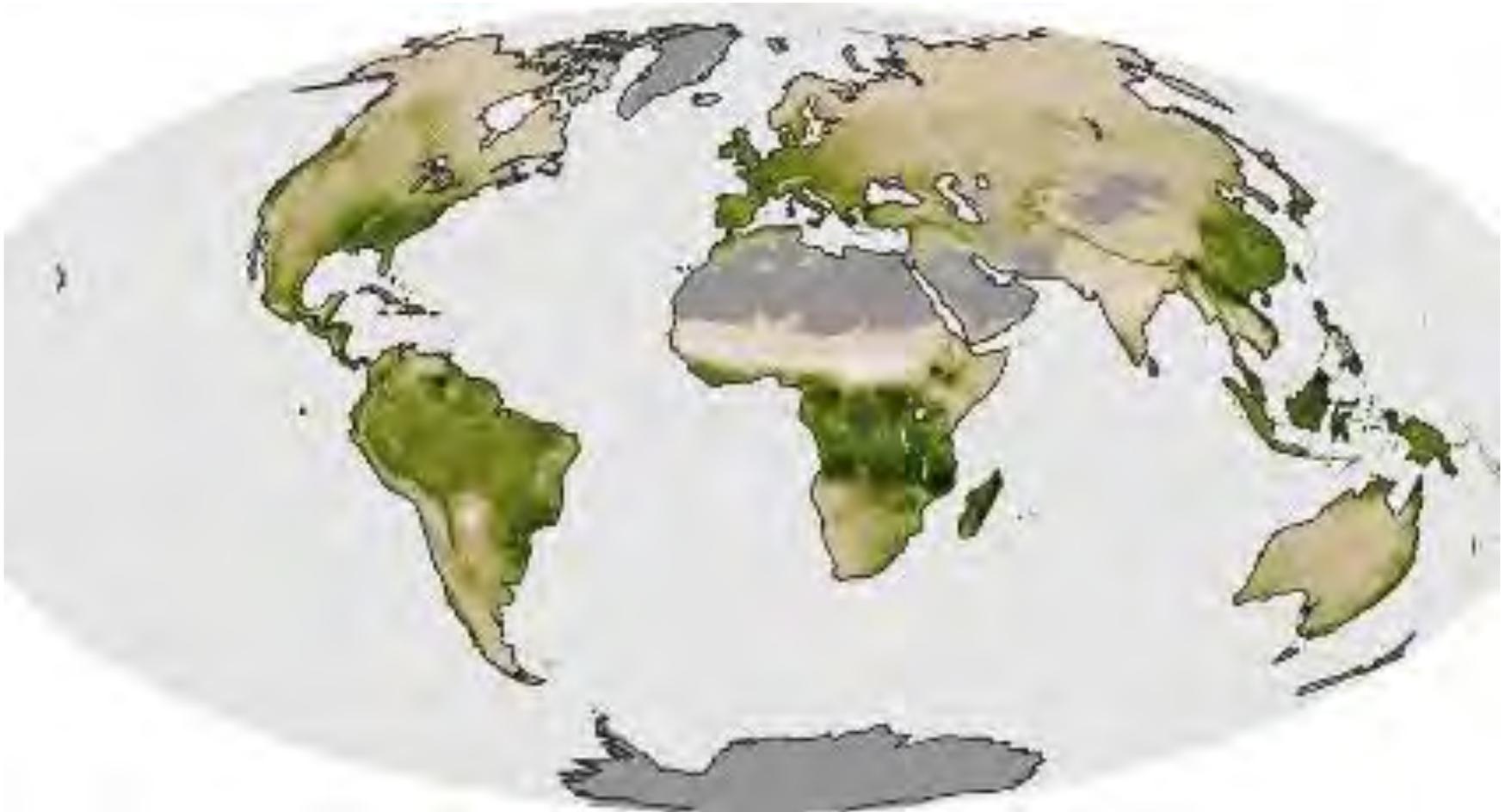




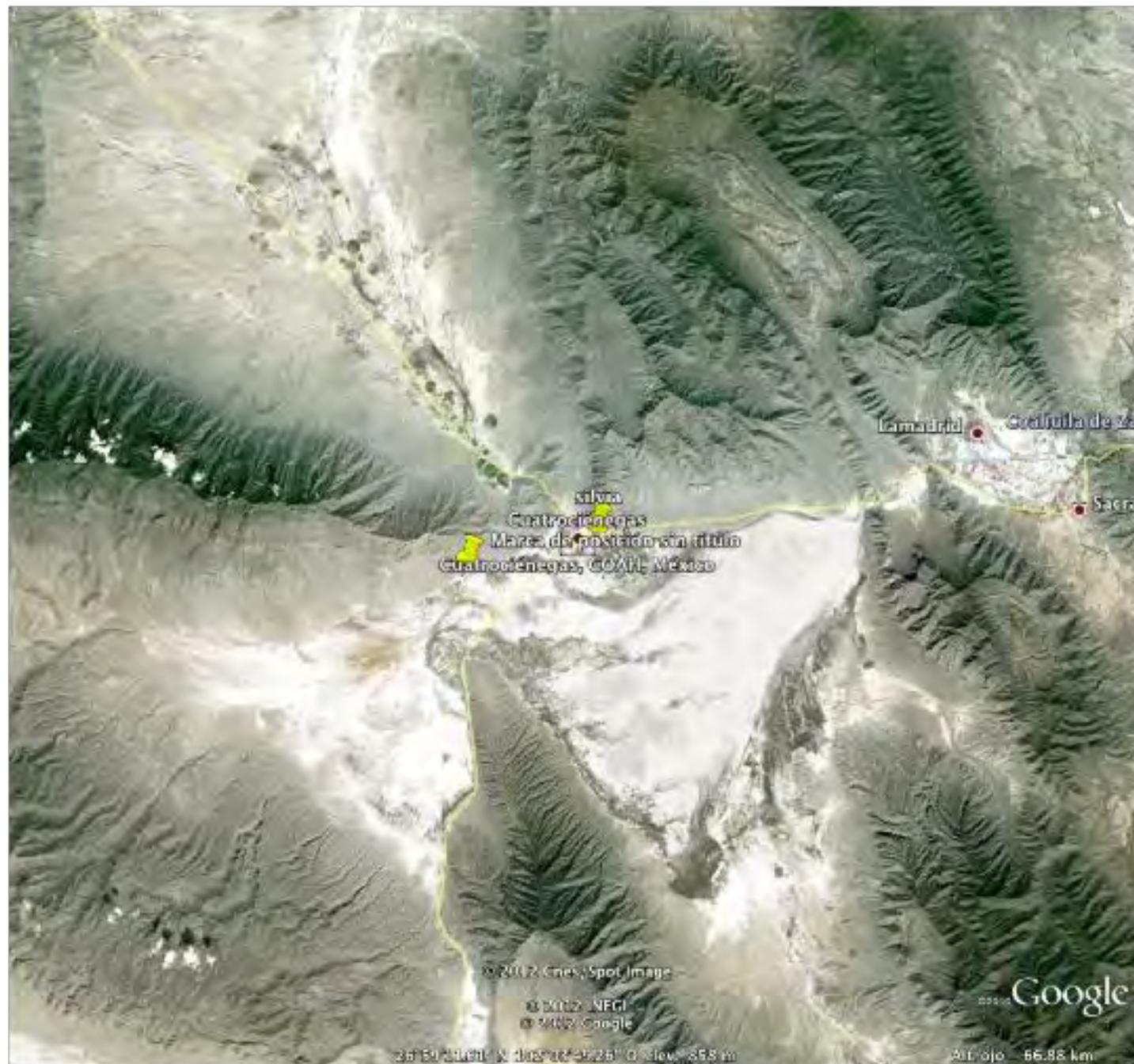
Valeria Souza, Luis Eguiarte,  
UNAM

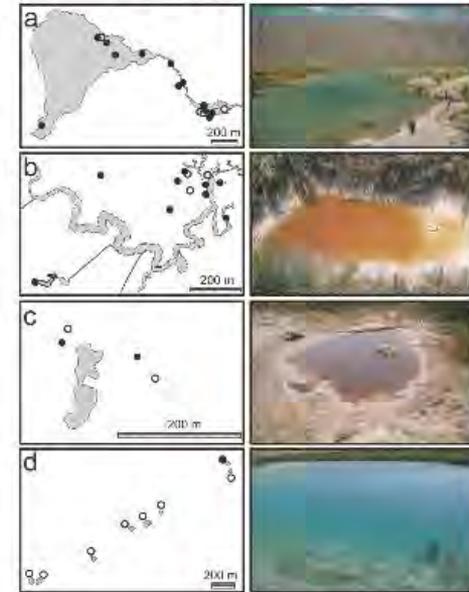
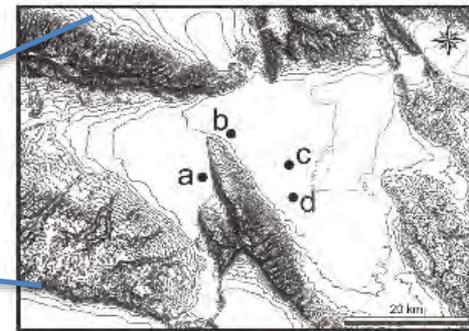
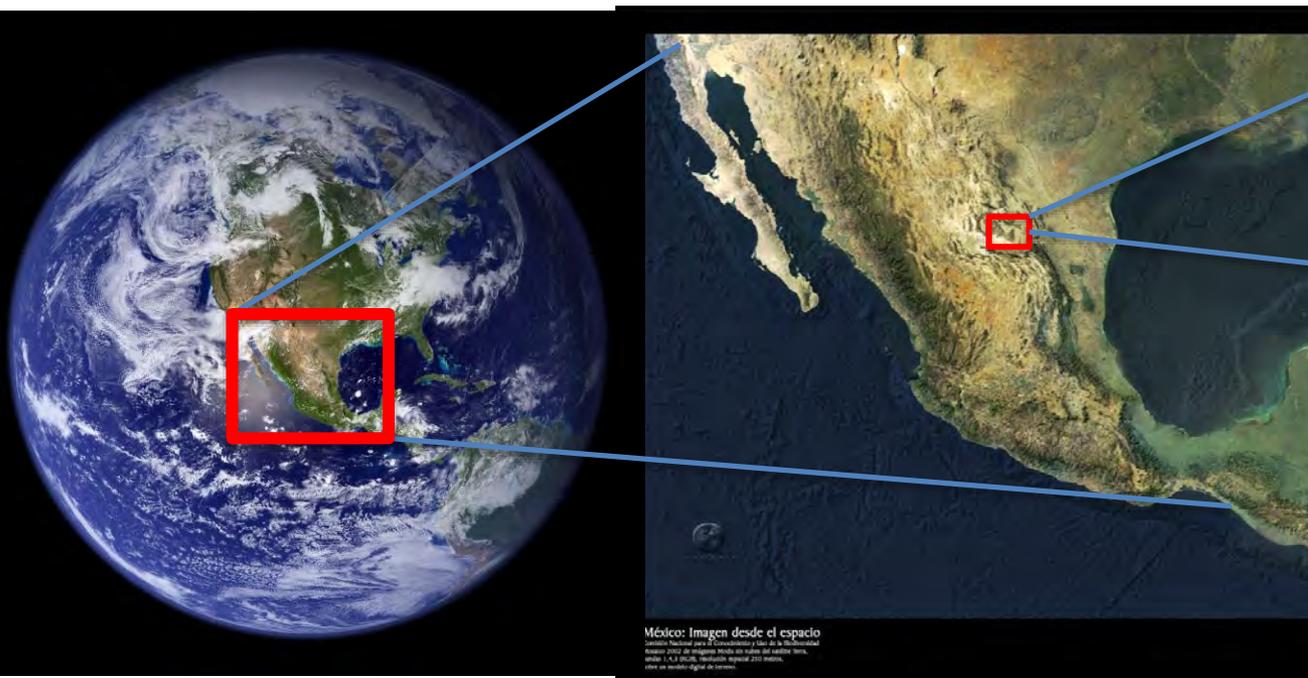
# Cuatro Ciénegas: que hemos aprendido en 16 años

Estamos acostumbrados a buscar la diversidad en “lo verde”



Cuatro  
Ciénegas  
Coahuila,  
México  
Es una  
mariposa  
blanca  
donde lo  
“verde” no  
es evidente.





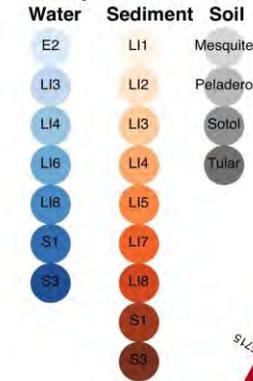
Pero es tal vez el sitio mas diverso del planeta!!!



Inventario total del Churince,  
un proyecto muy ambicioso  
que lleva casi 5 años financiado  
por WWF-FCS

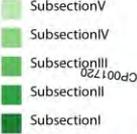


# Samples



# Taxonomy

## Cyanobacteria



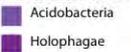
## Firmicutes



## Actinobacteria



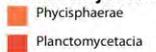
## Acidobacteria



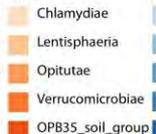
## Proteobacteria



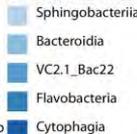
## Planctomycetes



## C+V



## Bacteroidetes



## Chloroflexi



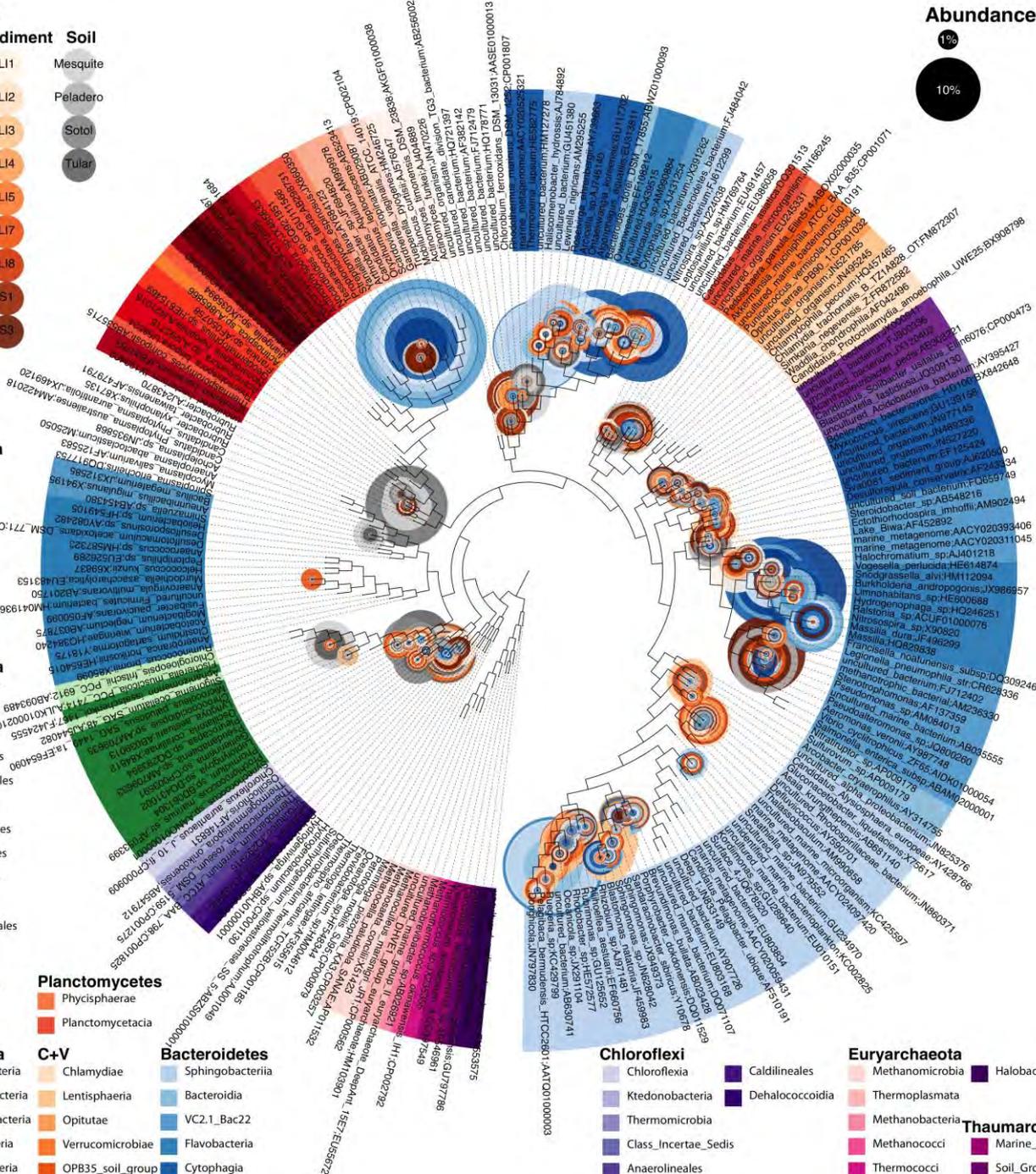
## Euryarchaeota



## Thaumarchaeota



## Abundance



16 Tags  
 Illumina  
 High seq  
 300bp  
 pair end

# Samples

- | Water | Sediment | Soil     |
|-------|----------|----------|
| E2    | L11      | Mesquite |
| L13   | L12      | Peladero |
| L14   | L13      | Sotol    |
| L16   | L14      | Tular    |
| L18   | L15      |          |
| S1    | L17      |          |
| S3    | L18      |          |
|       | S1       |          |
|       | S3       |          |

# Abundance



## Taxonomy

- ### Cyanobacteria
- SubsectionV
  - SubsectionIV
  - SubsectionIII
  - SubsectionII
  - SubsectionI

### Firmicutes

- Bacilli
- Clostridia

### Actinobacteria

- Actinomycetales
- Bifidobacteriales
- Micrococcales
- Streptomycetales
- Propionibacteriales
- Glycomycetales
- Pseudonocardiales
- Corynebacteriales
- Catenulisporales
- Frankiales
- Streptosporangiales
- Frankiales

### Acidobacteria

- Acidobacteria
- Holophagae

### Planctomycetes

- Phycisphaerae
- Planctomycetacia

### Proteobacteria

- Alphaproteobacteria
- Epsilonproteobacteria
- Gammaproteobacteria
- Betaproteobacteria
- Deltaproteobacteria

### C+v

- Chlamydiae
- Lentisphaeria
- Opitutae
- Verrucomicrobiae
- OPB35\_soil\_group

### Bacteroidetes

- Sphingobacteria
- Bacteroidia
- VC2.1\_Bac22
- Flavobacteria
- Cytophagia

### Chloroflexi

- Chloroflexia
- Ktedonobacteria
- Thermomicrobia
- Class\_Incertae\_Sedis
- Anaerolineales

### Caldilineales

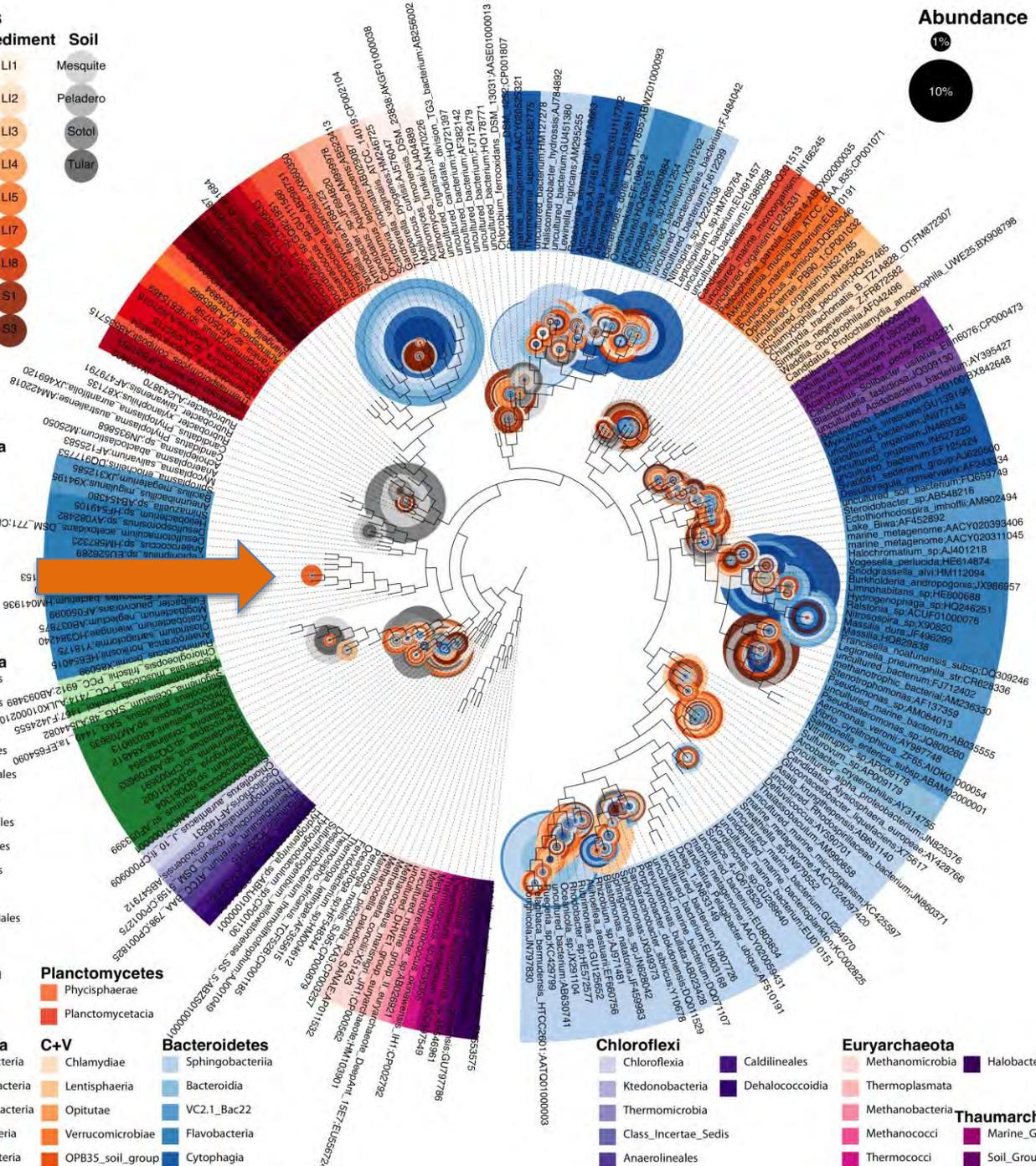
- Caldilineales
- Dehalococcoidia

### Euryarchaeota

- Methanomicrobia
- Thermoplasmata
- Methanobacteria
- Methanococci
- Thermococci

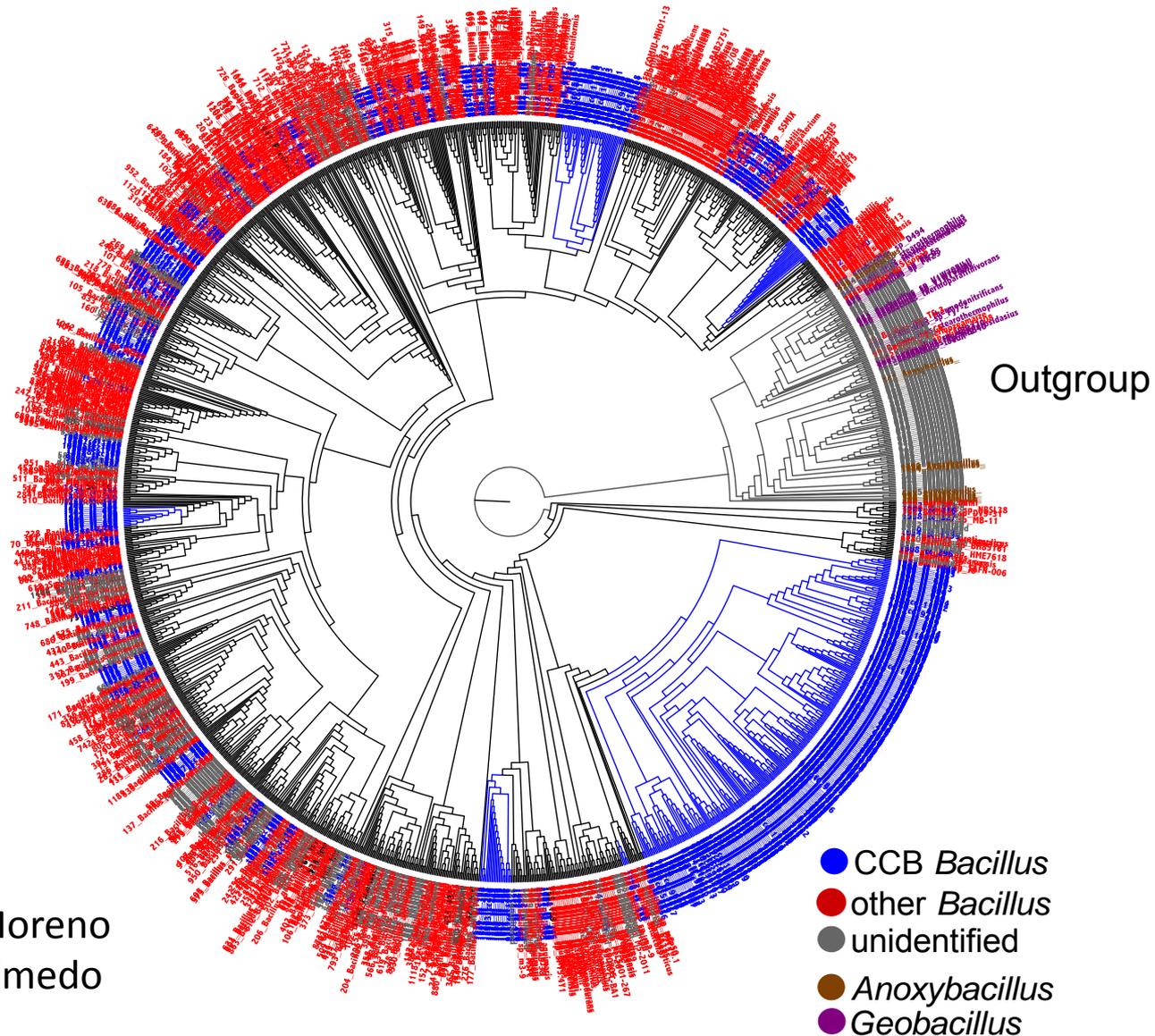
### Thaumarchaeota

- Halobacteria
- Marine\_Group\_I
- Soil\_Group\_SCG



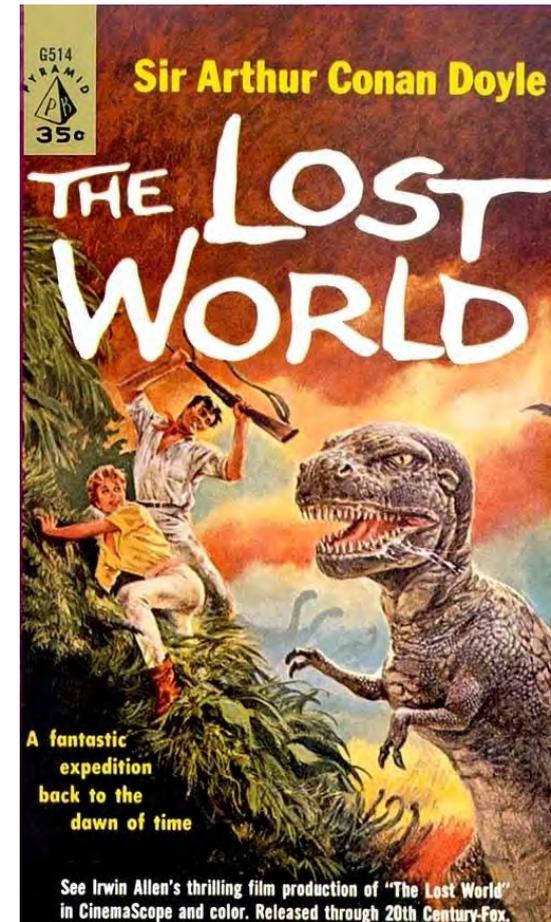
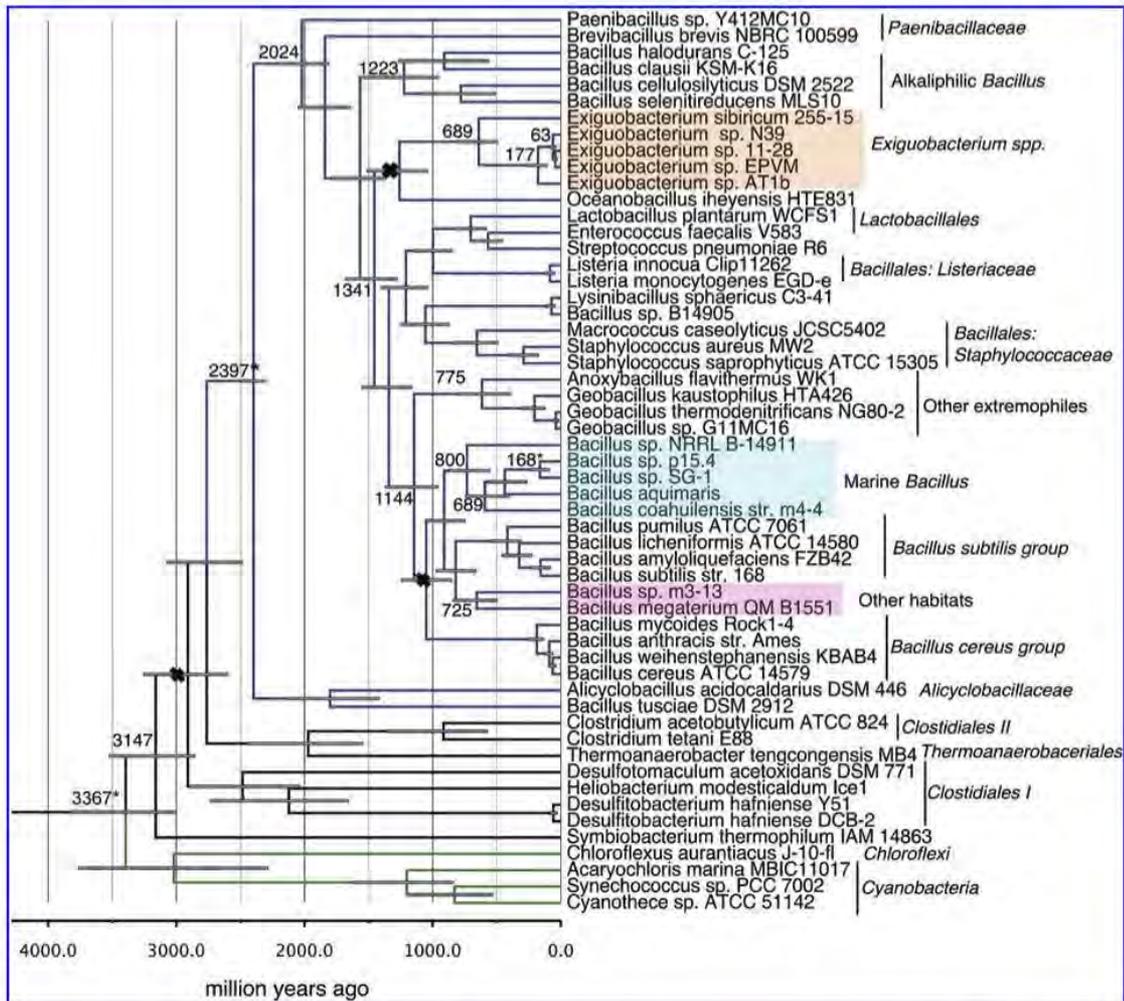
Bacillus del Churince son muy diversos, algunos de ellos se separaron de sus hermanos del mar cuando surgio el oxígeno!!!

1600 isolates of Bacilli from the world, 450 of them from CCB



Analisis Alejandra Moreno  
Aislados Gabriela Olmedo

Esto se confirma cuando comparamos genomas completos, no solo un gen.

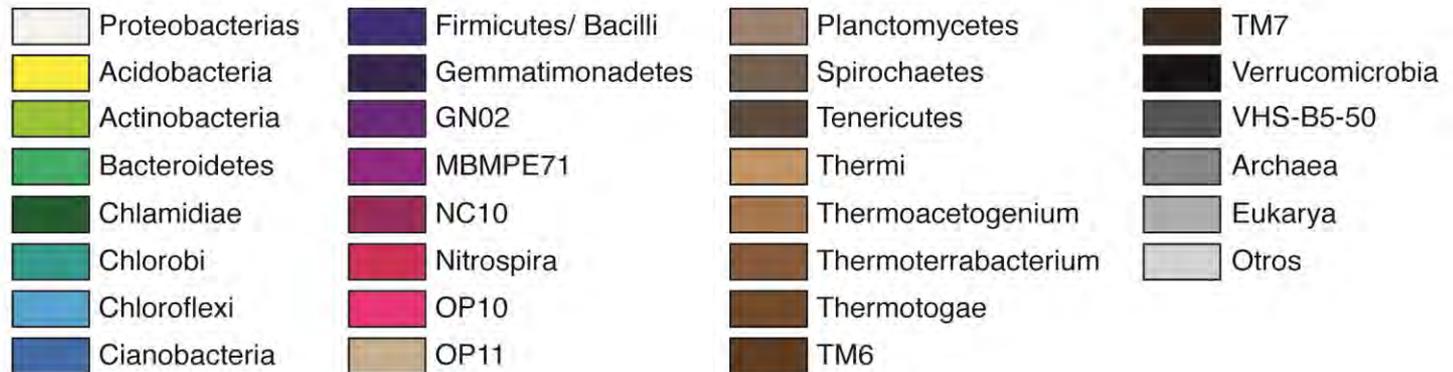
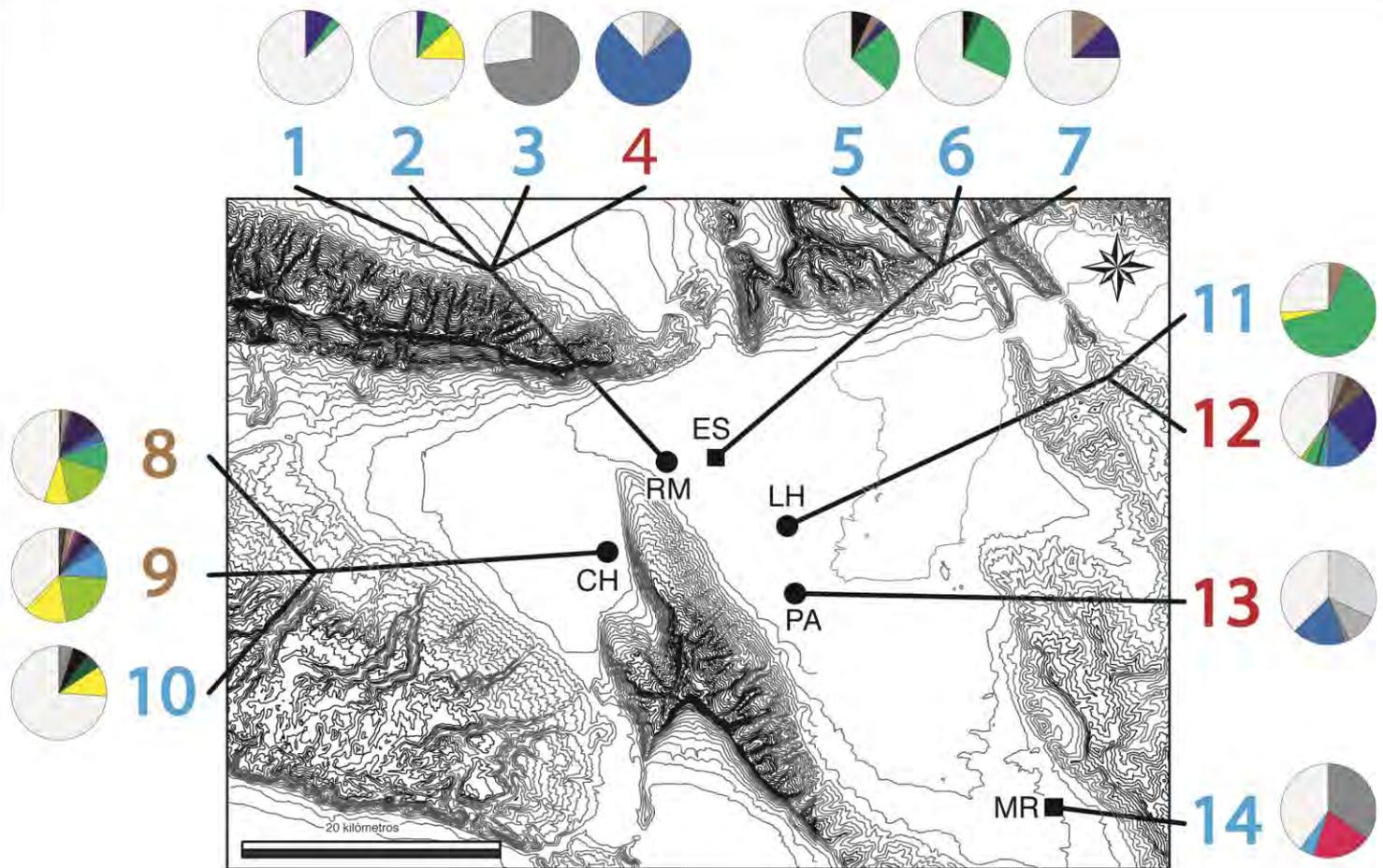


Reconstructions were done with a maximum likelihood method. **Molecular dating** was performed with a penalized likelihood method and **calibration points** based on geologic events.

Molecular clock of Bacillaceae 26 COG using complete genomes.  
Moreno Letelier et al., 2012, Astrobiology

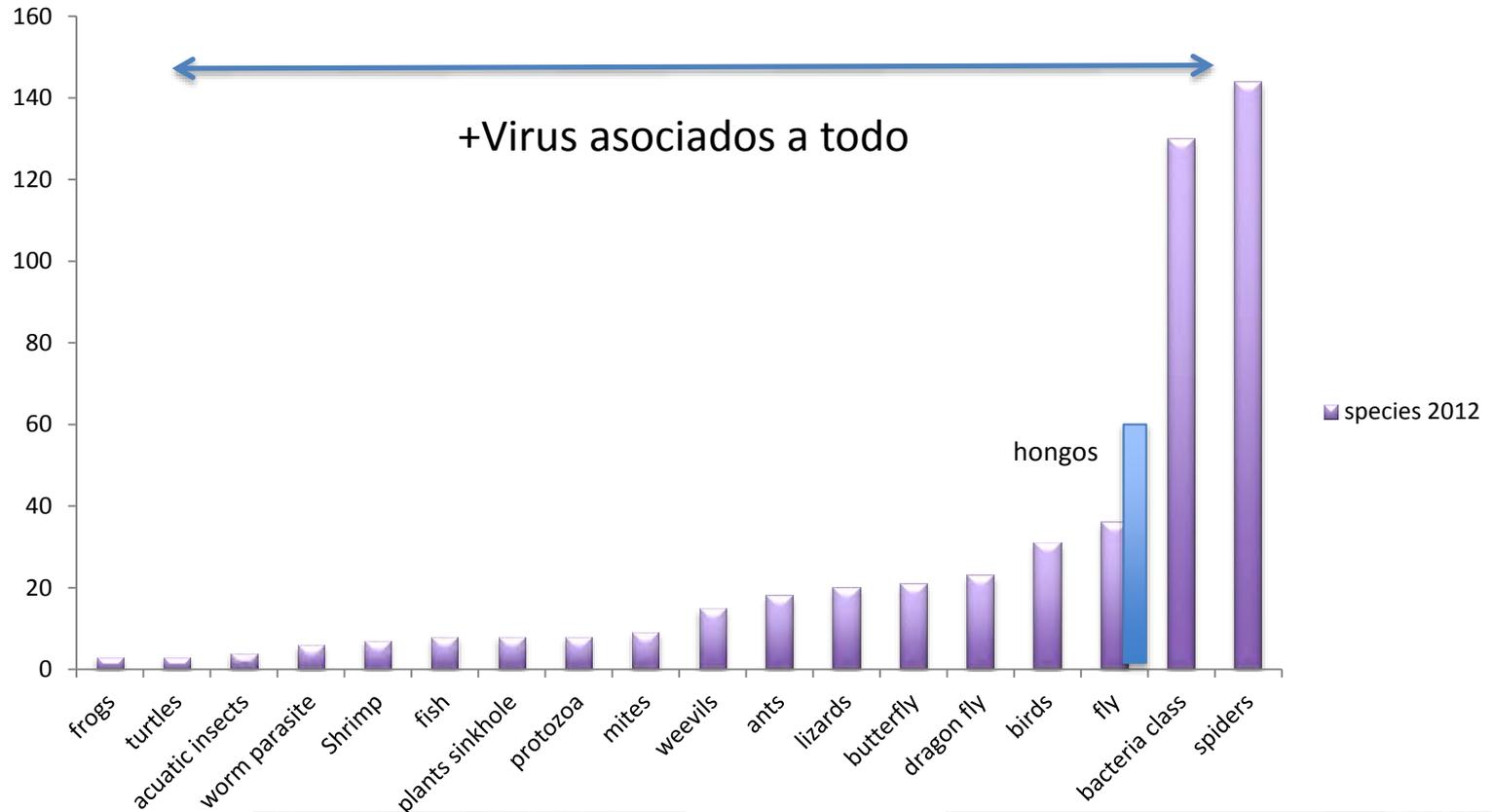


Pero esto es solo un sitio!! Cada lugar en cuatro cienegas es diferente al otro, aun a una escala de metros, por lo cual la diversidad TOTAL debe de ser gigantesca





# Species in Churince 2012





# Churince: a model of early earth and Mars:

$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  gypsum  
Jurassic signature on  
Earth and of a  
meteorite impact in  
young Mars

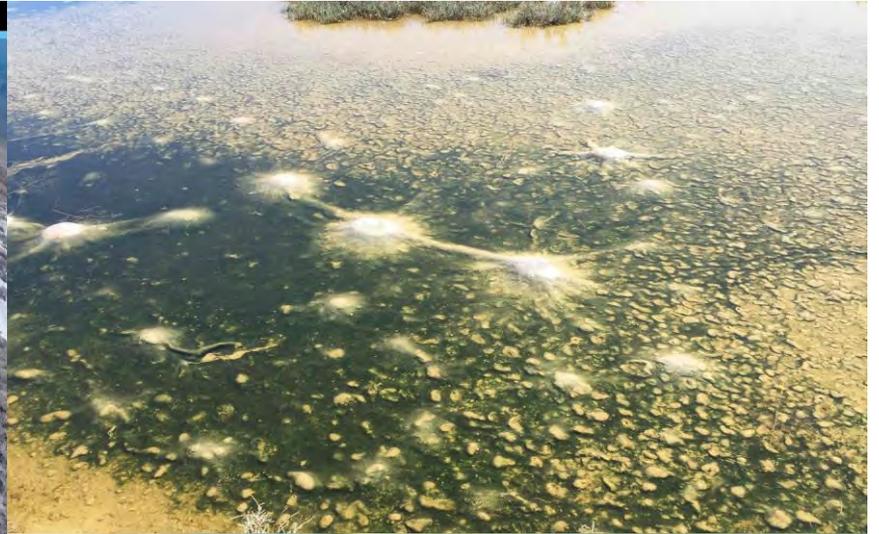
ISSN: 1531-1074

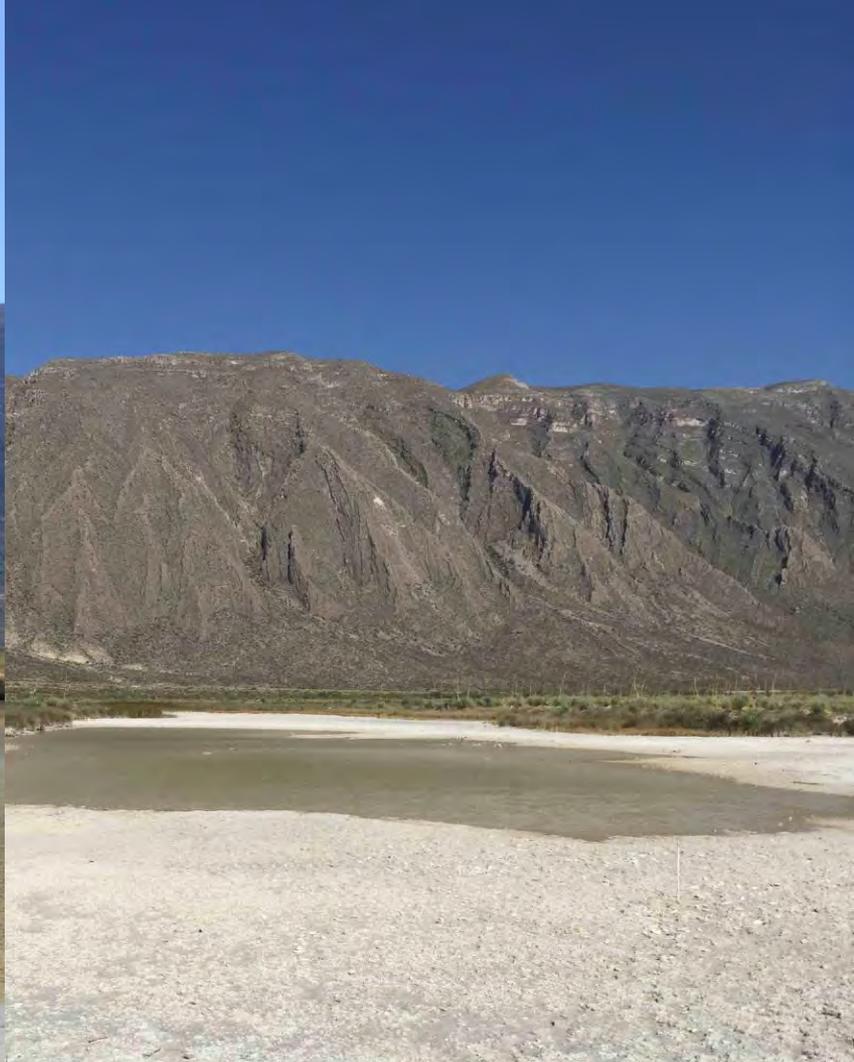
Volume 12, Number 7 July 2012

# Astrobiology



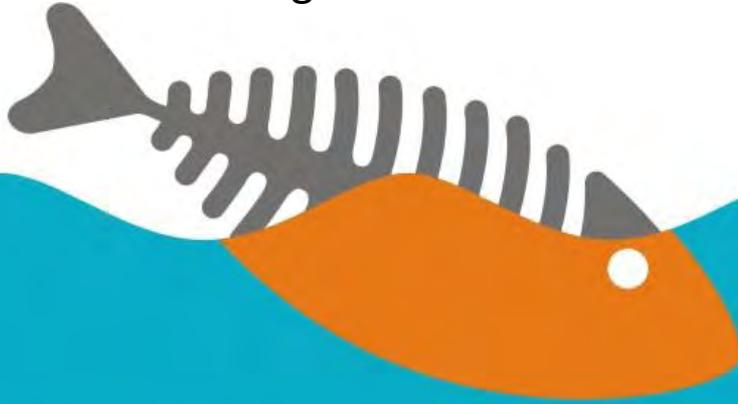
# Un brinco al Archaeno, primavera 2016





Parte de la paradoja, es tambien que este lugar que tiene linajes del precámbrico no ha podido sobrevivir a los últimos 15 años...

CONSERVATION: not so good...



VIVA, YA ganamos!!!

**SALVA**  
**CUATROCIENEGAS**

**HEY!!!**

Y el dinero...??

2006-2012



[www.salvacuatrocienegas.org](http://www.salvacuatrocienegas.org)

El humedal del garabatal llevaba 60 años seco por el desvío del agua del manatí principal por canales que llegan a medir más de 100 km...y llegan a frontera, cerca de Monclova



# Alfalfa





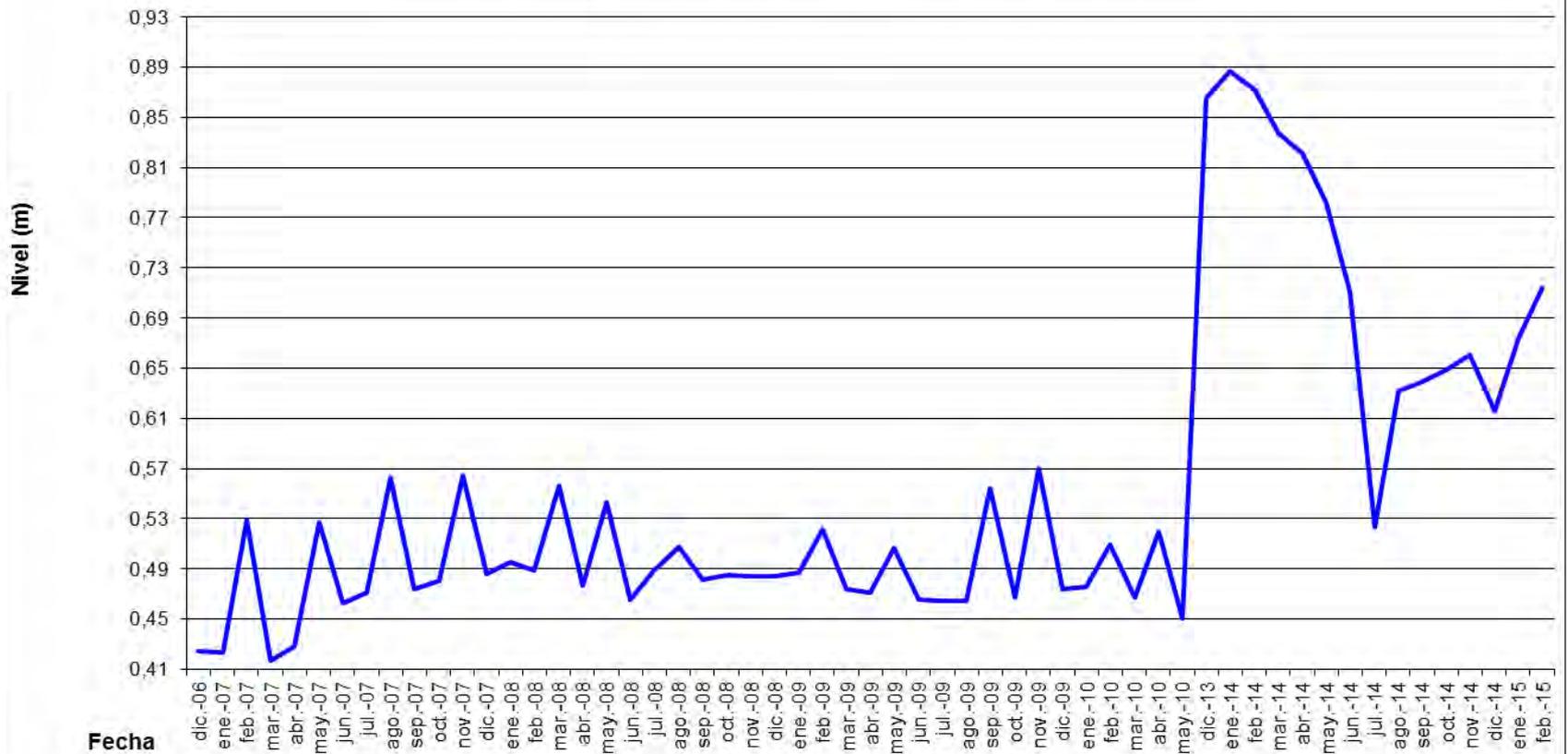
Restauración del  
garabatal en  
2013!!!  
Una victoria frágil



# El milagro del agua



## Nivel de agua de la Poza La Becerra



30 septiembre 2013



3 de octubre 2013



6 de octubre 2013



# Las Abras, funcionan como “canarios en la mina”



*Jaumea carnosa*



*Distichlis spicata*



*Bolboschoenus maritimus*



*Eustoma exaltatum*

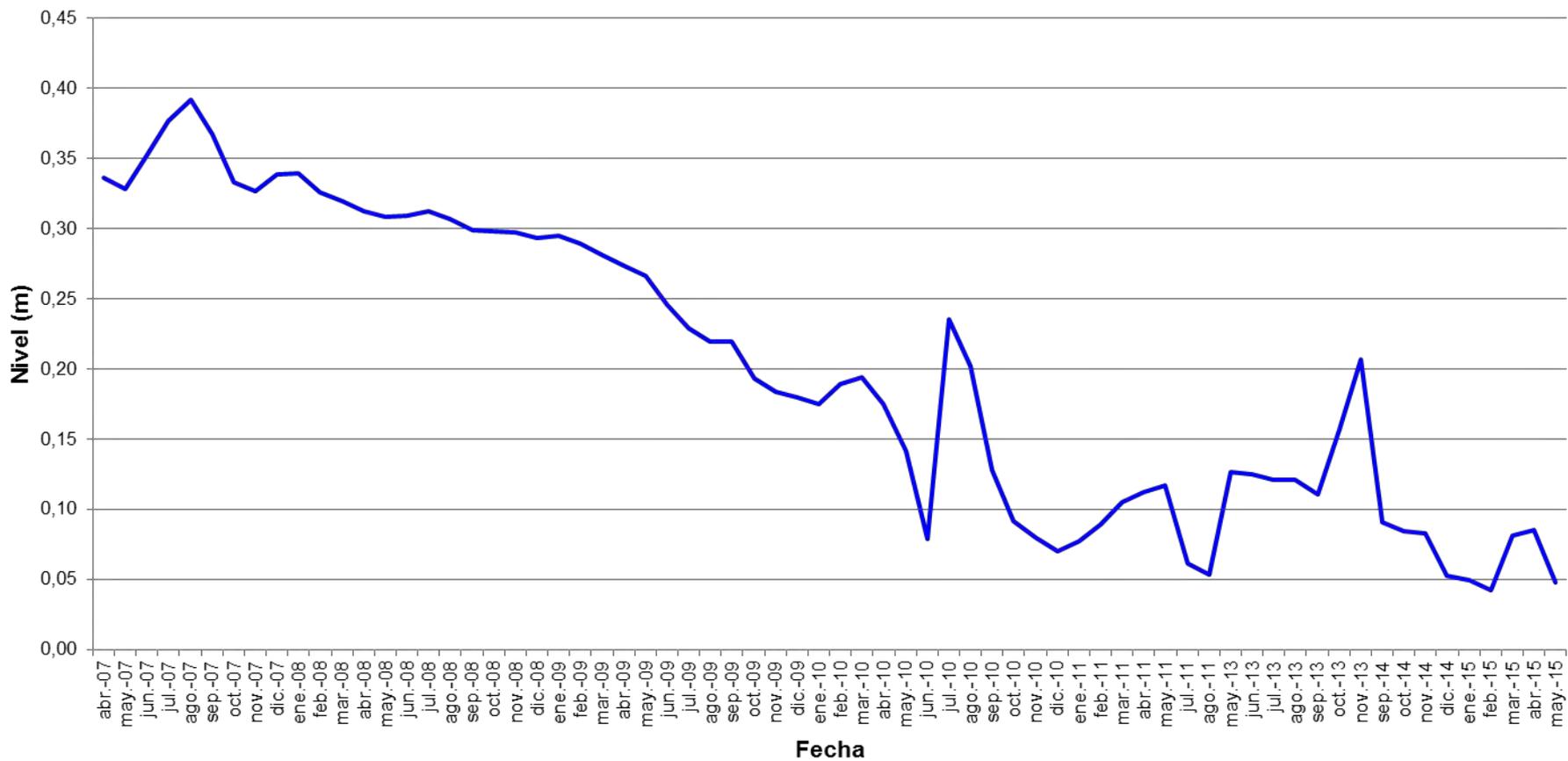


*Samolus ebracteatus* var *coahuilensis*



*Flaveria chlorifolia*.

### Promedio mensual del nivel de agua Poza Pozo Bonito







**Table 2. Status of Churince Aquatic Fauna. \*Designations as endemic or native refer to status in the Cuatro Cienegas basin as a whole; these species are not limited to the Churince system, thus disappearance in the later represents local population extirpation, not species extinction.**

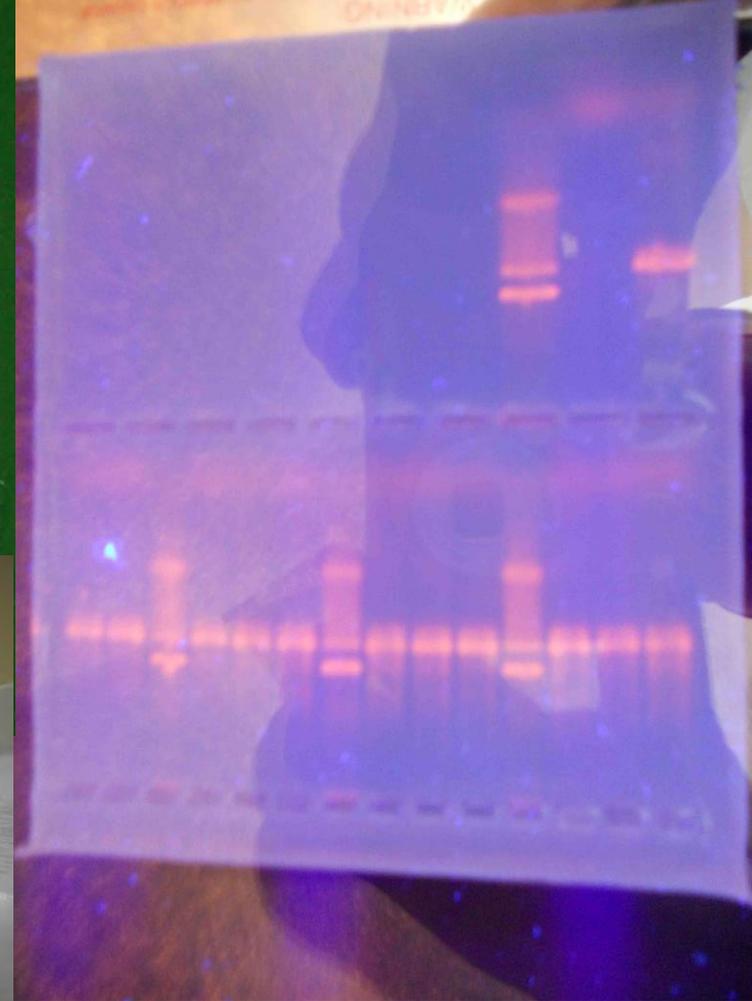
Fishes (Common name)	Status in CC*	Abundance (Distribution) May 2011	Abundance (Distribution) October 2011
<b><i>Astyanax mexicanus</i> (Mexican Tetra)</b>	<b>Native</b>	<b>Likely Extirpated</b>	<b>Likely Extirpated</b>
<i>Cyprinella xanthicara</i> (Cuatro Cienegas Shiner)	Endemic	Highly Reduced	<b>Possibly Extirpated</b>
<i>Cyprinodon atrorus</i> (Bandfin Pupfish)	Endemic	Reduced	Highly Reduced (Highly Reduced, Shifted Upstream)
<i>Cyprinodon bifasciatus</i> (Twine Pupfish)	Endemic	Highly Reduced	Highly Reduced (Limited to Poza Churince)
<b><i>Cyprinodon</i> Hybrids (Natural Pupfish Hybrids)</b>	<b>Endemic</b>	<b>Highly Reduced</b>	Highly Reduced (Highly Reduced)
<i>Dionda</i> sp. (Roundnose Minnow)	Likely Endemic	Highly Reduced	Highly Reduced (Highly Reduced)
<b><i>Gambusia longispinis</i> (Cuatro Cienegas Gambusia)</b>	<b>Endemic</b>	<b>Likely Extirpated</b>	<b>Likely Extirpated</b>
<i>Gambusia marshi</i> (Robust Gambusia)	Native	Reduced	Highly Reduced (Highly Reduced)
<b><i>Hemichromis guttatus</i> (Jewel Cichlid)</b>	<b>Introduced non-native</b>	<b>Highly abundant</b>	<b>Common in Most of Remaining System</b>
<b><i>Herichthys minckleyi</i> (Cuatro Cienegas Cichlid)</b>	<b>Endemic</b>	<b>Reduced (Reduced)</b>	Reduced (Reduced)
<i>Lepomis megalotis ssp1</i> (Cuatro Cienegas Sunfish)	Endemic	Reduced	Highly Reduced (Highly Reduced, Shifted upstream)
<i>Micropterus salmoides ssp1</i> (Cuatro Cienegas Bass)	Endemic	Appears Stable	Reduced (Reduced)
<i>Pylodictis olivarius</i> Flathead Catfish)	Native	Unknown	Unknown
<b>Hydrobiid Snails</b>			
<b><i>Mexipyrghus churinceanus</i> Mexican Banded Springsnail</b>	<b>Endemic</b>	<b>Possibly Extirpated</b>	<b>Possibly Extirpated</b>
<b><i>Mexithauma quadripaludium</i></b>	<b>Endemic</b>	<b>Possibly Extirpated</b>	<b>Possibly Extirpated</b>
<i>Nymphophilus minckleyi</i>	Endemic	Reduced	Highly Reduced (Highly Reduced)



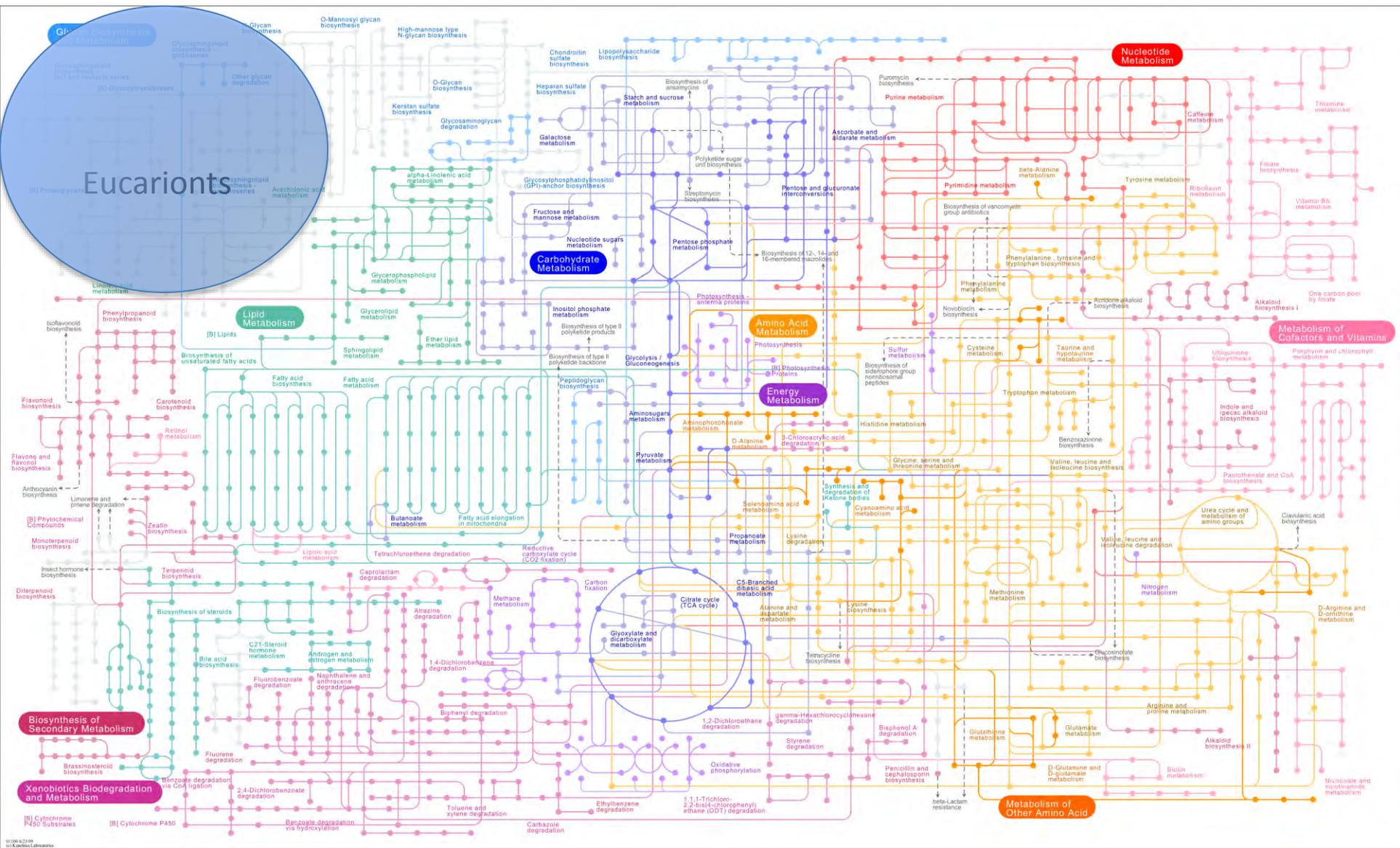
Para transformar el futuro hay que transformar a los niños  
educación ambiental a través del arte (LALA)  
educación ambiental a través de la ciencia: 10-12 (Slim). Los de  
bachillerato como educadores de los de secundaria

# 60 becarios en el CBTA 22





**Los adolescentes han sido parte del estudio de la la diversidad utilizando ecologia molecular, ahora son capaces de diagnosticar el estado del suelo de los campos agrícolas**



El potencial genético de los tapetes microbianos es extraordinario. Miles de antibióticos y compuestos que permiten reutilizar, reciclar y reducir el uso de agroquímicos, bioremediación





¿Se puede restaurar  
el suelos?

Como?

③ probiótico ① → materia orgánica  
+ mat. orgánica + lombricompo  
+ probiótico

Variables

coenzimas
acaros
Tamaño planta
Tamaño raíz
- rendimiento

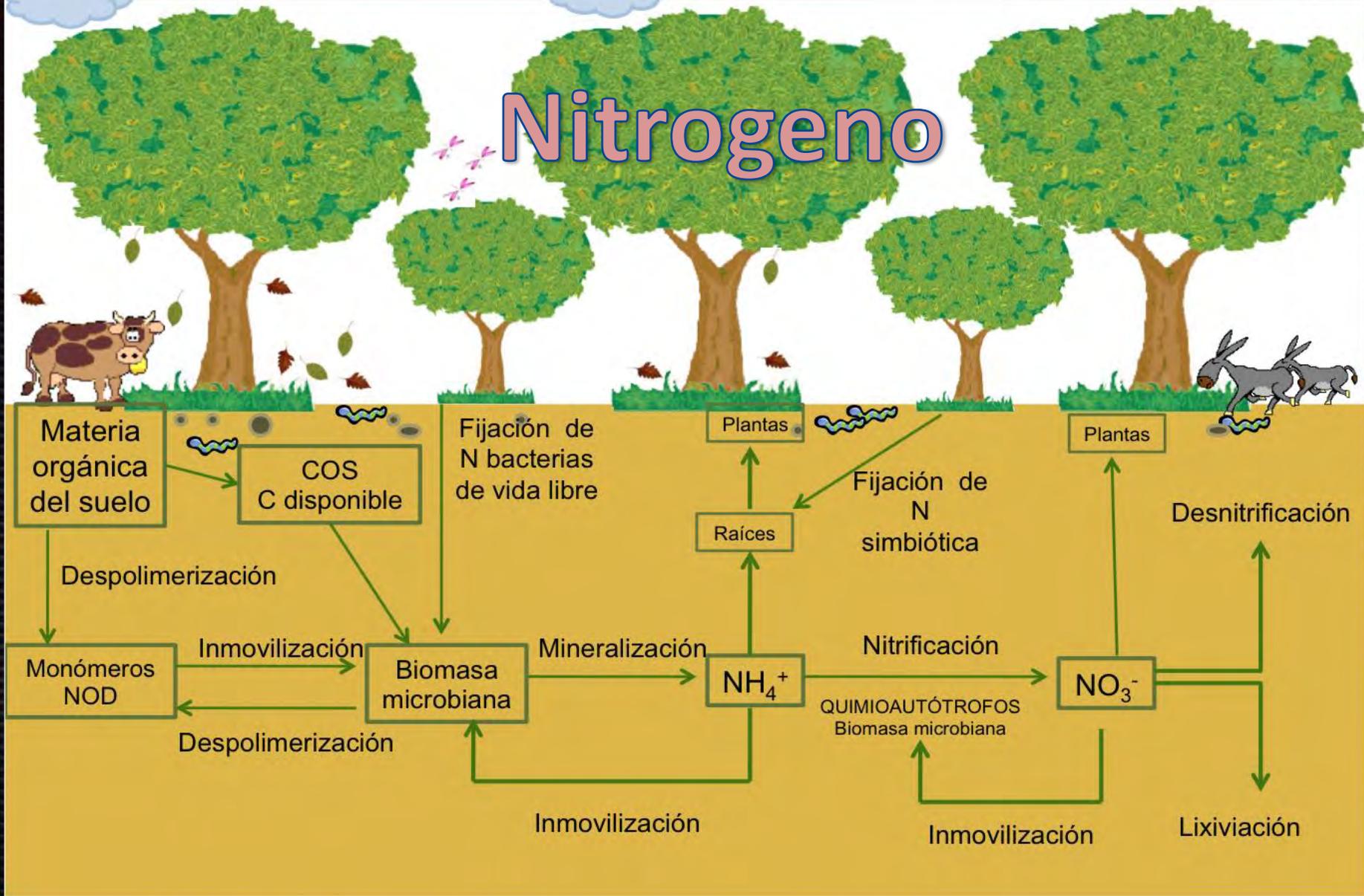
② → lo mismo que  
siempre

Estadística

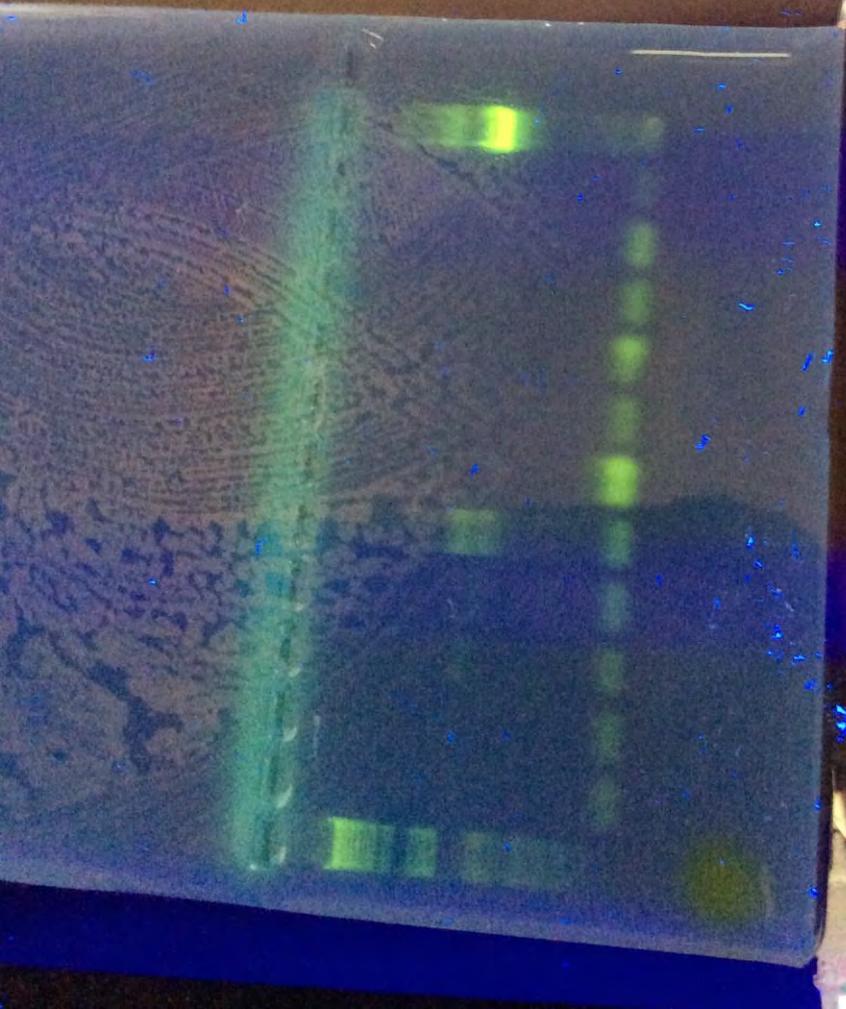
replica 3 >  
testigos



# Nitrogeno



Primer curso 2014 como esta el suelo agrícola y de que se enferma la alfalfa. La alfalfa esta enferma de exceso de agua, y pierden a los fijadores de Nitrogeno a pesar de meter NITRAGIN



# 2015 curso de agricultura sustentable en el CBTA 22



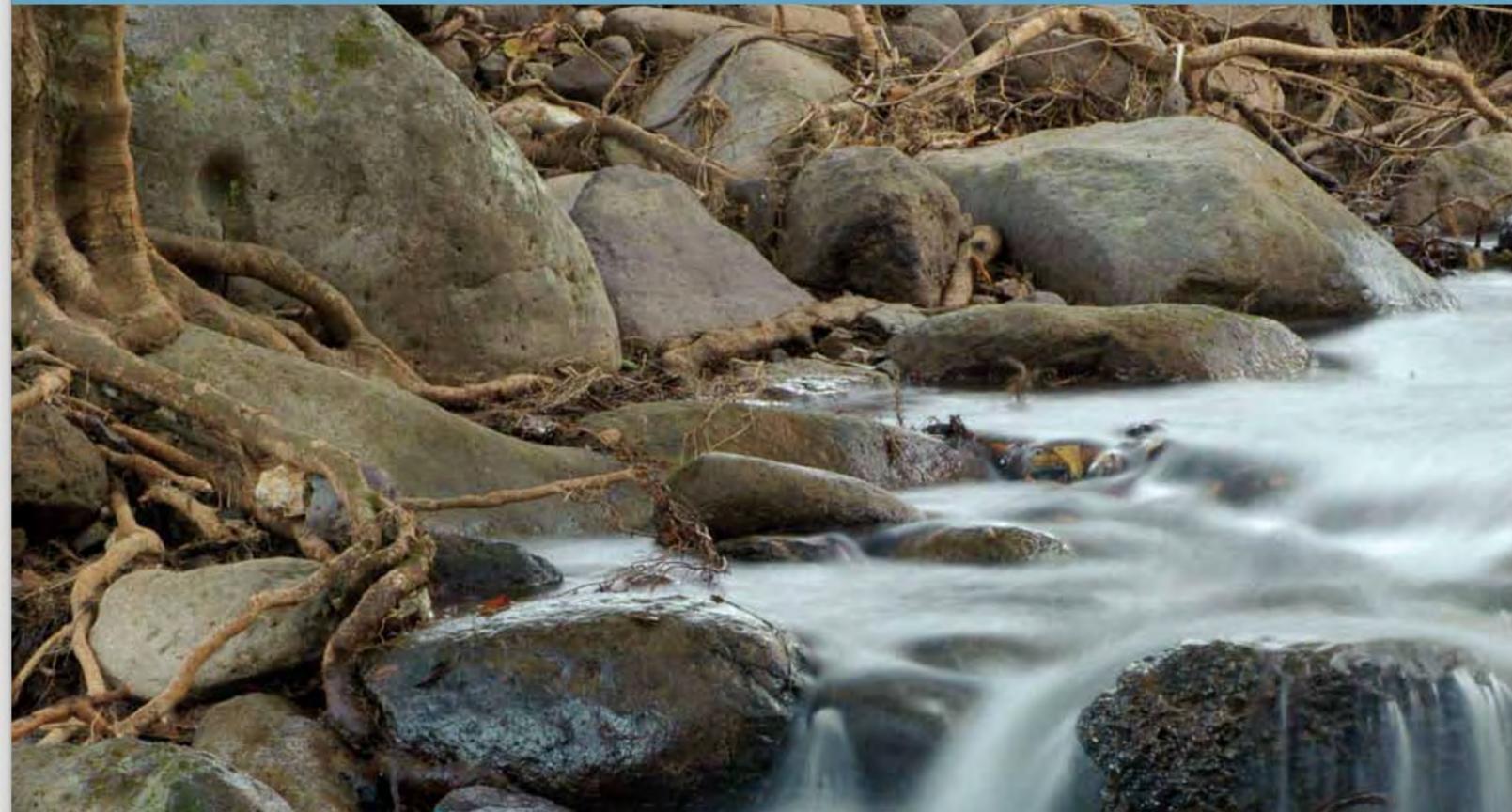


# IDENTIFICACIÓN DE RESERVAS POTENCIALES DE AGUA PARA EL MEDIO AMBIENTE EN MÉXICO

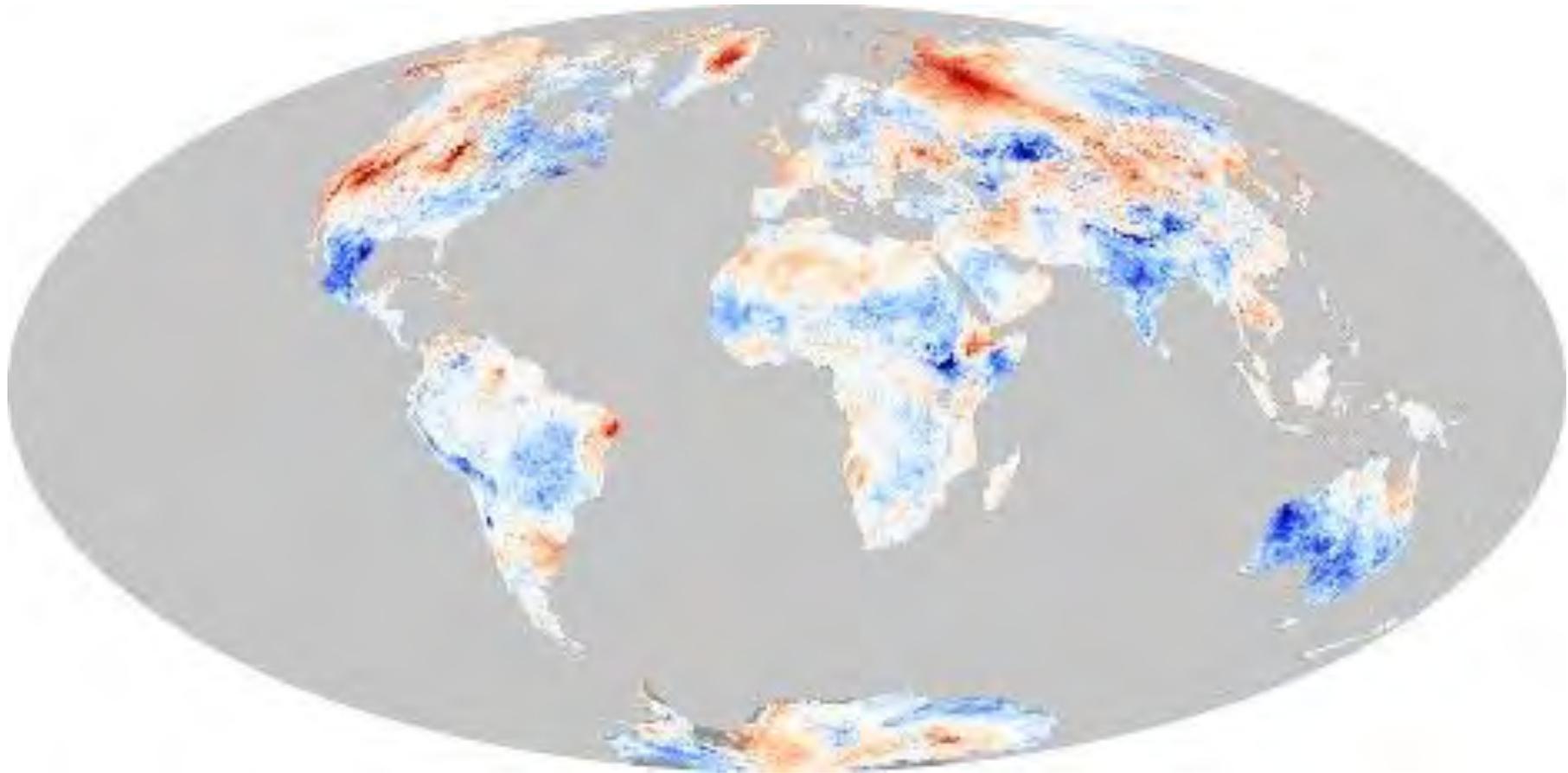


**GOBIERNO  
FEDERAL**

**SEMARNAT**



Al borde del abismo ambiental, todavía hay tiempo para transformar el futuro





# GRACIAS

\$\$NASA, Semarnat, CONACyT, WWF/Slim, UNAM-  
Papiit

- MEXICO

- **Luis Eguiarte**
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- ....y 50 investigadores mas

- USA

- Jim Elser
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- Everteth Shock
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- Evan Carson
- Jorge Soberon
- Rodolfo Dirzo

