
Science and Technology in São Paulo, Brazil

Carlos H. de Brito Cruz
Scientific Director
Fapesp



State of São Paulo, Brasil

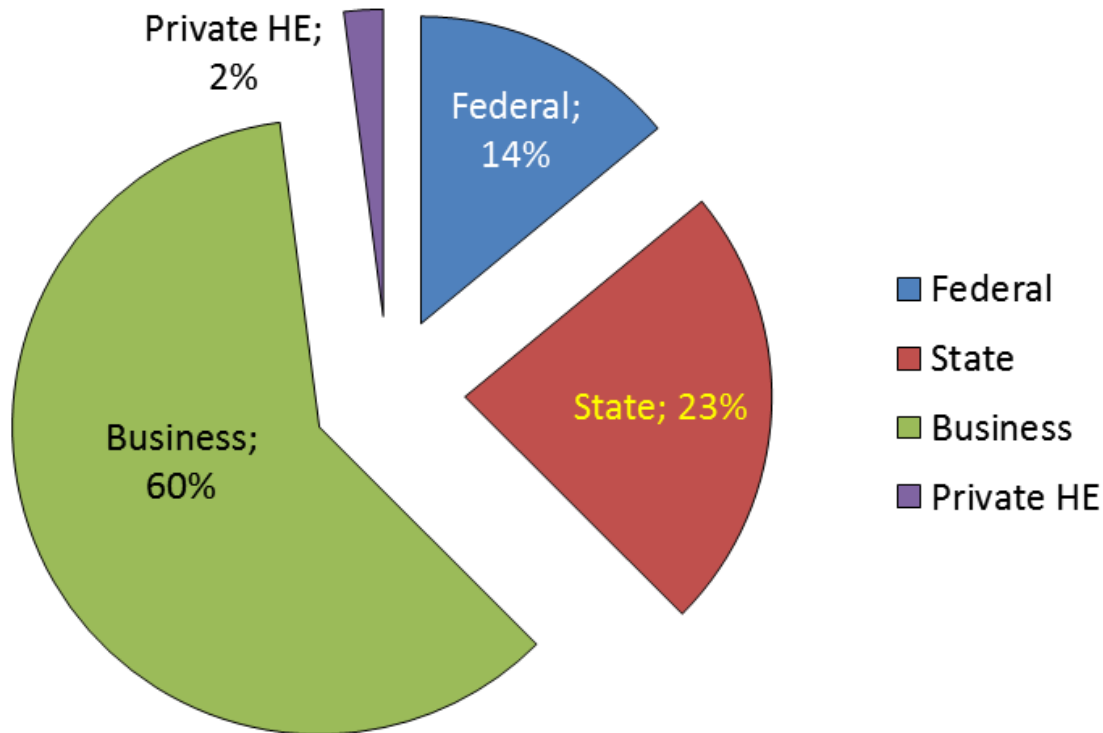


41 Million people
 34% of Brazil's GDP
 50% of Brazilian science
 13% of State budget to HE and R&D
 1.64% GDP for R&D

3 State Universities
 3 Federal Universities
 52 State Tech Faculties
 45% of the PhDs graduated in Brazil (4,937 in 2010)
 22 Research Institutes (19 state/3 federal)
 1 Research Foundation
 62% of R&D public support comes from State sources

São Paulo: R&D Expenditures, 2010, by source

Sources for R&D expenditures in São Paulo, 2010

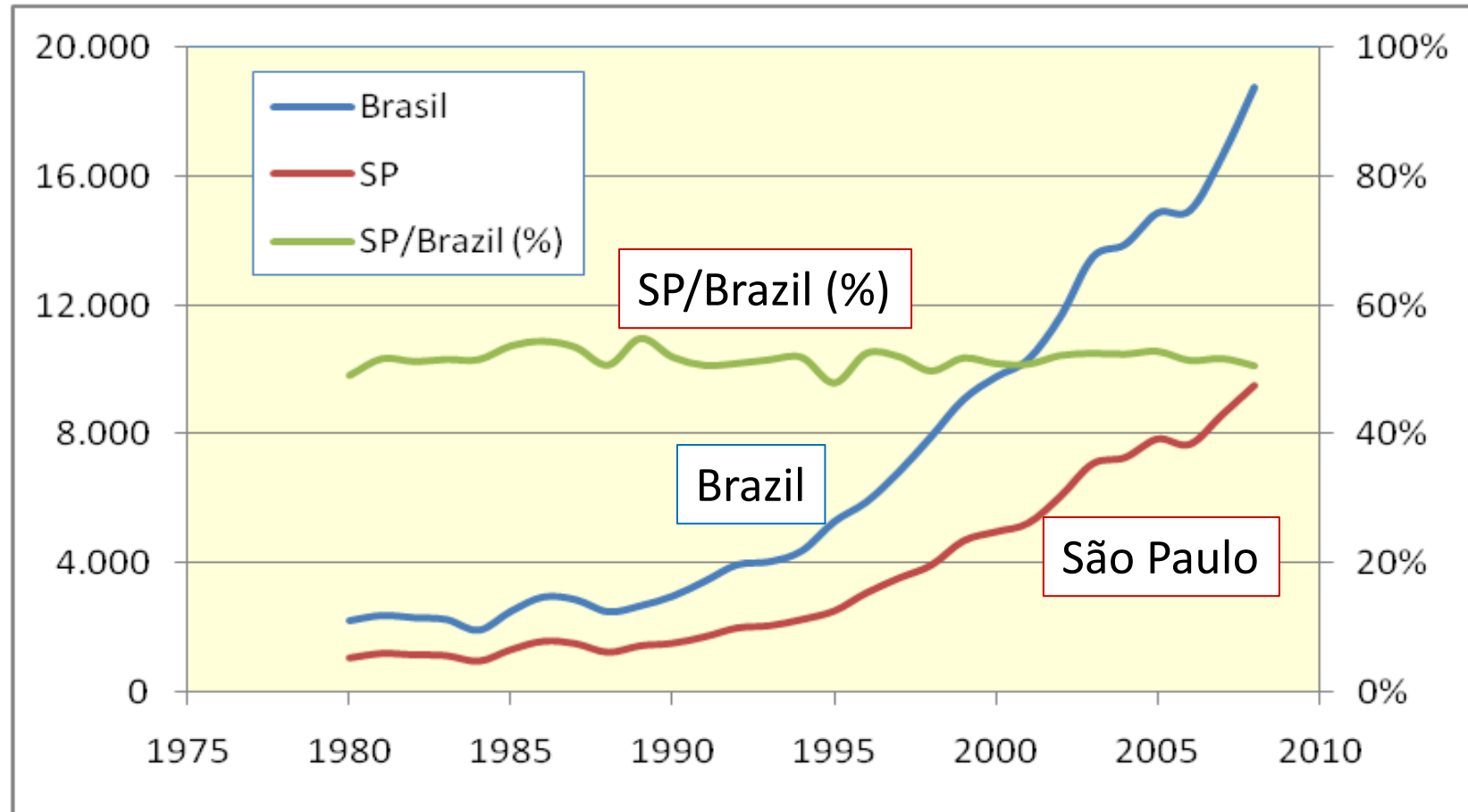


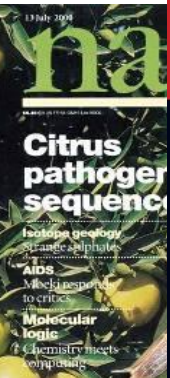
- R&D expenditures total 1.64% of state GDP
 - Grew from 1.52% in 2008
- Public expenditures
 - State 62%
 - Federal 38%

Fapesp: São Paulo Research Foundation

- Mission: support research in all fields
- All proposals are peer reviewed (20,000 proposals in 2011)
- Funded by the State of São Paulo with 1% of all state revenues
 - Started in 1962
- Annual budget: \$PPP 503 M in 2010
 - **Fellowships** (3,000 SI, 2,600 MSc, 3,700 DrSc, 1,600 Post-docs)
 - **Academic R&D** (Thematic, Regular, Young Investigators)
 - **University-Industry Joint R&D**: Microsoft, Agilent, Braskem, Oxiteno, GSK, SABESP, VALE, Petrobrás, Embraer, Padtec, Biolab, Cristalia, Whirlpool, **Boeing , GSK ...**
 - **Small bussiness R&D**: 1,200 SBE's (close to two awards per week in 2010)

Brazil: growing number of scientific articles in international journals

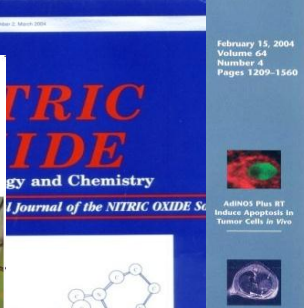




Invertebrate Systematics



www.pobin.com/ugarganahs Volume 23 • Issue 6 • 2009

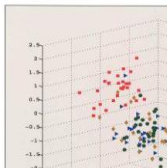


Analyst

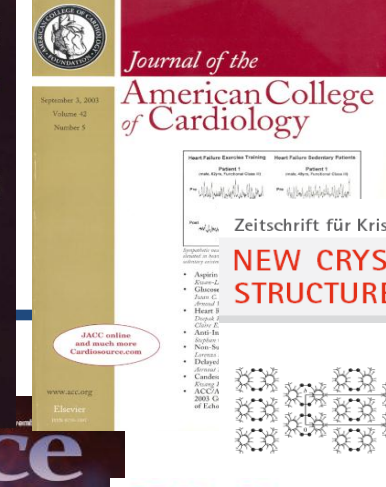


Themed Issue on Ambient Mass Spectrometry

Cancer Research



PCCP

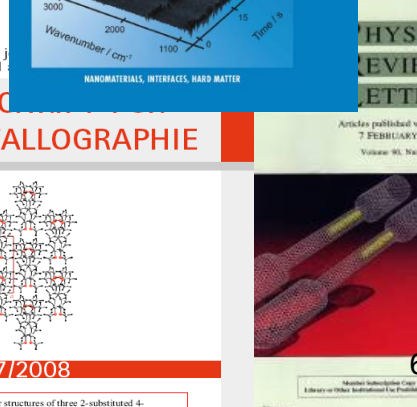
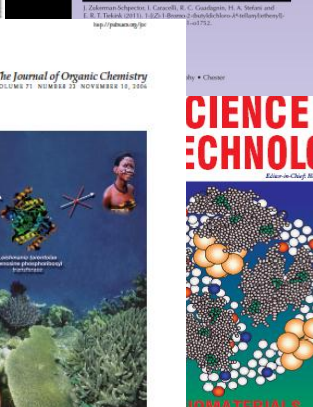
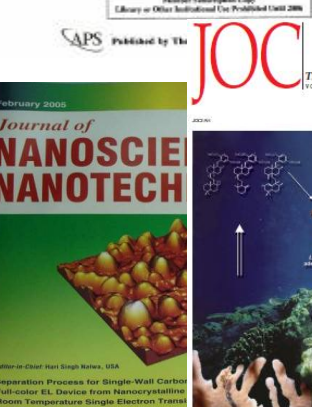
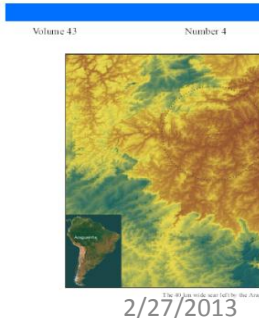
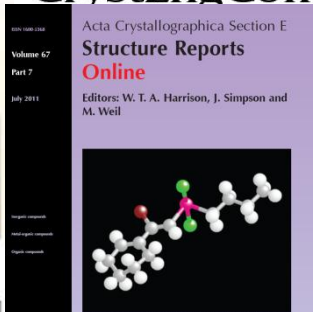
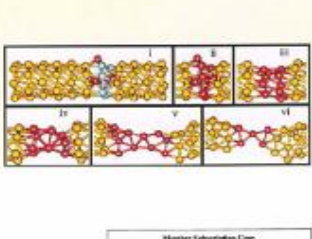
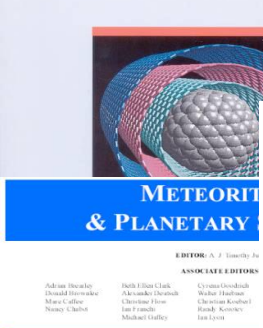
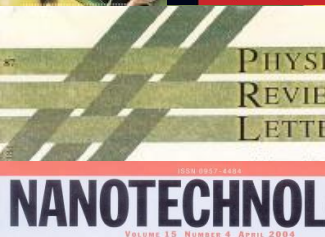
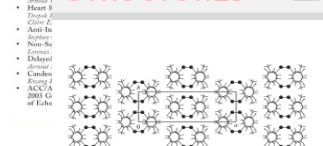


Journal of the American College of Cardiology



Zeitschrift für Kristallographie

NEW CRYSTAL STRUCTURES



Asteroids • Comets • Craters • Interplanetary Dust • Interstellar Medium
Lunar Samples • Meteors • Meteorites • Natural Satellites • Planets • Tokites
Origin and History of the Solar System

Now including Journal of Materials Letters

Separation Process for Single-Wall Carbon Full-color EL Device from Nanocrystalline Room Temperature Single Electron Transistors MOF Capacitors Fabricated by Nano-sized C₆₀ Polymers

Published by the American Chemical Society

Crystal and molecular structures of three 2-substituted 4-methylbenzoic acid derivatives studied by X-ray crystallography and by PM6 calculations

Published by the American Physical Society

FAPESP: international agreements for joint research funding

- Agreements with foreign funding agencies, universities and companies

RCUK (UK)	UE-CNPq (Bioenergy)
KCL; Surrey;Southampton;Nottingham (UK)	CONICET (Ar); CONICYT (Ch)
DFG (Ge)	ISTP (Ca)
CNRS; ANR (Fr)	NSF (U.S.) – CNIC and ICC
INSERM;INRIA;INRA (Fr)	Microsoft Research
U. Toronto (Ca)	MIT (U.S.)
U. W. Ontario (Ca)	FCT (Portugal)
Hebrew Univ. Jerusalem (Israel)	Belmont Forum – Future Earth

- 303 joint proposals supported, 2005-2010
 - U.S 115; France 87; Germany 41; U.K. 27; Argentina 11; Canada 8; Portugal 8

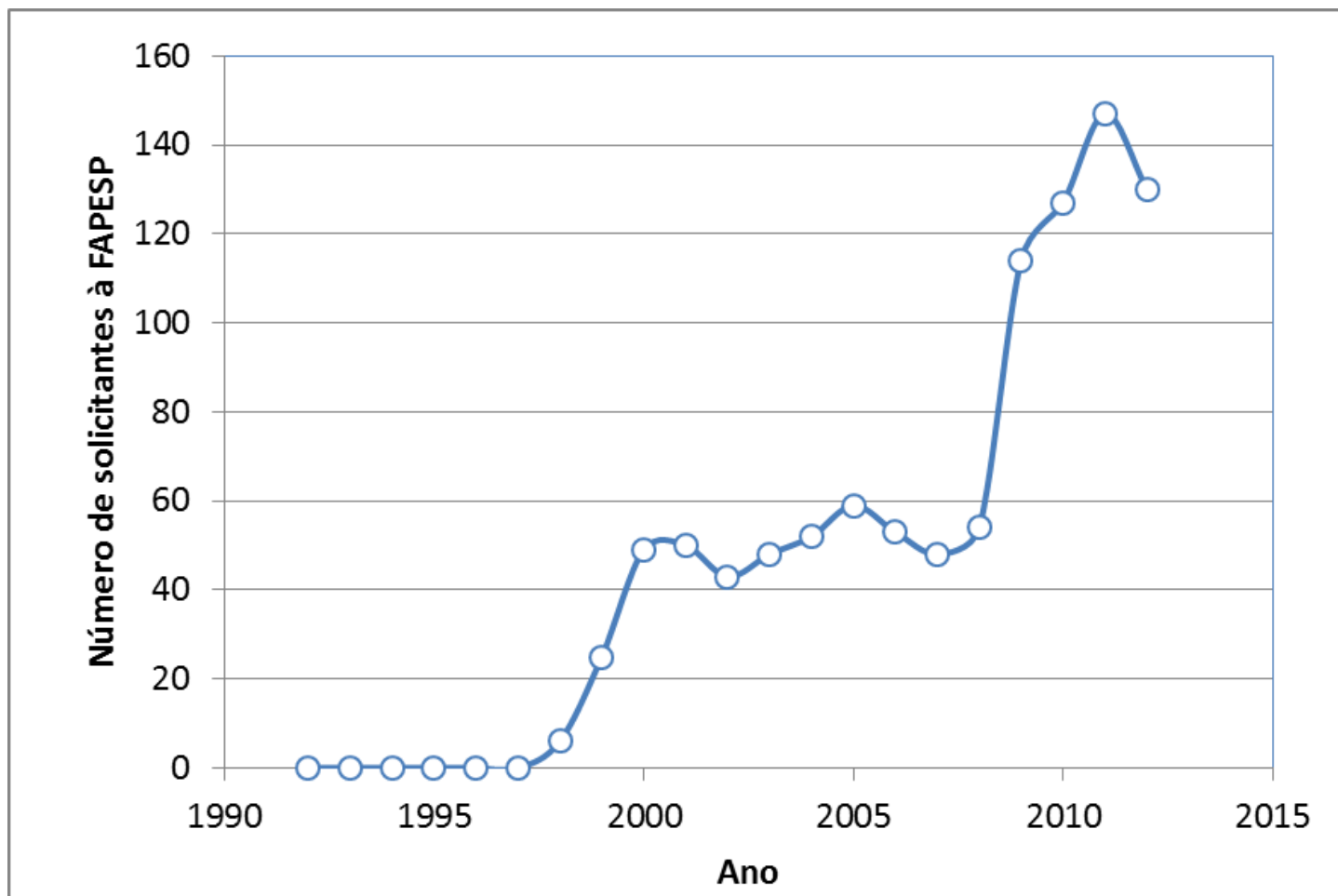
FAPESP: International cooperation, 2004-2012



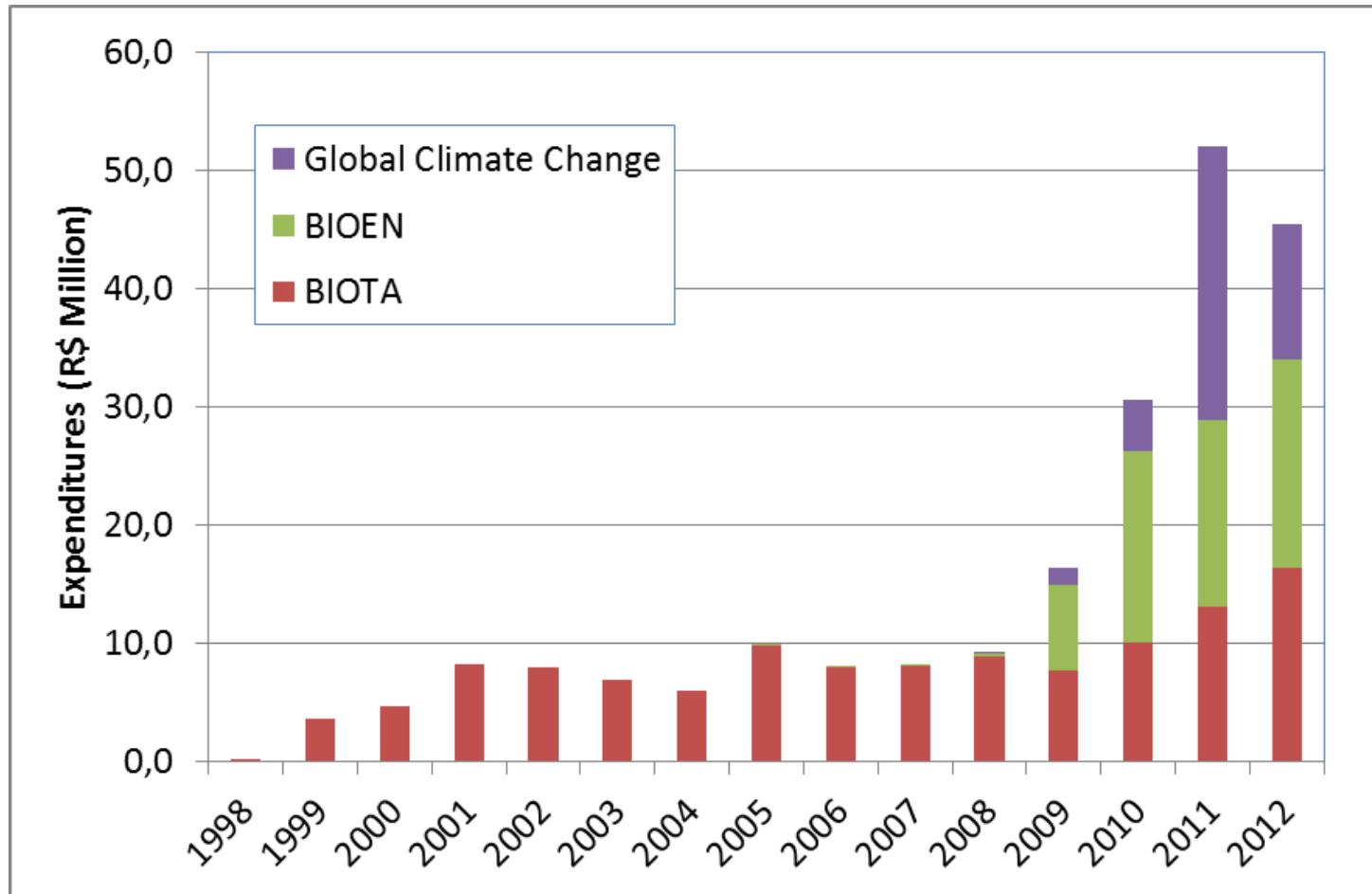
FAPESP's Sustainability Related Research Programs

- BIOEN-FAPESP: Bioenergy research
 - Feedstock, processing, green chemistry, engines, sustainability
 - 300+ scientists (50 from abroad); 600+ graduate students
 - R\$ 73 million (FAPESP); R\$ 55 million (State Government); R\$ 5 million (industry)
- BIOTA-FAPESP: Biodiversity and conservation research
 - 150 scientists; 500 graduate students
 - R\$ 93 million
- GCG-FAPESP: Global Climate Research
 - 70 scientists; 100 graduate students
 - R\$ 65 million

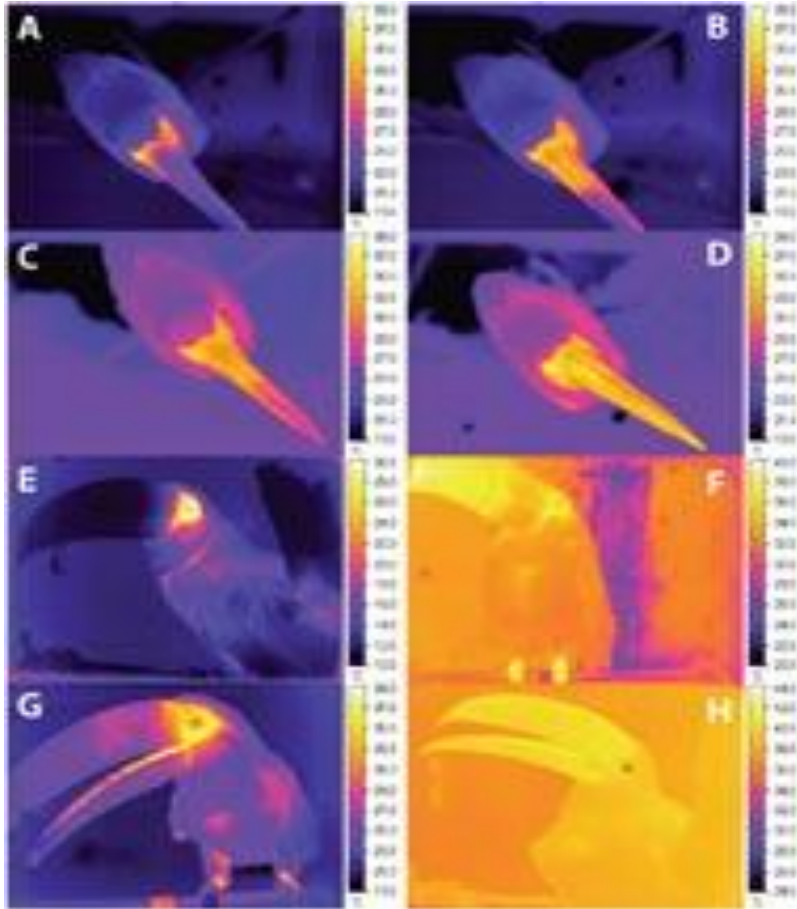
BIOTA, BIOEN and GCC: number of PIs



FAPESP expenditures in BIOTA, BIOEN and GCC (1998-2012): R\$ 217 million



BIOTA: Science, July 2009



Heat Exchange from the Toucan Bill Reveals a Controllable Vascular Thermal Radiator
Glenn J. Tattersall, *et al.*
Science 325, 468 (2009);
DOI: 10.1126/science.1175553

REPORTS

Heat Exchange from the Toucan Bill Reveals a Controllable Vascular Thermal Radiator

Glenn J. Tattersall,^{1,3} Denis V. Andrade,^{2,3} Augusto S. Abe^{2,3}

The toco toucan (*Ramphastos toco*), the largest member of the toucan family, possesses the largest beak relative to body size of all birds. This exaggerated feature has received various interpretations, from serving as a sexual ornament to being a refined adaptation for feeding. However, it is also a significant surface area for heat exchange. Here we show the remarkable capacity of the toco toucan to regulate heat distribution by modifying blood flow, using the bill as a transient thermal radiator. Our results indicate that the toucan's bill is, relative to its size, one of the largest thermal windows in the animal kingdom, rivaling elephants' ears in its ability to radiate body heat.

SP Environment Secretary bases Resolution on BIOTA research



SECRETARIA DE ESTADO DO MEIO AMBIENTE

GABINETE DO SECRETÁRIO

PUBLICADA EM 14/03/88 – SEÇÃO I – PÁG.36

RESOLUÇÃO SMA-15 DE 13 DE MARÇO DE 2008.

Dispõe sobre os critérios e parâmetros para concessão de autorização para supressão de vegetação nativa considerando as áreas prioritárias para incremento da conectividade.

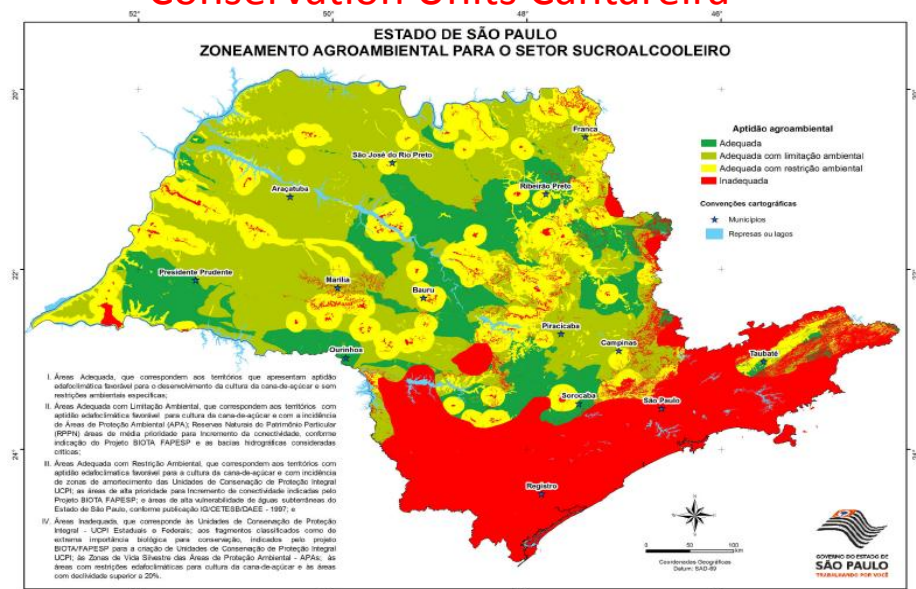
O SECRETÁRIO DE ESTADO DO MEIO AMBIENTE, em cumprimento ao disposto nos artigos 23, VII, e 225, § 1º, I, da Constituição Federal, nos artigos 191 e 193 da Constituição do Estado, nos artigos 2º e 4º da Lei federal nº 6.938, de 31 de agosto de 1981, e nos artigos 2º, 4º e 7º da Lei estadual nº 9.509, de 20 de março de 1997, e

Considerando os resultados obtidos pela equipe de pesquisadores do Projeto Biota FAPESP e as informações presentes no mapa de "Áreas prioritárias para incremento da conectividade" e "Áreas prioritárias para criação de Unidades de Conservação" resultantes do Projeto Biota FAPESP;

- Several Governor Decrees and Resolutions

– Decree 53.939, 06Jan09 – Legal Reserves

– Decree 54.746, 04Sep09 – Conservation Units Cantareira



Para o verde renascer

Estes mapas constituem o suporte científico para orientar as estratégias de conservação, preservação e restauração da biodiversidade nativa do Estado de São Paulo.

Conexões urgentes

Áreas prioritárias para implantação de Reserva Legal ou de Reserva Particular do Patrimônio Natural e para restauração (corredores ecológicos) interligando fragmentos de vegetação nativa



Limites

- Basins hidrográficas
- Unidades de conservação de proteção integral
- Remanescentes de vegetação nativa

Basins hidrográficas

1. Mantiqueira
2. Paraíba do Sul
3. Ubatuba/Itaipava
4. Paraíba do Sul
5. Paraíba do Sul/Capão/União
6. Alto Tietê
7. Baixada Santista
8. Sapucaia Grande
9. Mogi-Guaçu
10. Tietê/Sorocaba
11. Região de quaternário/Alto do Sul
12. São João do Rio Preto
13. Tietê/Jacaré
14. A. do Paraíso/Paraíba
15. Tietê/Grande
16. Tietê/Santos
17. Médio Paraíba/Paraíba
18. São João do Rio Preto
19. São João do Rio Preto
20. Açupe
21. Paraíba
22. Paraíba/Paraíba

Alguns habitantes de nossas matas



Epífitas são plantas que vivem sobre outras plantas e não são parasitas. Elas são comuns em florestas e matas, especialmente em áreas úmidas e sombreadas.



As lagartixas são animais muito comuns em florestas e matas. Elas são importantes para o controle de pragas e são também muito interessantes para os pesquisadores.



A maioria das aves são animais muito comuns em florestas e matas. Elas são importantes para o equilíbrio do ecossistema e são também muito interessantes para os pesquisadores.



Os macacos são animais muito comuns em florestas e matas. Eles são importantes para o equilíbrio do ecossistema e são também muito interessantes para os pesquisadores.



As árvores são importantes para o equilíbrio do ecossistema e são também muito interessantes para os pesquisadores.

Guias da biodiversidade paulista

Estes mapas sintetizam dez anos de levantamentos sobre a biodiversidade paulista e propõem estratégias para manter e até mesmo ampliar as áreas ocupadas pela fauna e flora nativas. Reduzidos ao longo dos séculos com a expansão da agropecuária e das cidades, florestas, cerrados, mangues, campos e restingas cobrem hoje apenas 13,9% do território paulista - o equivalente a 3,5 milhões de hectares, dos quais 77% pertencem a proprietários particulares e 23% estão protegidos pelo Estado.

Tesouros a céu aberto

Fragmentos indicados para criação de unidades de conservação de proteção integral



Próximos destinos

Áreas prioritárias para levantamentos de flora e fauna, necessários para definição de novas estratégias de conservação e recuperação da biodiversidade nativa



Flora e fauna em números

Com os três mapas foram levantados dados em 19.777 registros de espécies de plantas e animais em São Paulo. Esses dados foram sintetizados em um mapa de vegetação para orientar os trabalhos de conservação e a criação de novas unidades de conservação. A distribuição geográfica de 10.411 espécies de plantas e animais levantadas no território paulista. Sua biodiversidade está representada por:

6.529 espécies de plantas floríferas	360 de peixes de água doce
2.016 de insetos	162 de anfíbios
1.627 de aracnídeos	149 de mamíferos
523 de aves	91 de répteis
50 de plantas criptógamas	

Mais informações em www.biodiversidade.org.br



Projeto elaborado para conservação e restauração da biodiversidade do Estado de São Paulo. Coordenação: Programa de Pós-Graduação em Ecologia e Evolução, Departamento de Ecologia e Evolução, Instituto de Biologia, Universidade de São Paulo (IB-USP). Apoio: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

Bioenergy: three research initiatives at

FAPESP

- Scientific and Technology roadmap
 - Research Project in our Public Policy Program
- BIOEN
 - Research program; 10 years
 - Basic research core
 - Connections to application through partnership with companies
- Bioenergy State Research Center
 - Hubs in the three state universities – USP, Unicamp, Unesp
 - Funding: State Government, FAPESP and the Universities

BIOEN: 314 scientists

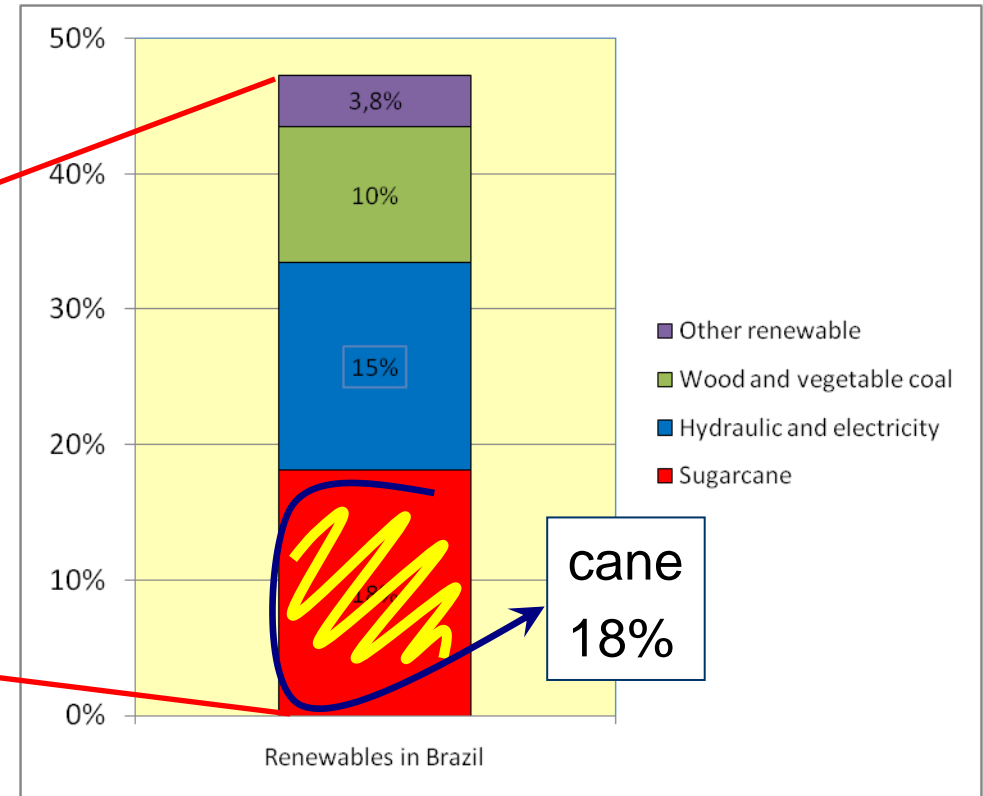
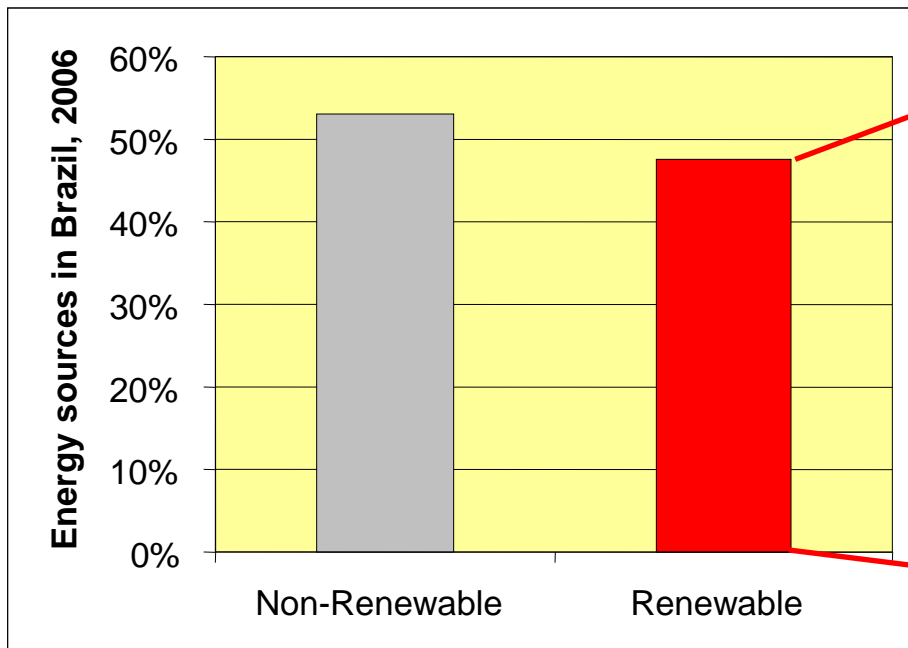
- 56 research projects
- 314 scientists
 - 229 from São Paulo
 - 33 from other Brazilian states
 - MG 12; RJ 8; Pr 3; RS 3
 - 52 from other countries
 - U.S. 26; Fr 7; Ge 4; Ne 4; De 3; Sp 3

Type of support	Qty
2-year grants	20
5-year grants	29
Young Investigators	7
Industry-University	11
Fellowships	132

FAPESP's Research Program on Bioenergy (BIOEN): 5 areas

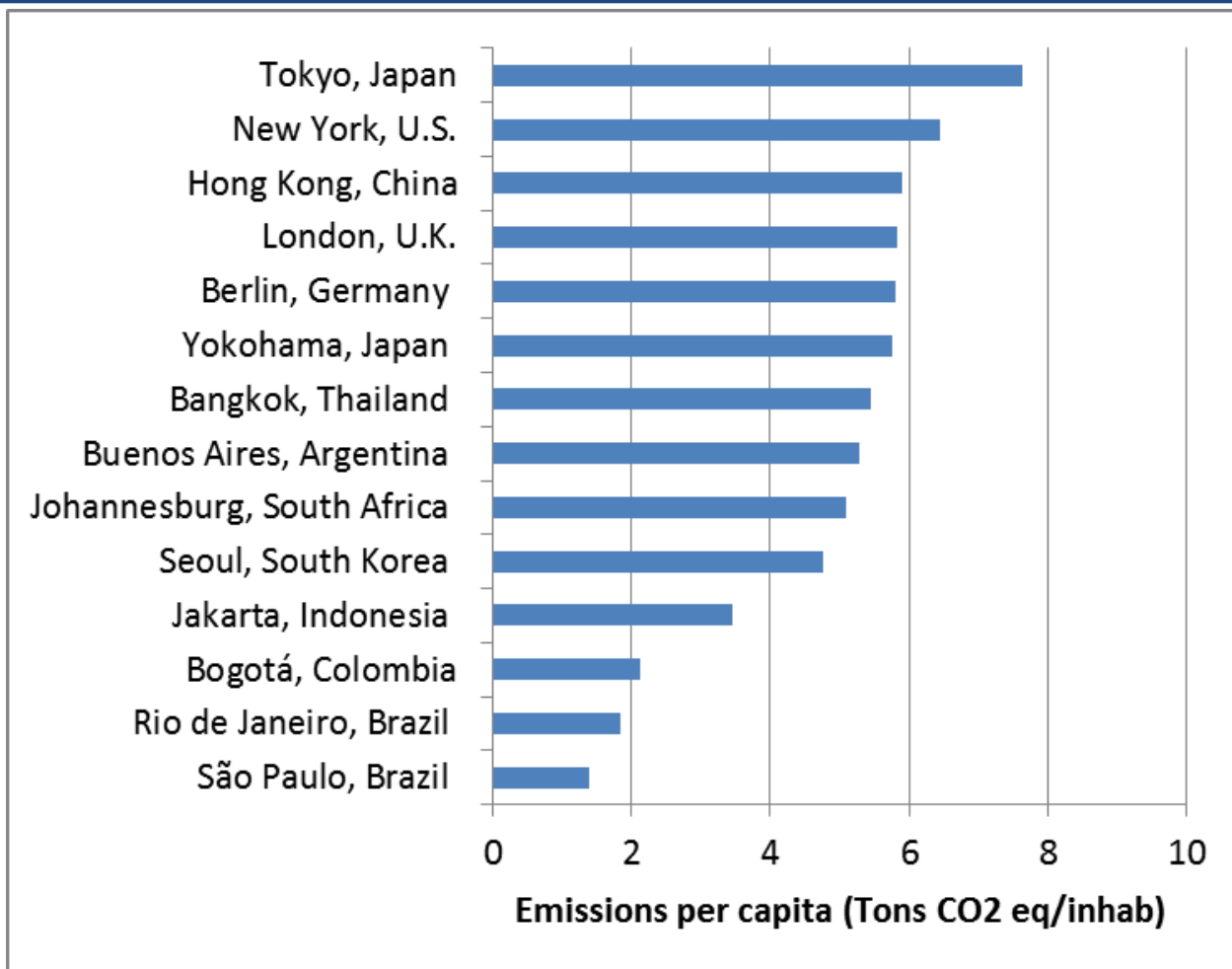
- Improvements in the feedstock: building a better cane plant for energy - EnergyCane
- Production of Ethanol and other products: hydrolysis, pyrolysis, gasification, fermentation, distillation
- New processes in alcohol-chemistry
- Ethanol based engine and fuel cell developments
- The Economics of Ethanol, Ethanol production and the environment, Social impacts, the new agriculture of food and energy

Brazil: 47% of energy from renewable sources (2009); 18% from sugarcane



Renewables in Brazil: 47%; World: 13%; OECD: 7,2%

Ethanol use leads to low emissions



FAPESP's BIOEN research program: 84 → 148 → 212 → 381 ton/Ha??

Review article

Sugarcane for bioenergy production: an assessment of yield and regulation of sucrose content

Alessandro J. Waclawovsky^{1,†,‡}, Paloma M. Sato^{1,‡}, Carolina G. Lembke¹, Paul H. Moore² and Glauca M. Souza^{1,*}

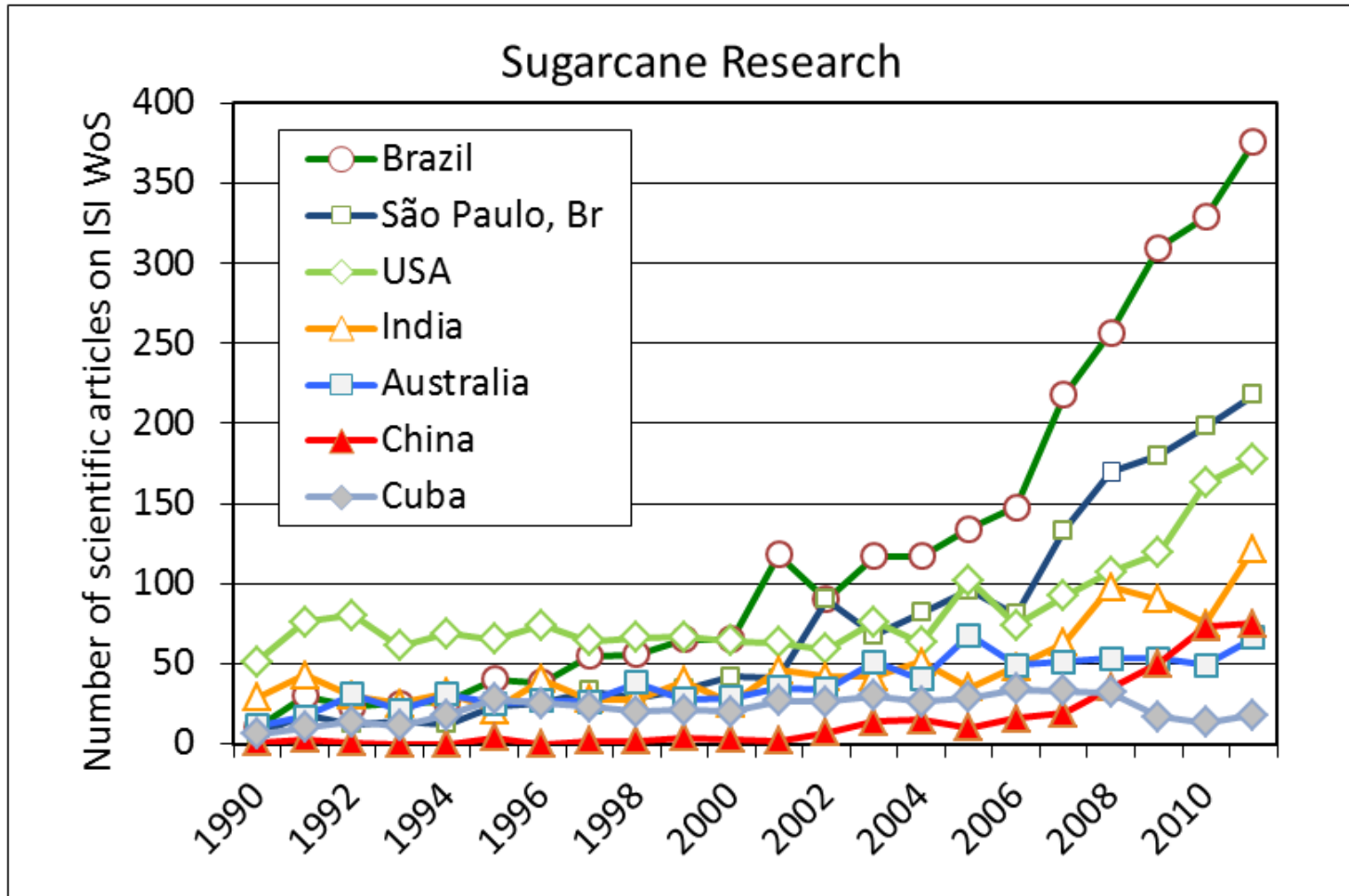
¹Departamento de Bioquímica, Instituto de Química, Av. Prof. Lineu Prestes, São Paulo, Brazil

²Hawaii Agriculture Research Center, Kuniā, HI, USA

Table 1 Average, maximum and theoretical sugarcane yields (Australia, Colombia, and South Africa) and total dry matter production

Type of yield	Cane yield	Biomass*	
	t/(ha yr)	t/(ha yr)	g/(m ² d)
Commercial Average	84	39	10.7
Commercial maximum	148	69	18.8
Experimental maximum	212	98	27.0
Theoretical maximum	381	177	48.5

Sugarcane research



BIOEN: FAPESP-Industry agreements for joint funding

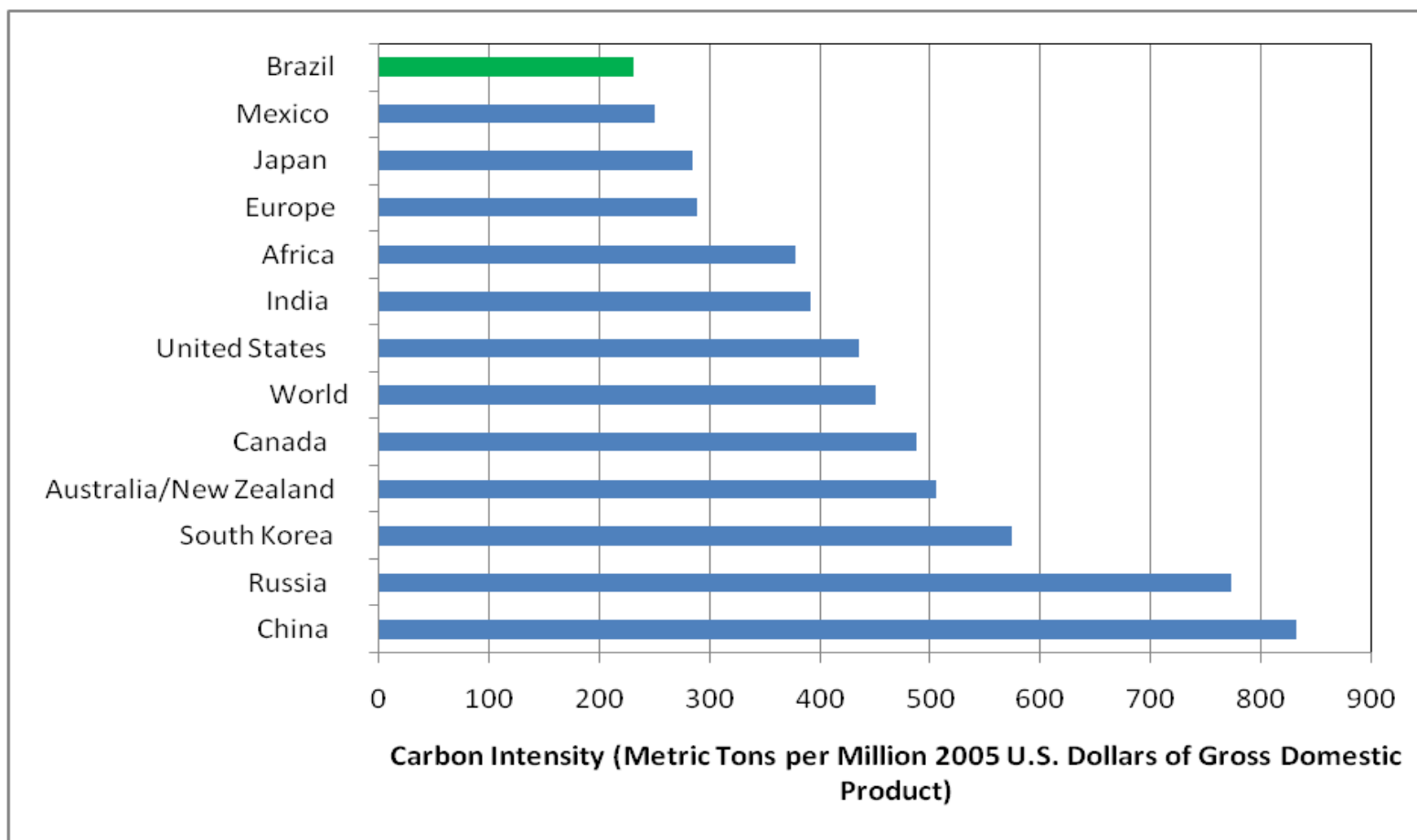
- Joint industry-university research (next 10 years)

Company	Subject	Val. (Indus.+FAPESP)
Oxiteno	Lignocellulosic materials	R\$ 6,000,000
Braskem	Alcohol-chemistry	R\$ 50,000,000
ETH	Sugarcane	R\$ 20,000,000
Boeing	Aviation Biofuels – 1st stage	R\$ 1,200,000
BP	Processes and Sustainability	R\$ 100,000,000
Microsoft	Algorithms for gene sequencing	
PSA	Ethanol powered engines - ERC	R\$ 16,000,000

FAPESP Research Program on Global Climate Change

- Global Climate Modelling
 - Supercomputer – 15 Tflops sustainable
 - FINEP + FAPESP
- Water, Carbon and Nitrogen cycles, Ecosystems, Aerosols, Land use change, Agriculture and husbandry, Human health, Human dimensions
- Expenditures to date – R\$ 75 million
 - R\$ 20 milhões em 17 Projetos Temáticos
 - R\$ 40 milhões (15 FAPESP/25 MCT) no supercomputador
 - R\$ 15 milhões no navio oceanográfico

Intensidade de Carbono no PIB

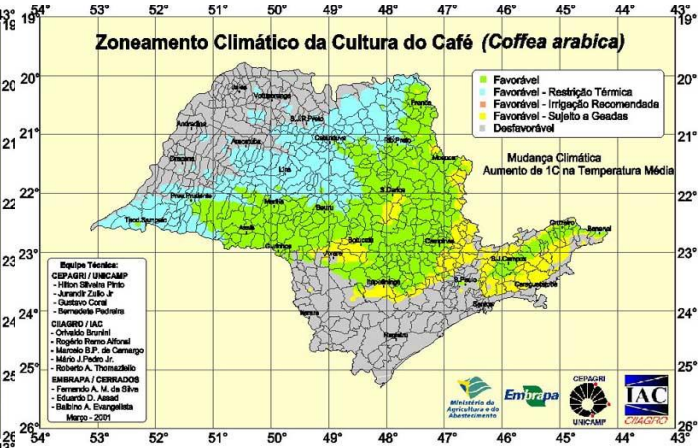


GCC effects on Coffee plantations in SP

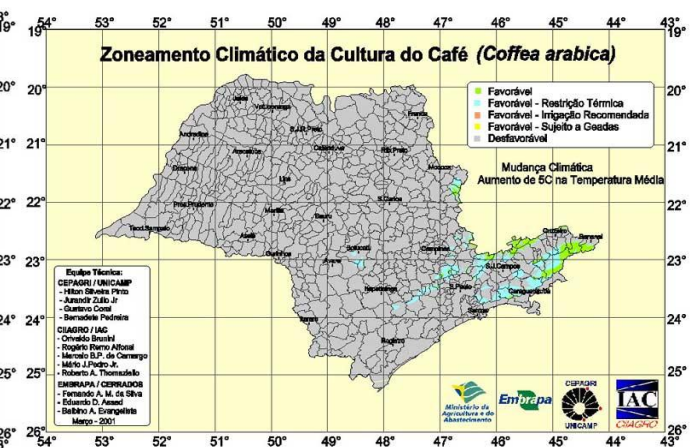
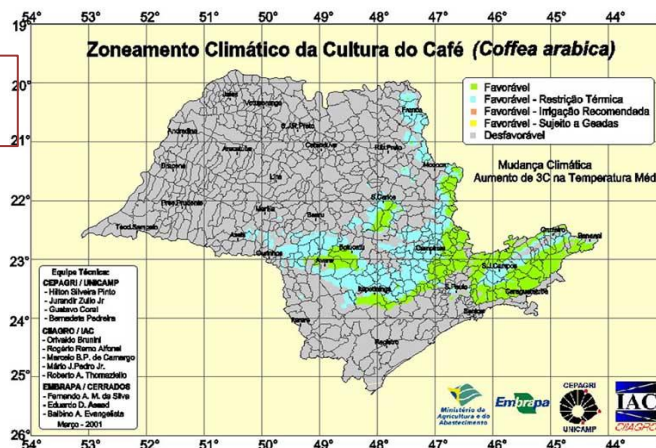
Present



+1°C



+3°C

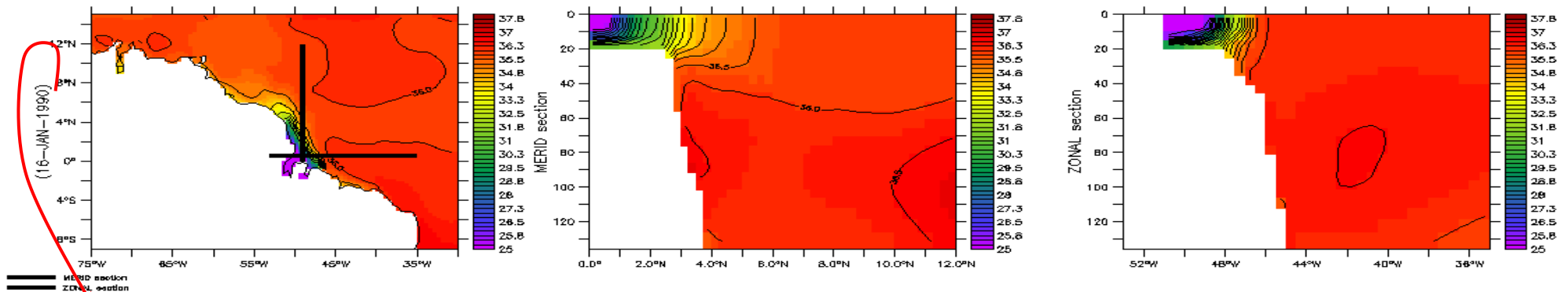


(Fonte: CEPAGRI, Unicamp)

Modeling Global Climate with an eye on the South Atlantic - Salinity

Possible with a new supercomputer (30,258 cores; 244 TFlops/sw; 3.84 Pb disk + 6 Pb tape;)

Fresh water discharge from the Amazon River lowers regional salinity (res. 10 – 100 km)



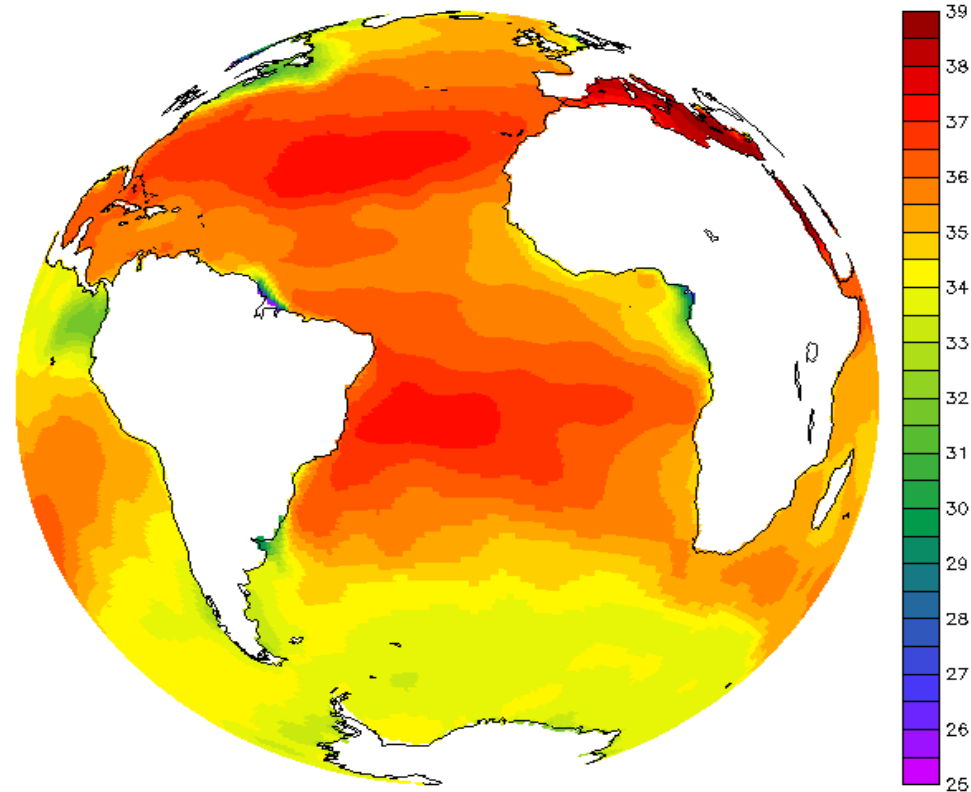
10 years time frame, displayed monthly

Authors: Gilvan Sampaio e Carlos Nobre, PFPMCG, INPE

Modeling Global Climate with an eye on the South Atlantic - Salinity

DEPTH (dbars) : 2.536
TIME : 16-JAN-1990 12:00 NOLEAP DATA SET: 19900101.ocean_month
global_coupled_T1

FERRET Ver. 8.62
NOAA/PWEL TRAP
21-SEP-2010 13:10:48



SALT * MP_MASK

Authors: Gilvan
Sampaio e Carlos
Nobre, PFFMCG,
INPE

Mudança Climática, Biodiversidade Marinha e Oceanos

- Instrumentos
 - Barco para pesquisa
 - Navio oceanográfico – Alpha Crucis
 - Barco – Alpha Delphini





BIOTA: Science – Perspectives, April 6, 2009



PERSPECTIVES

ECOLOGY

The Forgotten Megafauna

Dennis M. Hansen¹ and Mauro Galetti^{1,2}

Large terrestrial vertebrates—called megafauna—play key roles in ecosystem dynamics by feeding on plants and by maintaining habitat heterogeneity (1). A global wave of megafauna extinctions occurred 50,000 to 10,000 years ago, when many large continental mammals were lost (2–5). Classical definitions of megafauna are based on such continental mammals and are variously given as animals larger than 44 kg (6) or above 1000 kg (7). Here, we argue that the megafauna concept should be extended beyond an absolute animal size to be context-dependent. In any given ecosystem, the largest vertebrates have ecosystem impacts that are similar on a relative scale to those of the largest vertebrates in another ecosystem: One ecosystem's mesofauna is another ecosystem's megafauna.

An ecosystem function that clearly illustrates this argument is animal-mediated seed dispersal. Here, the link between animal body

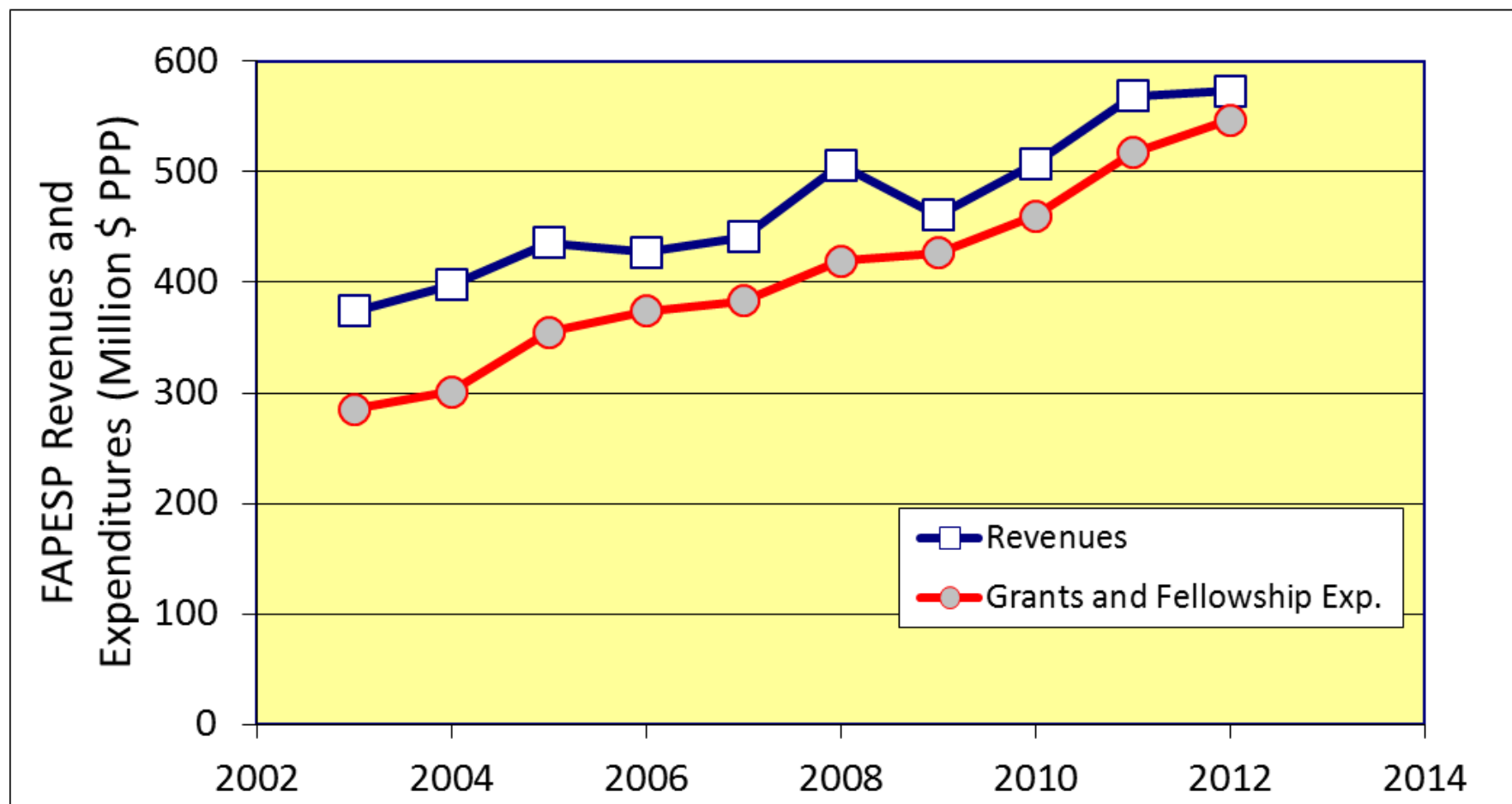


Scaling the megafauna. The magnitude of loss of frugivorous megafauna is currently most dramatic on islands, as illustrated by the smaller drawn sizes of the giant ground sloth and the gomphothere from South America, compared with the elephant bird in Madagascar and the giant tortoise of Mauritius. However, many continental regions are poised to catch up.

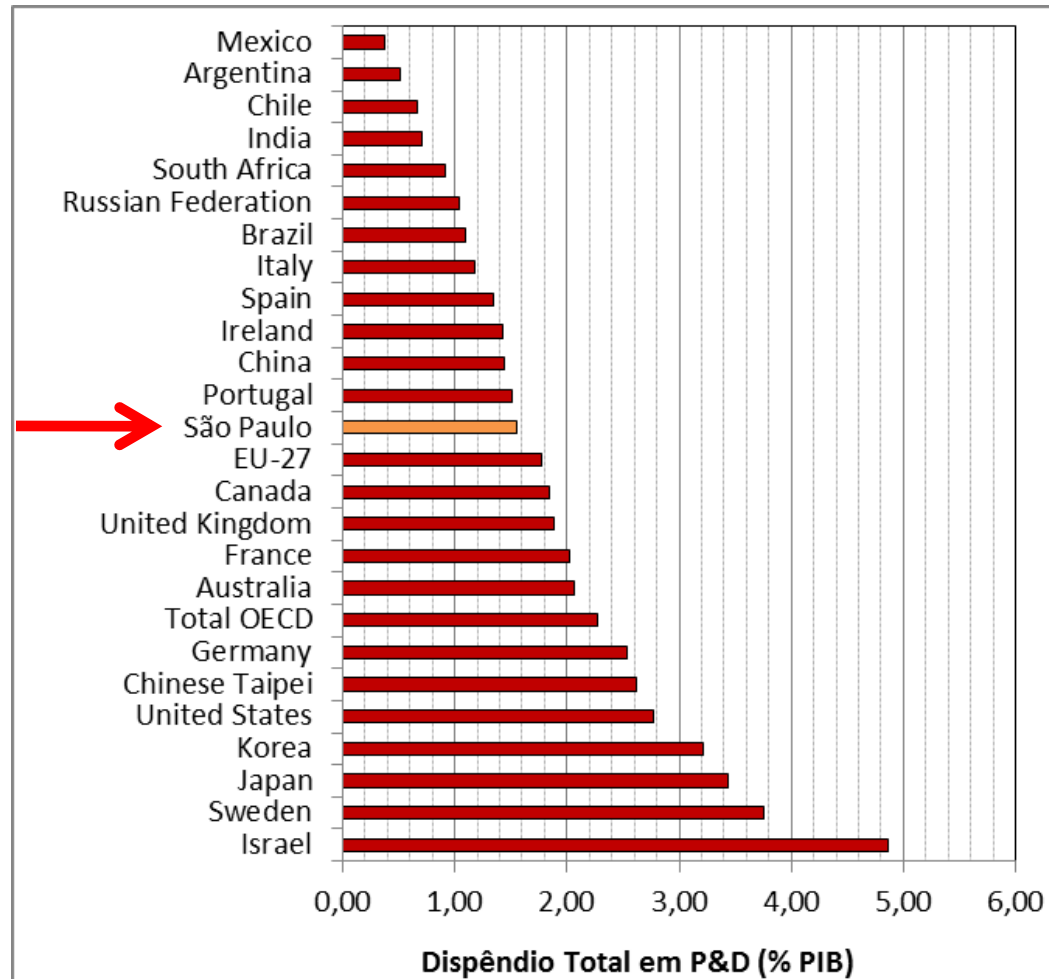
To illustrate our point, we have examined [blank] in relative terms, led to a greater megafaunal

An expanded megafauna concept elucidates how extinctions of the largest vertebrates in any ecosystem have similar effects.

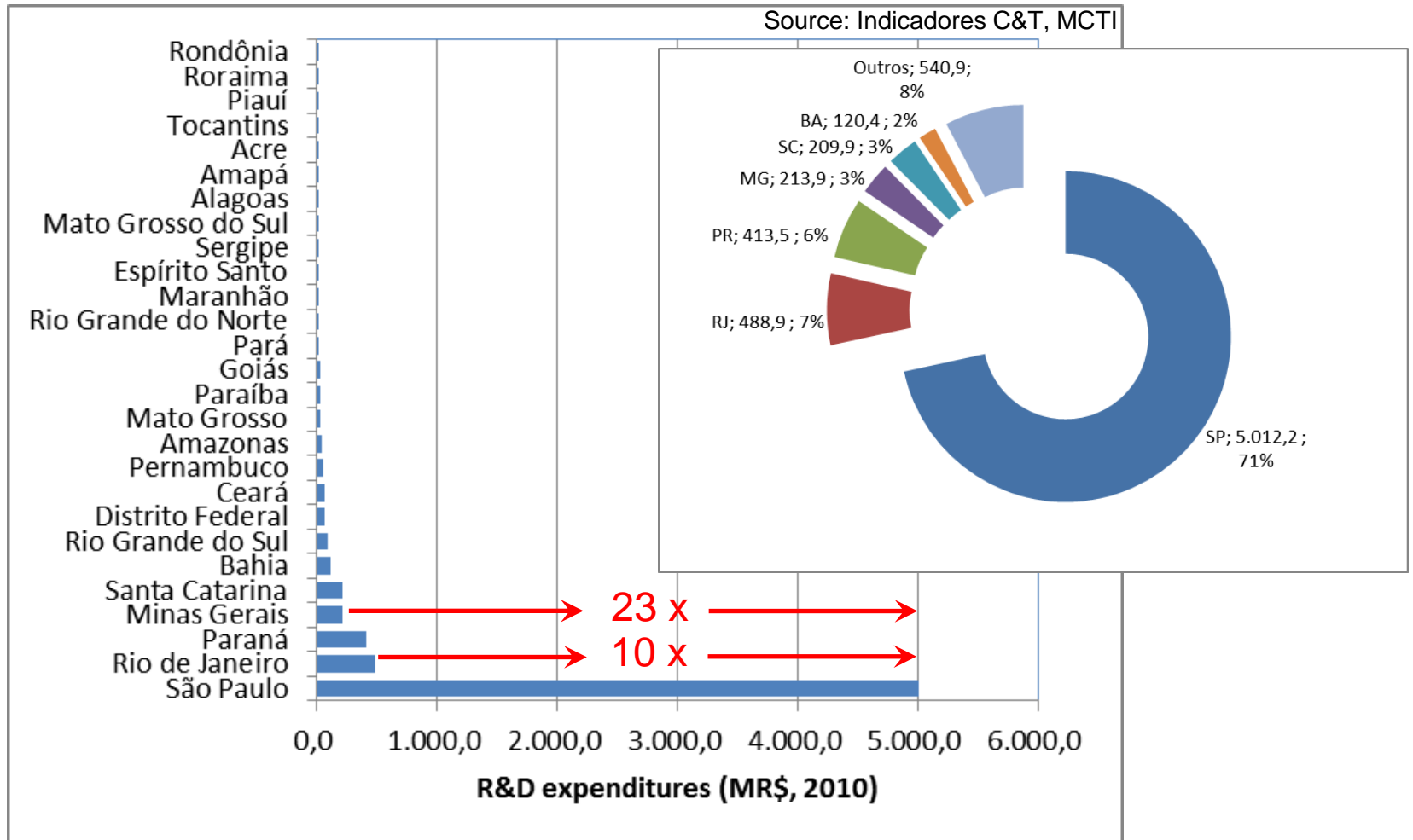
FAPESP yearly expenditures



SP, R&D Expenditure International standing



State level support for R&D in Brazil, 2010



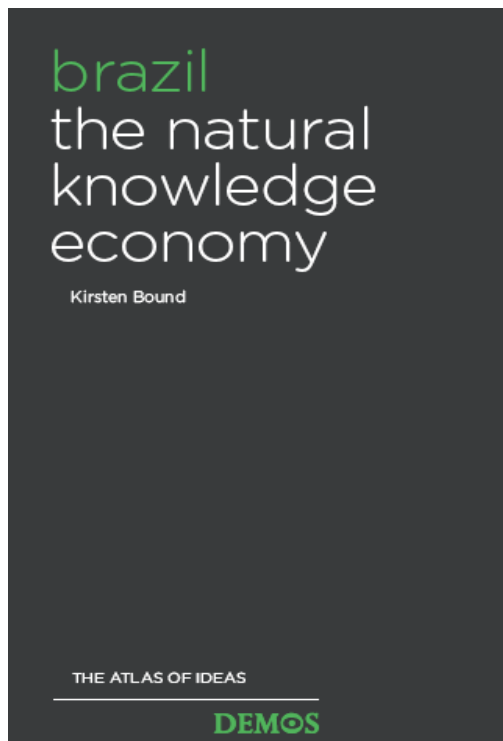
State of São Paulo Bioenergy R&D – BIOEN

- Academic Basic and Applied Research
 - Advancement of knowledge – US\$ 35M
 - Plus US\$ 75 M (10 years) for a statewide Research Center
 - Young Investigator Awards – US\$ 6 M
 - Open to young foreign scientists who want to come to Brazil
- Joint industry-university research (5 years)

Brazil: a Natural Knowledge Economy

(K. Bound, Demos, 2008)

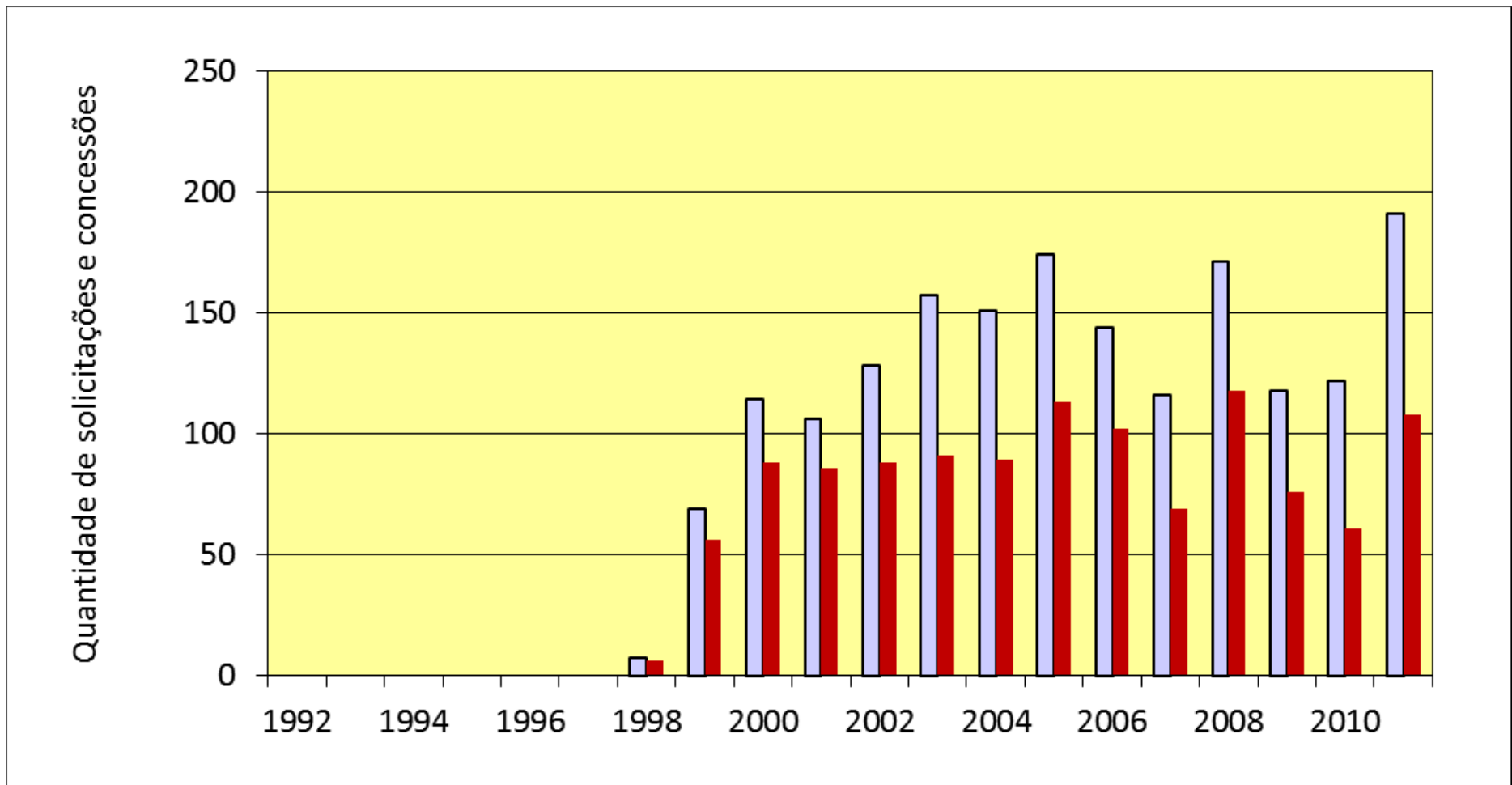
- http://www.demos.co.uk/files/Brazil_NKE_web.pdf



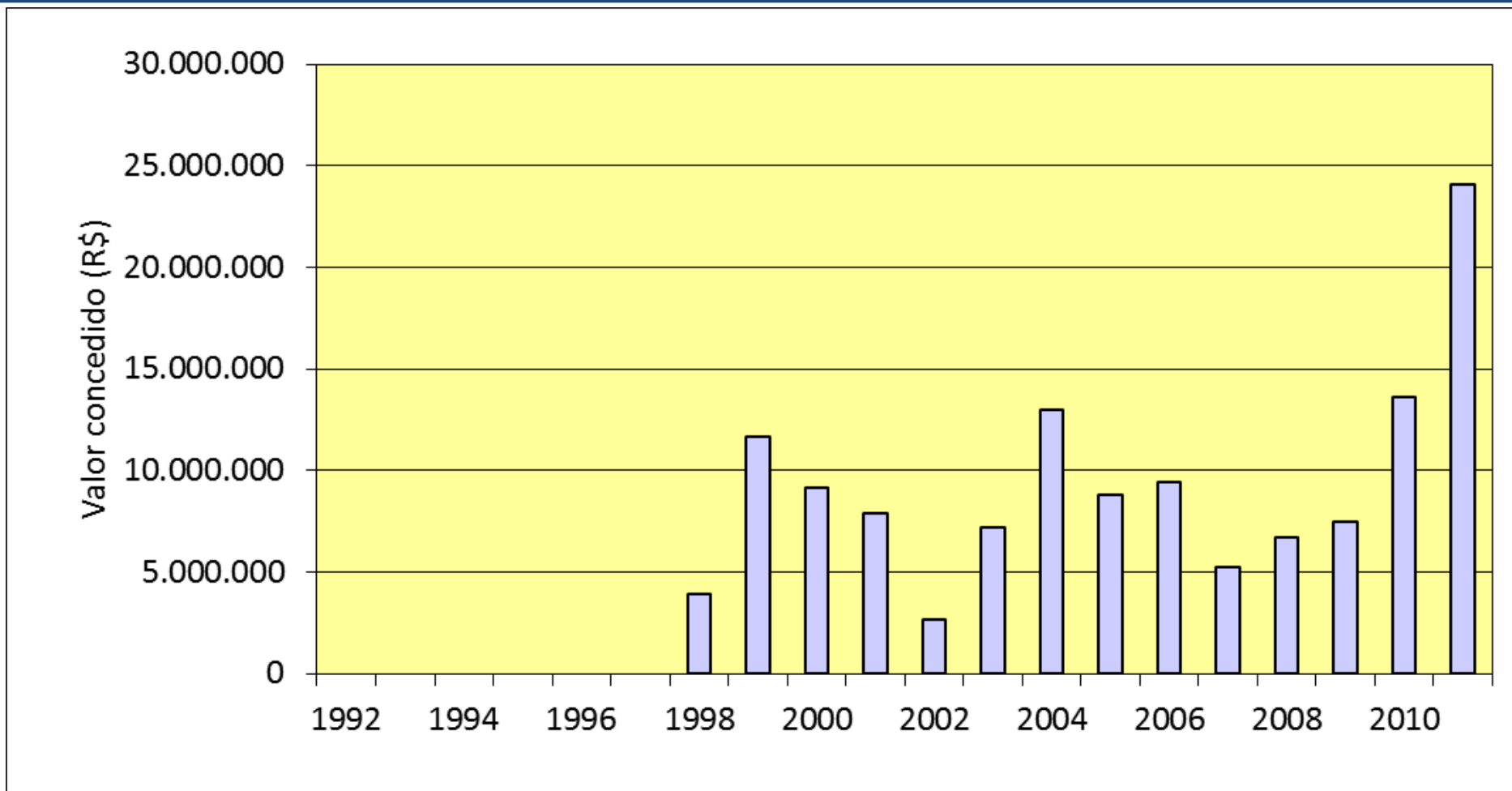
‘São Paulo is another country’⁹³

The state of São Paulo in South Eastern Brazil is home to over 20 per cent of the country’s population. Almost 11 million of these people live in metropolitan Sao Pãulo, one of the world’s five largest cities.⁹⁴ The state contributes over a third of Brazil’s GDP. As a result of its demographic and economic power, São Paulo dominates Brazilian science and innovation. The state spends more on research and development than any Latin American country apart from Brazil. Of the eight best Brazilian universities, five are in São Paulo. One university, USP, accounts for more than a quarter of the scientific publications produced by the country, and the state has the highest number of innovative companies.

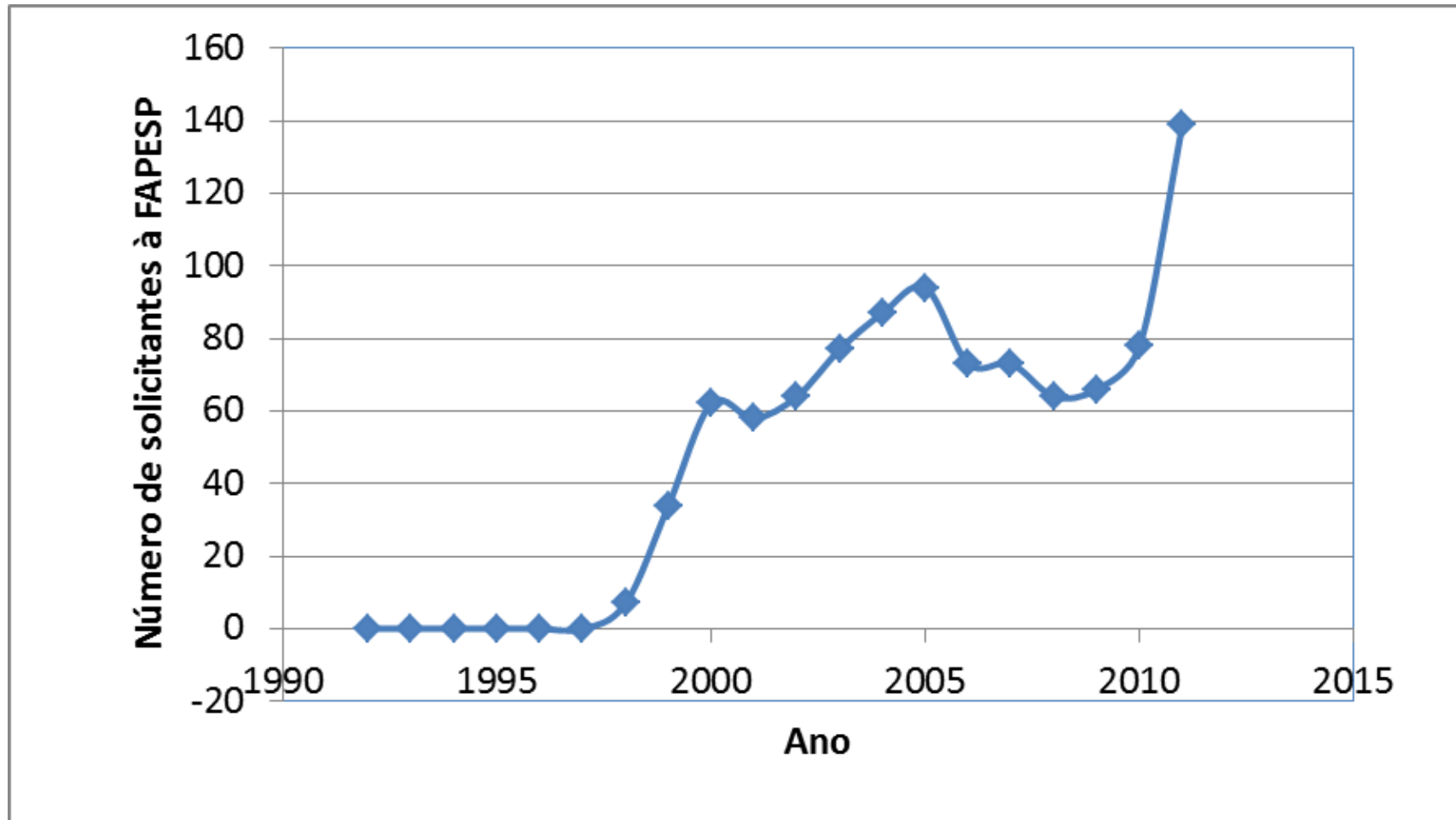
BIOTA FAPESP – submissions and approvals



BIOTA FAPESP: value approved



BIOTA FAPESP: number of researchers submitting proposals



Alpha Crucis



Momentos



Addsoft

Pacífico Norte