

N.I. Vavilov and the geography, conservation, and use of crop diversity

Colin K. Khoury

“The Vavilov Method: Utilizing Genetic Diversity”

Texas A&M Plant Breeding Symposium

16 February 2017

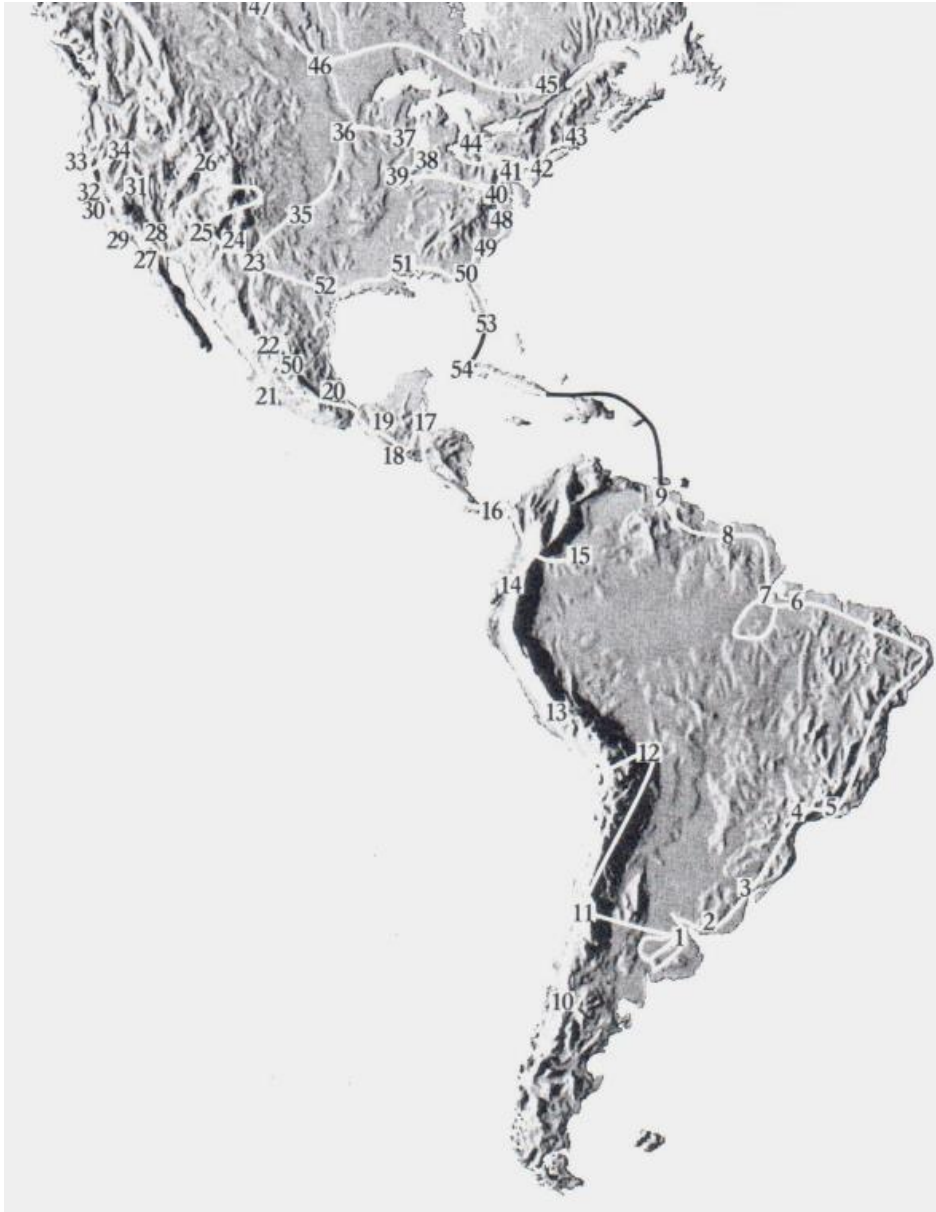
College Station, TX



N.I. Vavilov (1887–1943)



Vavilov's explorations, 1916-1940



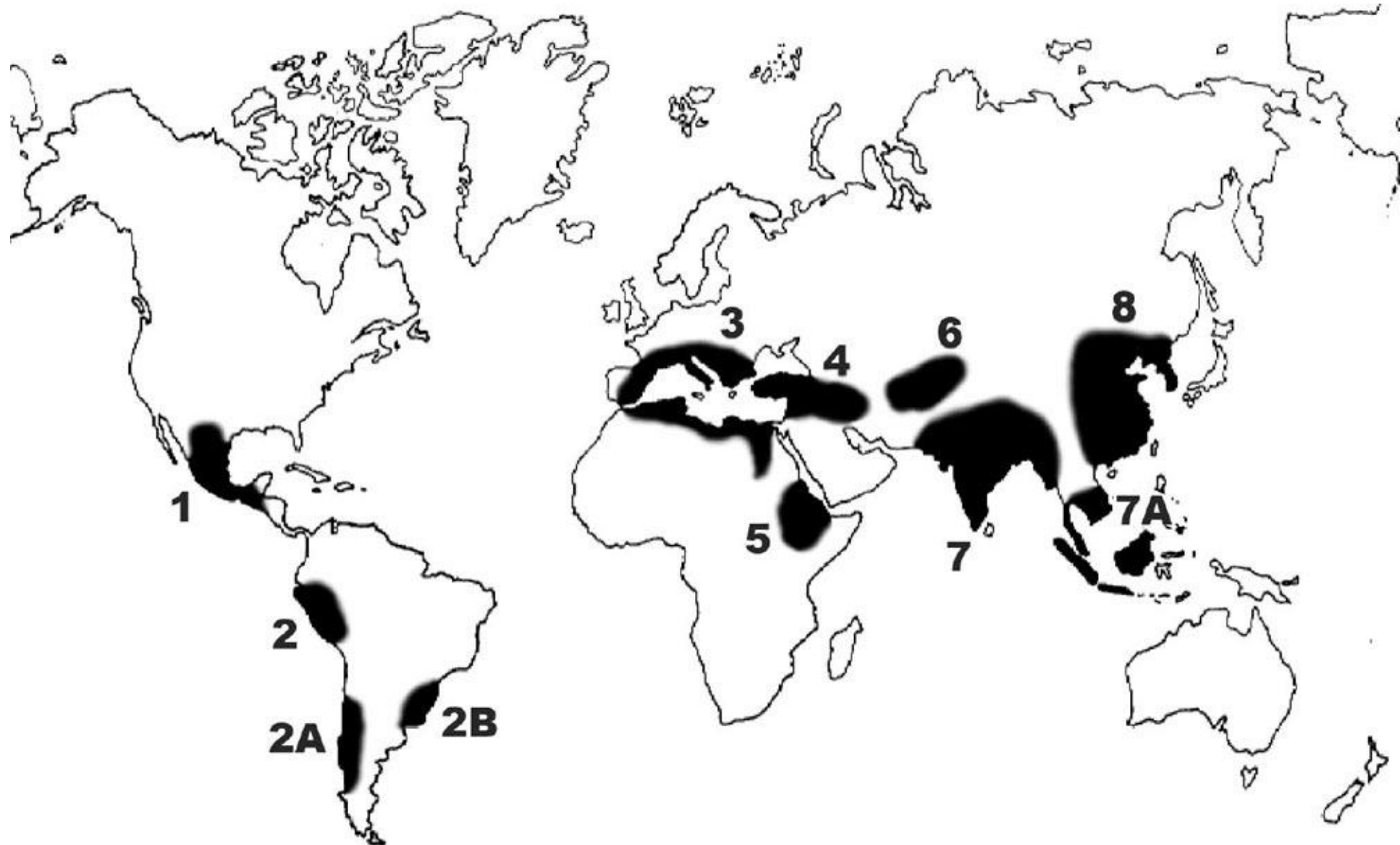




The search for crop diversity

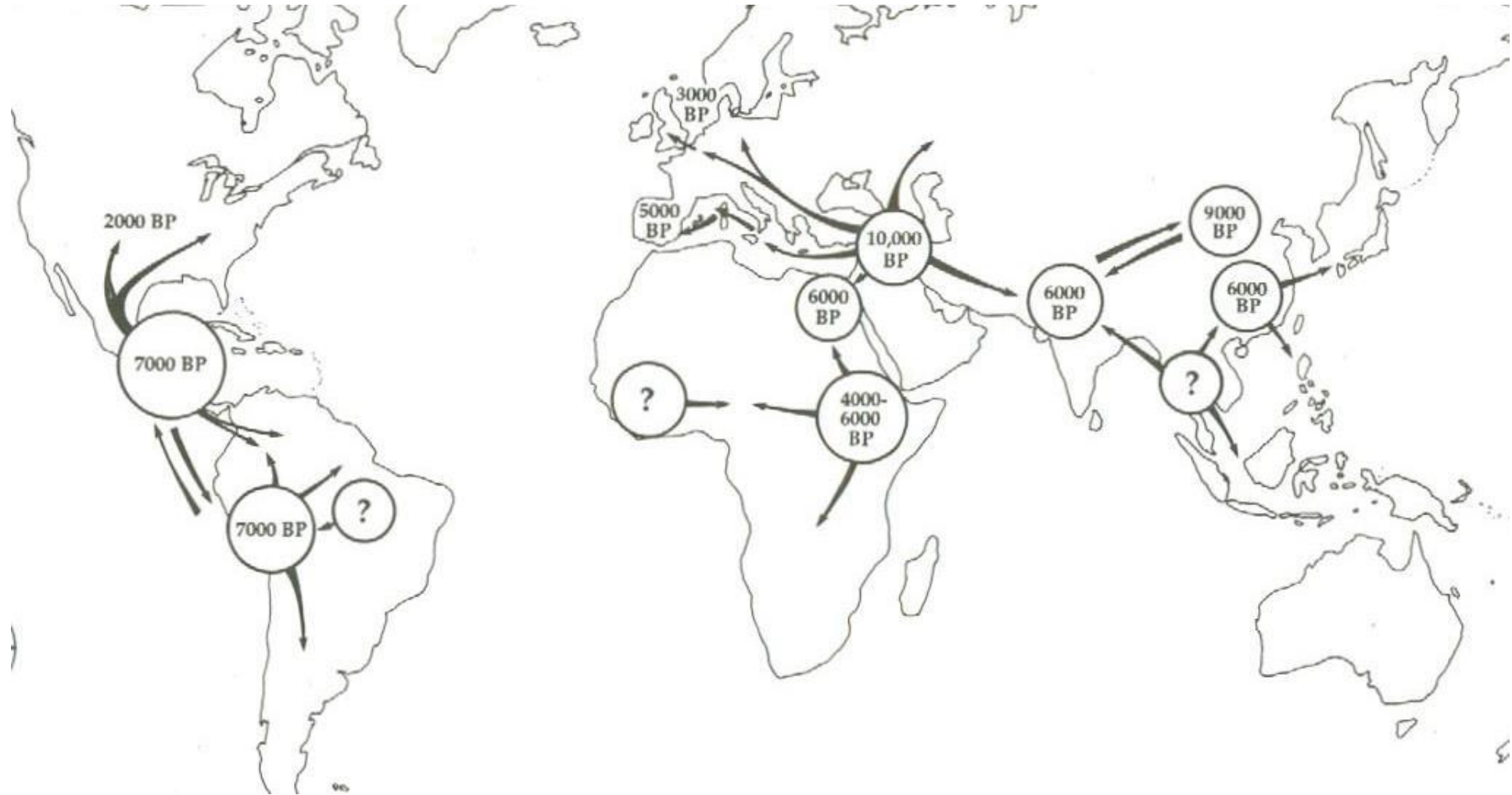


Centers of origin of cultivated plants



(1) Mexico-Guatemala, (2) Peru-Ecuador-Bolivia, (2A) Southern Chile, (2B) Southern Brazil, (3) Mediterranean, (4) Middle East, (5) Ethiopia, (6) Central Asia, (7) Indo-Burma, (7A) Siam-Malaya-Java, (8) China and Korea.

Timelines for emergence of agriculture



Siege of Leningrad (1941-1944)



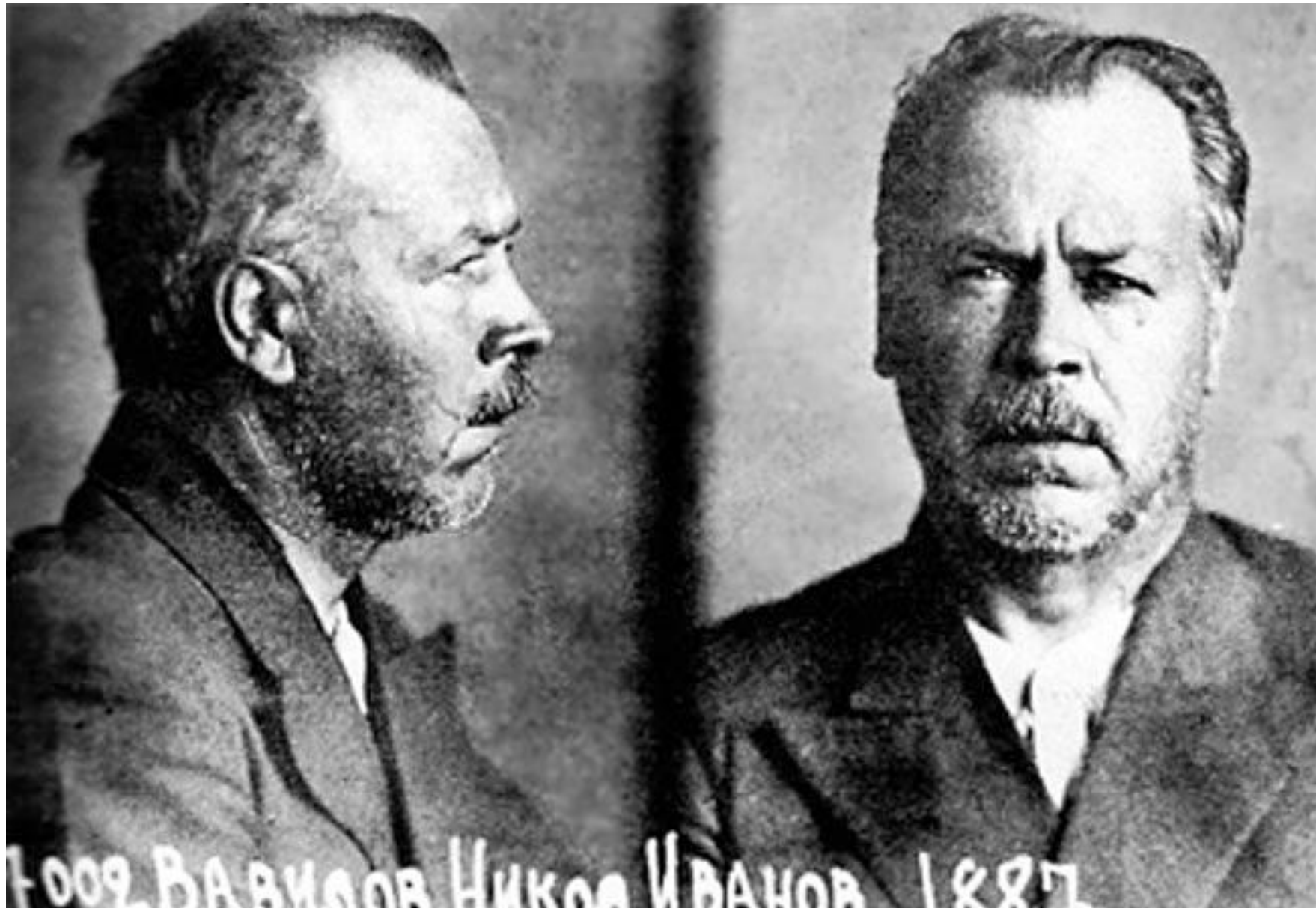
Colleagues lost



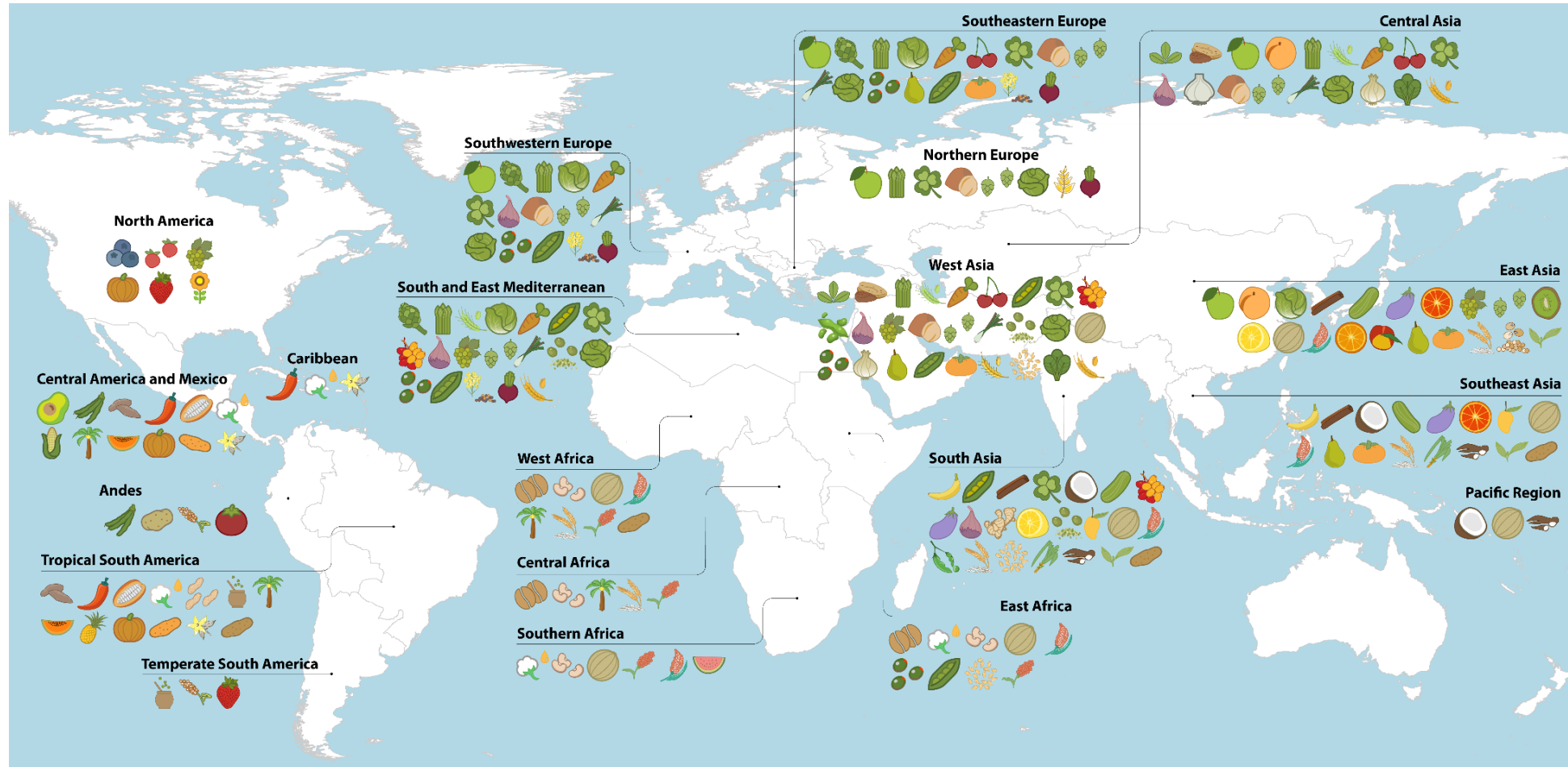
Colleagues lost



The ultimate irony

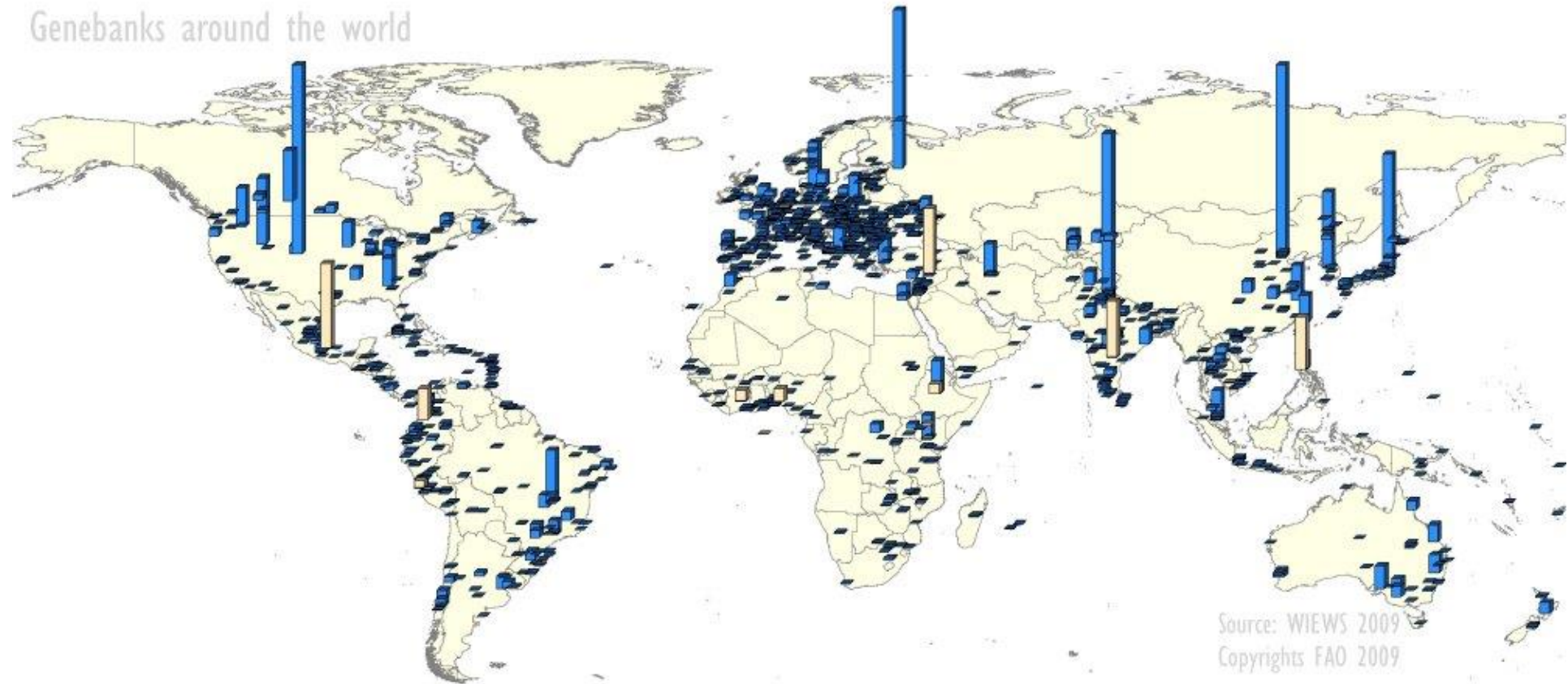


Geography of diversity concepts continue to evolve

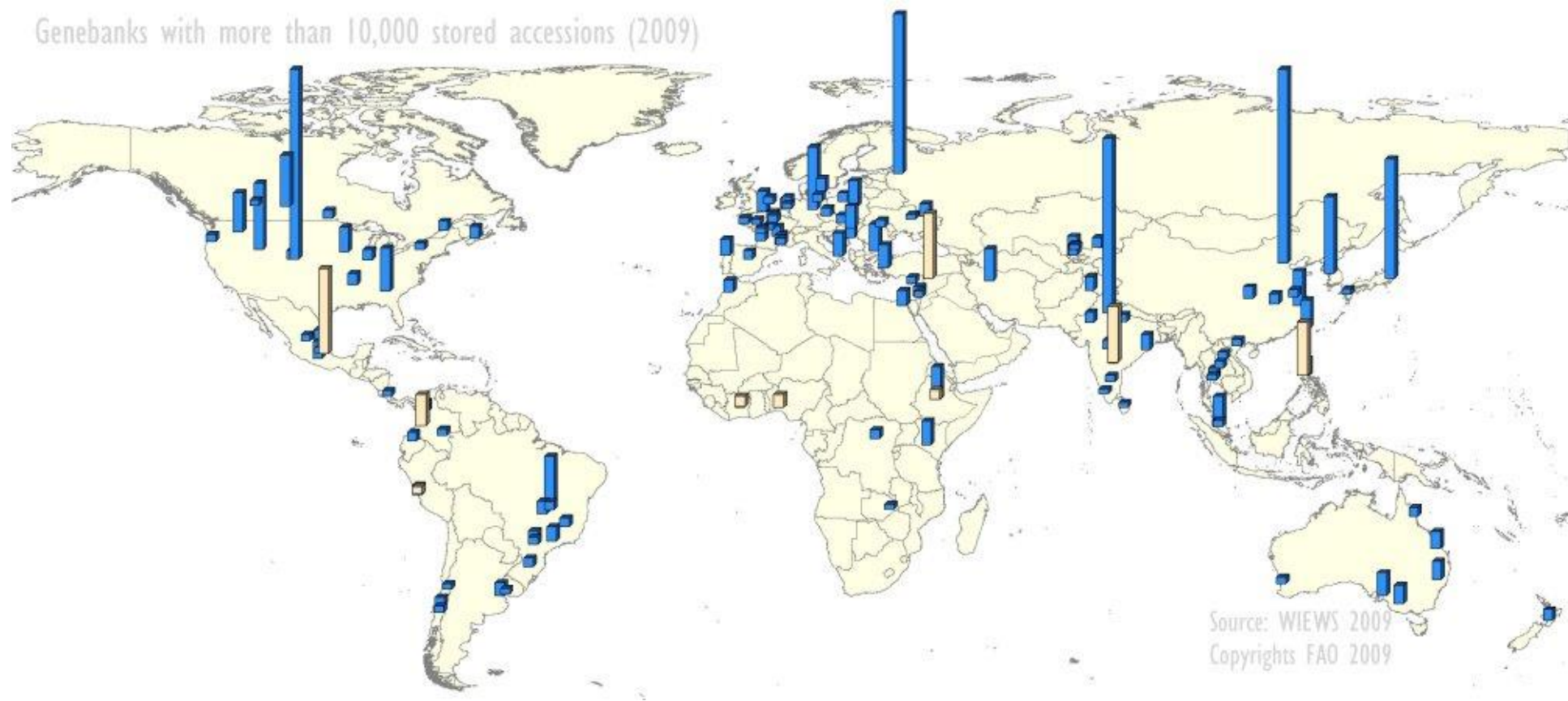


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|---------------------|--------------------|----------------|------------|----------------|----------------------|---------------------|--------------|----------------|
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| Almonds | Blueberries | Cocoa beans | Faba beans | Kiwi | Millets | Peas | Rye | Sweet potatoes |
| Apples | Cabbages | Coconuts | Figs | Leeks | Oats | Pigeonpeas | Sesame | Taro |
| Apricots | Carrots | Coffee | Garlic | Lemons & limes | Olives | Pineapples | Sorghum | Tea |
| Artichokes | Cassava | Cottonseed oil | Ginger | Lentils | Onions | Plums | Soybean | Tomatoes |
| Asparagus | Cherries | Cowpeas | Grapefruit | Lettuce | Oranges | Potatoes | Spinach | Vanilla |
| Avocados | Chickpeas | Cranberries | Grapes | Maize | Papayas | Pumpkins | Strawberries | Watermelons |
| Bananas & plantains | Chillies & peppers | Cucumbers | Groundnut | Mangoes | Palm oil | Quinoa | Sugar beet | Wheat |
| Barley | Cinnamon | Dates | Hazelnuts | Mate | Peaches & nectarines | Rape & mustard seed | Sugarcane | Yams |

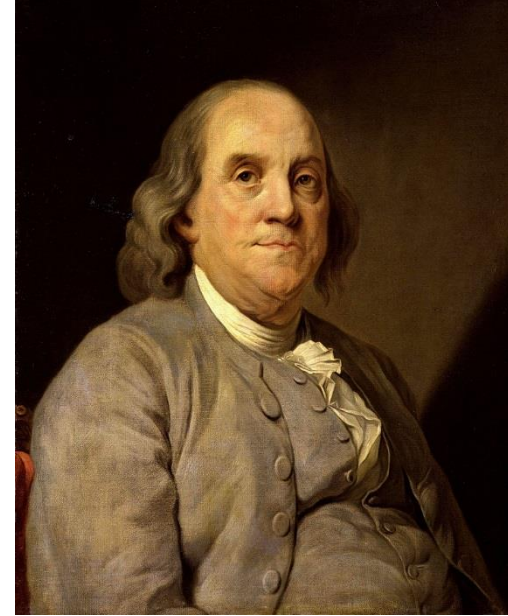
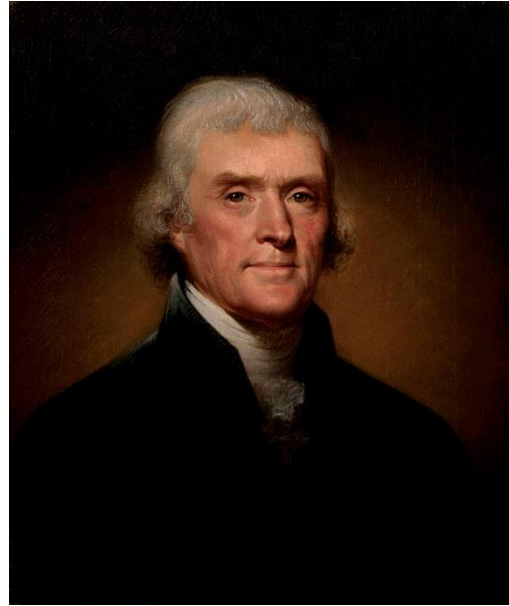
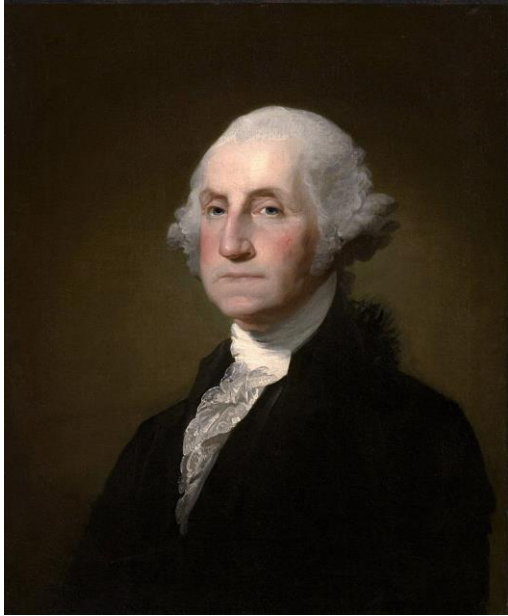
The world's public genebanks



The world's big public genebanks



Some early genetic resource introducers to the U.S.

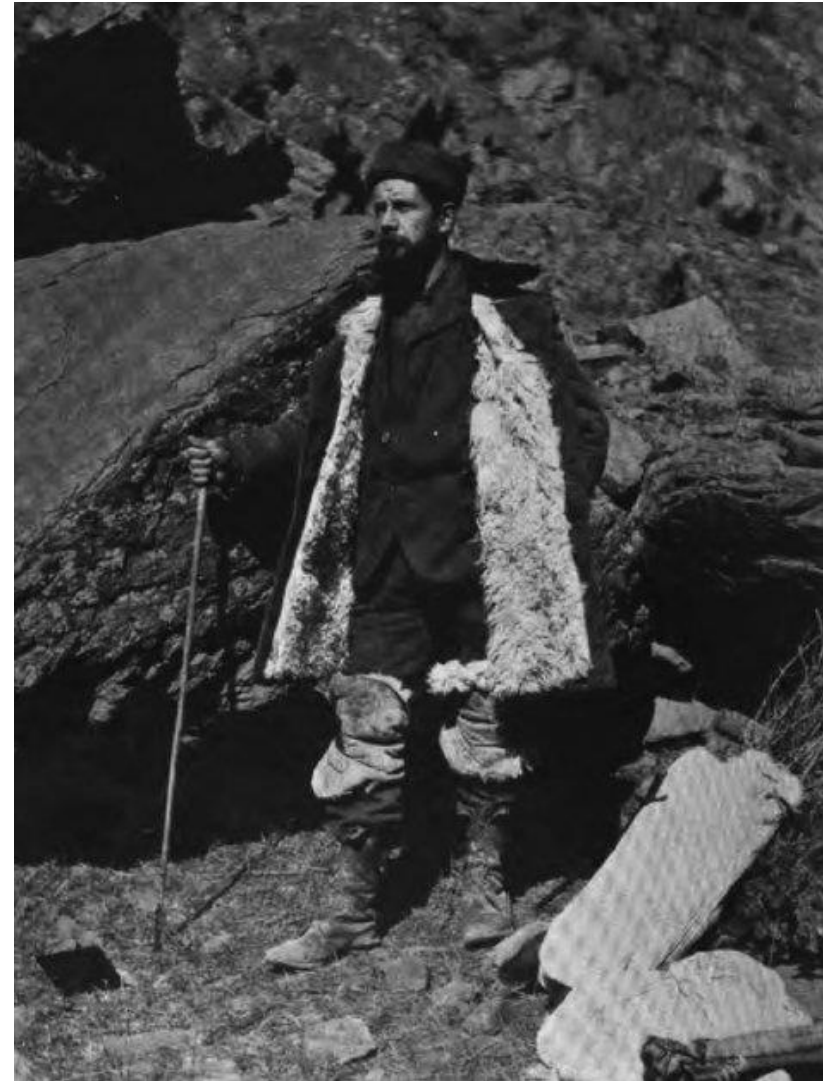


“The greatest service which can be rendered to any country is to add a useful plant to its culture; especially a bread grain. Next in value to bread is oil” Thomas Jefferson, 1800

Origins of crop diversity collections in the U.S.

Seed package distributions by
the U.S. Government to U.S. farmers

Period	Average number of seed packages per year
1862-1869	824,747
1870-1879	1,289,434
1880-1889	3,495,123
1890-1897	10,195,250

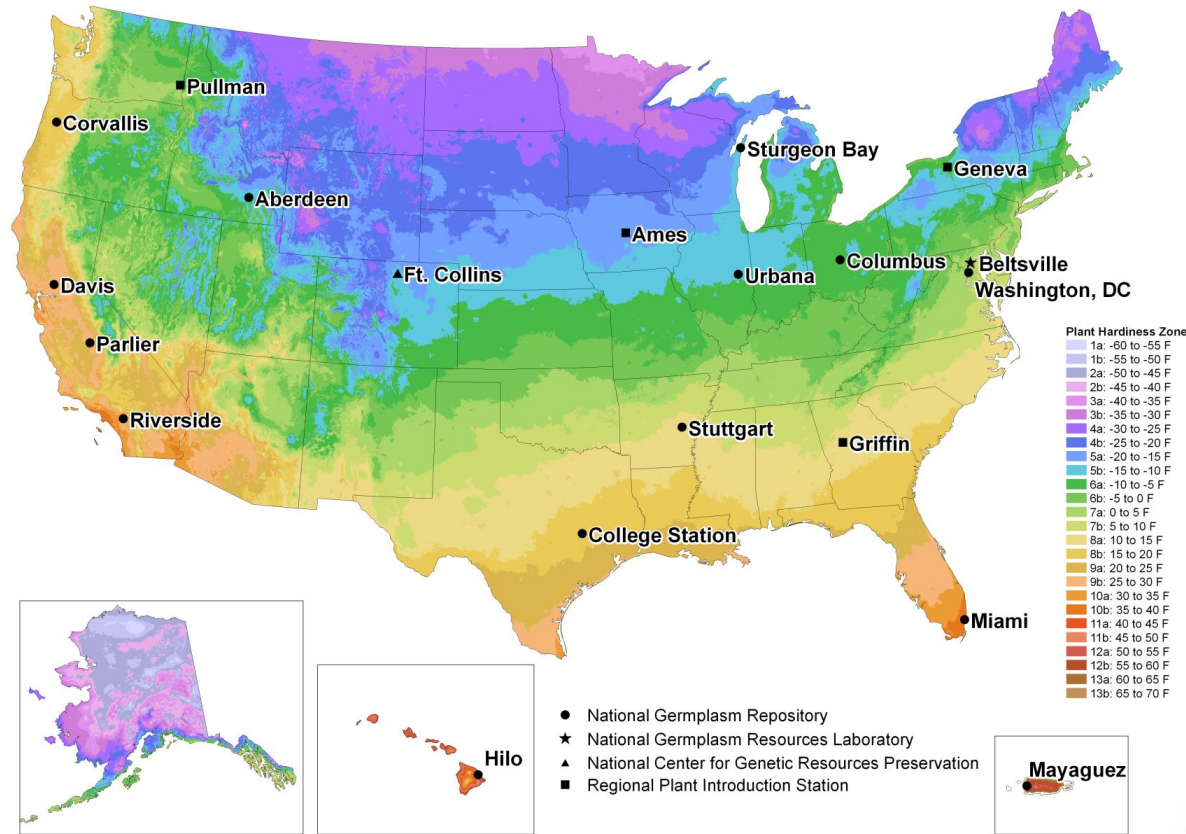


Frank N. Meyer (1875-1918)



Homesteaders in Wisconsin in 1895

USDA ARS National Plant Germplasm System



- 575,000 accessions
- 15,000 species
- 250,000 samples distributed/yr







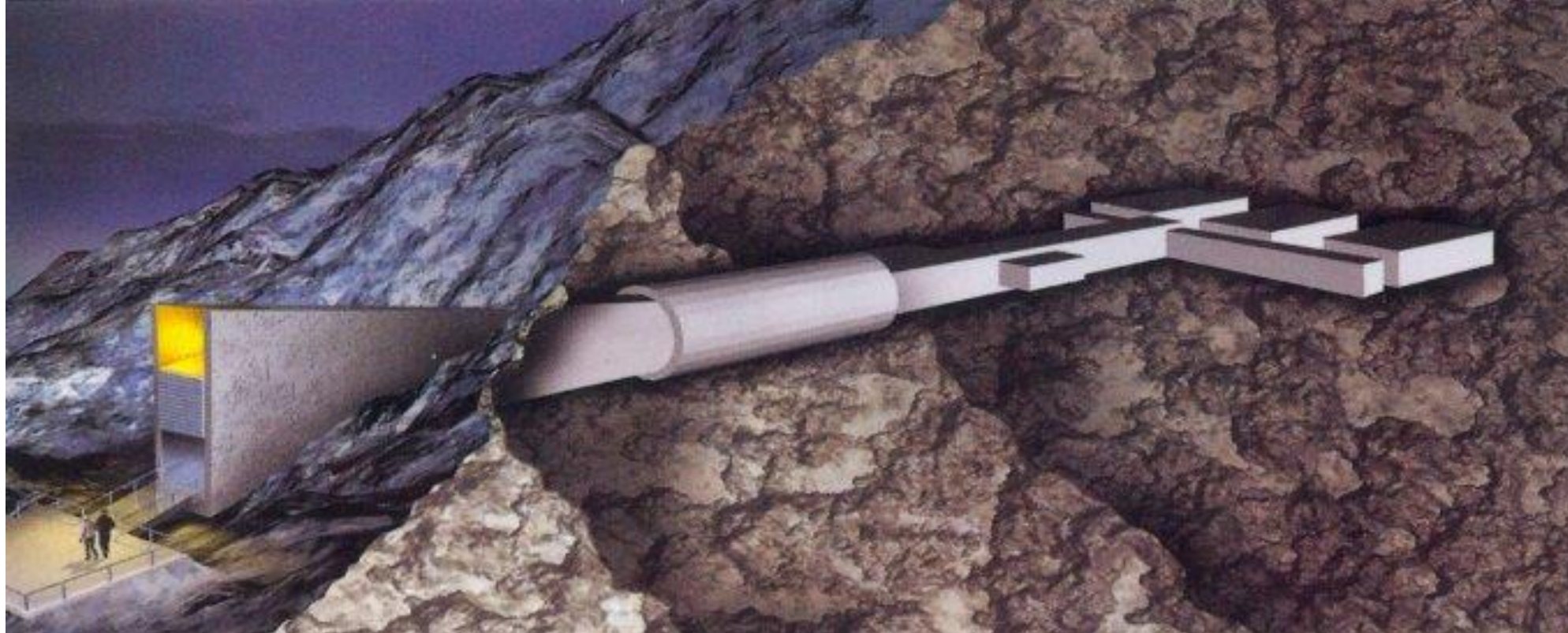




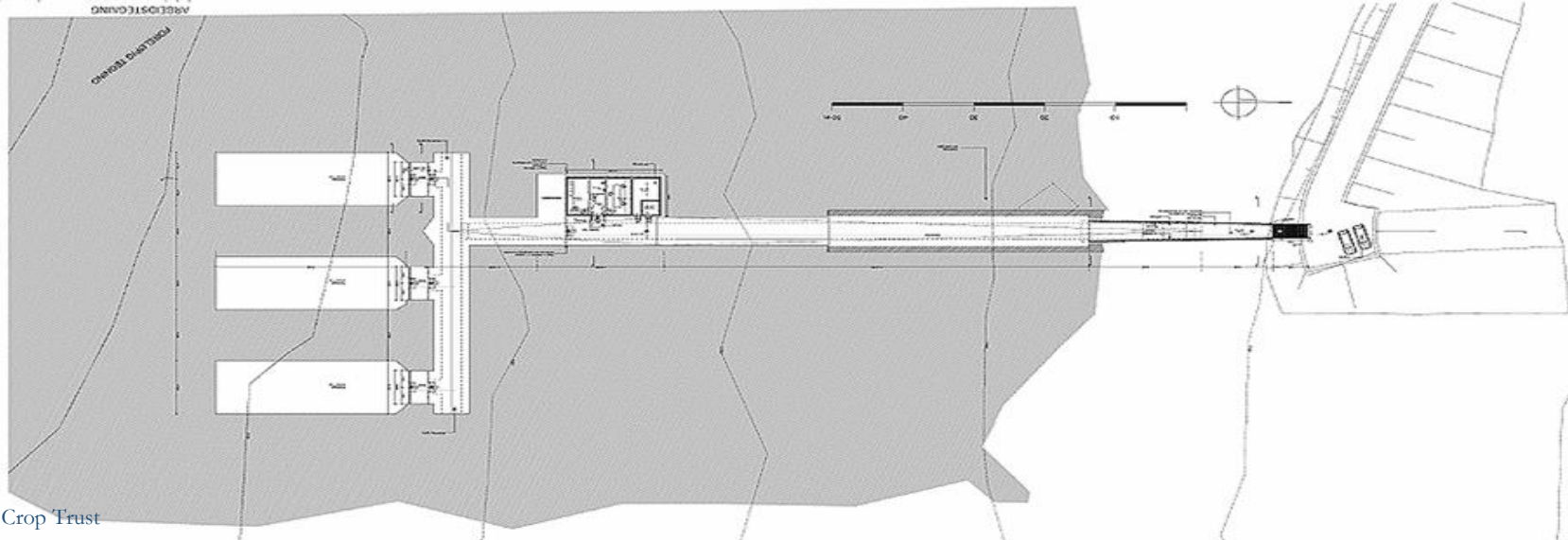
Vær oppmerksom på
isbjørnfare

*Be aware of the polar
bear danger*

KINGS
BAY



Architect	STUDIO 3 ARCHITECTURE
Client	STADT GÖTTINGEN
Project Name	STADT GÖTTINGEN
Scale	1:500
Date	2010



Crop Trust

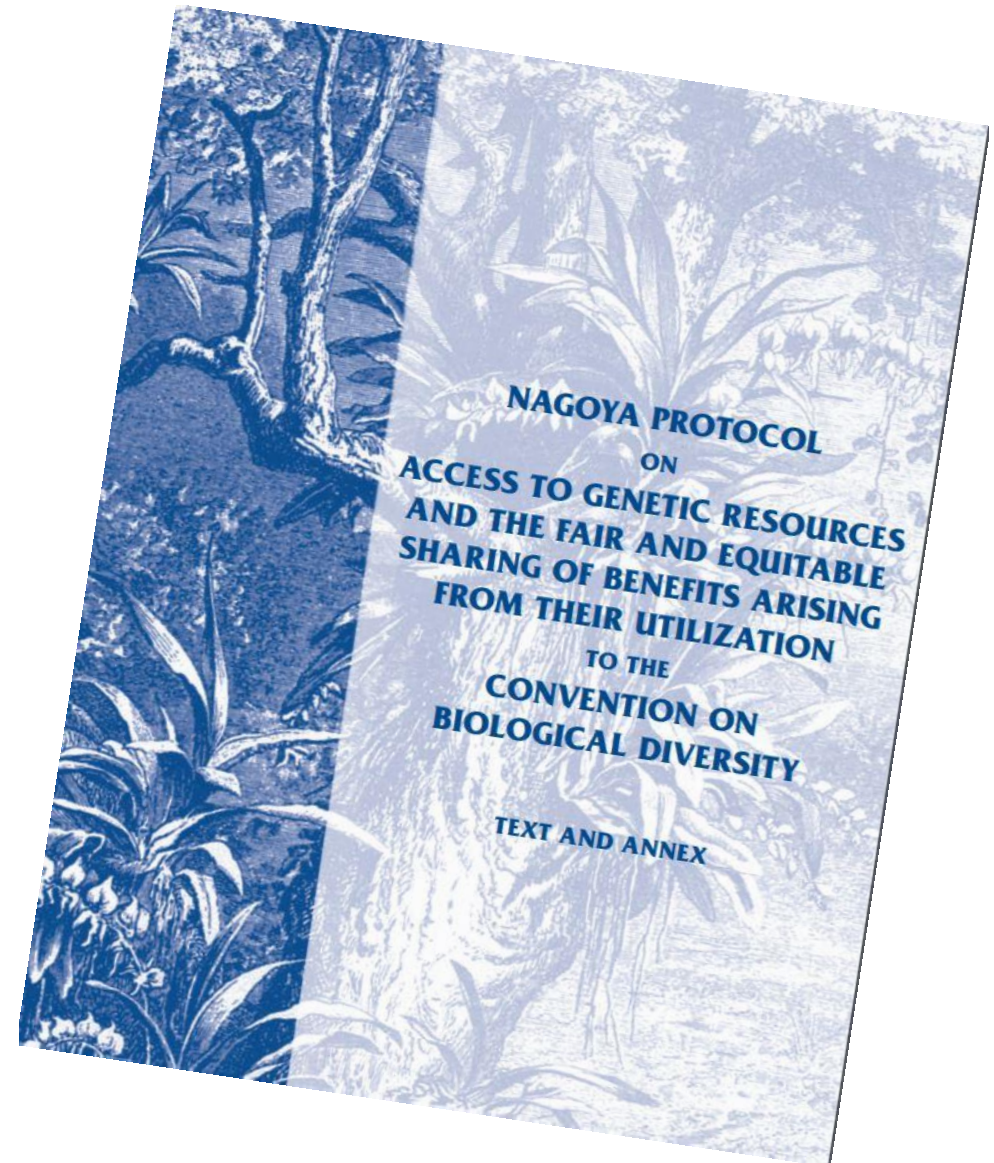
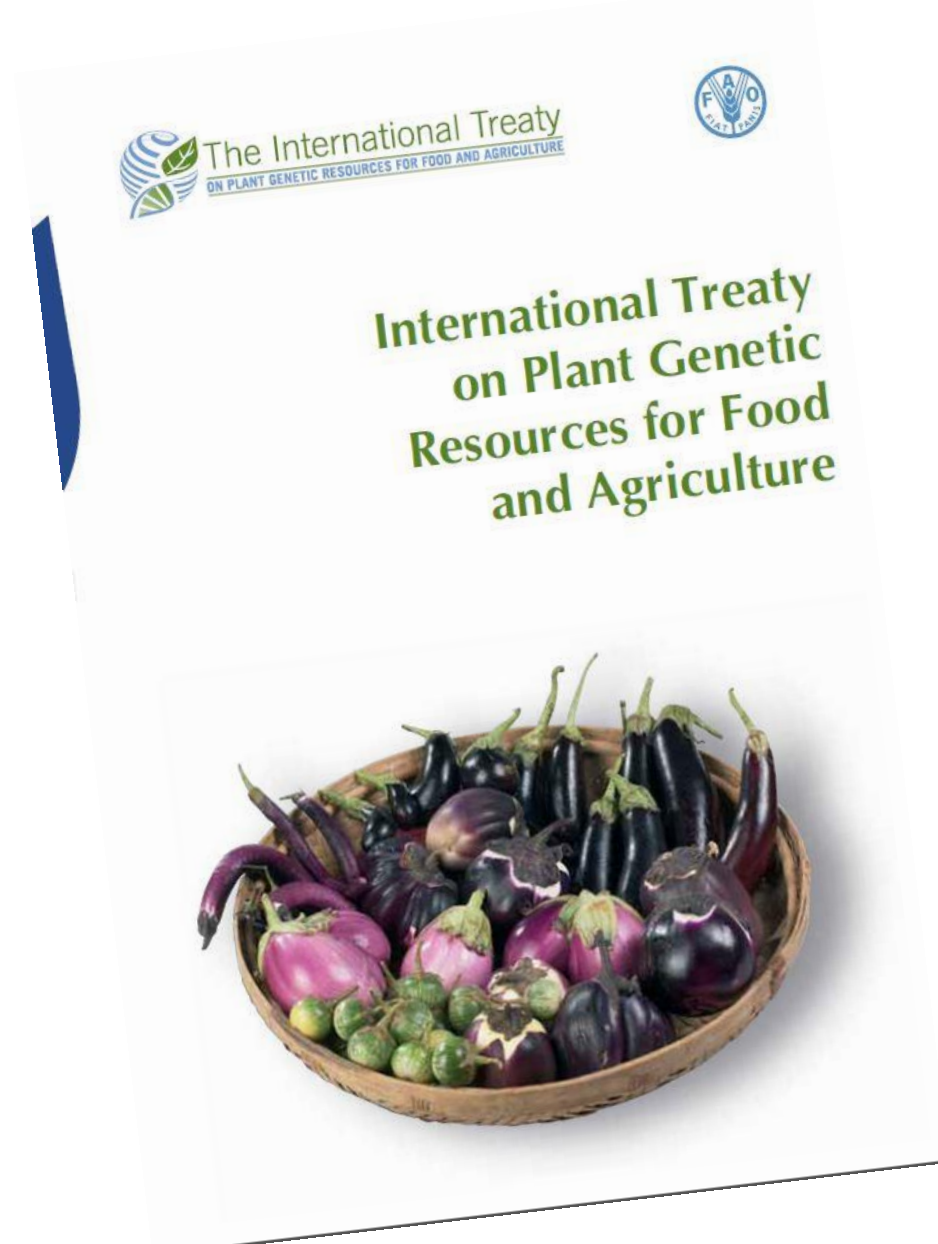




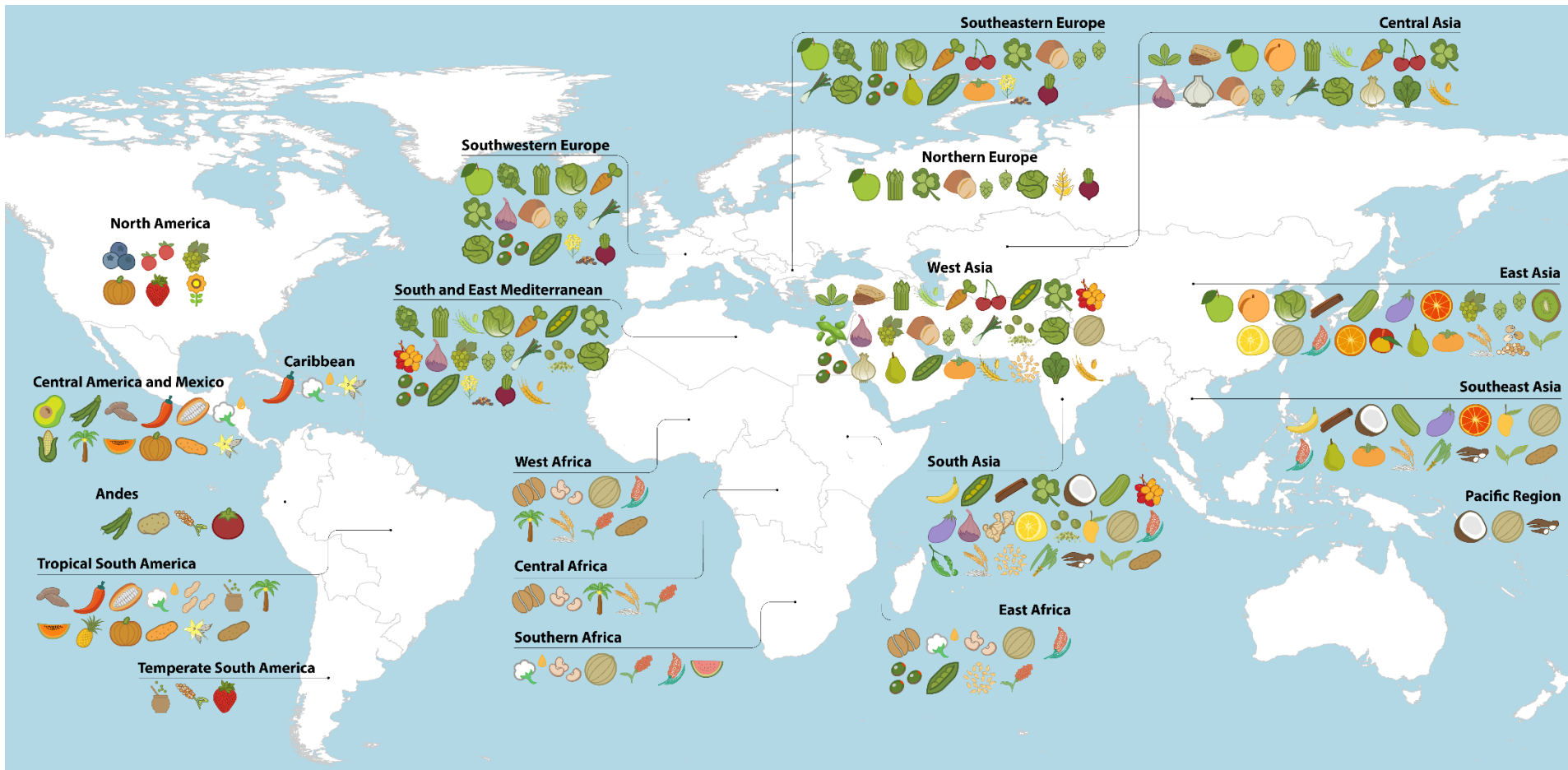
Doomsday happens every day



Interdependence with regard to genetic resources

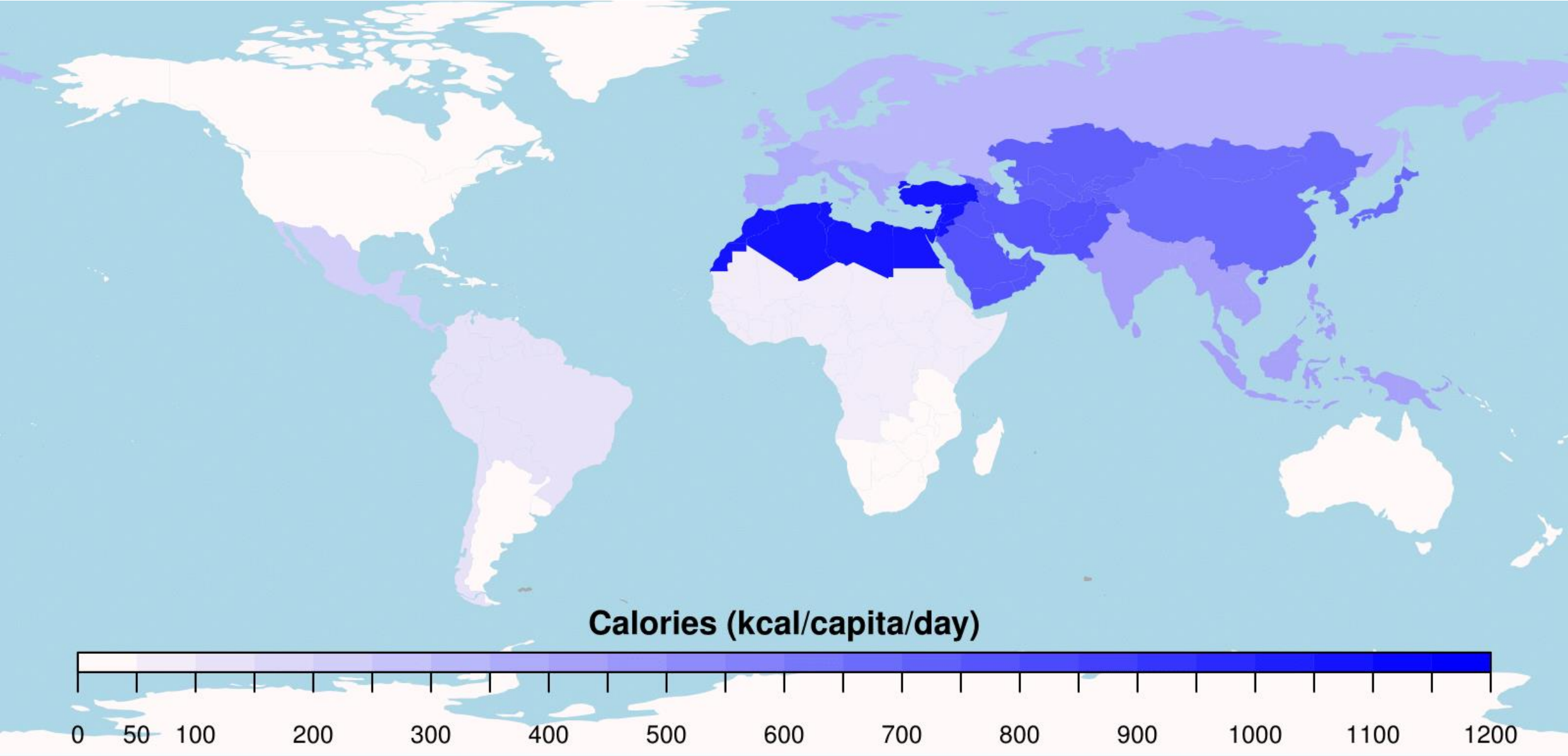


Primary regions of diversity of major crops



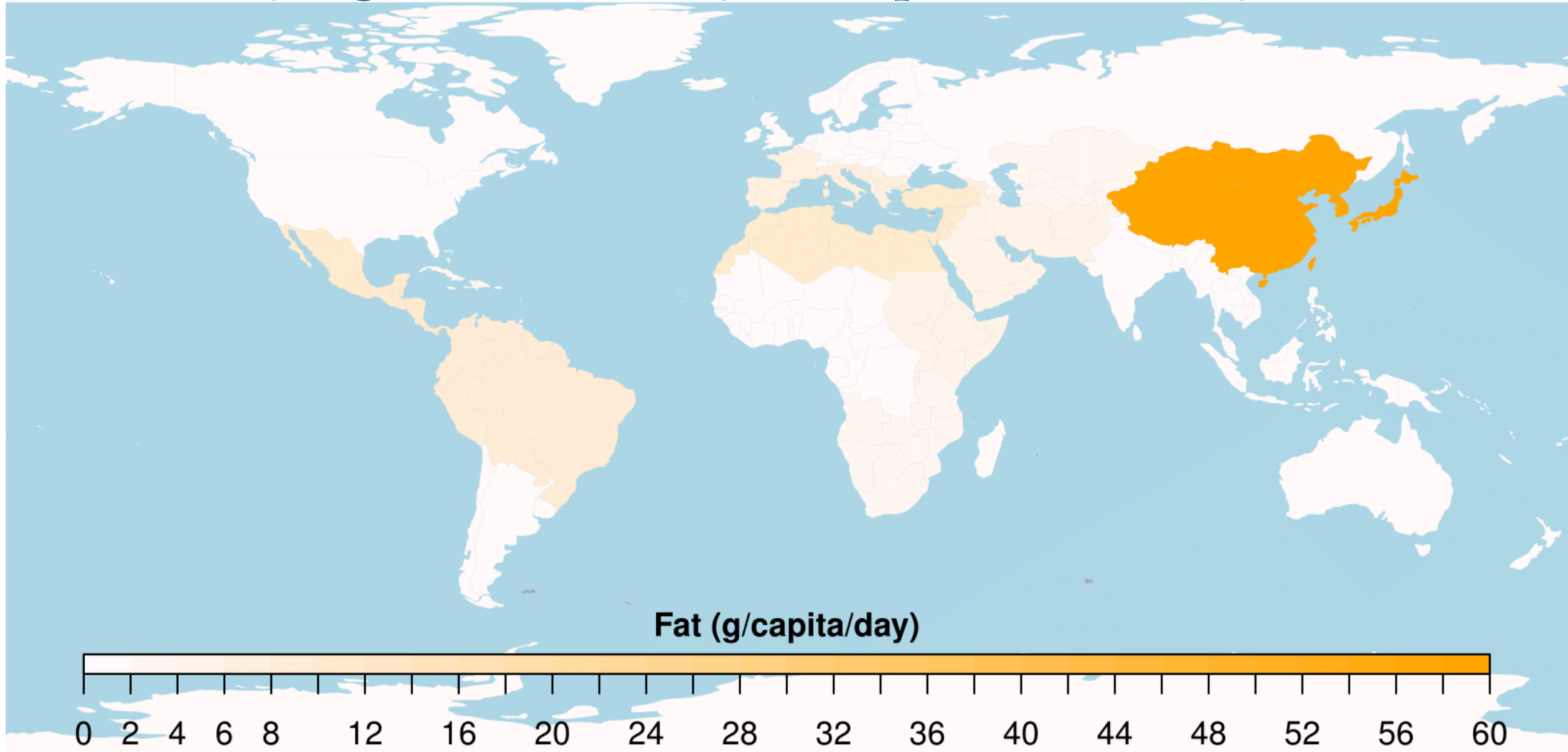
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| Bananas & plantains | Chillies & peppers | Cucumbers | Groundnut | Mangoes | Papayas | Quinoa | Sugar beet | Wheat |
| Barley | Cinnamon | Dates | Hazelnuts | Mate | Peaches & nectarines | Rape & mustard seed | Sugar cane | Yams |

Primary regions of diversity of crops consumed by the USA

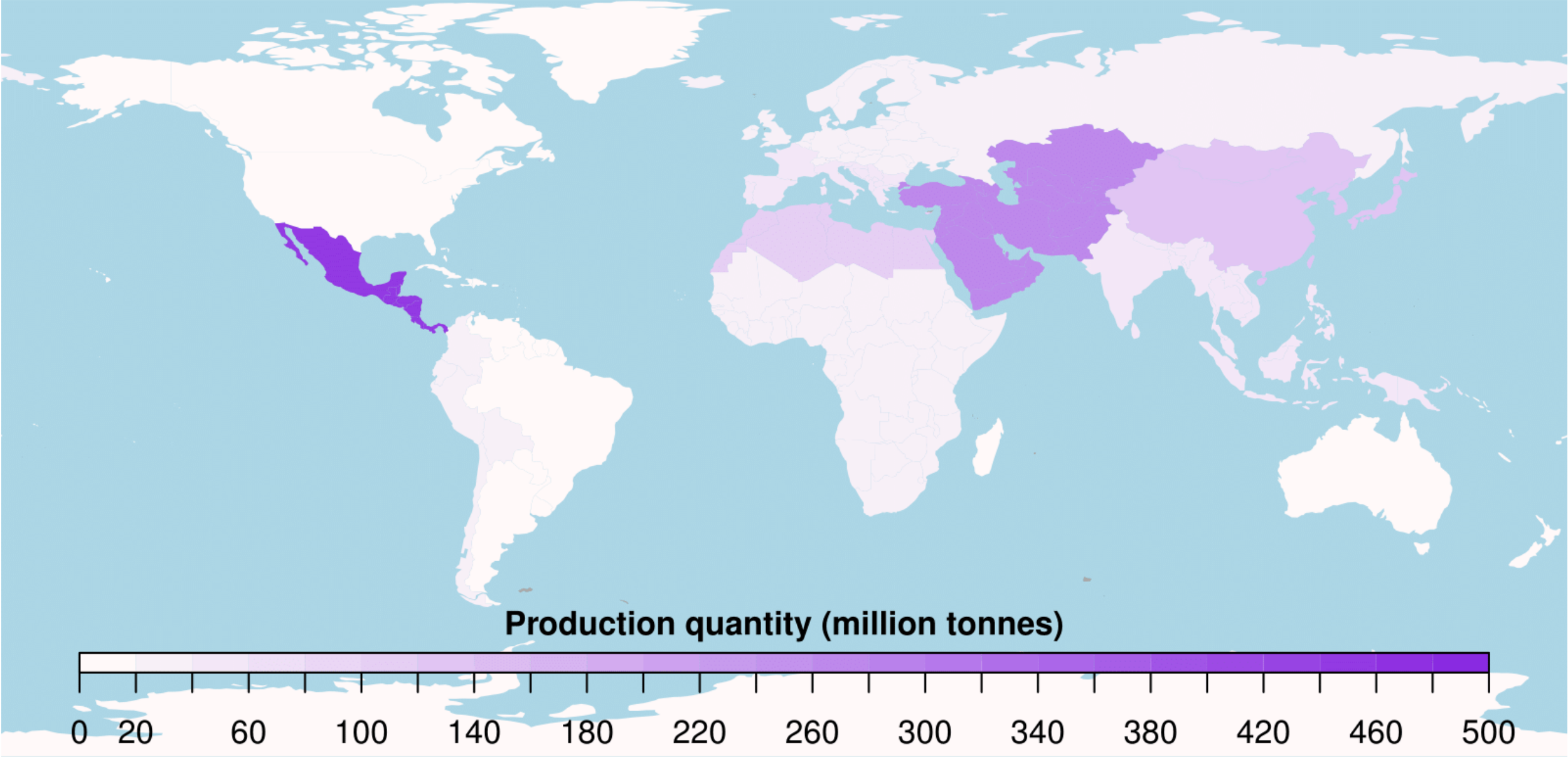


Khoury *et al.* (2016). *Proc. Royal. Soc. B* 283(1832): 20160792.

Primary regions of diversity of crops consumed by the USA

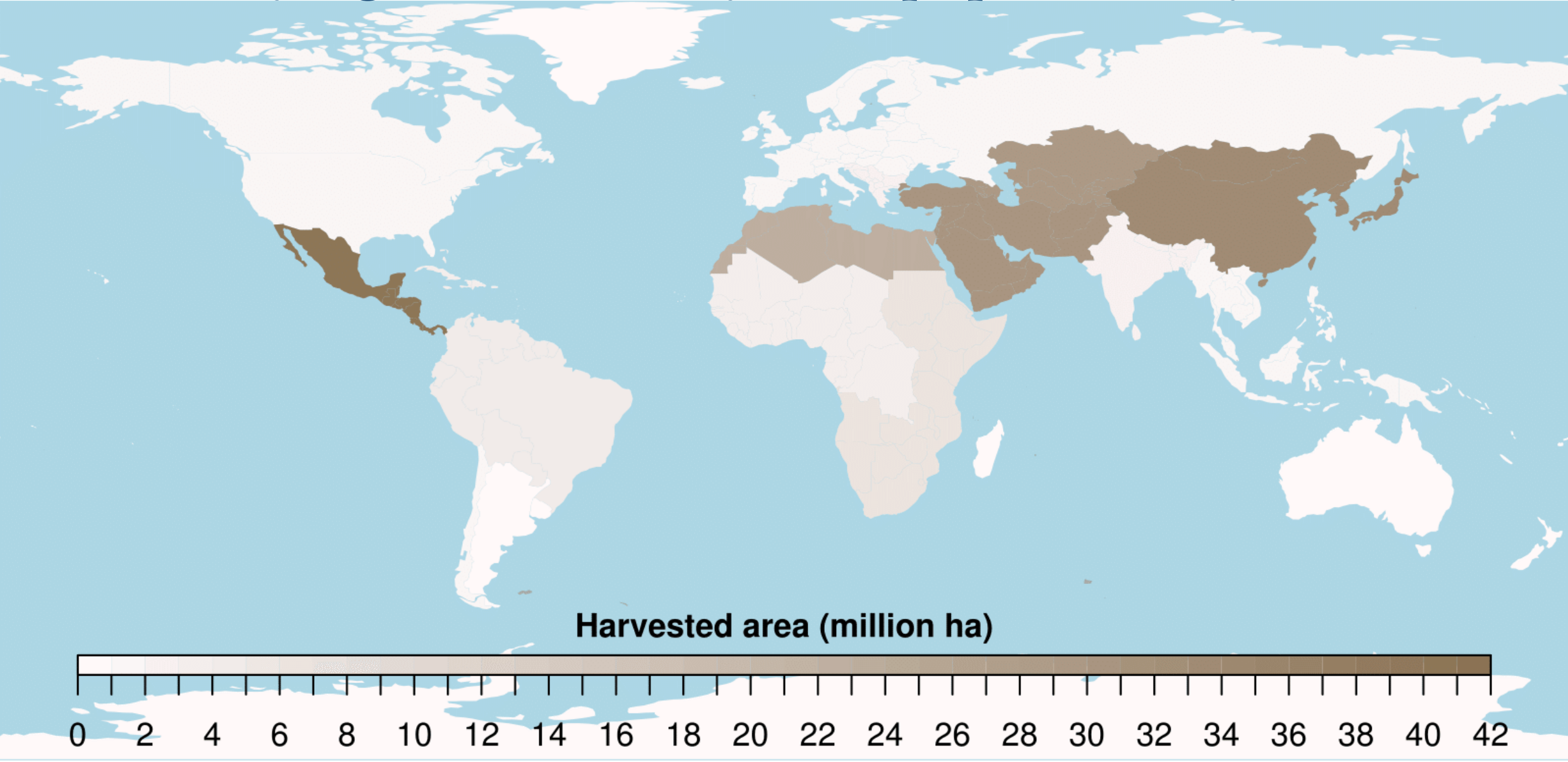


Primary regions of diversity of crops produced by the USA

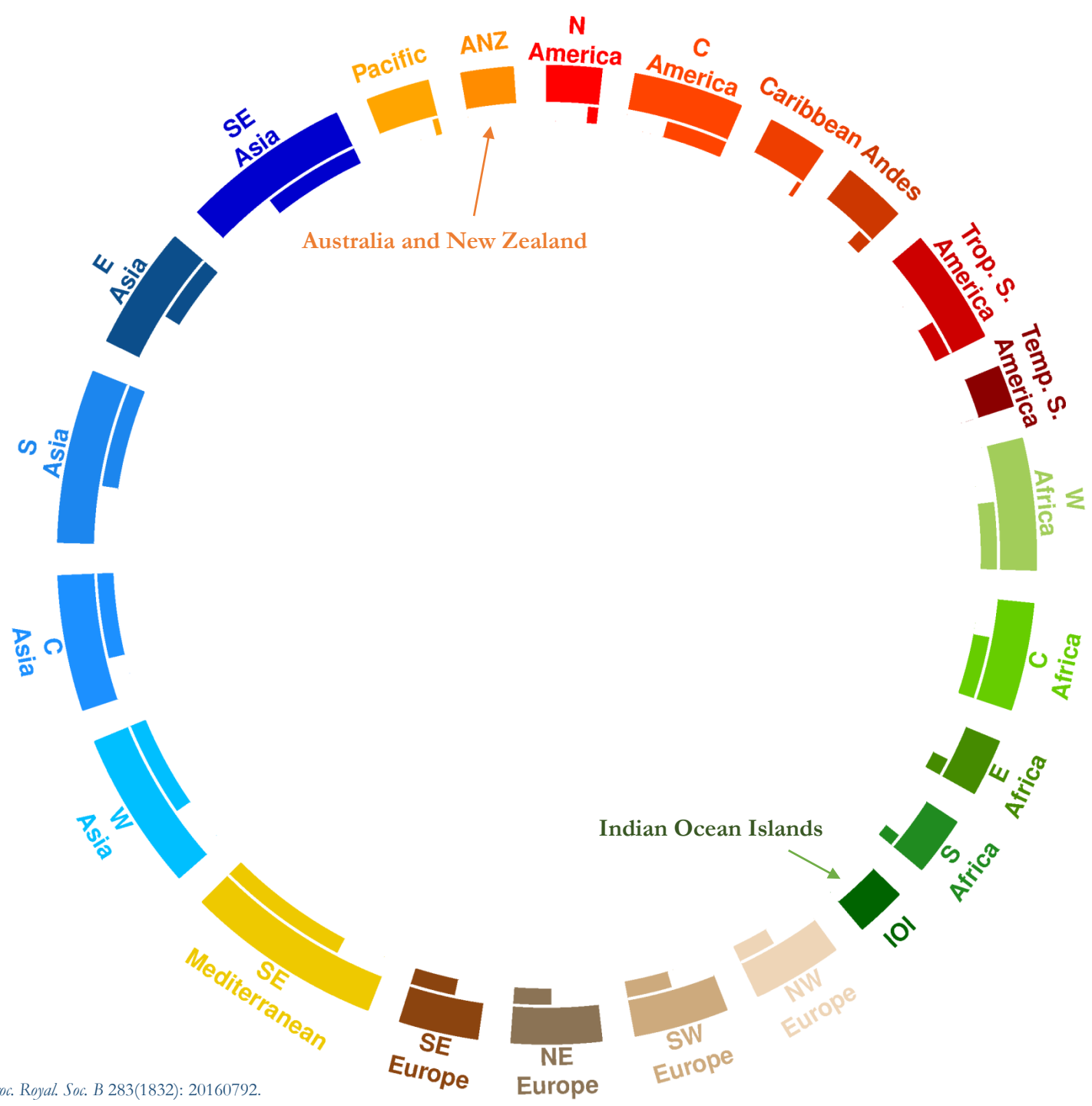


Khoury *et al.* (2016). *Proc. Royal Soc. B* 283(1832): 20160792.

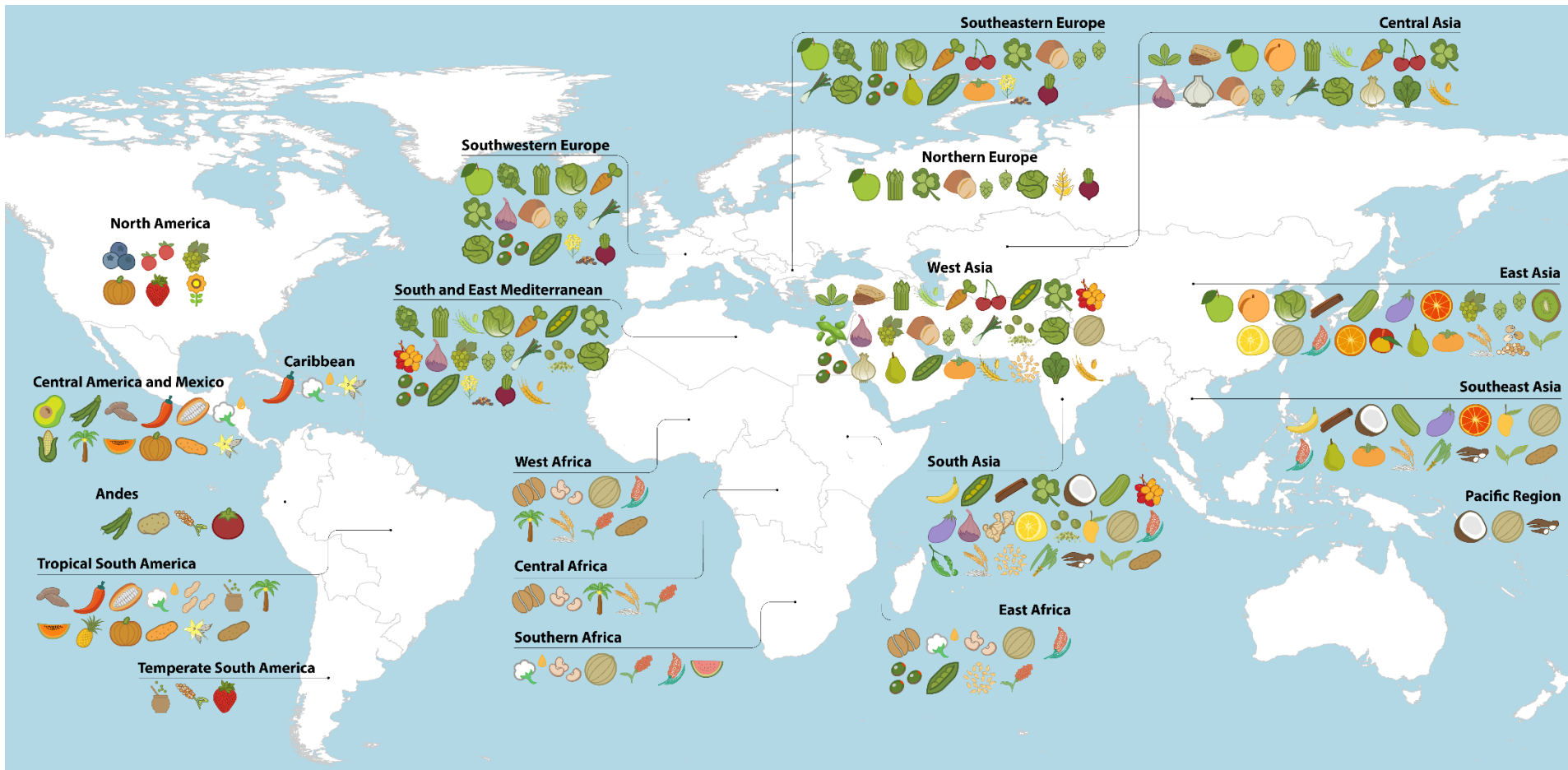
Primary regions of diversity of crops produced by the USA



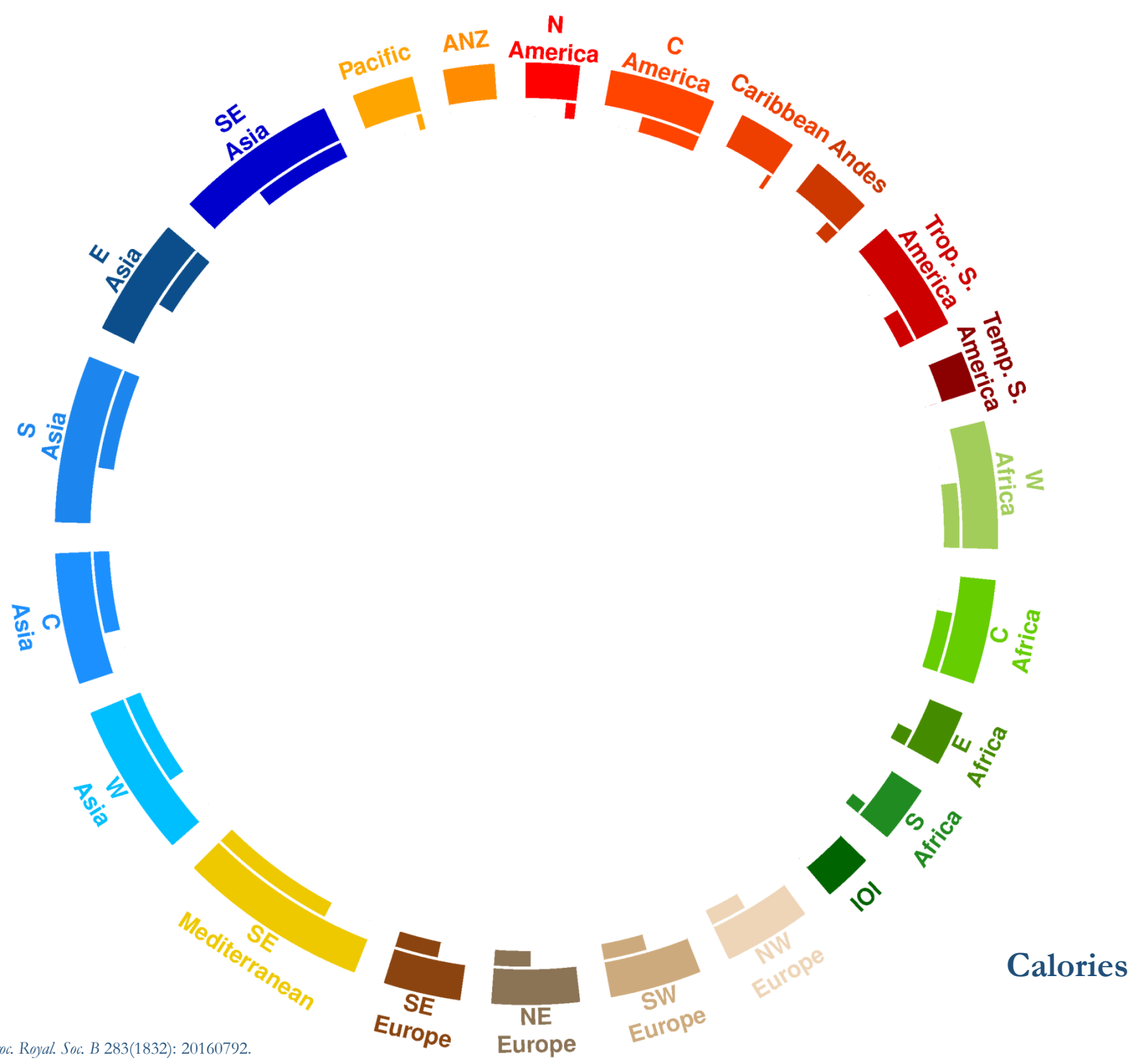
Khoury *et al.* (2016). *Proc. Royal. Soc. B* 283(1832): 20160792.

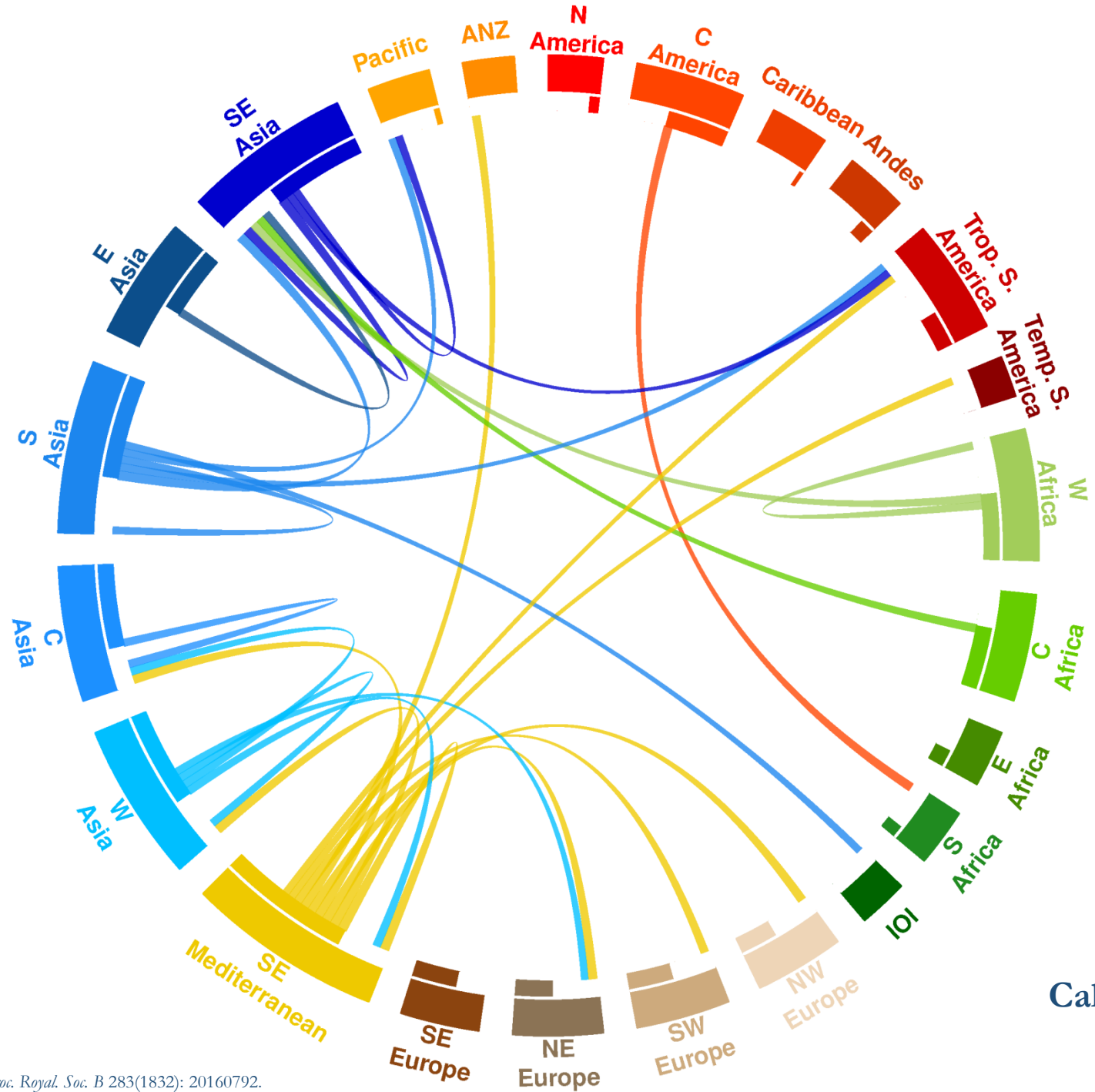


Primary regions of diversity of major crops

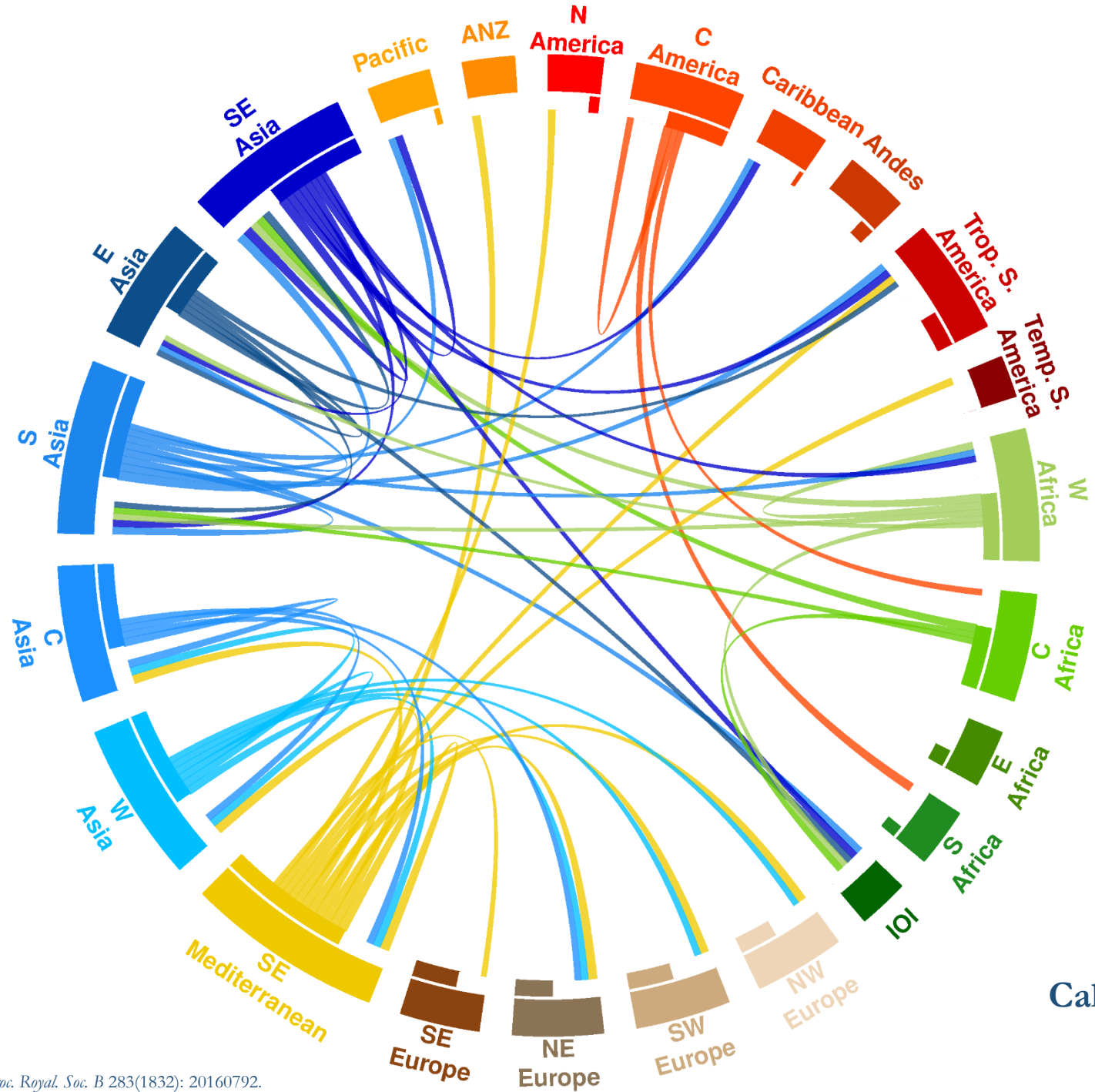


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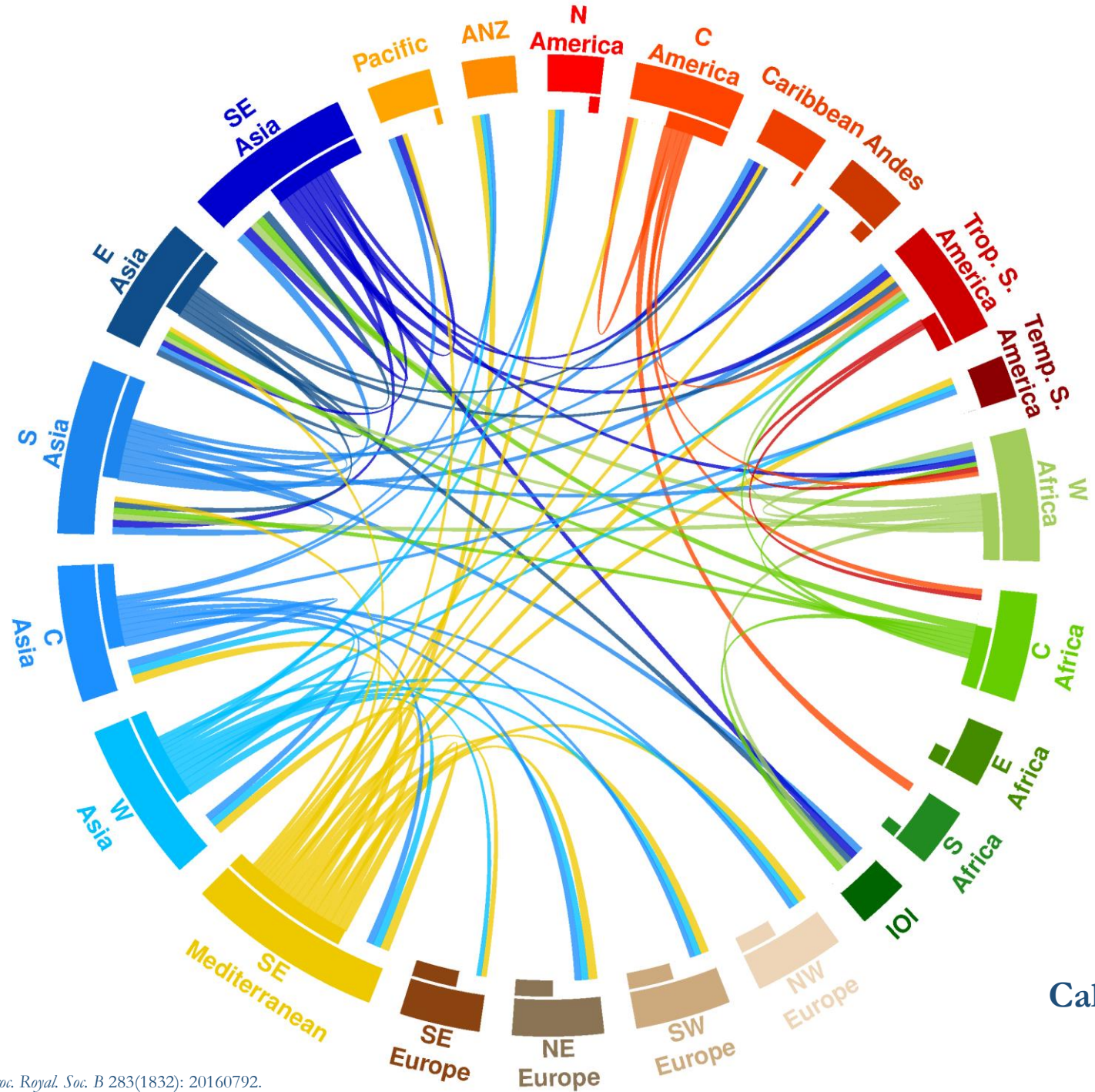


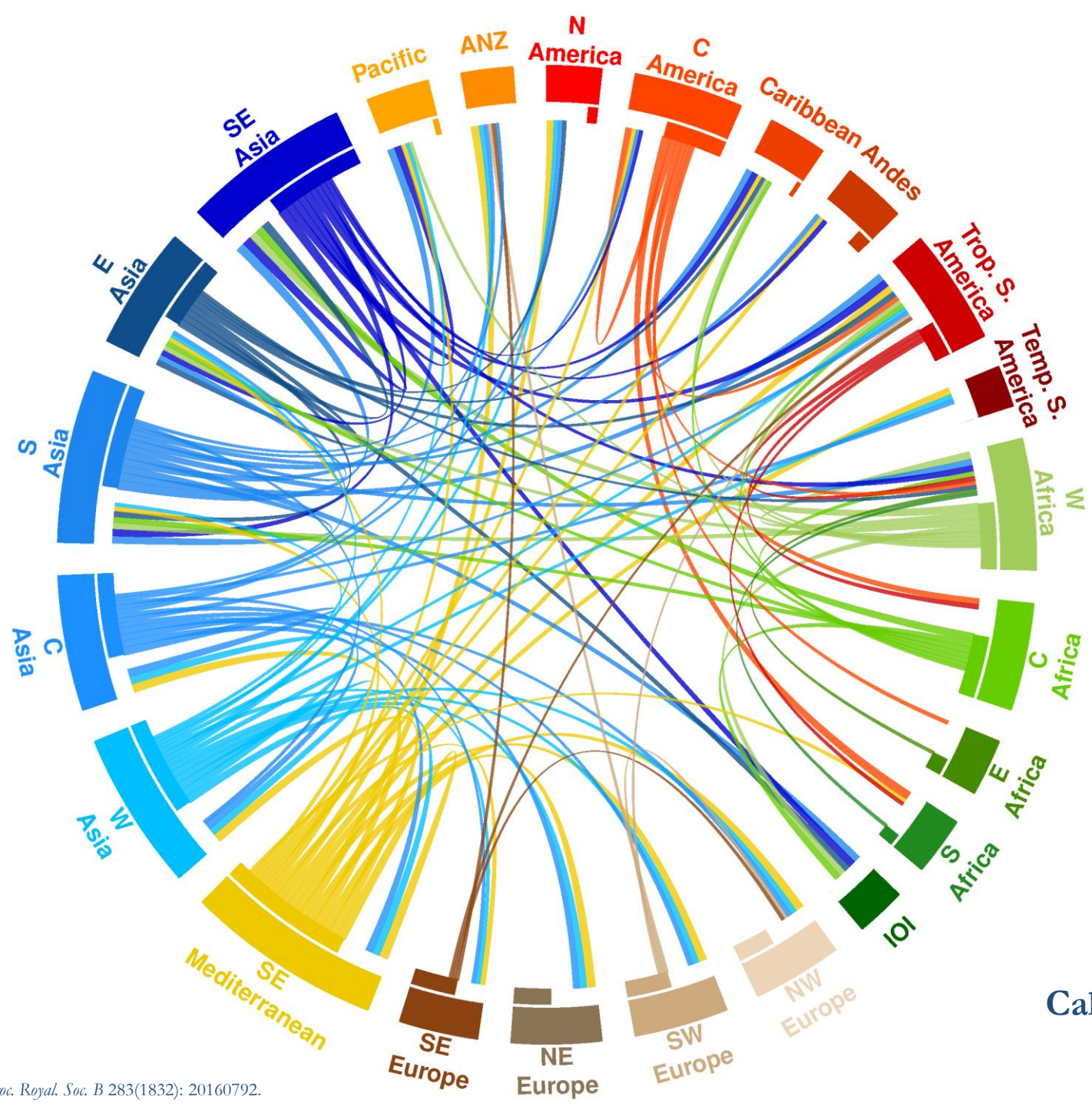


Calories

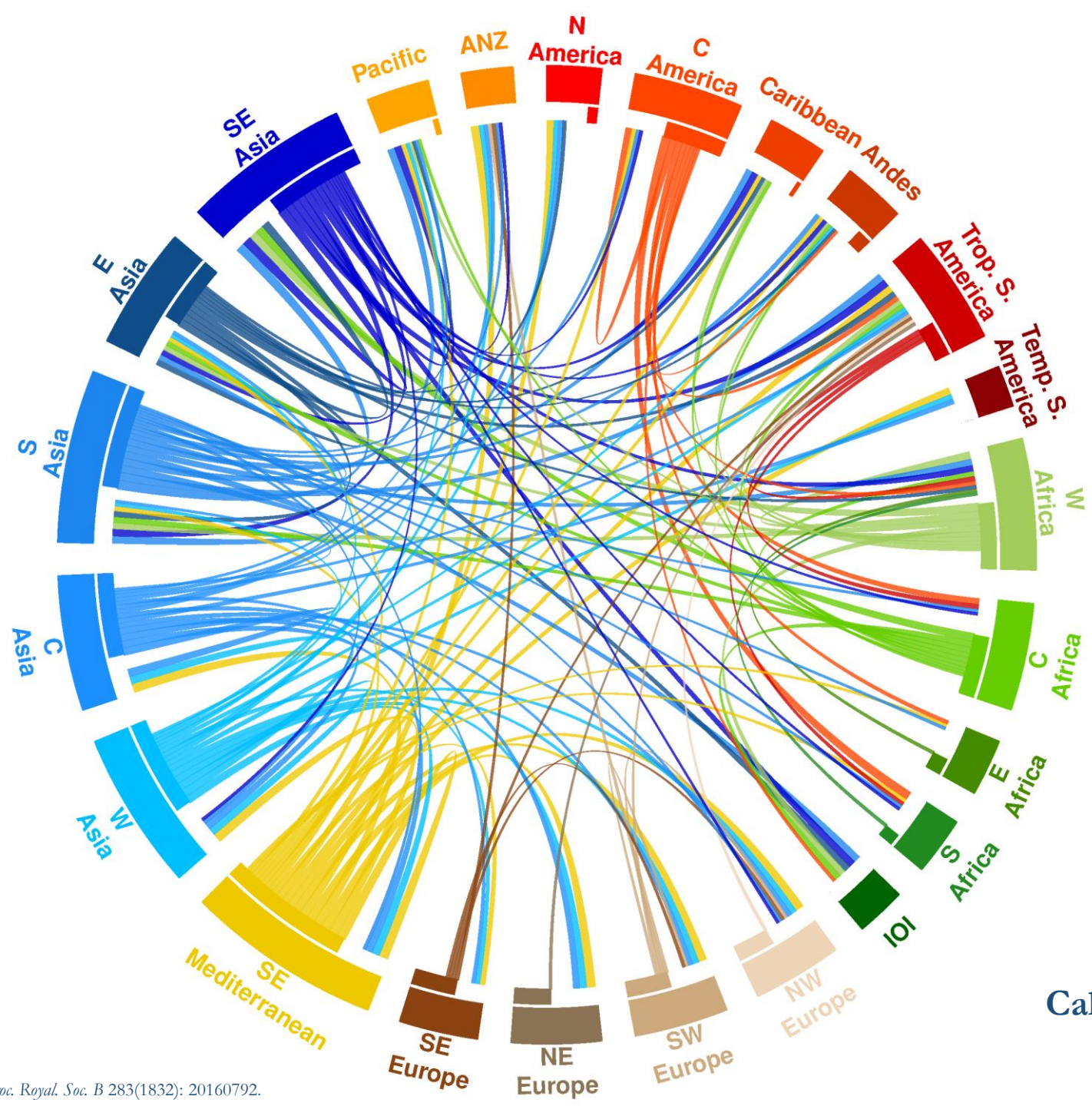


Calories

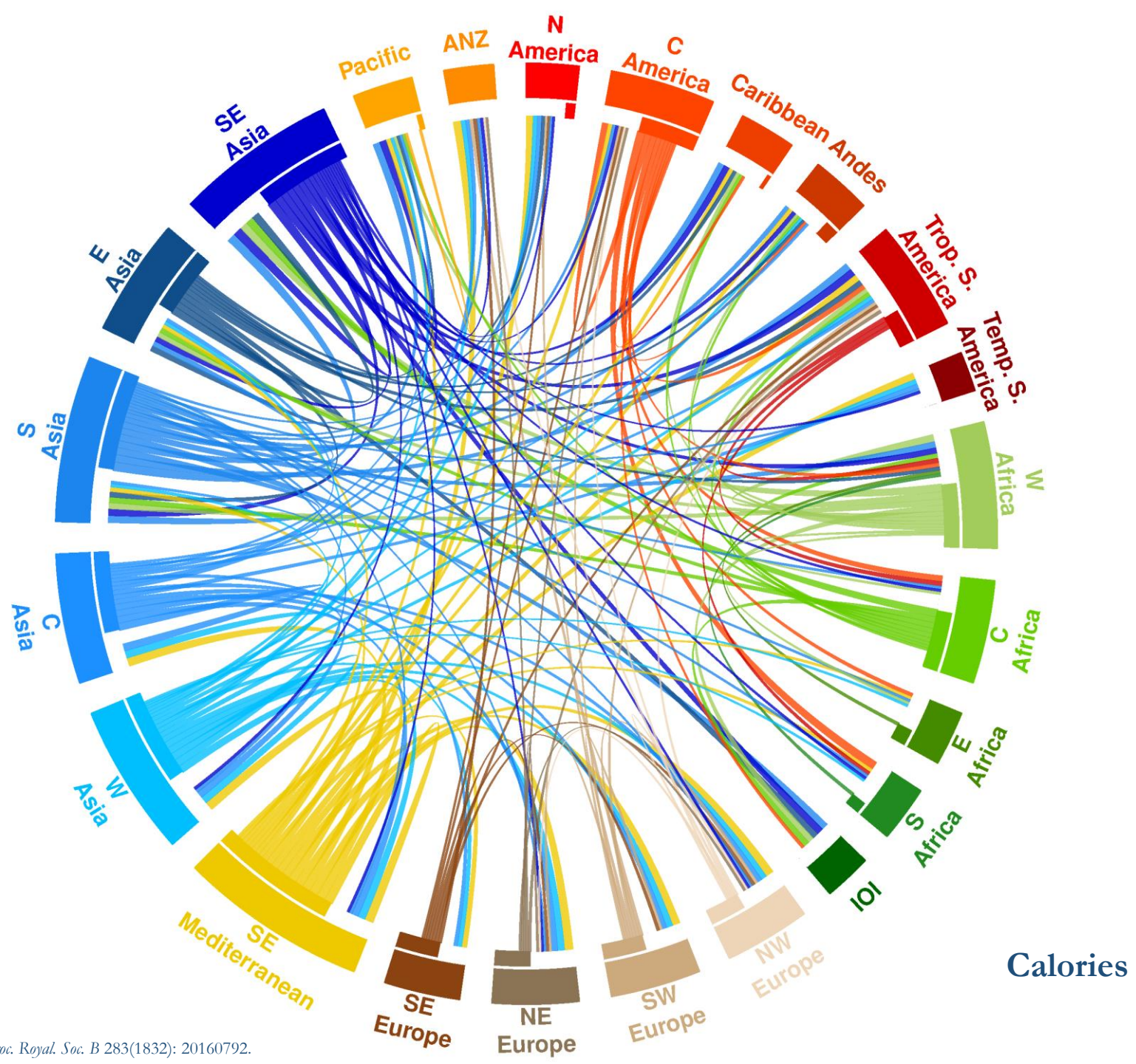


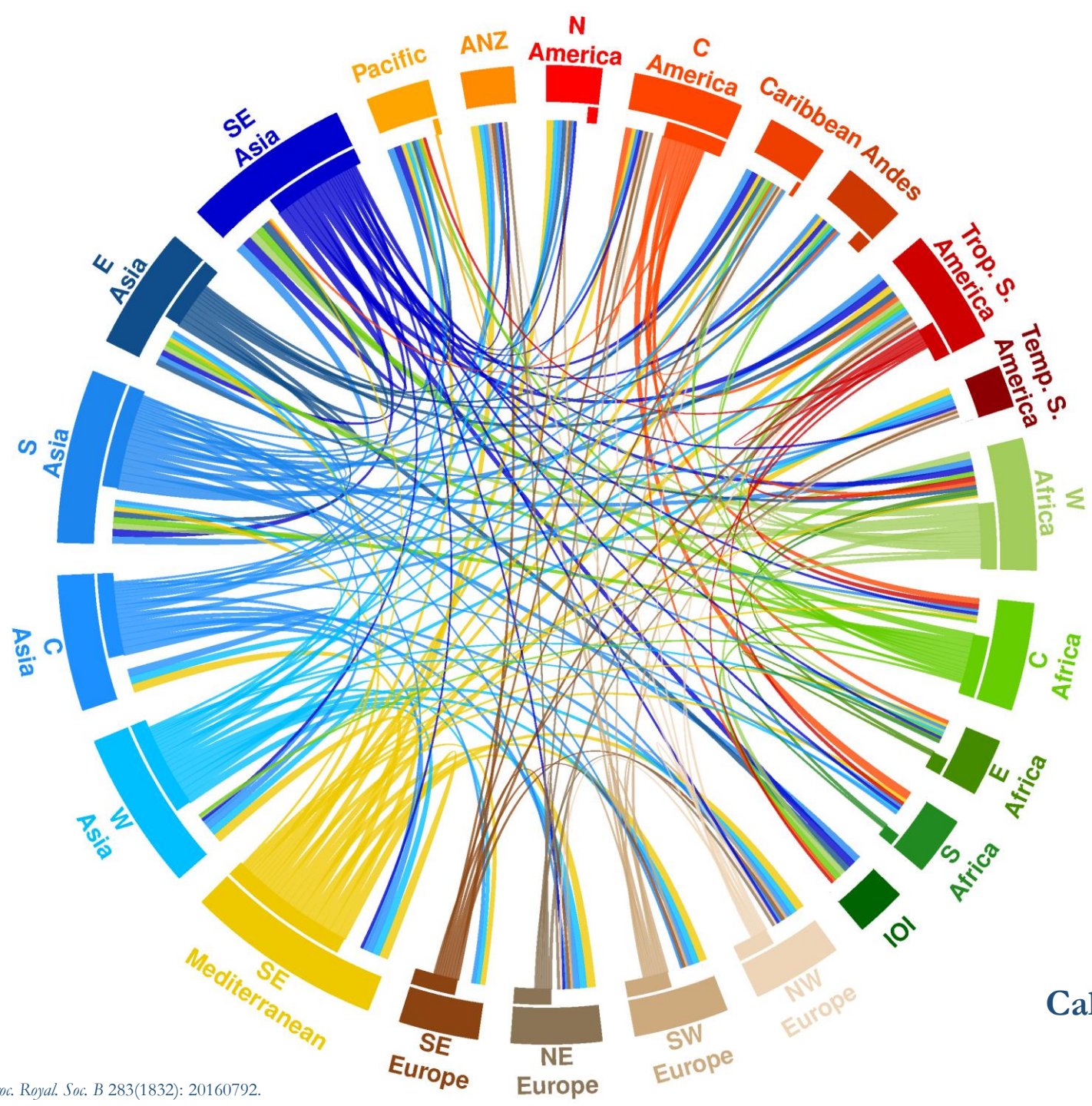


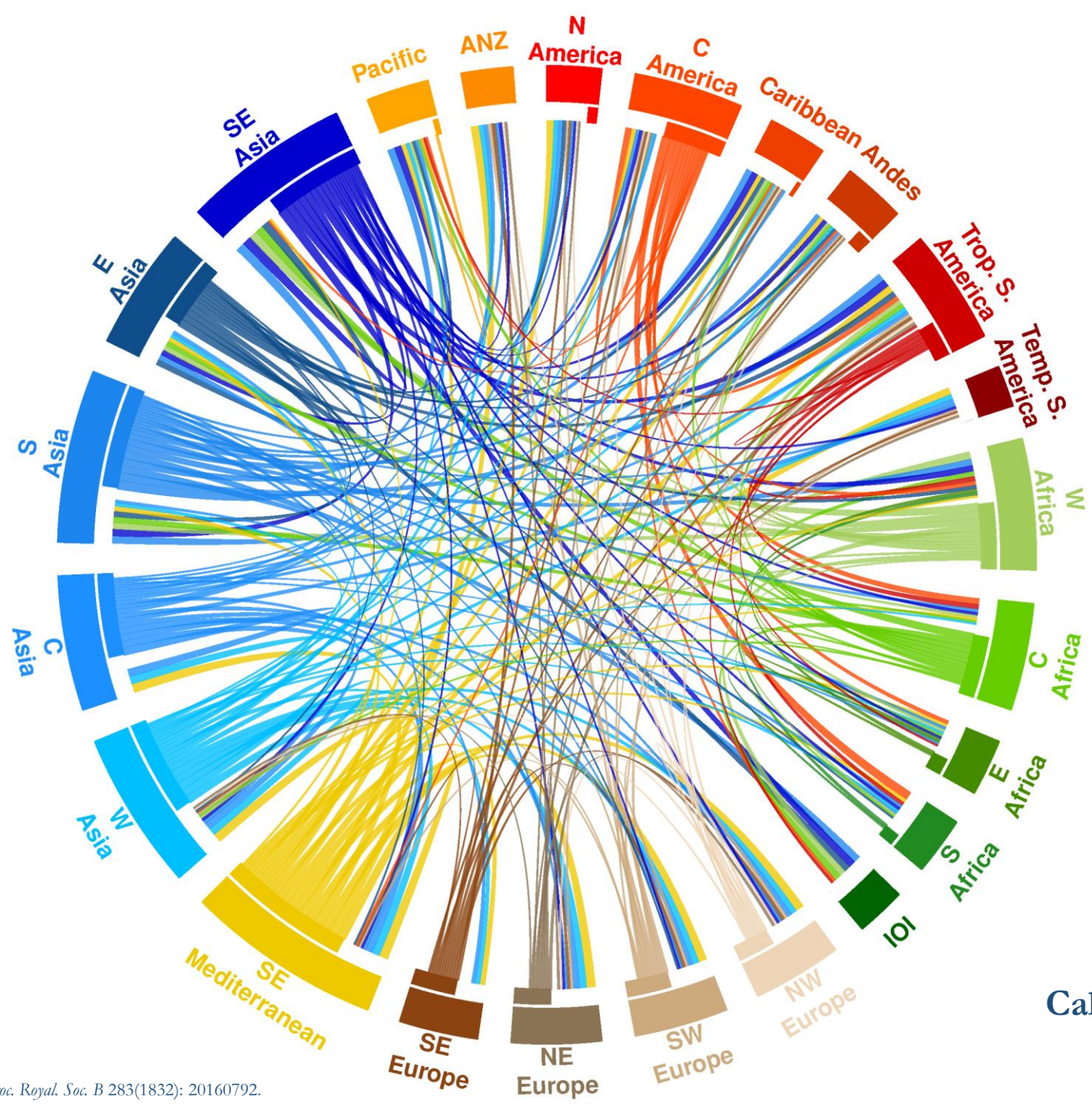
Calories



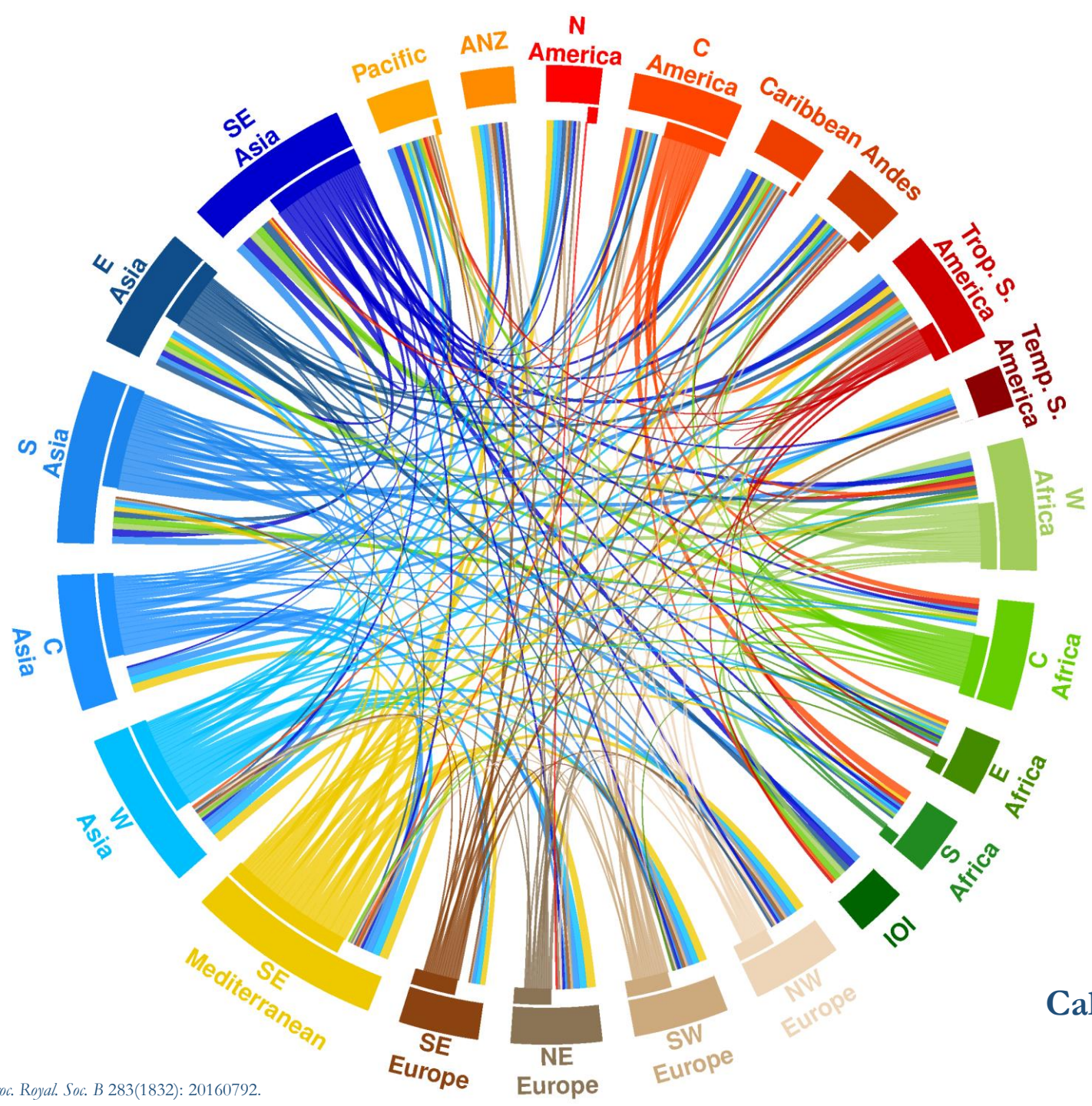
Calories



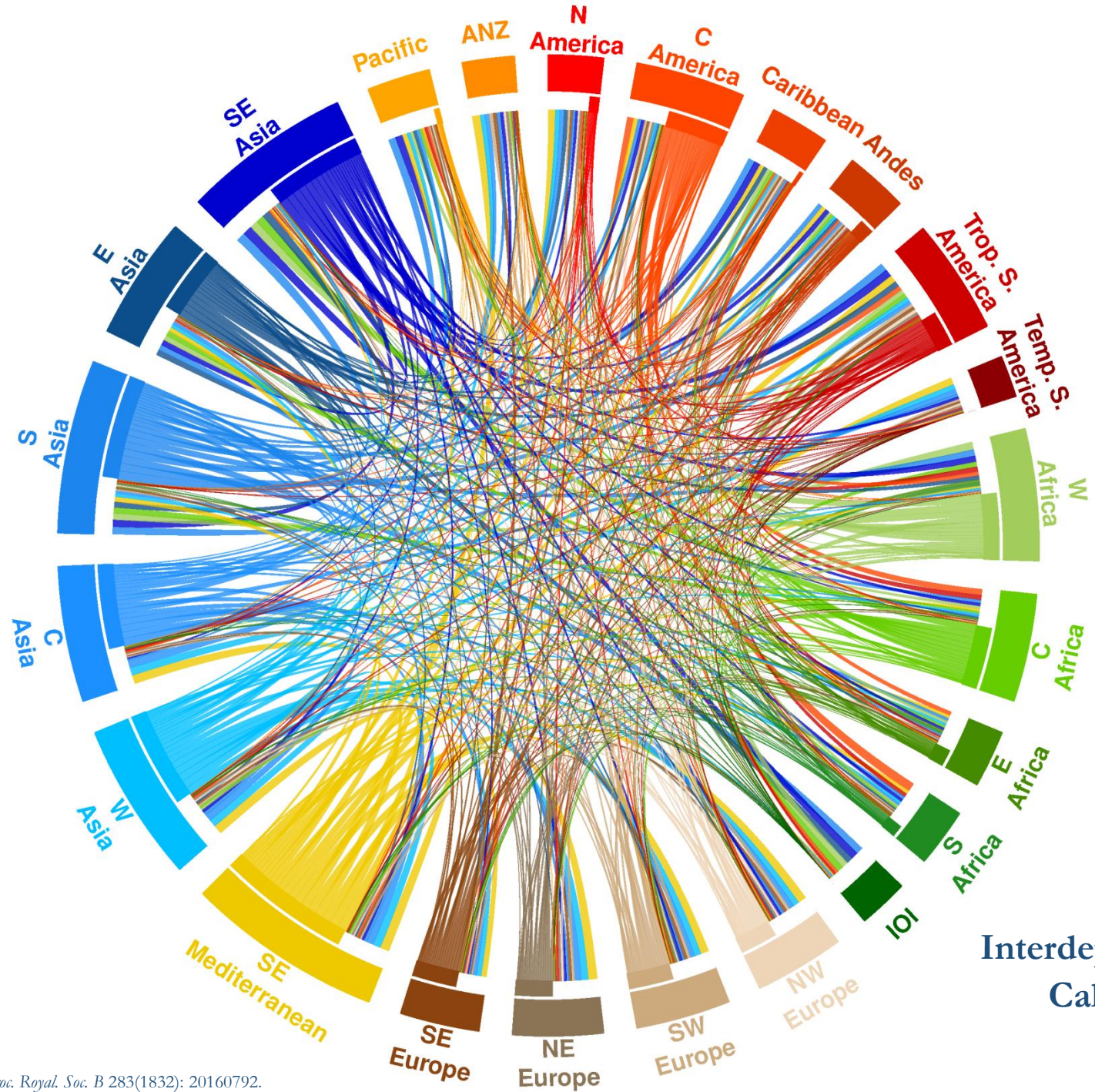




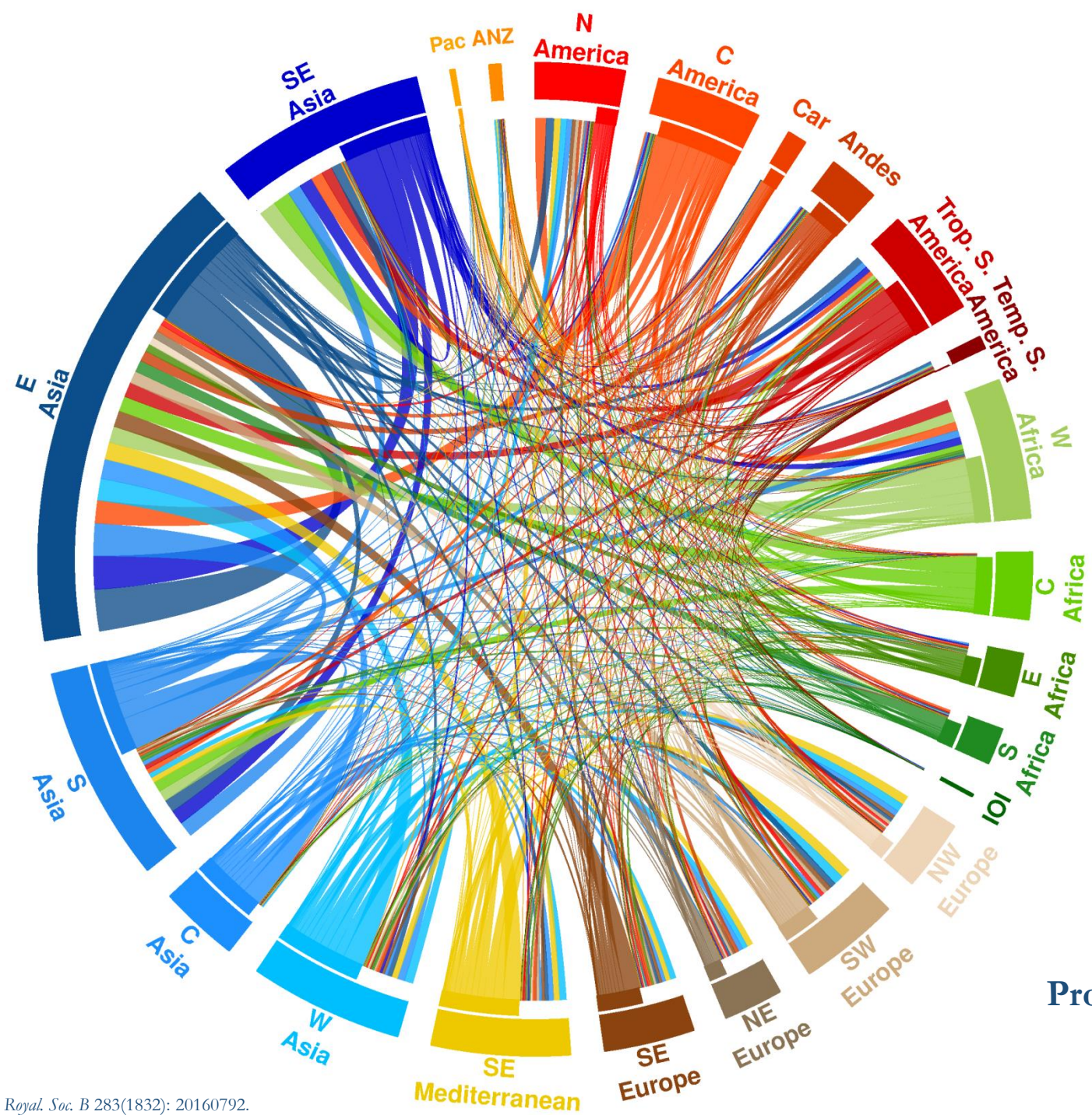
Calories



Calories

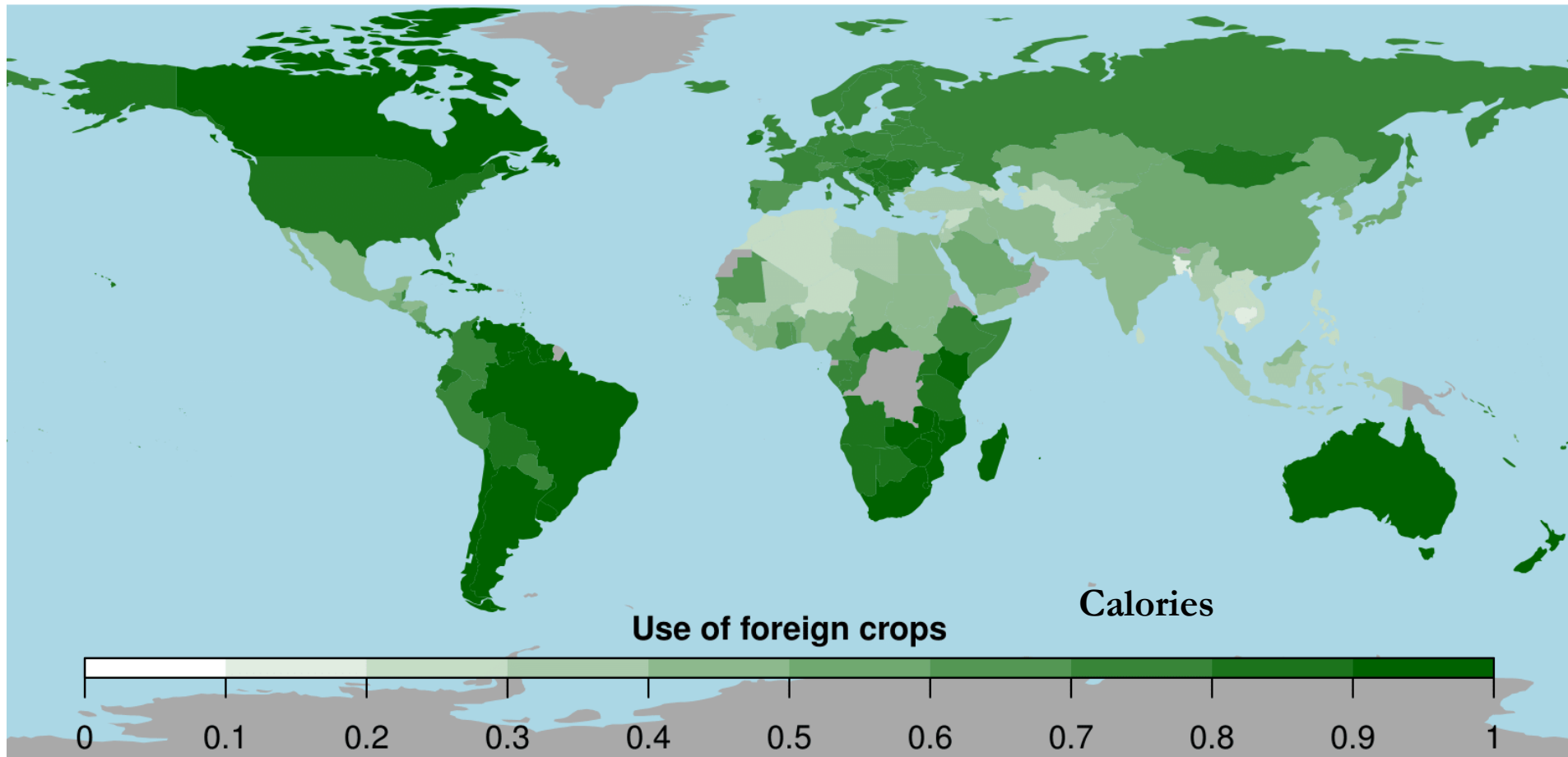


Interdependence
Calories



Production
value

Degree of consumption per country of “foreign” crops



USA national food supply:

89.9% \pm 4.1 of calories are from foreign crops

94.7% \pm 2.1 of protein

96.4% \pm 0.9 of fat

84.2% \pm 5.5 of food weight

Global average of national food supplies:

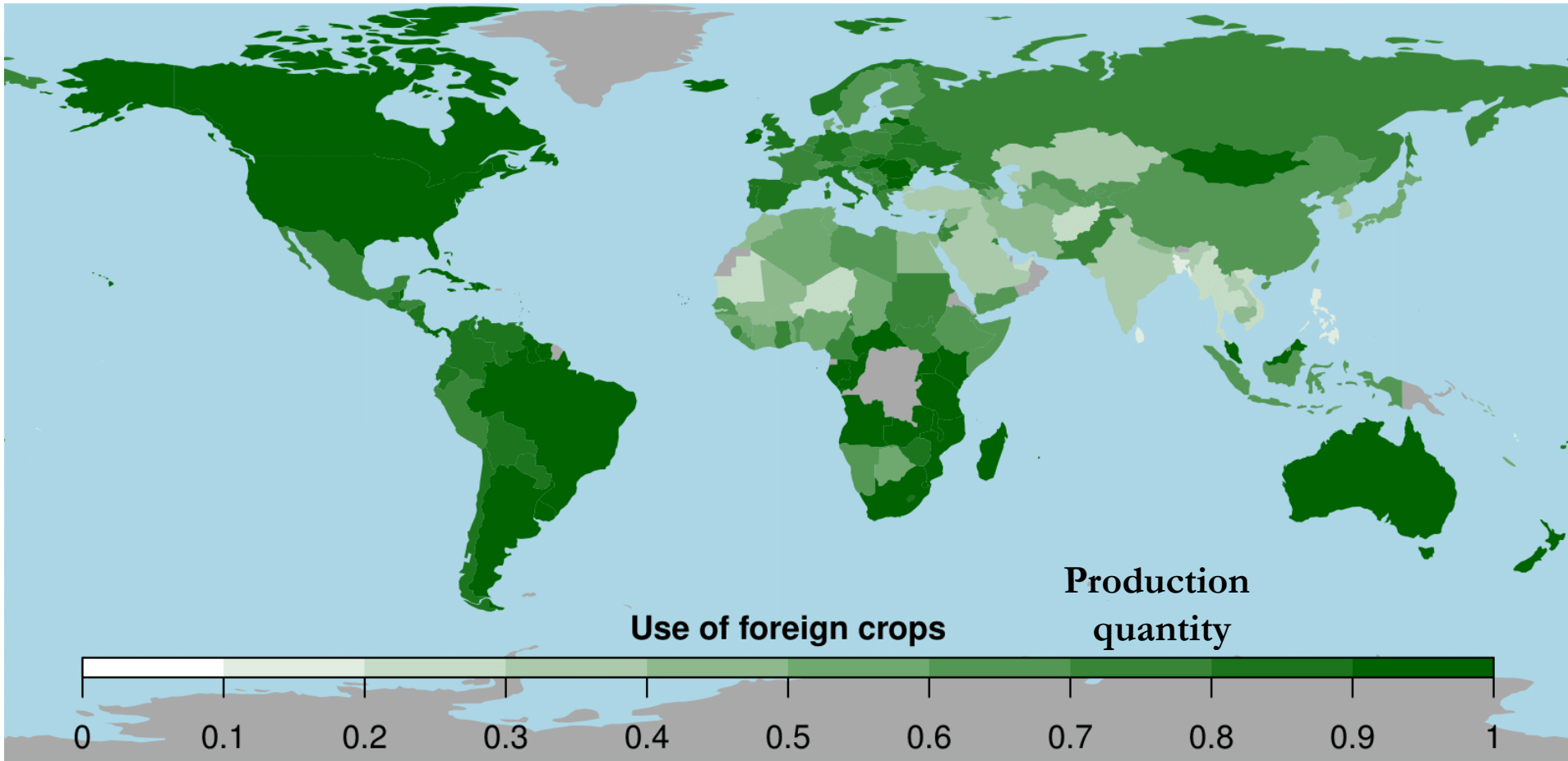
65.8% \pm 1.8 of calories are from foreign crops

66.6% \pm 2.1 of protein

73.7% \pm 1.6 of fat

68.7% \pm 1.4 of food weight

Degree of production per country of “foreign” crops



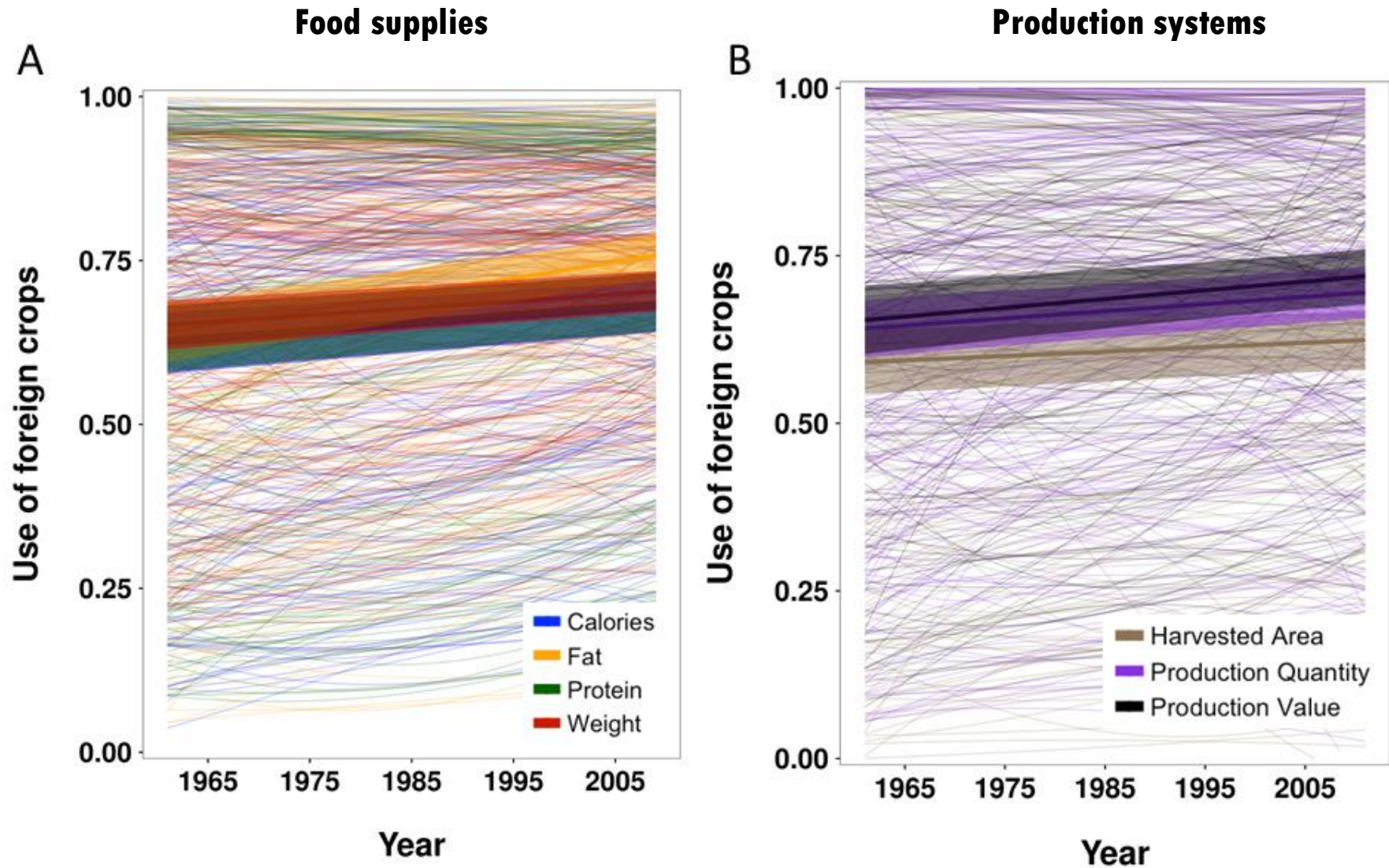
USA national agricultural production:

98.7% \pm 1.1 of production quantity is foreign crops
98.8% \pm 1.1 of harvested area
94.9% \pm 1.1 of production value

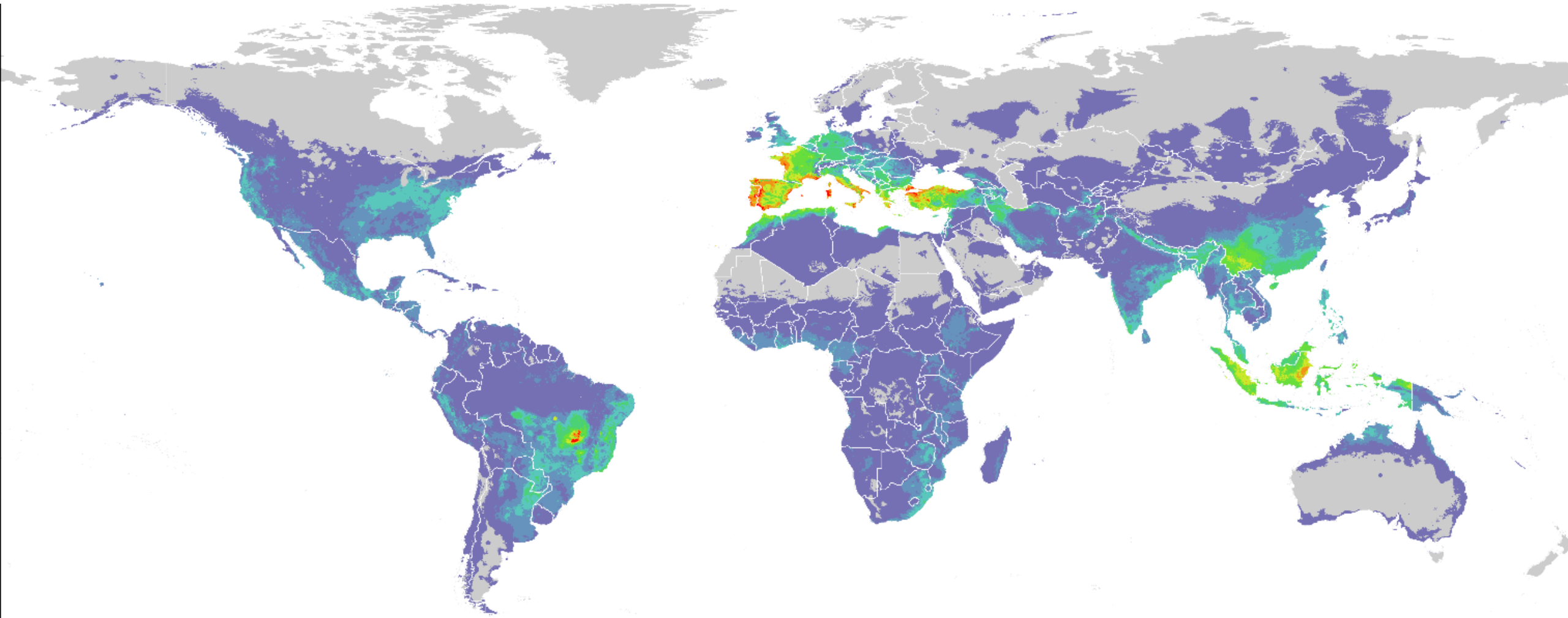
Global average of national agricultural production:

71.0% \pm 1.8 of production quantity is foreign crops
64.0% \pm 2.2 of harvested area
72.9% \pm 1.9 of production value

Use of “foreign” crops has increased over time



The journey isn't over



Distributions of wild relatives of important food crops of high priority for further collecting

of taxa



Threats to Vavilov's legacy



Коллекция
Дикая терновка
терновка
сорт - 200

Thank you!

c.khoury@cgiar.org

Khoury *et al.* (2016) Origins of food crops connect countries worldwide.
Proc. R. Soc. B 283(1832): 20160792.

Castañeda-Álvarez *et al.* (2016) Global conservation priorities for crop wild relatives.
Nature Plants 2(4): 16022.

Khoury *et al.* (2014) Increasing homogeneity in global food supplies and the implications for food security. *PNAS* 111(11): 4001-4006.

