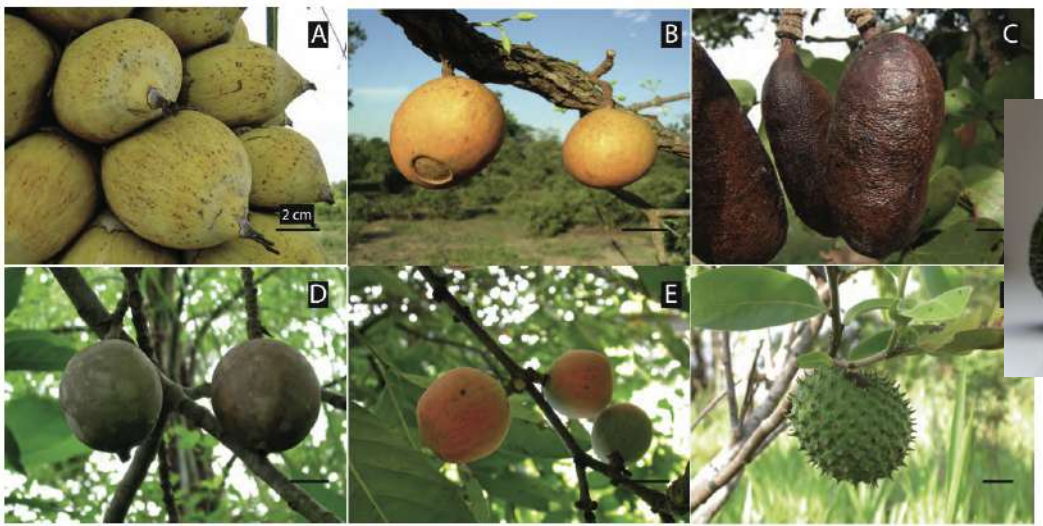


Janzen & Martin (1982); Guimarães et al. (2008), Pires et al. (2017)

Megafauna Fruits: two types

A. fleshy fruits 4–10 cm in diameter with up to 5 large seeds (generally >2.0 cm diameter)

B. fleshy fruits >10 cm diameter with numerous (>100) small seeds.

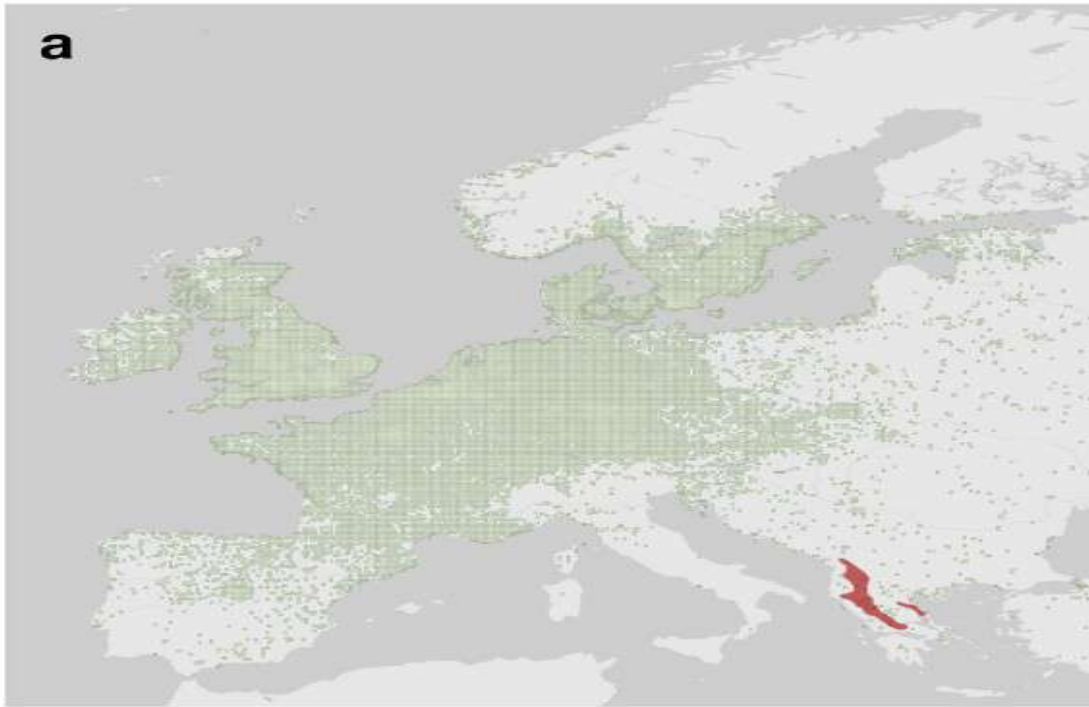


[2] Guimarães et al. (2008)

Horse Chestnut (*Aesculus hippocastanum*)

Horse Chestnut (*Aesculus hippocastanum*)

- In modern native range confined to the southern Balkan peninsula and Turkey
  - Difficult regenerating
- Brought to others parts of Europe by Romans and popularised in 1600s.
- Grows (and fruits) up to (almost) the arctic circle



Tighe (2026)

Horse Chestnut (*Aesculus hippocastanum*)

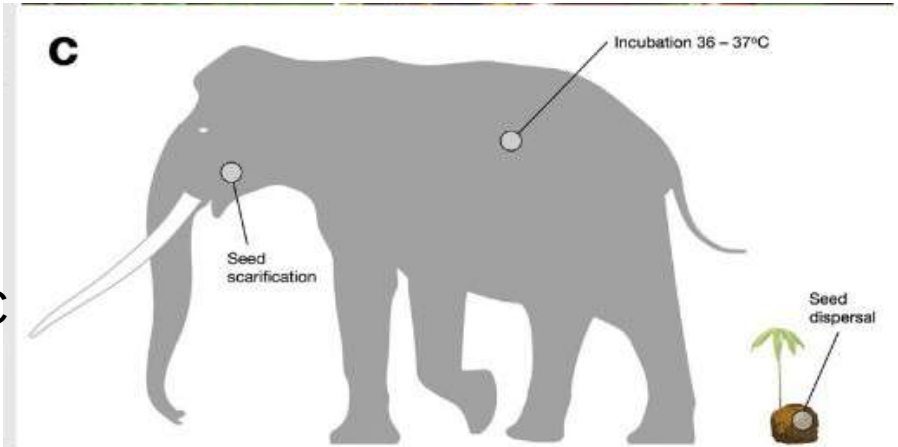
- Fit the description of megafauna fruits
  - Brown shell
  - Few big seeds

- Needs cold to break dormancy or incubation at 36°C
  - the intestinal track of elephants is 36-37°C

- Removal of seeds from shell help with germination

- Cannot deal well with dessication (but not a problem when covered in elephant dung)

- The one species in its genus that does regenerate *Aesculus assamica* is in the range of asian elephants.



Obroucheva & Antipova (2003);Tighe (2026)

Horse Chestnut (*Aesculus hippocastanum*)

- Used to have a wider distribution across Europe
  - Pleistocene Finds: *Iberia, Southern France, Italy and across the Balkan peninsula*
  - Pliocene Finds: *Germany, Italy*
- During last glacial maximum (LGM) range contracted to the Balkan peninsula
- never recolonised Europe at the end of the Pleistocene as it had in previous interglacial periods.

Tighe (2026)

Apple (Malus sp.) & other Rosaceae


Malus sp.


Pyrus pyraster


Mespilus germanica


Prunus armeniaca


Cydonia oblonga


Prunus persica

Apple (Malus sp.) & other Rosaceae

- Rosaceae with large fruits predate humans
  - appear in the Miocene
  - Endozoochorory has evolved at least 2 times in rosaceae
  - Humans start to actively disperse apples by the late holocene.

- Not strictly “domesticated”
  - we graft and clone to “lock in” favourable (wild) traits

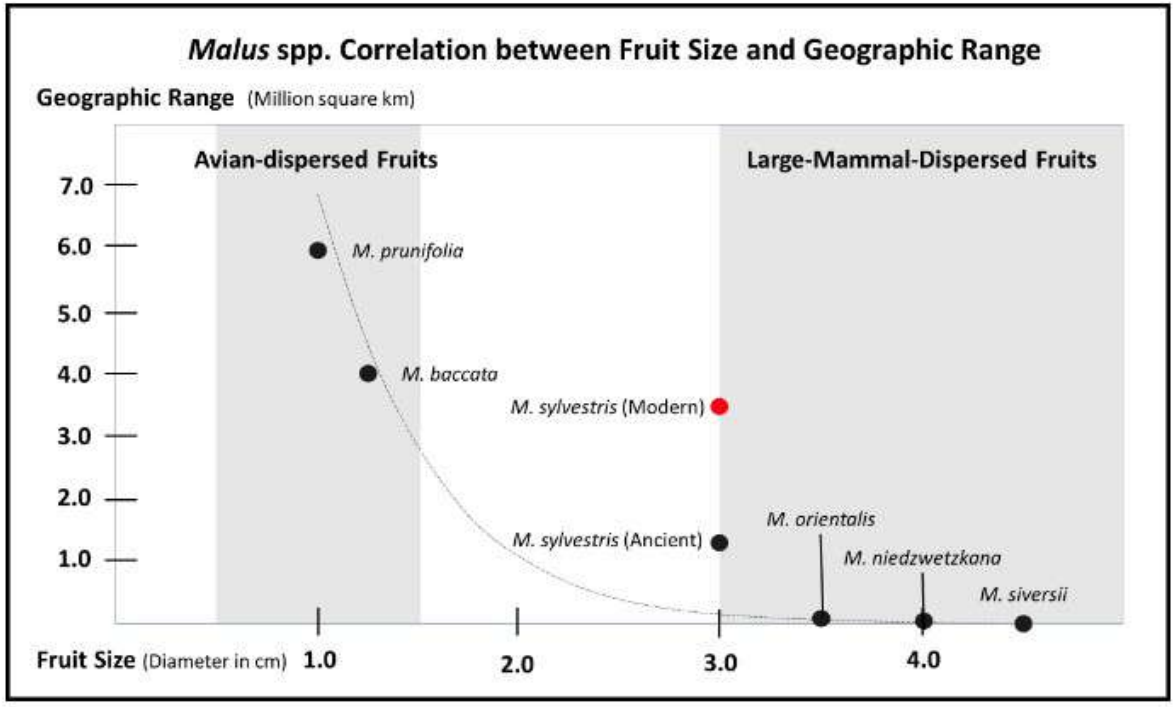
Spengler (2019)

Wild Fruit-bearing Rosaceae are threatened

- Diverse, but many are are listed as endangered (e.g., *Prunus americana*).

- Eurasian large fruiting rosaceous species
  - range reduction
  - loss in genetic diversity throughout the Holocene.
  - fragmentary populations

- the larger the fruit among trees in the Malus genus, the more restricted the extant range.



Spengler (2019)

Ecological anachronisms

- Exposure to acid and consumption by animals increases germination rates in Malus
- Few wild species that eat them in large quantities
- Ruminants generally do not eat fruits
  - sugar and acidity gives stomach problems
  - Ruminant gut systems are more likely to destroy seeds*
- Malus retains fruit after the seeds are ripe and the sugar content is at its highest
  - suggests that the trees evolved with a disperser able to reach terminal limbs.
- Most likely dispersers are: elephants, rhinos and horses.

Spengler (2019), Bai et al. (2023)

Ecological anachronisms

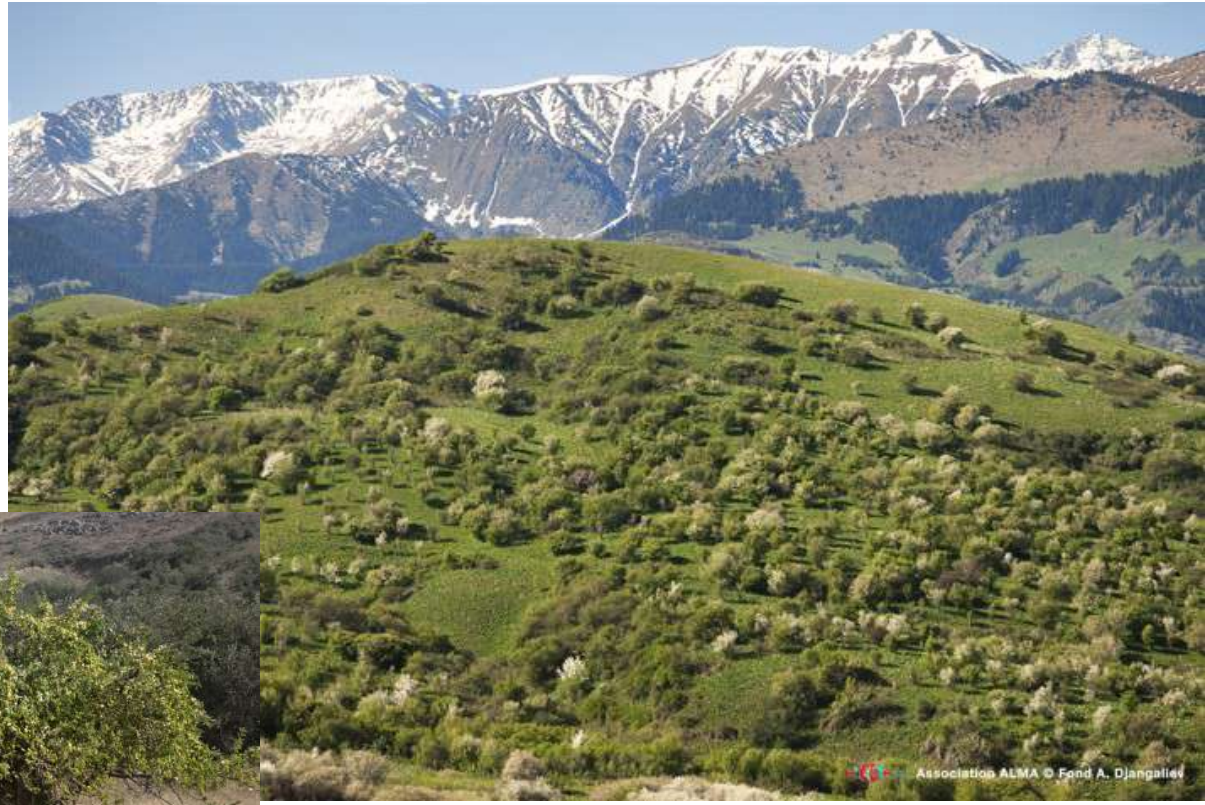
Consequences

- Dropping fruit directly below a tree
- parent/offspring competition
- sibling/sibling competition
- attraction of seed predators due to heavy densities of food
- increased fungal infections and seed mortality (due to high sugar concentration)

Spengler (2019)

Ecological anachronisms

- Cannot compete well with tall species.
  - Malus “occurs” naturally in open patches and forest edges
  - well suited to European savannas created by herbivory (= savannas)



Spengler (2019)

Other megafauna fruits?


Castanea sativa


Juglans regia

Conclusion

- Megafauna are an integral (but missing) part of Europe’s Ecosystems

- Our trees evolved in ecosystems with megafauna and their adaptations still show this

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