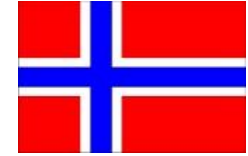




AquaNor 2015 - Seminar "Aquaculture in Brazil"
20th August 2015 – SINTEF - Trondheim/Norway



Research and aquaculture development in Brazil

Eric Arthur Bastos Routledge

Research and Development Head
Embrapa Fisheries and Aquaculture - Brazil



Ministério da
Agricultura, Pecuária
e Abastecimento



Summary

- Brazilian R&D system
- Brazilian undergraduate and graduate courses in Aquaculture and fisheries
- Embrapa
- Aquaculture species and research areas
- Considerations.

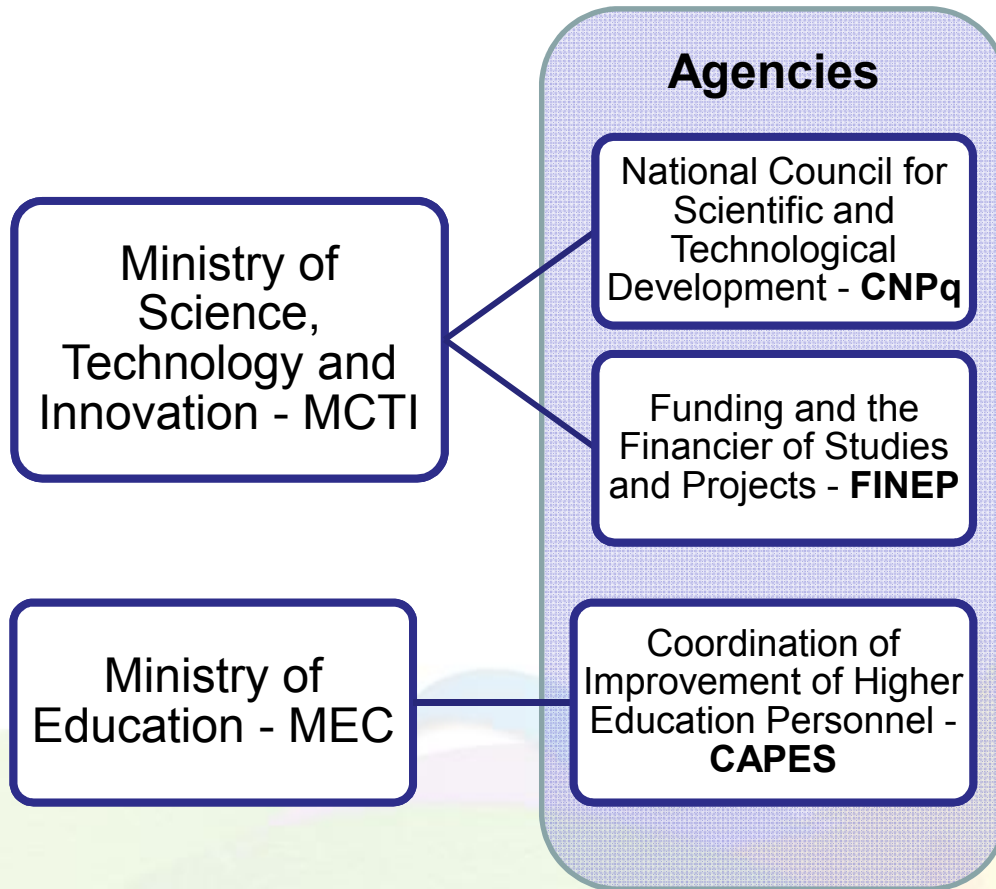


Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Brazilian R&D main stakeholders



- Scholarships, grants and projects;
- Funding program and research projects (research proposer in specific research areas);



- Funding scholarships to undergraduate and postgraduate students and training for researchers.
- International Scientific Cooperation



Ministério da
Agricultura, Pecuária
e Abastecimento



Main R&D funding sources in Brazil

- National Scientific and Technological Fund – FNDCT:

- FINEP coordination;
- 16 funds;
- Resources obtained by *royalties* e financial compensation (2014 ≈ R\$ 3,8 billions, around U\$ 1.1 billion);

Os Fundos Setoriais:

CT - Aeronáutico	Fundo Setorial Aeronáutico
CT - Agronegócio	Fundo Setorial de Agronegócios
CT - Amazônia	Fundo Setorial da Amazônia
CT - Aquaviário	Fundo para o Setor de Transporte Aquaviário e Construção Naval
CT - Biotecnologia	Fundo Setorial de Biotecnologia
CT - Energ	Fundo Setorial de Energia
CT - Espacial	Fundo Setorial Espacial
CT - Hidro	Fundo Setorial de Recursos Hídricos
CT - Info	Fundo Setorial para Tecnologia da Informação
CT - Infra	Fundo de Infra-Estrutura
CT - Mineral	Fundos Setorial Mineral
CT - Petro	Fundo Setorial do Petróleo e Gás Natural
CT - Saúde	Fundo Setorial da Saúde
CT - Transpo	Fundo Setorial de Transportes Terrestres
CT - Verde Amarelo	Fundo Verde e Amarelo - Para Interação Universidade-Empresa
Funttel	Fundo Setorial para o Desenvolvimento Tecnológico das Telecomunicações



Ministério da
Agricultura, Pecuária
e Abastecimento



Brazilian R&D main stakeholders

MPA and MCTI together to promote research in fisheries and aquaculture target areas – Funding in a proportion: 1 to 3

- Partnership with governmental research agencies (CNPq / FINEP);
- Public calls to support R&D projects in specific areas;
- Scholarships for students and researchers;
- Improve and build laboratory and experimental hatchery facilities;

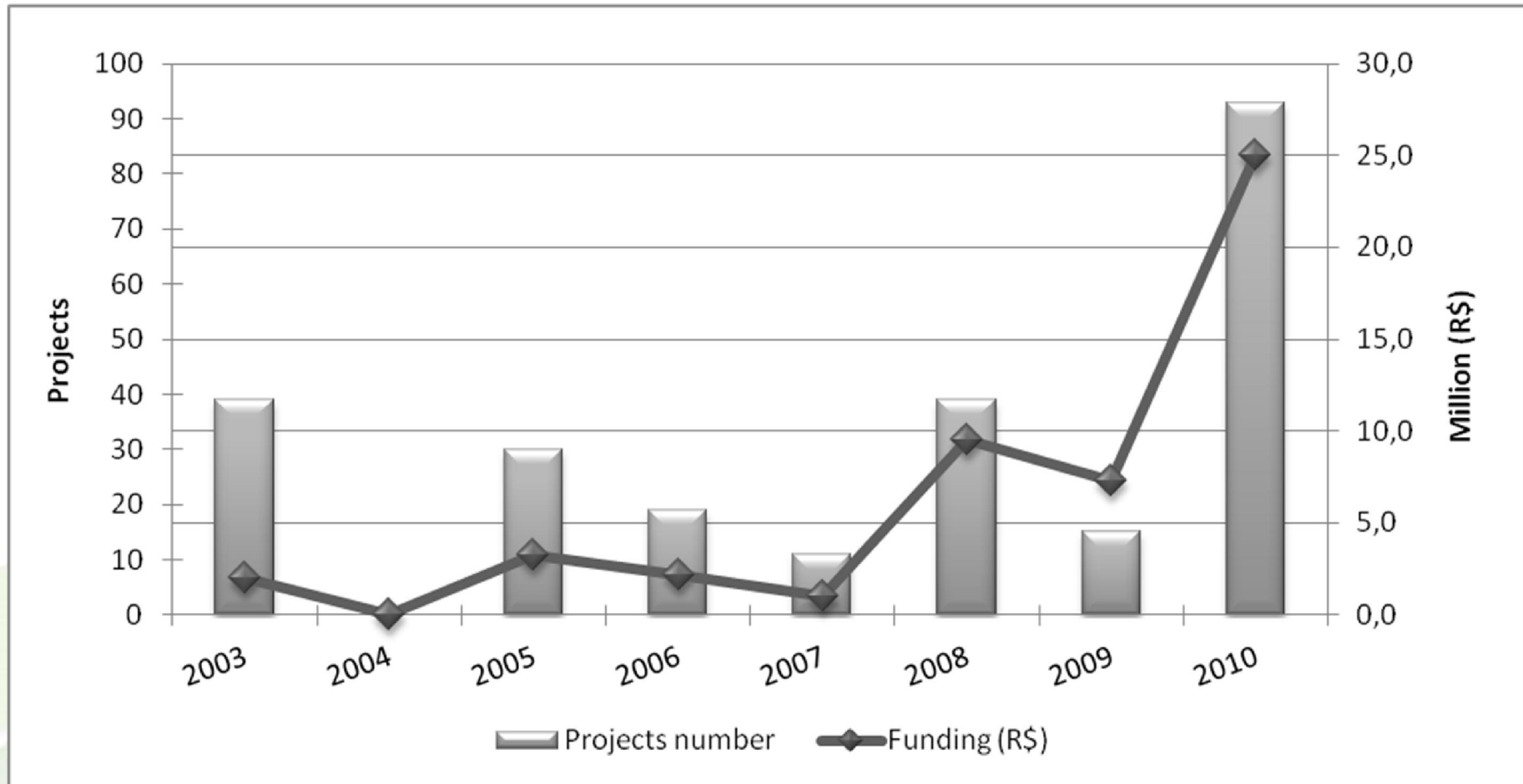


Ministério da
Agricultura, Pecuária
e Abastecimento



Brazilian R&D main stakeholders

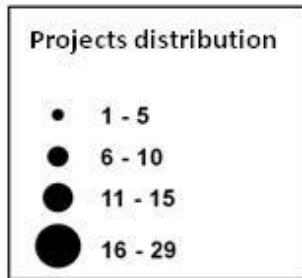
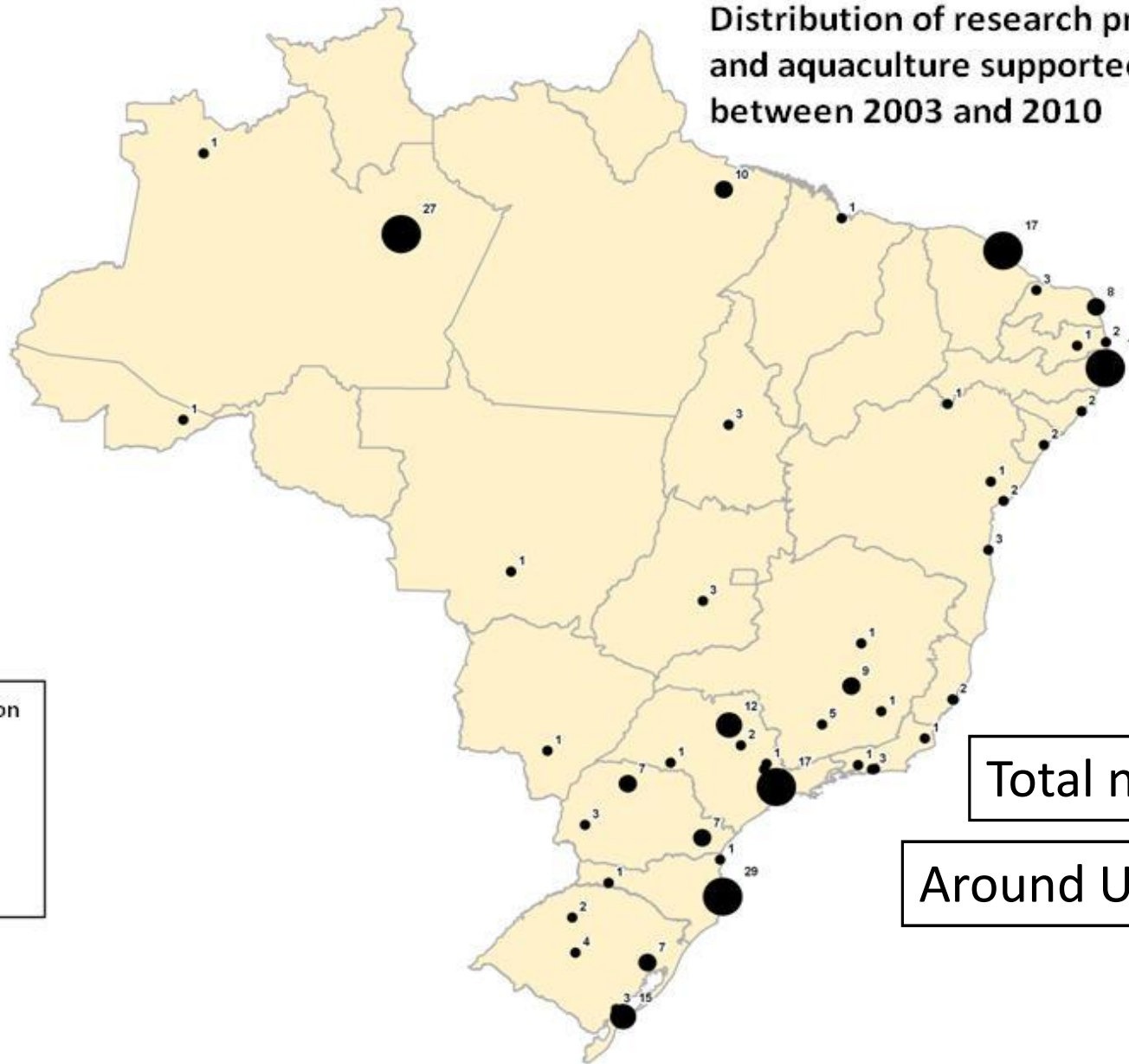
Projects funded in partnership (MPA / MCTI): 2003 - 2010



Ministério da
Agricultura, Pecuária
e Abastecimento



Distribution of research projects in fishery and aquaculture supported by public calls between 2003 and 2010



Total number: 246

Around U\$ 27 million

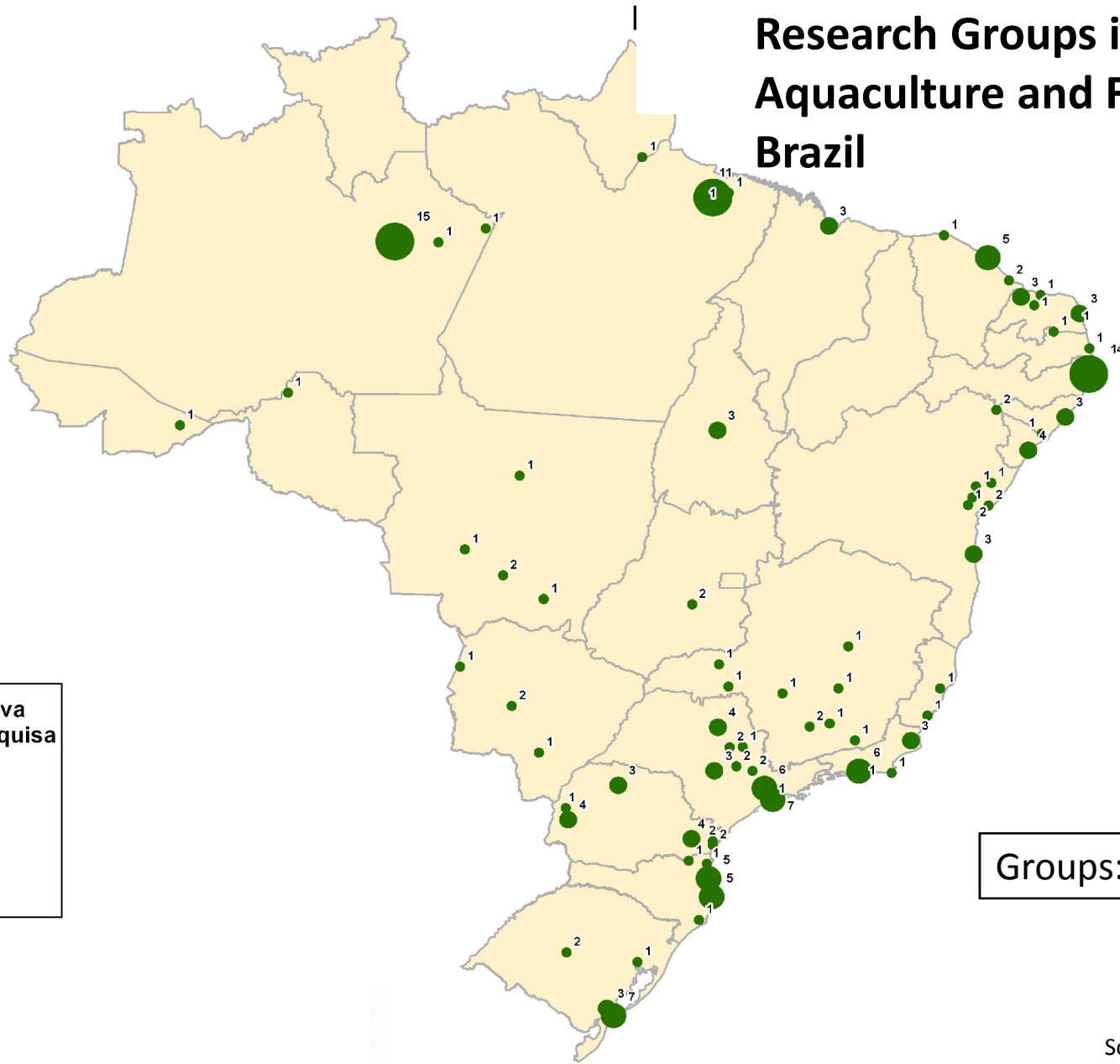
Source: MPA (2012)



Ministério da
Agricultura, Pecuária
e Abastecimento



Research Groups in Aquaculture and Fisheries in Brazil



Distribuição relativa de grupos de pesquisa

- 1 - 2
- 3 - 4
- 5 - 8
- 9 - 15

Groups: 195

Source: CAPES, 2012



Ministério da
Agricultura, Pecuária
e Abastecimento



Brazilian aquaculture diversification



Source: MPA, 2012



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Main native species farmed in Brazil

Tambaqui (*Colossoma macropomum*)



©FAO/Aquaculture photo library/D. Soto



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Main native fish species farmed in Brazil



1st Tambaqui



[Source](#)



[Source](#)

2nd Tambacu and Tambatinga (hybrids)



[Source](#)

3rd Surubim (and hybrids)



[Source](#)

4th Pacu



[Source](#)

5th Matrinxã



[Source](#)

6th Pirapitinga



[Source](#)

7th Piau – *Brycon* spp

Source: IBGE, 2013



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

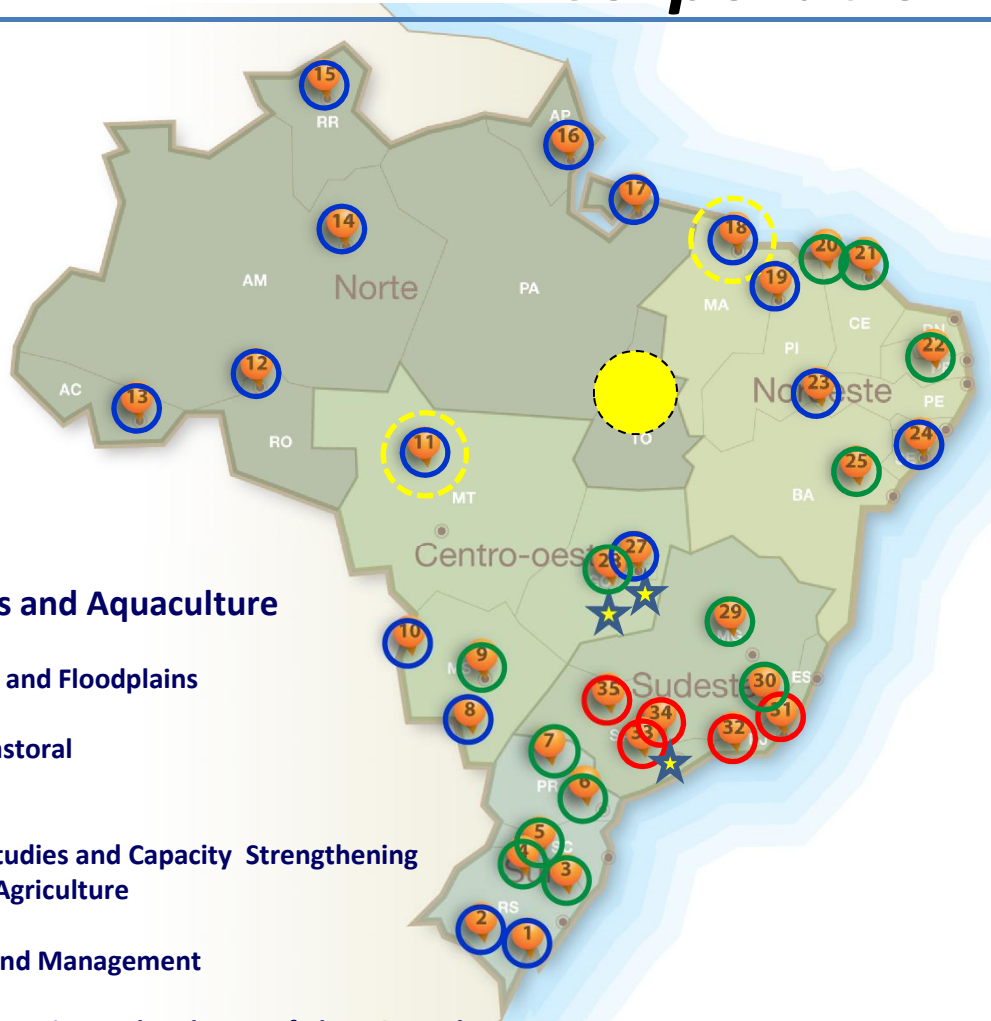
Embrapa – The Brazilian Agricultural Research Corporation

Established in 1973
Employees: 9,805
Total Scientists: 2,480
PhD/DSc: 1,941
Budget: US\$ 900 millions

A Network of 47 Research Centers and Services

-  Fisheries and Aquaculture
-  Palm Trees and Floodplains
-  Agrosilvopastoral
-  Advanced Studies and Capacity Strengthening in Tropical Agriculture
-  Strategic Land Management
-  Quarantine Station and Exchange of Plant Germplasm

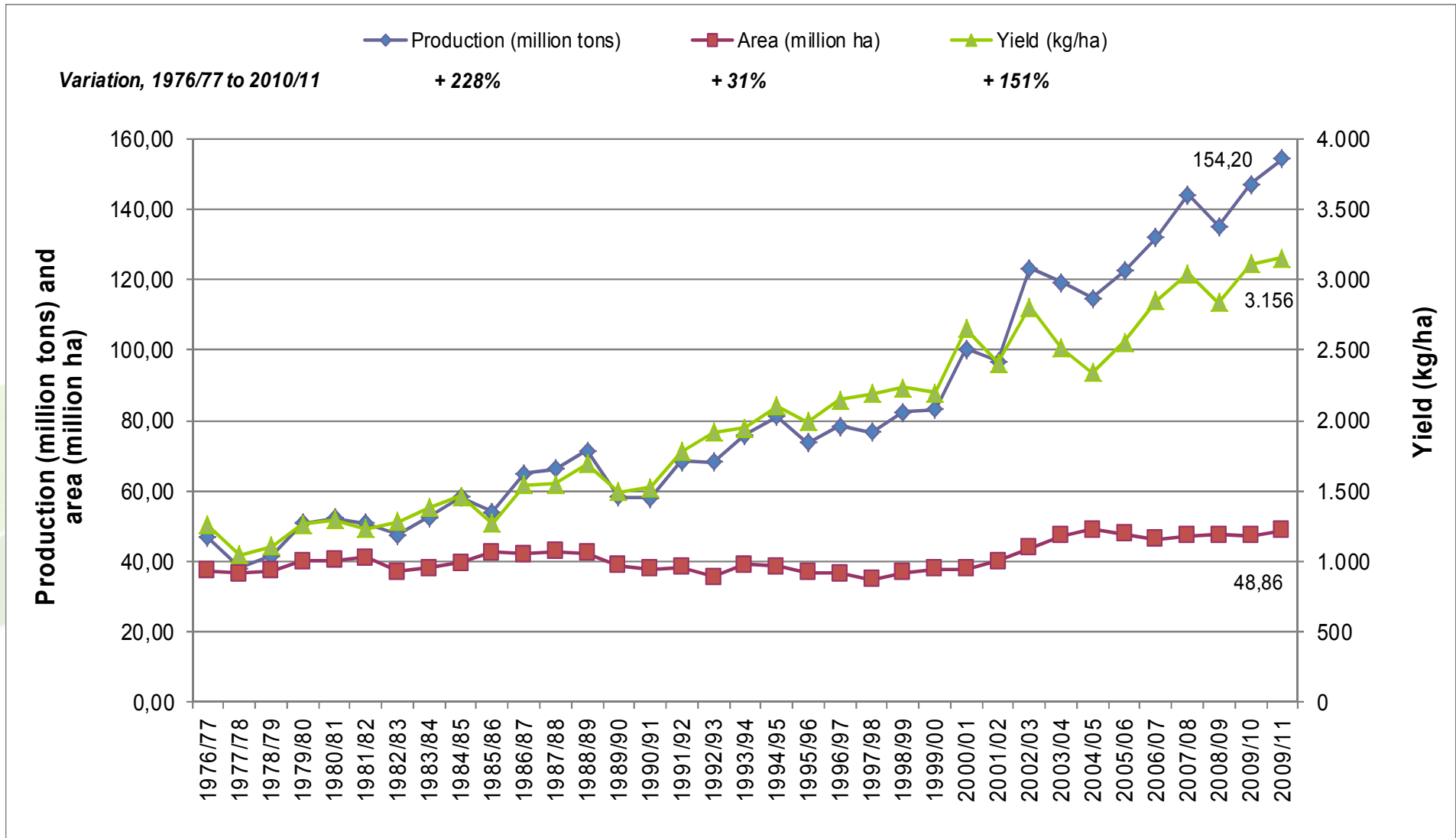
-  National Thematic
-  National Product
-  Ecorregional/Agroforestry
-  Services



Ministério da
Agricultura, Pecuária
e Abastecimento



Growth of Agricultural Productivity Grains in Brazil - (1976/2011)



Source: after CONAB, 2010;2011.

Production and exports in animal meat in 2014 – Forecast (Fao, 2014)

Source	Production (1000 t)	Exports (1000 t)
Aquaculture	165,9 (35,1%)	59,4 (65,6%)
Swine	115,5 (24,5%)	7,2 (7,9%)
Poultry	108,7 (23,0%)	13,5 (14,9%)
Cattle	68,0 (14,4%)	9,4 (10,5%)
Sheep and goats	14,0 (3,0%)	1,0 (1,1%)
Total	472,1	90,5



Fisheries and Aquaculture



Ministério da
Agricultura, Pecuária
e Abastecimento

GOVERNO FEDERAL
BRASIL
PAÍS RICO É PAÍS SEM POBREZA

MISSION

Provide technological solutions for sustainable aquaculture, fisheries and agriculture systems for the brazilian society.



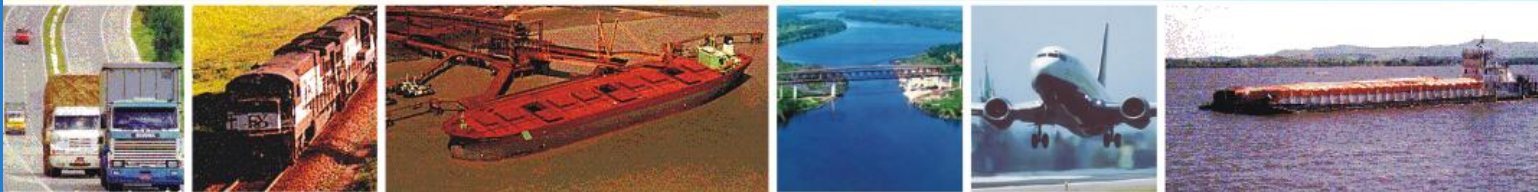
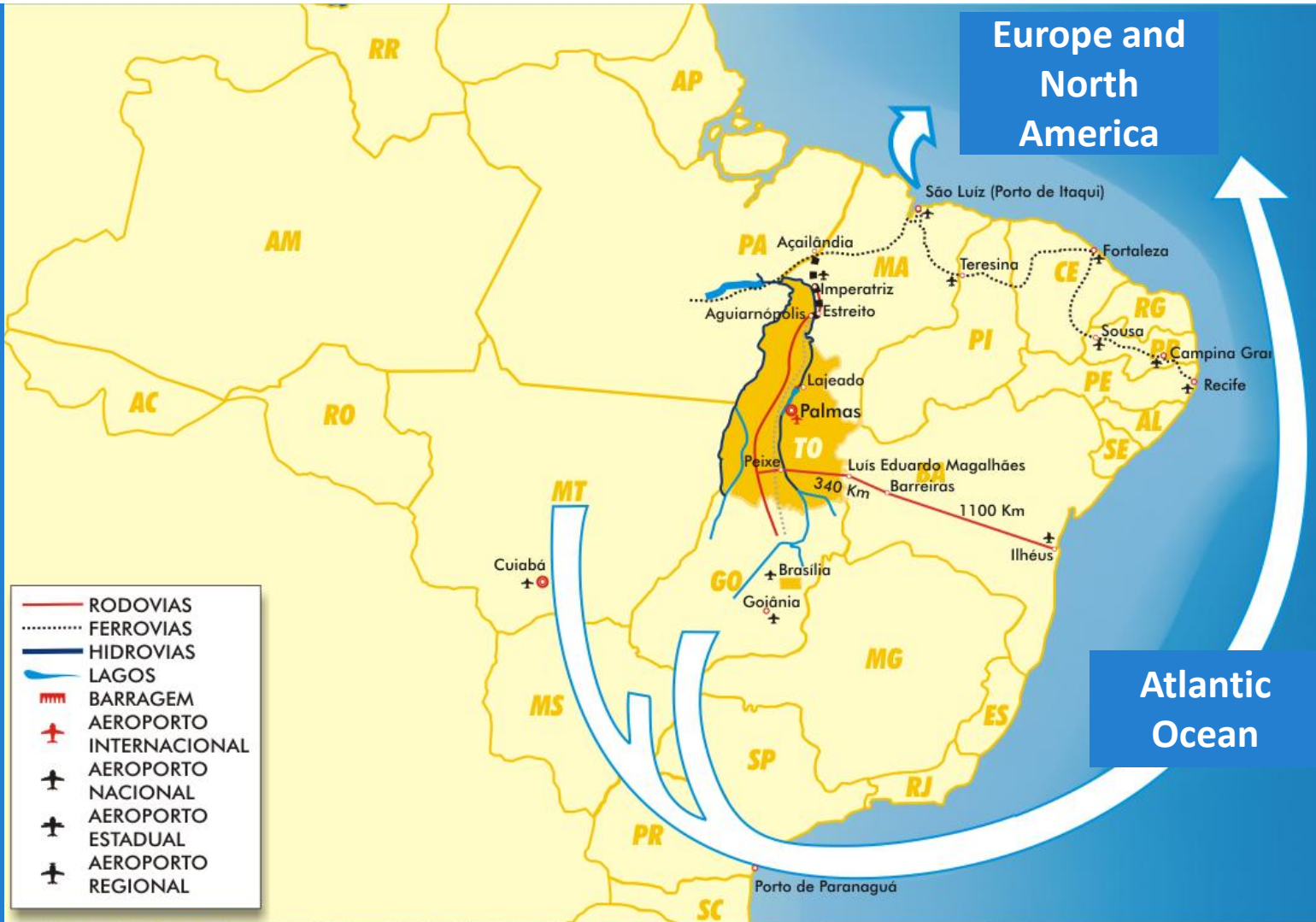
Fisheries and Aquaculture

Headquarter

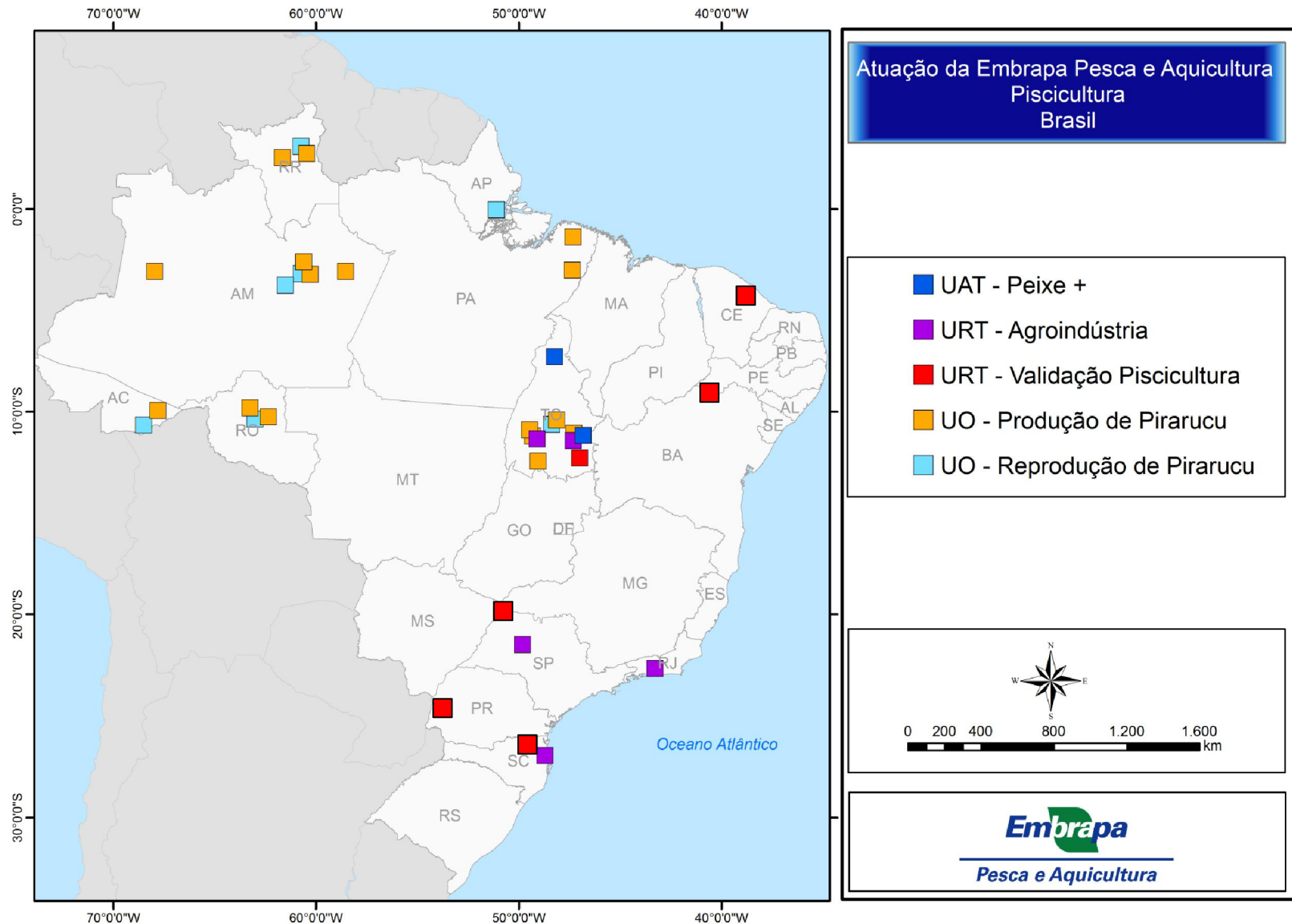
- ✓ 99 ha - 8 km North of Palmas, TO
- ✓ Over 6,000 m² of built area (Offices, laboratories, etc)
- ✓ Team – 90 employees
 - ✓ 30 researchers
 - ✓ 60 support staff



TRANSPORTATION INFRASTRUCTURE
LOGISTICS



Embrapa's working spots in Aquaculture



Embrapa's aquaculture species priorities



Source: Alberto Nunes, 2015



Embrapa's aquaculture species priorities

Source



Source

Source

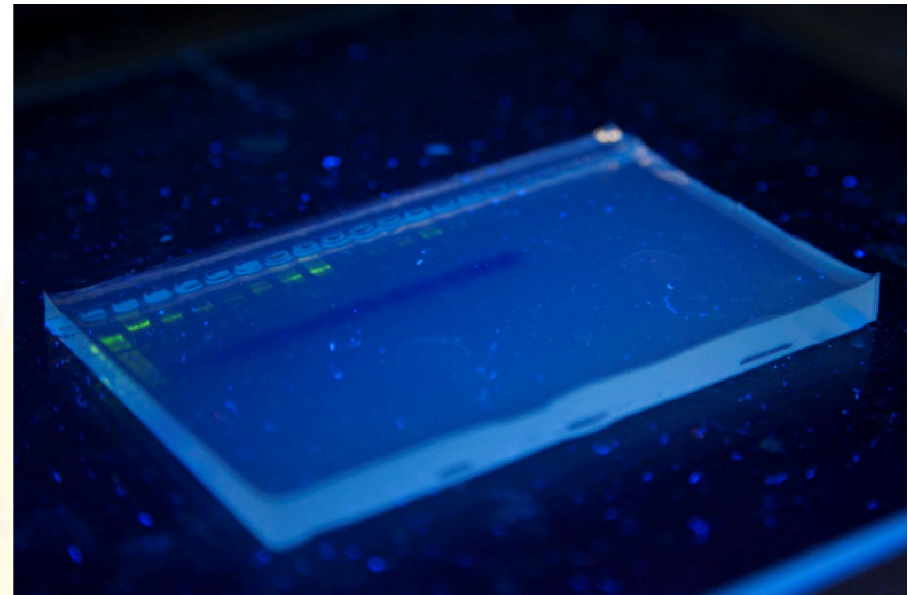
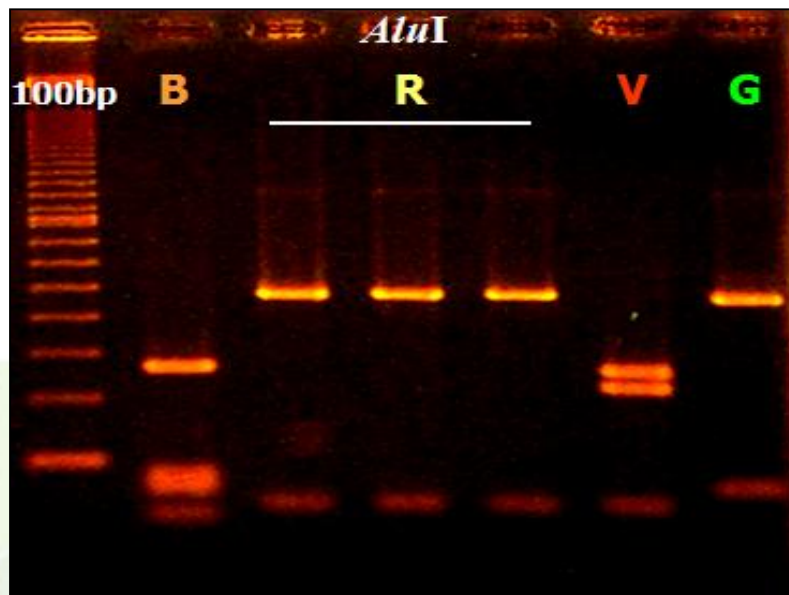


Source



Aquaculture research areas

- **Reproduction, Genetic Improvement and Resources Conservation:** genetic improvement and genomics, weight gain and resistance

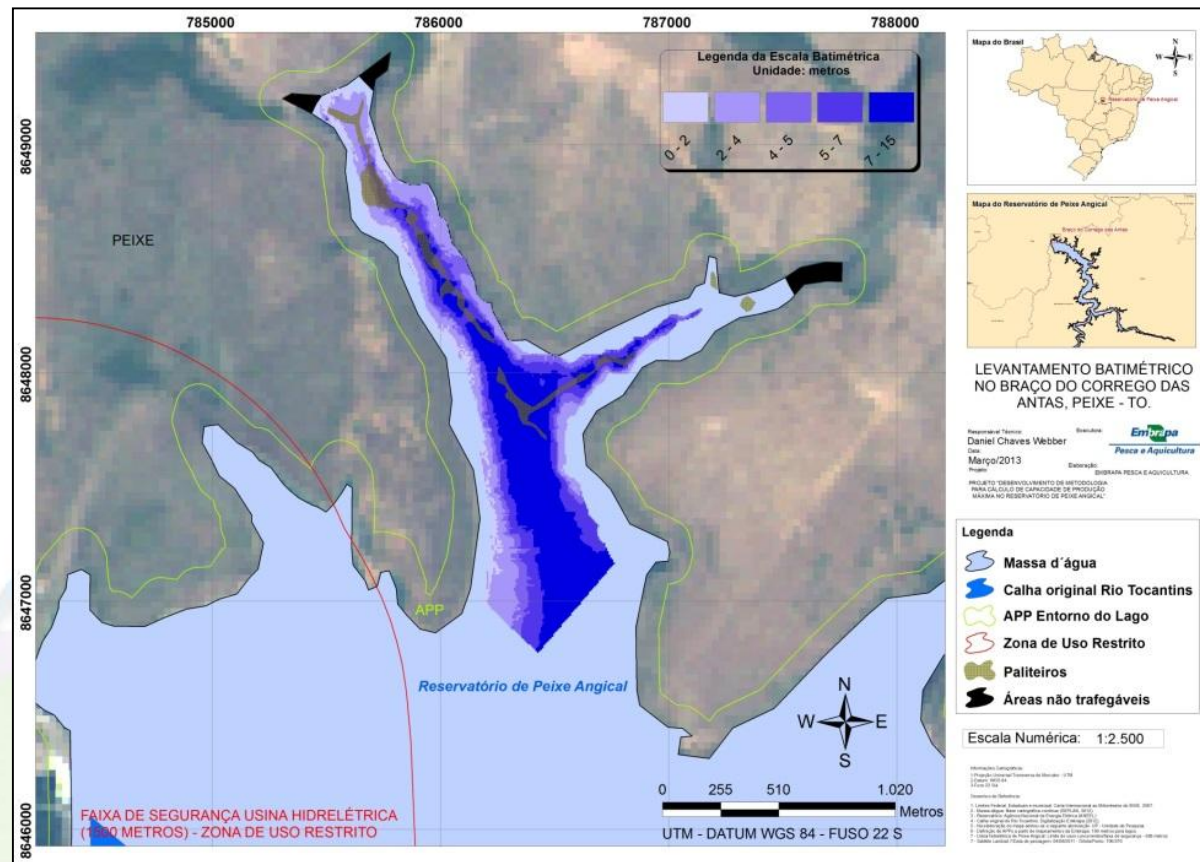


Ministério da
Agricultura, Pecuária
e Abastecimento



Aquaculture research areas

- **Carrying capacity:** applied GIS, methodology and analysis to determinate the aquaculture carrying capacity model for brazilian conditions;

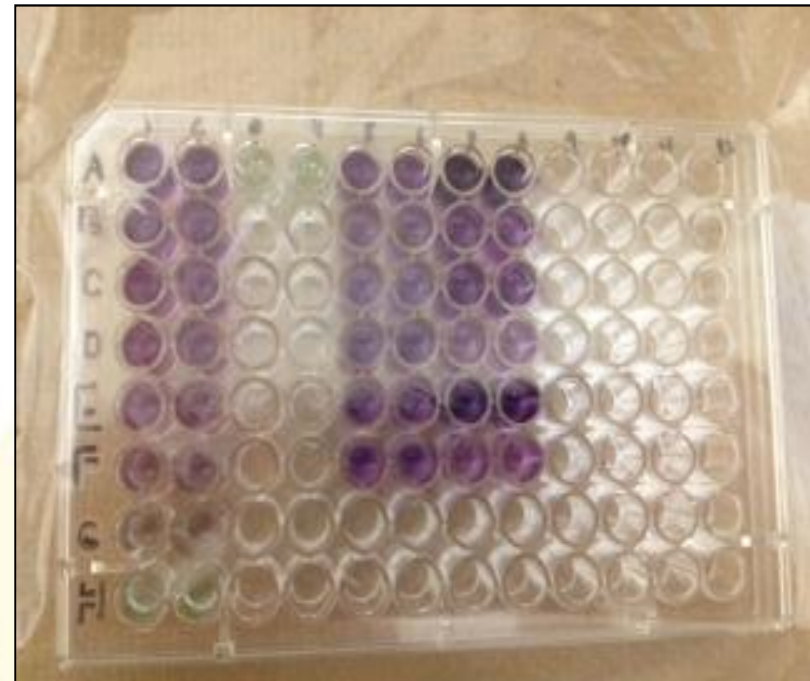


Ministério da
Agricultura, Pecuária
e Abastecimento



Aquaculture research areas

- **Fish health and diseases:** Techniques and methods of prevention, diagnosis and prophylaxis, epidemiology;



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Aquaculture research areas

- **Feeding and Nutrition:** technologies to lower-cost feed that minimize the impact on water quality and improve FCR, understanding nutritional requirements (micro-nutrients, amino acids, energy, etc.)



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Aquaculture research areas

- **Aquaculture Engineering:** developing, adaption and applying equipment to improve farming systems;
- **Management systems and farming:** breeding, larval rearing and grow out systems / biofloc / RAS.



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Aquaculture research areas

- **Sustainability:** Development of technologies to reduce the negative effects from aquaculture production systems;
- **Water quality:** Real time monitoring systems, BMP on aquaculture farms and sites.



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Aquaculture research areas

- **Economic studies:** market, feasibility and strategic studies, global chain;
- **Processing technologies and marketing:** added value products, co-products, water reuse, marketing and sales strategies.



Embrapa

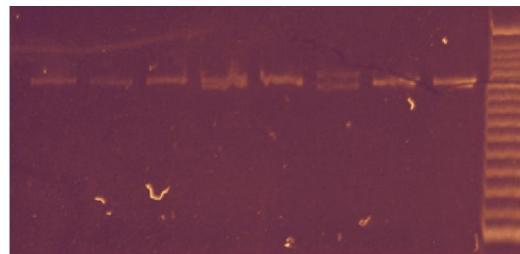
Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

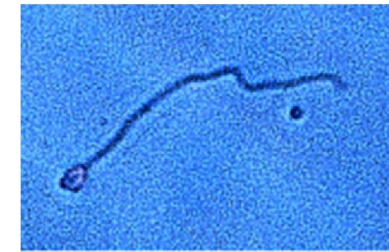
Genome Assembly of the Amazon freshwater fish Tambaqui (*Colossoma macropomum*)



Initial screening of inbreeding by Molecular Markers and sperm cryopreservation of selected fish



Source: Eduardo Varela



Source: Eduardo Varela

Genome sequencer is like:



DNA copies of the genome



Sequence Reads

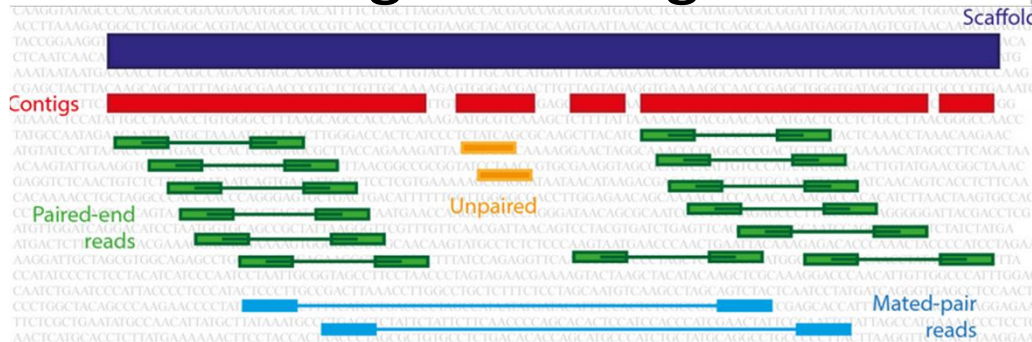


Assembled genome

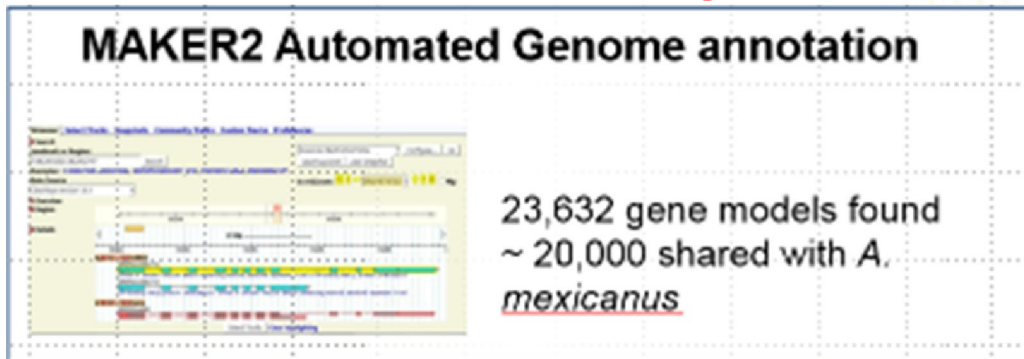


1st Draft “De Novo Assembly” tambaqui

- Read 124.8 Giga base pairs
- 85x Average Coverage



- Tambaqui Genome has 1.54 Gpb
- Found around 20,000 genes



19/01/2015 Abstract: de novo Genome Assembly of the South American Freshwater Fish Tambaqui (*Colossoma macropomum*) (Plant and An...

PLANT & ANIMAL GENOME XXIII

The Largest Ag-Genomics Meeting in the World.

January 10-14, 2015
San Diego, CA

www.intpag.org

P0231

de novo Genome Assembly of the South American Freshwater Fish Tambaqui (*Colossoma macropomum*)

Date: Monday, January 12, 2015

Room:

Francisco P. Lobo , Embrapa Informática Agropecuária, Campinas, Sao Paulo, Brazil
 Leandro C. Cintra , Embrapa Informática Agropecuária, Campinas, SP, Brazil
 Eduardo Sousa Varela , Embrapa Pesca e Aquicultura, Palmas, TO, Brazil
 Anderson Luis Alves , Embrapa Pesca e Aquicultura, Palmas, TO, Brazil
 Luciana Cristine Vasques Villela , Programa de Pós-Graduação em Ciências Animais, Universidade de Brasília, Brasília, DF, Brazil
 Naiara Milagres Augusto da Silva , Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil
 Samuel Rezende Paiva , Embrapa Labex US – Secretariat of International Affairs, Fort Collins, CO
 Alexandre R. Caetano , Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil

The Tambaqui (*Colossoma macropomum*) is a freshwater fish species naturally found in the Amazon river basin which has historically been widely exploited by community and commercial fishing. Recent efforts to domesticate, breed and raise the species in aquaculture systems has led to significant increases in production (>10-fold) over the last ten years. Current production is above 120,000 metric tons per year with a strong growth trend, making it the most important native aquaculture species in Brazil. Data for generating the draft assembly were produced from shotgun libraries with two different insert sizes and mate-paired libraries with four different sizes sequenced (2x150bps) with Illumina HiSeq2000 technology. A total of 124.8Gbp quality-filtered nucleotides were sequenced which amount to 85x mean genome coverage, considering previously published information (C-value = 1,5pg = 1.467Gbp). Sequence assembly was performed with SOAPdenovo and generated 8,924 scaffolds spanning 1.54 Gbp (N50: 2,041,733bp (162 scaffolds), N90: 200,945bp (1009 scaffolds), ~500Mbp of unmapped nucleotides). Gene model prediction is underway with MAKER2 using as extrinsic evidence protein and EST data from phylogenetically related taxa. This represents the first report of a draft genome sequence for this species and will be a valuable source of information for marker detection/selection, genetic improvement, conservation and basic biology studies in this species.

Back to: Genome Mapping, Tagging & Characterization: Aquaculture - Odd

Previous Poster | Next Poster >>

Source: Francisco Lobo

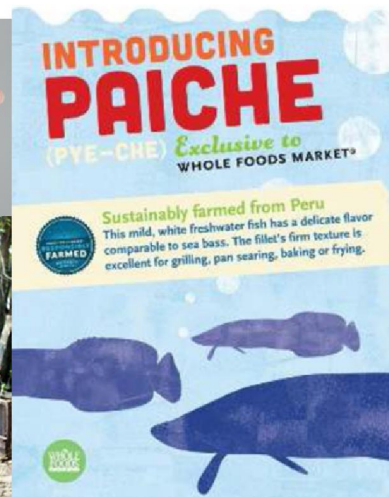


Ministério da
Agricultura, Pecuária
e Abastecimento



SNP Discovery and Genotyping in farmed and wild pirarucu “paiche” (*Arapaima gigas*) broodstock

Source: Embrapa



Source: Whole Food Markets



Source: Whole Food Markets



Source: Embrapa

- Understanding the recent domestication process
 - To Broodstock Management
 - To improve Breeding Methods



Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

GOVERNO FEDERAL
BRASIL
PAÍS RICO É PAÍS SEM POBREZA

Control of reproduction in Arapaima



- Spawning control (environment/endocrine)
- Sex ID (genetic/molecular/morphologic markers - RAD)
- Proteomics (cephalic secretion)



UNIVERSITY OF
STIRLING



Ministério da
Pesca e Aquicultura

GOVERNO FEDERAL
BRASIL
PÁTRIA EDUCADORA

R&D –Brazilian challenges and targets

- Scientific community and industry willing more to work together;
- Applied scientific knowledge as a tool to fill out technological gaps;
- More qualified human resources to deal with real world and new technologies;
- Modernization of research facilities and “on farm” validation of results ;
- More focus – target species



Ministério da
Agricultura, Pecuária
e Abastecimento



Considerations

- Increase interaction among stakeholders;
- Research institutions should be more aware of development policies: Priorities, results, feedback;
- Aquaculture brazilian *expertise* (“knowledge islands”) should be spread to other potential aquaculture regions;
- Research in Brazil must involve and be based in industry demands;
- Funding should be regular for strategic projects.



Ministério da
Agricultura, Pecuária
e Abastecimento



Considerations

- Aquaculture importance perception as a **economic sector** is increasing in Brazil;
- Professional interest to work in the aquaculture sector is greater compared to fisheries – **More opportunities**;
- Embrapa national center can be a **strategic player** in setting R&D networks to attend the government policies and aquaculture sector.



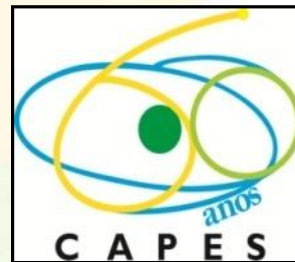
Embrapa

Ministério da
Agricultura, Pecuária
e Abastecimento

BRAZILIAN GOVERNMENT
BRASIL

Considerations

- Cooperation between The Norwegian Center for International Cooperation in Education (SIU) and The Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES) is going on;
- Setting up a program for the brazilian industry to invest in applied research focusing technological transfer from key areas of norwegian aquaculture industry;



Ministério da
Agricultura, Pecuária
e Abastecimento



Considerations

- Brazilian government could create a research and technology network program (Embrapa, universities and industry) focusing **applied research** to face challenges and bottlenecks;
- Brazilian specific credit could encourage **international investment** and technology transfer for aquaculture development, great opportunities for norwegian industry suppliers;
- Establish **fast track** access to international funds for strategic joint projects.



Ministério da
Agricultura, Pecuária
e Abastecimento



Considerations

- In a short term, **norwegian aquaculture technology** can be applied to Brazil main aquaculture industry – **tilapia**;
- Tilapia and tambaqui brazilian farmers may be potential norwegian partners in aquaculture diversification to develop **brazilian marine fishfarming**;
- SIU Norwegian decision markers could consider inducing **aquaculture as a specific area** in a joint call with CAPES;



Ministério da
Agricultura, Pecuária
e Abastecimento





Thank you for your attention !

eric.routledge@embrapa.br

Acknowledgements:

- The Research Council of Norway
Latin America programme
- Sintef: - Dr. Gunvor Øie
- Dr. Roger Richardsen
- NTNU: - Dr. Kjell Inge Reitan



Ministério da
Agricultura, Pecuária
e Abastecimento

