

Diet and Food Consumption in the light of Nutritional Ecology

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Holocene stability (last 10,000 years): agriculture and complex societies

Hunter-gatherer



10,000 yr ago



Farmers



Food supply and consumption have shaped the contemporary world

Extensive agriculture



Landscape fragmentation



Urbanization



Eutrophication

Intensive transportation



Changes in food supply and consumption



globalization and expansion of the trade market has transformed diet patterns from locally produced food items toward industrialized and processed items

"Supermarket diet"



People living in urban centers have access to a wide range of food products derived from a broad geographic range



significant exchange in **carbon** and **nitrogen** sources



more fossil fuel energy expenses
than physical energy expenses

Human nutrition transition in the developing regions

- Globalization and the expansion of market economies is transforming dietary patterns → locally produced food to industrial and processed products
- Exponential growth in urban centers is fuelled by large-scale emigration from rural areas in the developing world

clear shifts in the mode of subsistence

Health impacts attributed to these changes:

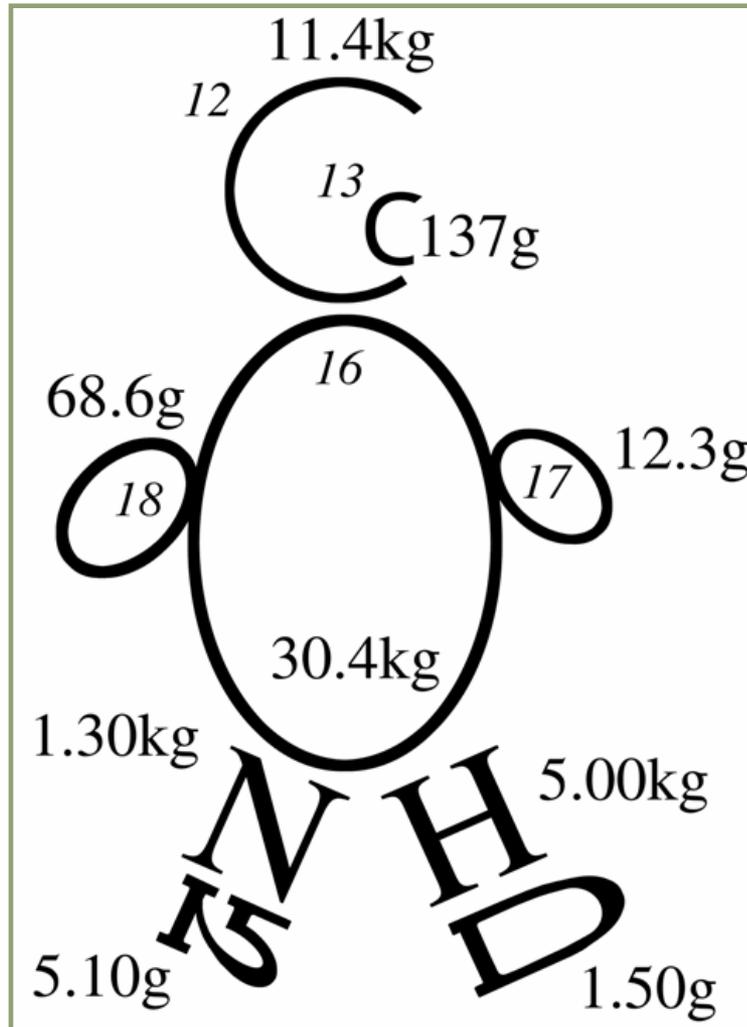
high rates of obesity, diabetes, high blood pressure and correlated heart diseases

Stable isotopes as tracers of changes in patterns of human diet

Central importance of food in the culture and human ecology

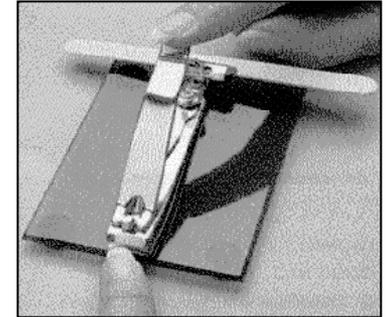
- can estimate the importance of C_4 grasses in human's diet
 - can reveal the extent of coupling still exists between food production and consumption

You are what you eat

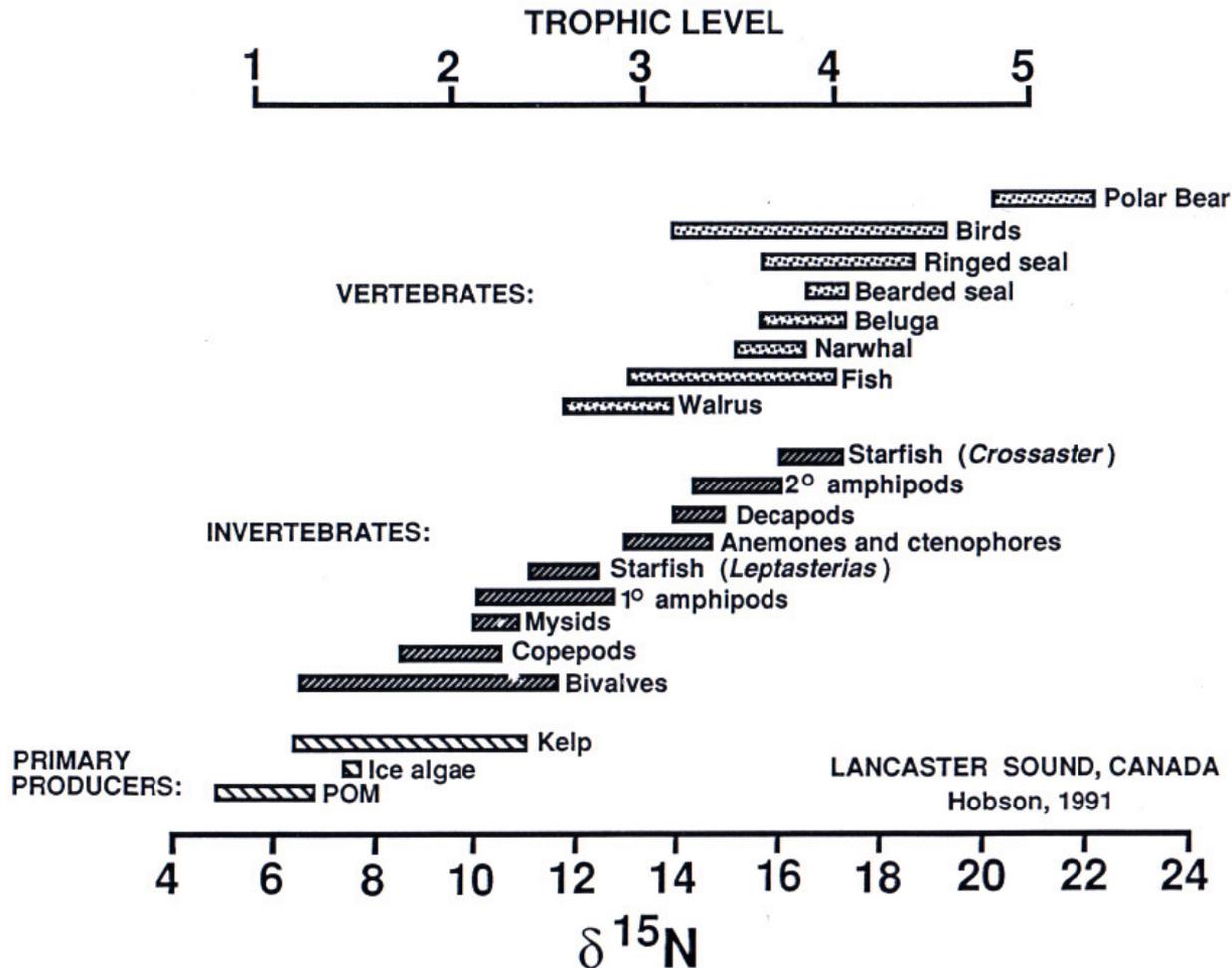


Geographical patterns of human diet derived from stable-isotope analysis of fingernails

- C and N isotope ratios of contemporary human fingernails
- Survey included only adults but of a wide range of age
- Samples collected from each volunteer by clipping the free edge of the fingernail and cleaned using a solution of 2:1 chloroform/methanol
- Every individual sampled had lived in the locality for a period of time longer than 2 years
- Survey under authorization by official human ethical committee

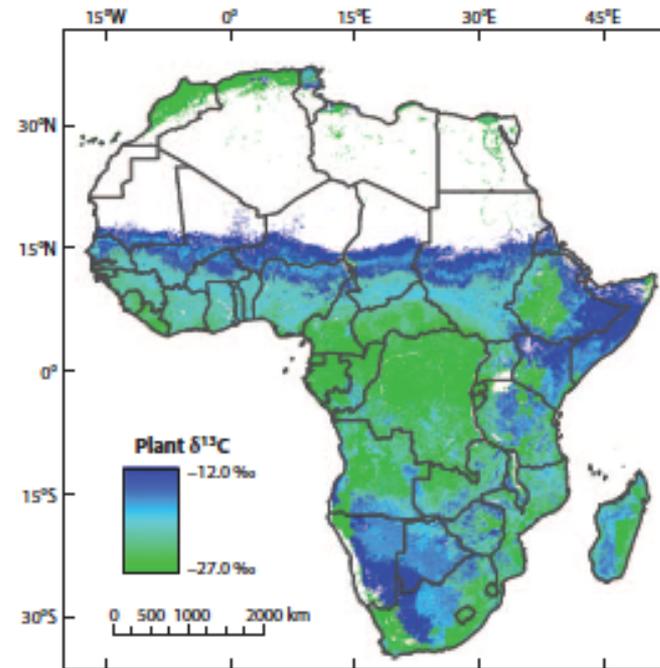


$\delta^{15}\text{N}$ increases about 3‰ in every trophic level



C_3

C_4

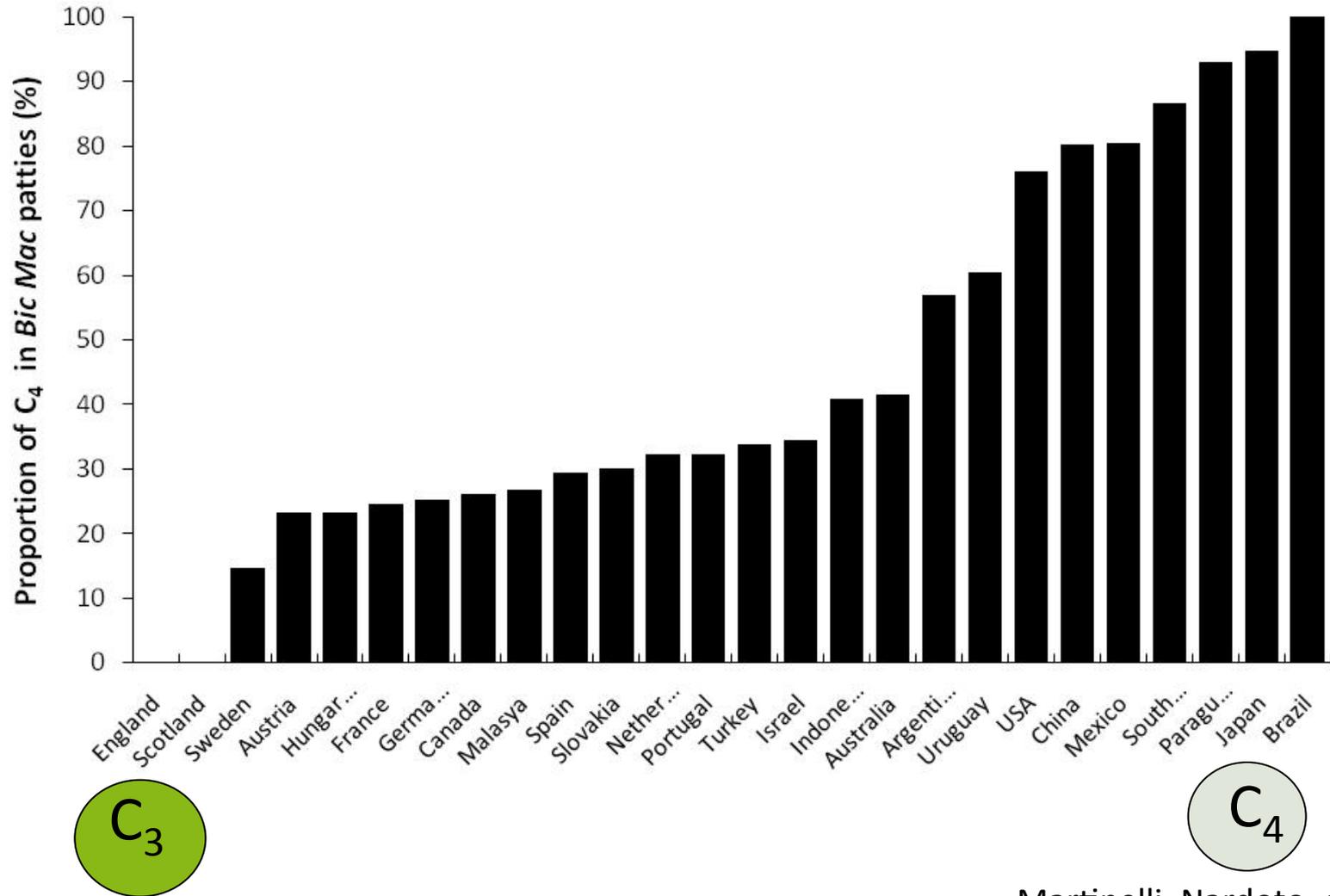


$\delta^{13}C$

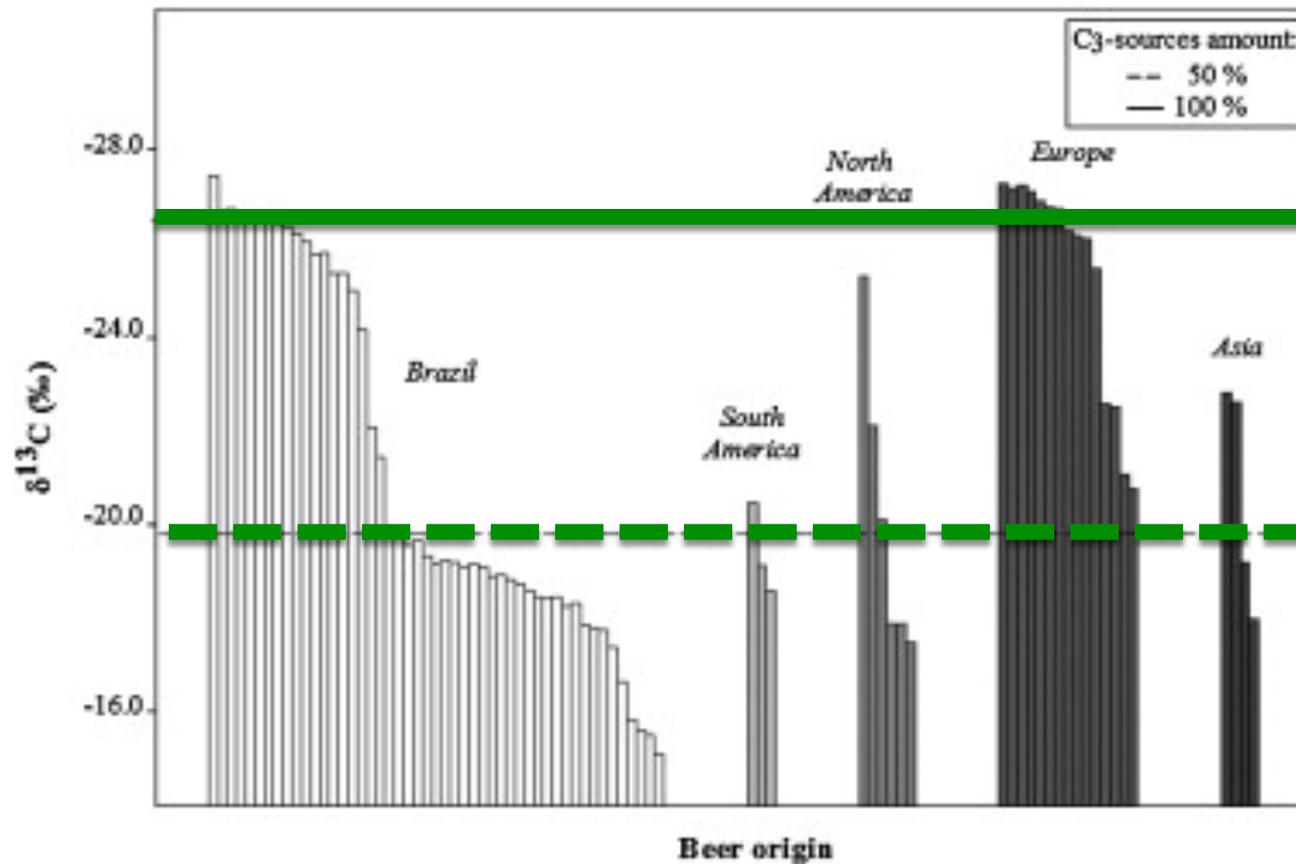
Figure 12

Isoscape for the $\delta^{13}C$ values of African vegetation based on modeled C_3 and C_4 plant and crop distributions. Map values are calculated assuming end-member $\delta^{13}C$ values of -27‰ and -12‰ for C_3 and C_4 vegetation, respectively, and do not account for physiological effects on C_3 photosynthetic isotope discrimination. Figure modified from Scill & Powell (2010).

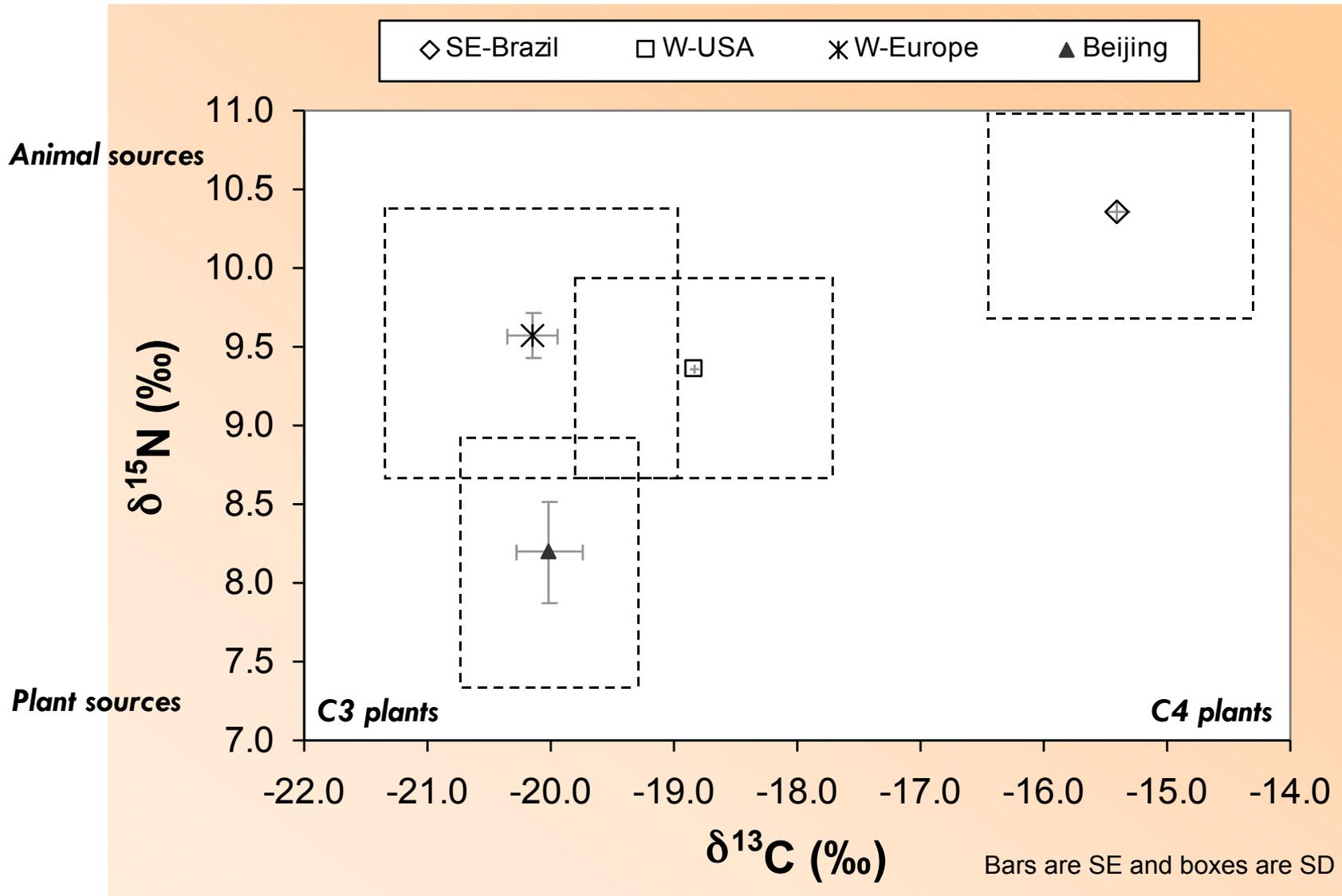
C4 grasses influence in contemporary human diet



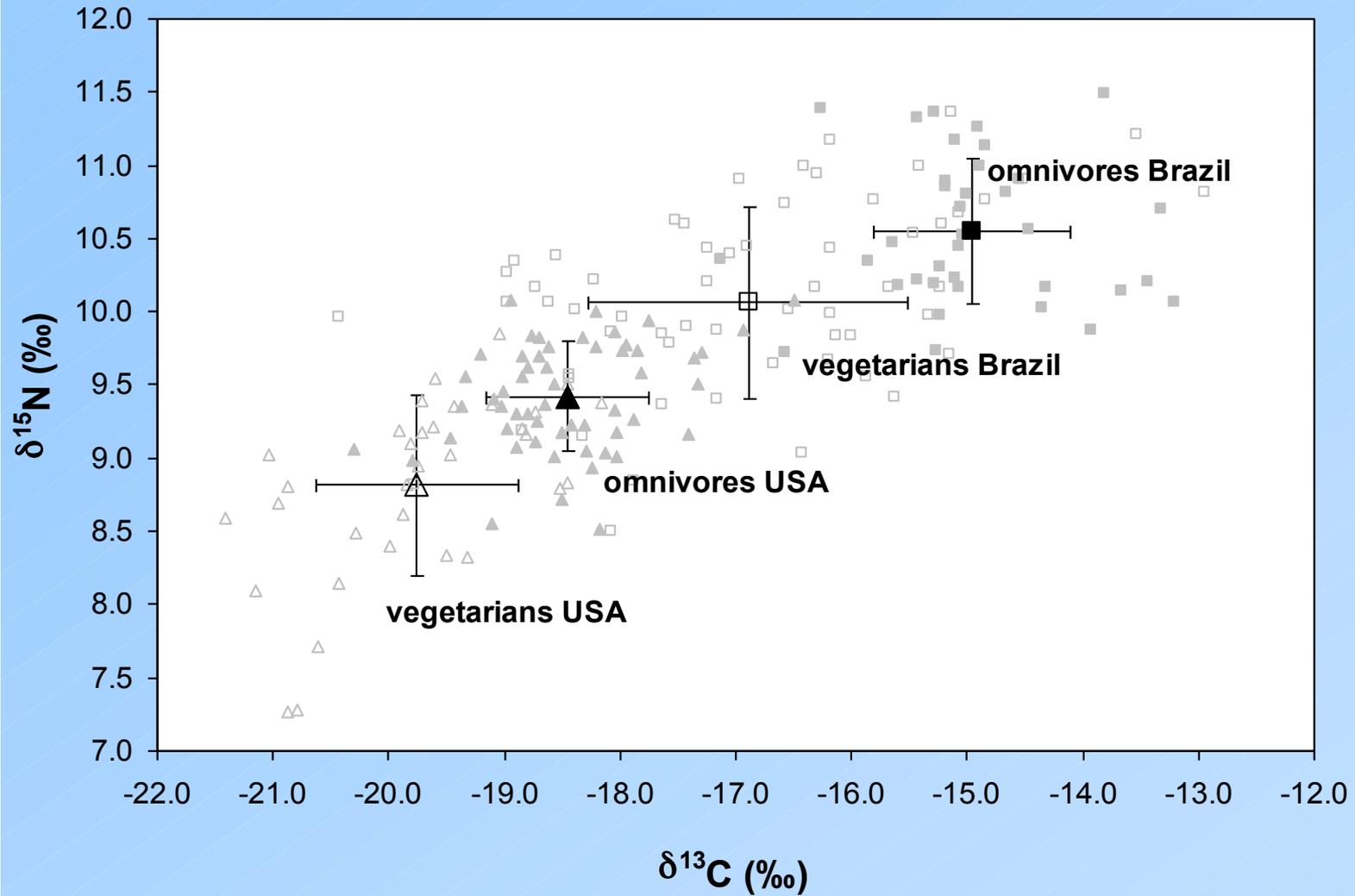
Another example: beer from different geographic regions



Geographical patterns of modern human diet



Heavy SE-Brazil versus light W-USA

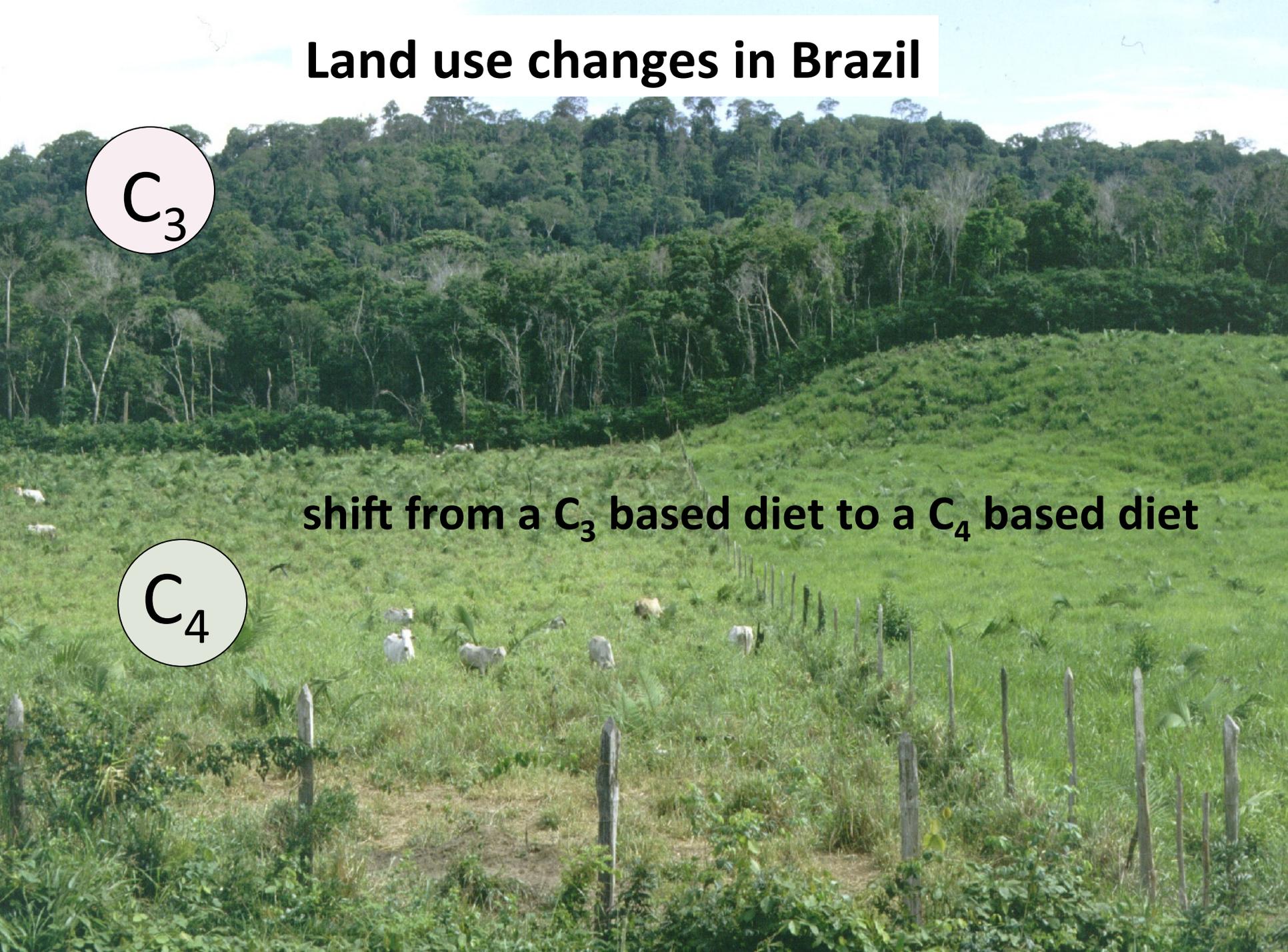


Land use changes in Brazil

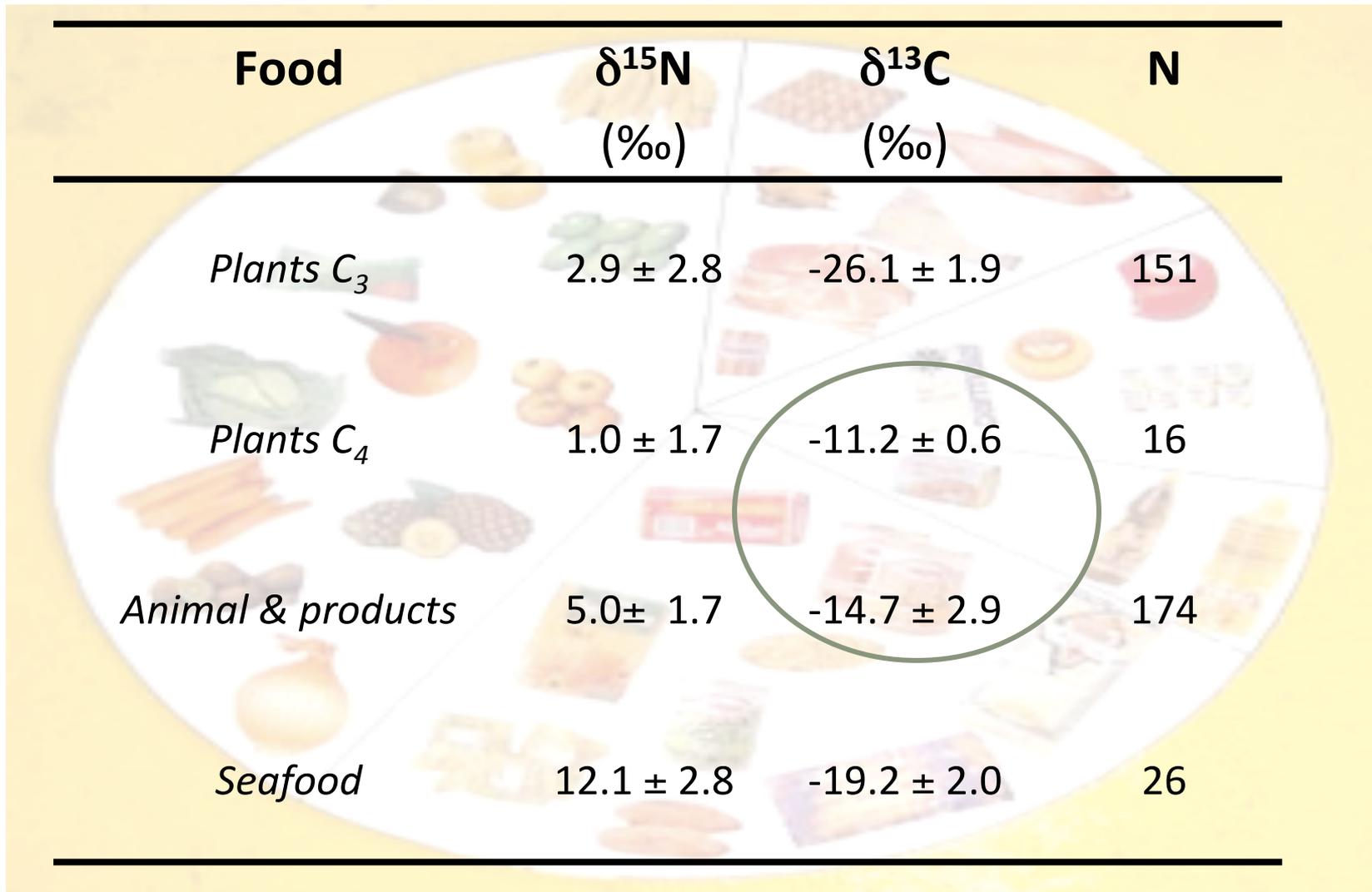
C_3

shift from a C_3 based diet to a C_4 based diet

C_4

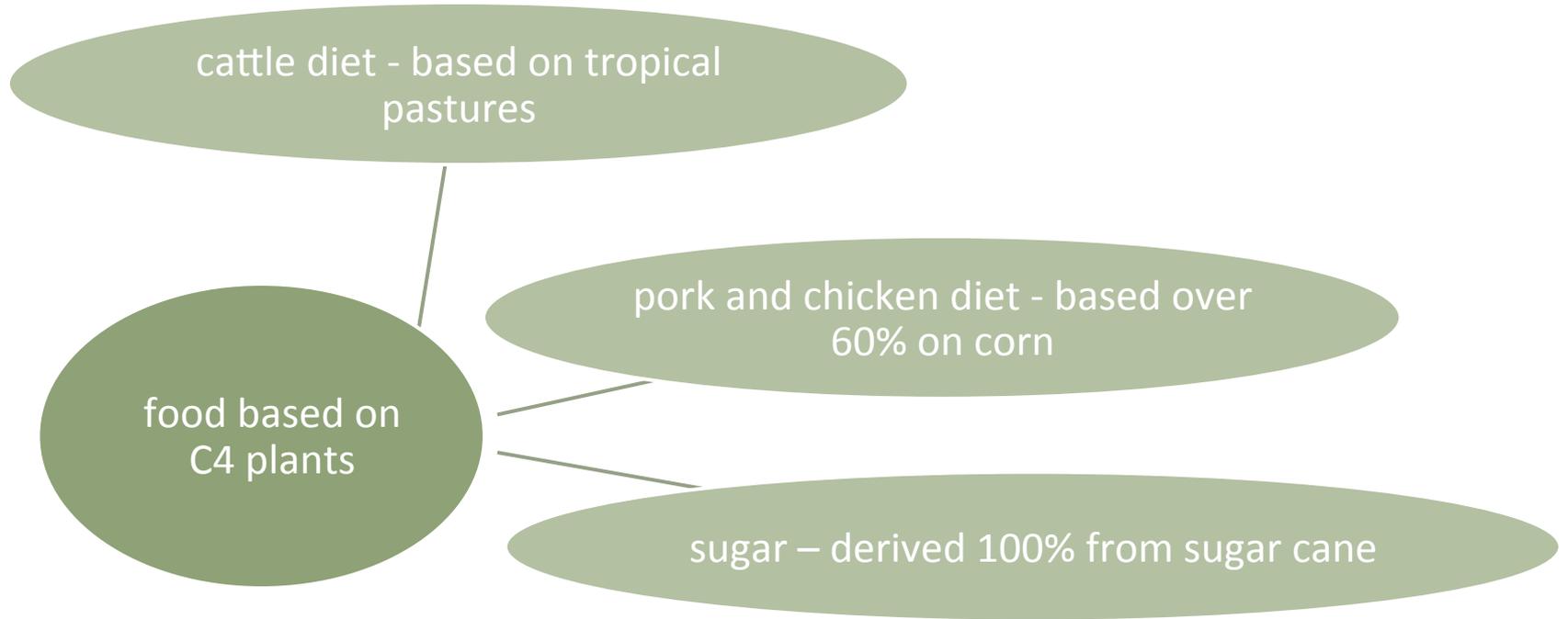


For Brazil:



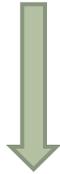
Source: Nardoto et al 2006

As the accessibility to food markets and the size of urban centers increase:



Sugar in Brazil:

Made exclusively from **cane**, a C_4 plant



sugar and any product that contains sugar
have in part an isotopic C_4 signal



rural-urban transition

Contemporary Amazon inhabitants:

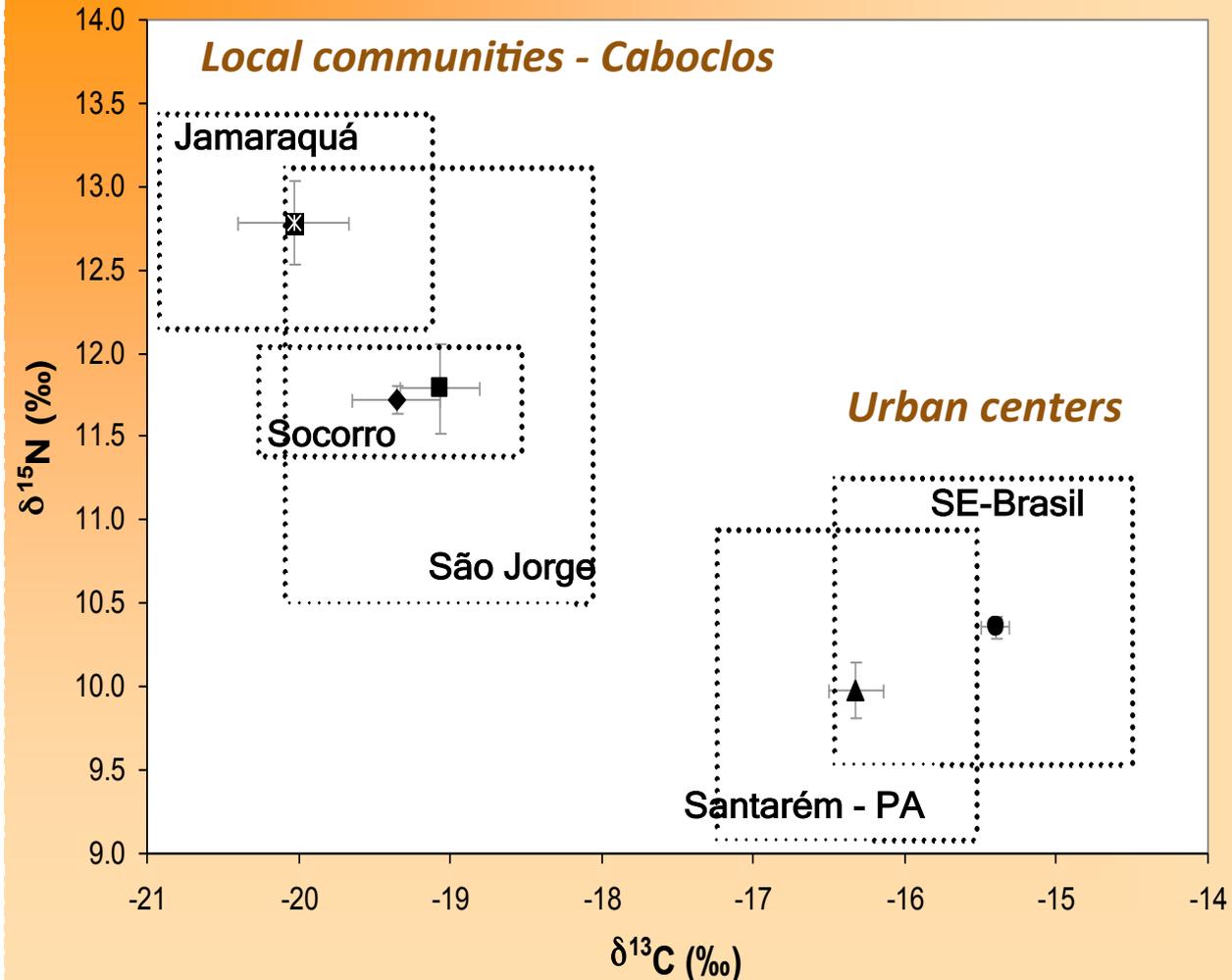
Mix of Indigenous Amazonian, European, African



Caboclos

intimately linked to regional markets

dependent for a wide array of goods



Map indicating the localities studied in the Brazilian Amazonia





Food intake from 24h-recall and stable isotope analysis



Nutritional implications

Brazilian Amazonian villages

Varzea
(villages located in floodplains near large
white water rivers)



(Japurá, Mairauá, AM)



(Nova Jerusalém, Amanã, AM)



Terra-firme
(villages located in not flooded areas -
uplands)

Dependence on the market economy

Basic goods:

sugar, coffee, rice, beans, fuel and fabrics



Options to get industrialized food:

- travel by water to the nearby town
- buy from boats that travel to these isolated villages
- go to the village grocery store (rarely available)

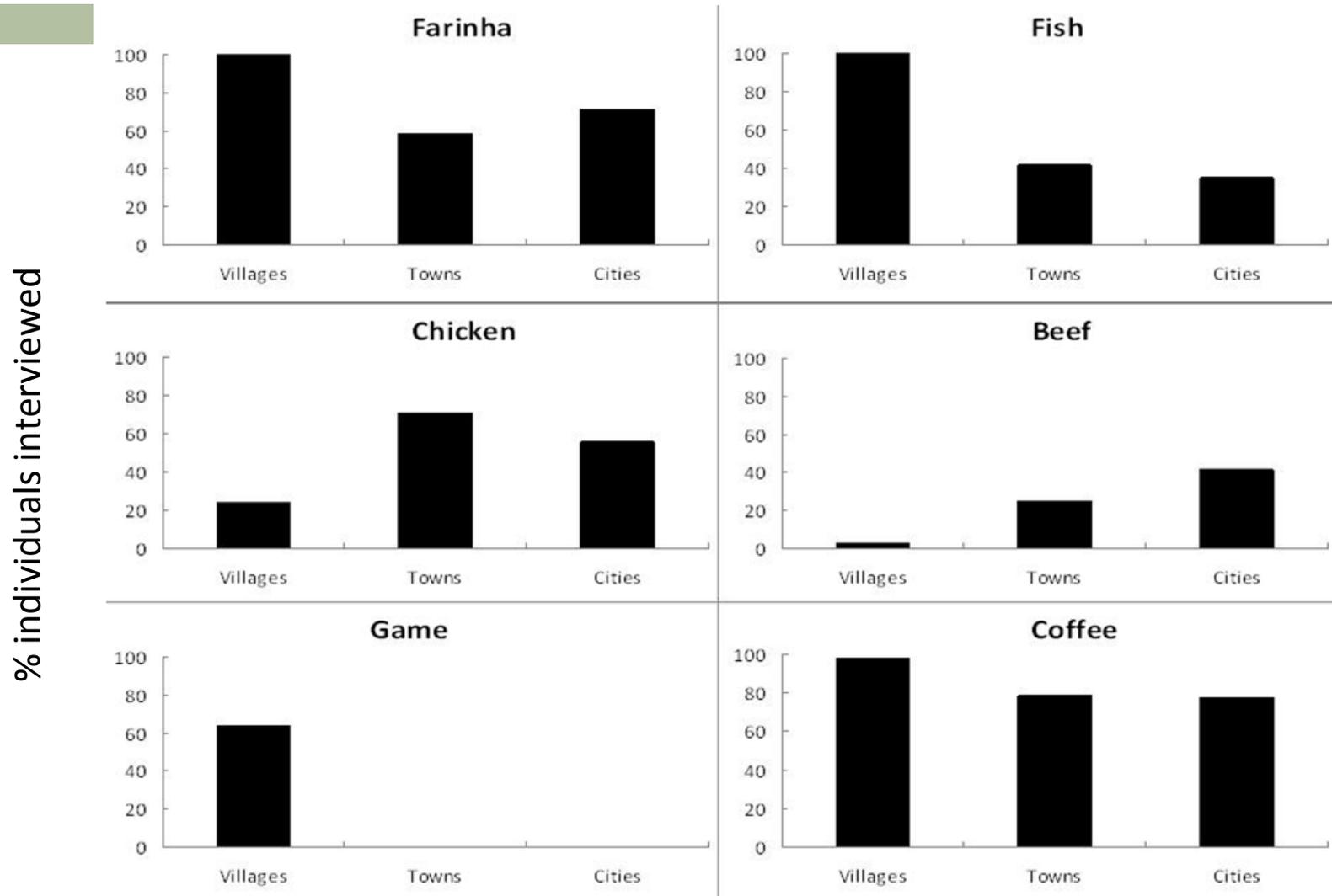
C and N isotope values of Amazonian local food

Food	$\delta^{15}\text{N}$ (‰)	$\delta^{13}\text{C}$ (‰)
cassava (manioc - tuber)	6.9	-26.7
fresh water fish* (omnivore – Tambaqui)	9.8	-27.8
game** (Agouti, Collared peccary)	9.6	-25.3

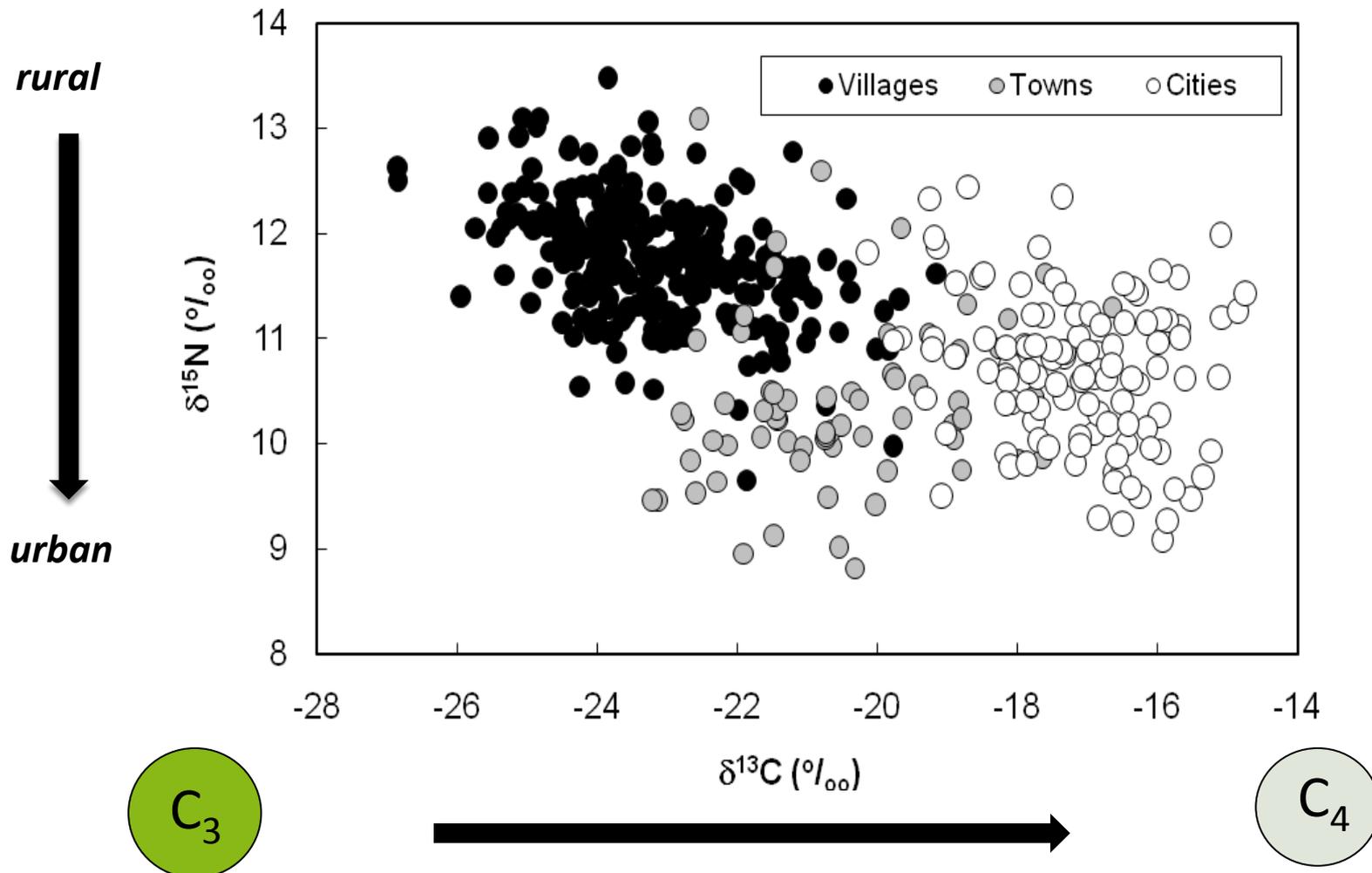
*nail; **muscle tissue

Forest values: $\delta^{15}\text{N}$ = 6 to 8 ‰ and $\delta^{13}\text{C}$ = -28 to -31 ‰

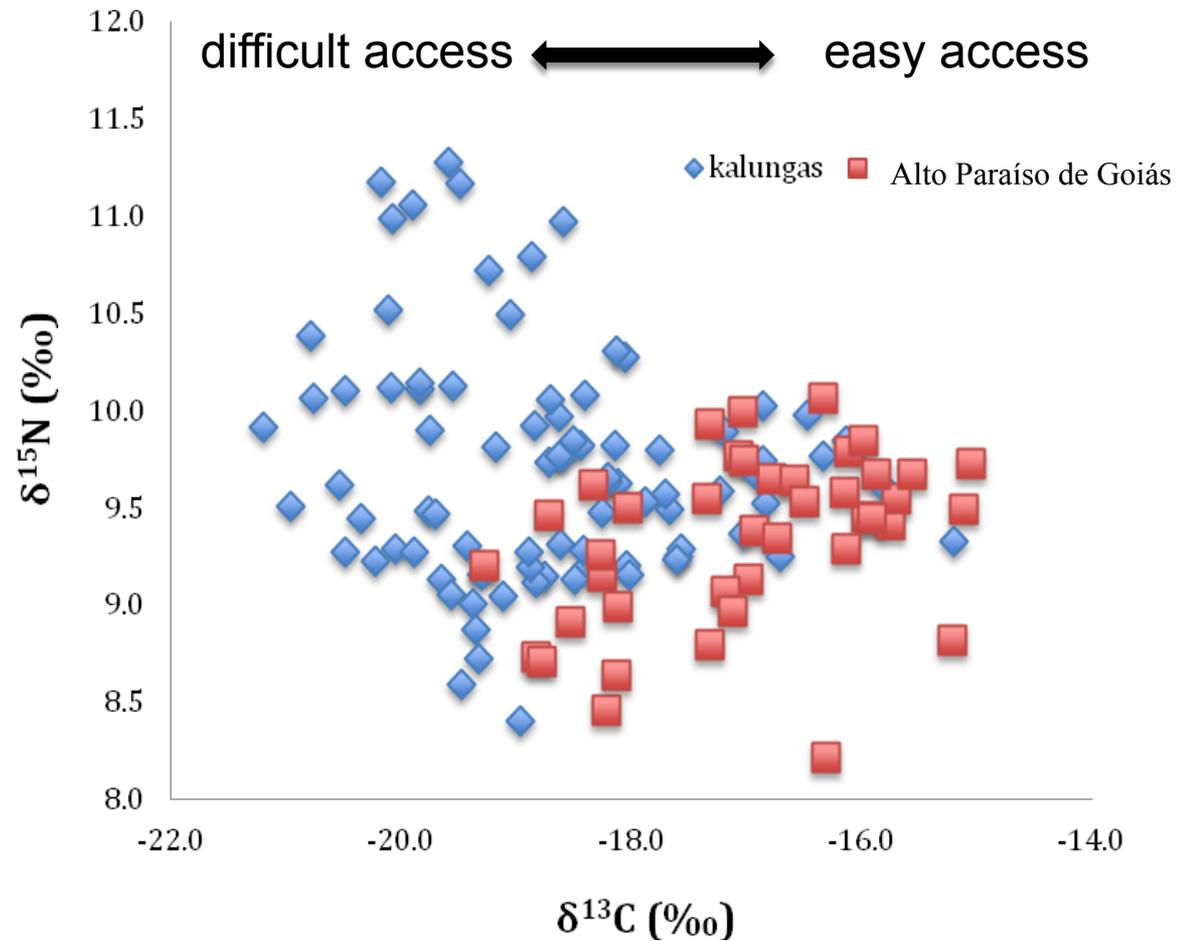
Individuals interviewed who regularly consume these items in the *Caboclos* villages, towns and cities of the Brazilian Amazon region:



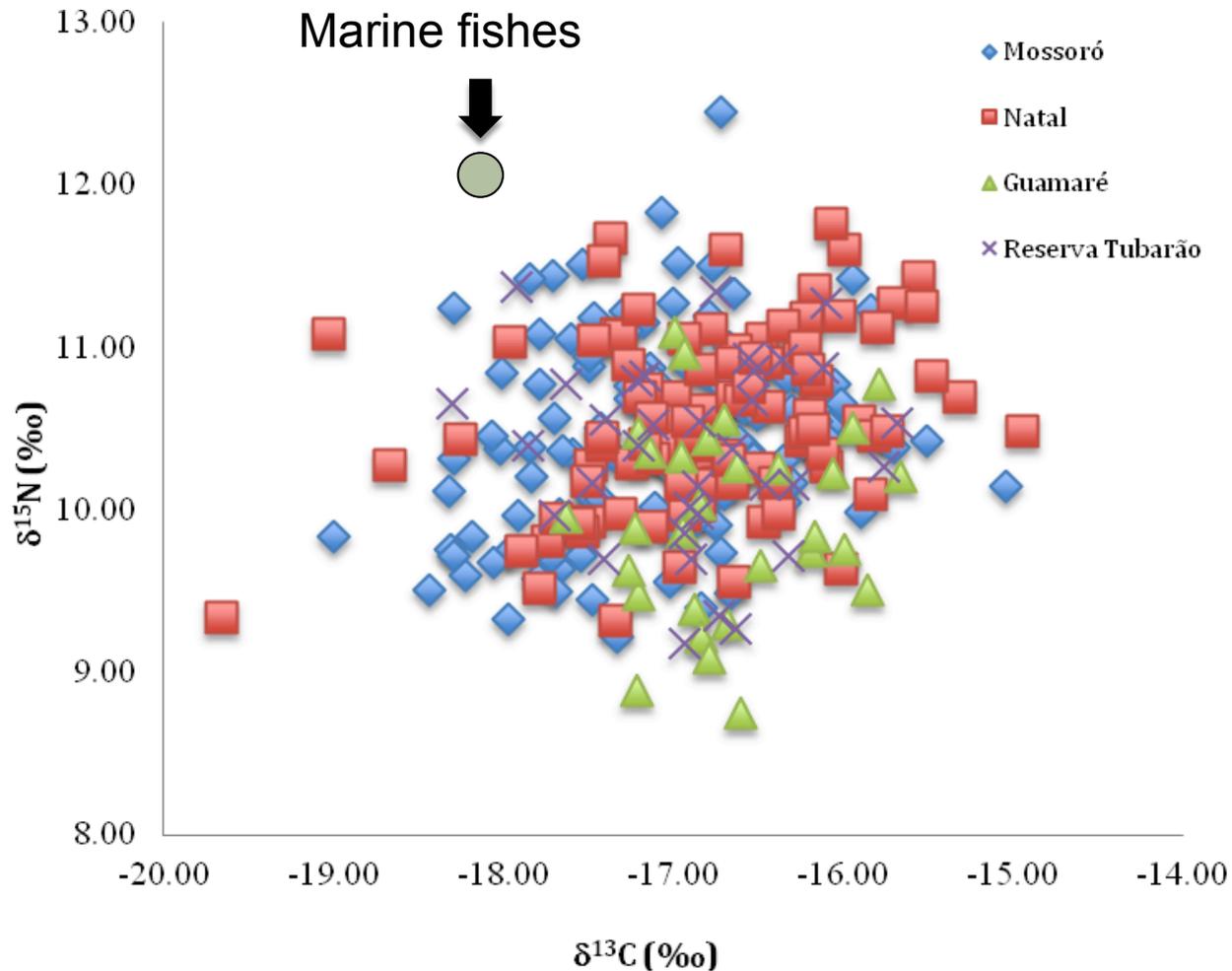
Transition from Locally Produced Foods to Processed Items



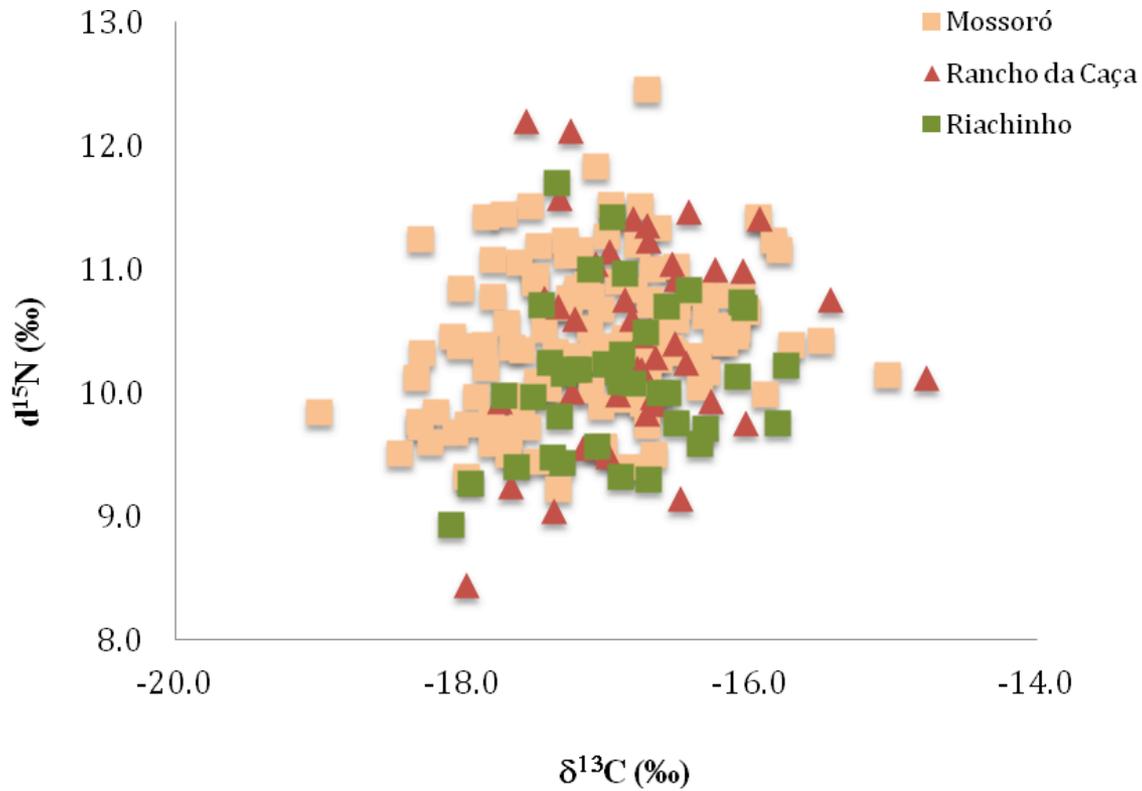
Kalungas (GO)



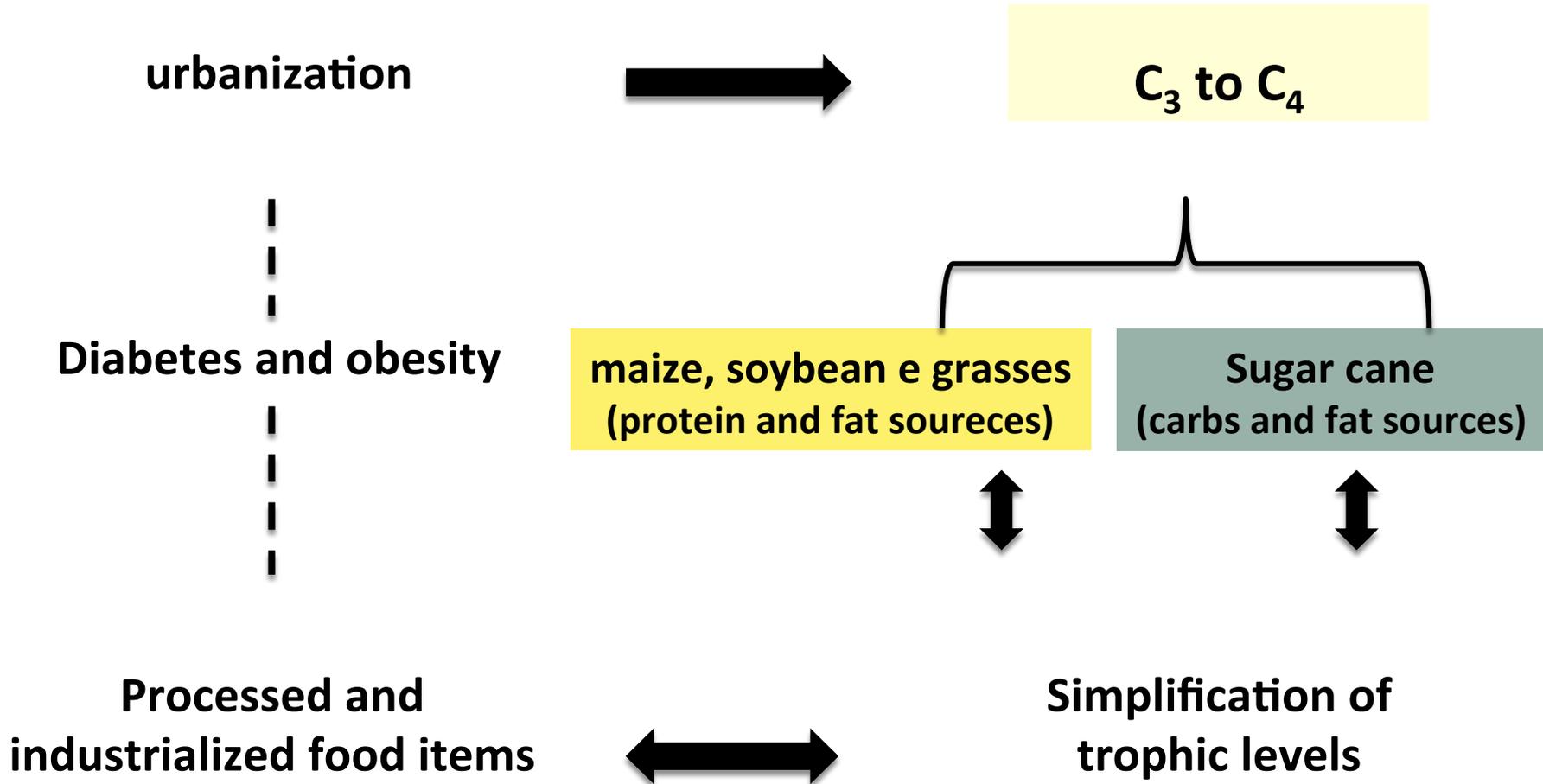
Fishery communities in the northeastern Brazil



Rural communities in the northeastern region of Brazil



Nutrition transition in Brazil



Urbanization effects:

- related health problems:

- obesity and high blood pressure, both associated with cardiac diseases and type II diabetes

- C and isotope ratios in the fingernails - decoupling from the local landscape ratios



can hold information directly related to both food sources and dietary practices

Socio-economical classes: C and N isotopes approach

Despite opportunities for a "global supermarket" effect to swamp out C and N isotope ratios in urbanized regions



differences between people from high and low incoming **social-economical** classes living in the SE-Brazil seem to persist:

Is economical and or a socio-cultural issue?

We are especially grateful with all volunteers whom made this work possible donating a piece of their fingernail

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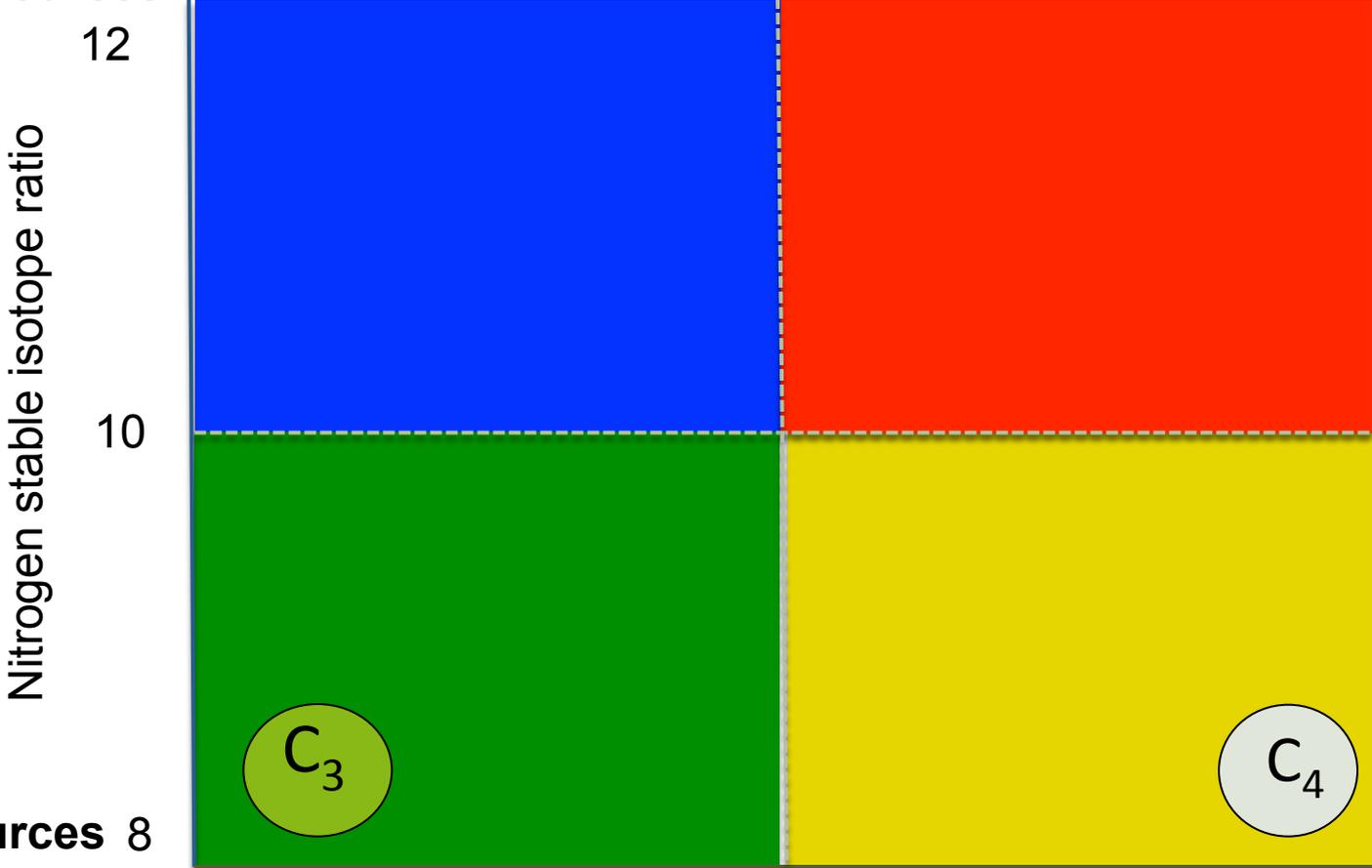
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Where are you fit in the plot?

Animal sources



Plant sources

- 28

- 18

- 10

Carbon stable isotope ratio