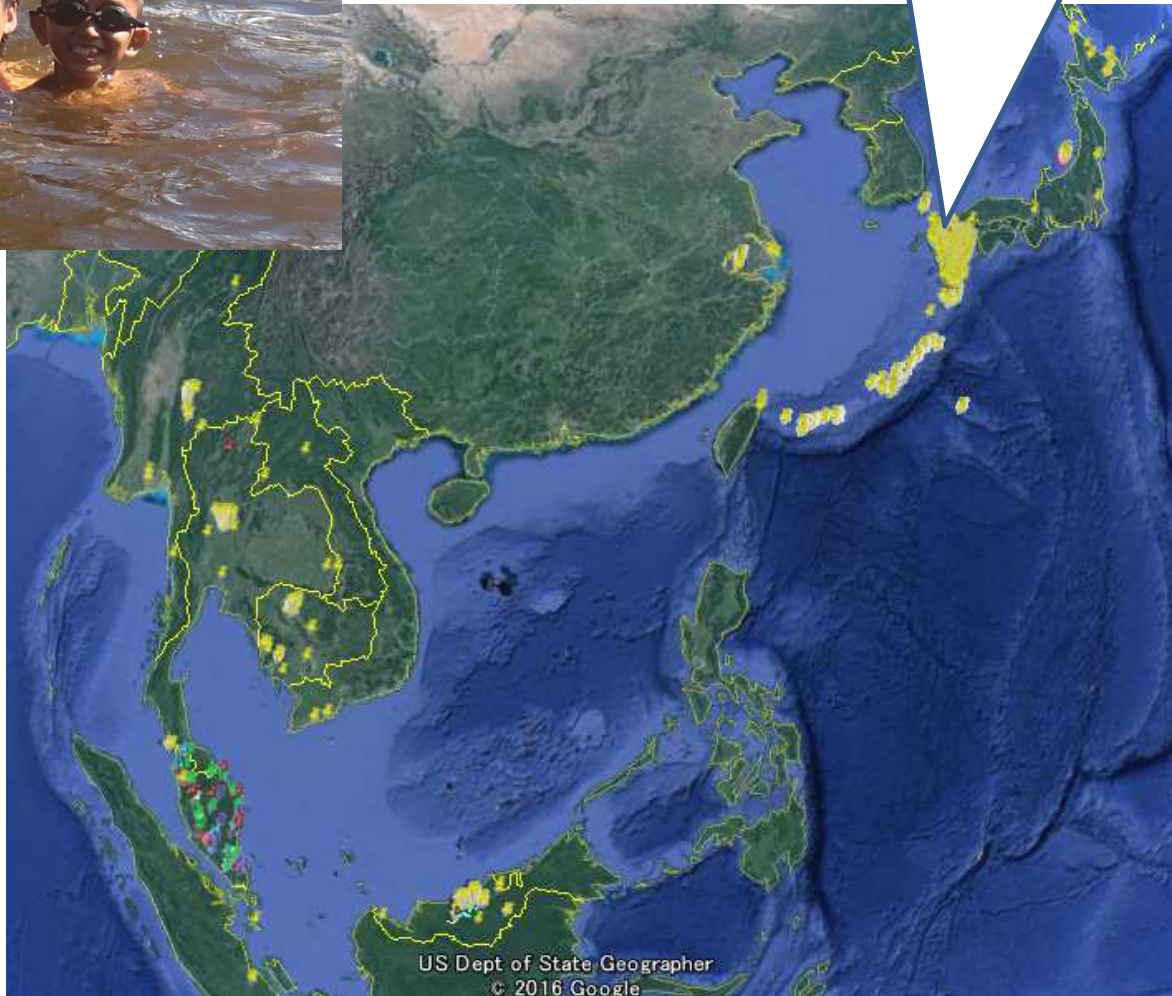


Who am I?

Yuichi Kano, Kyushu University, Japan

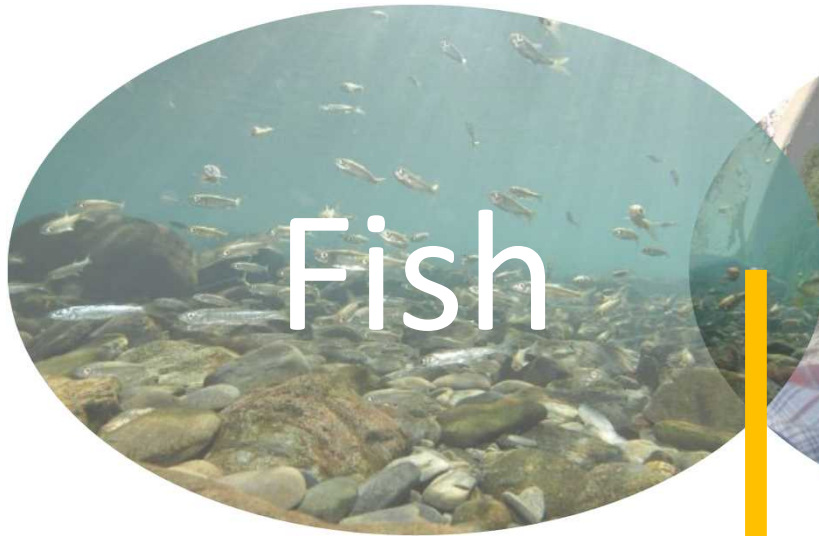


Distribution of freshwater fishes



Cliff ecology

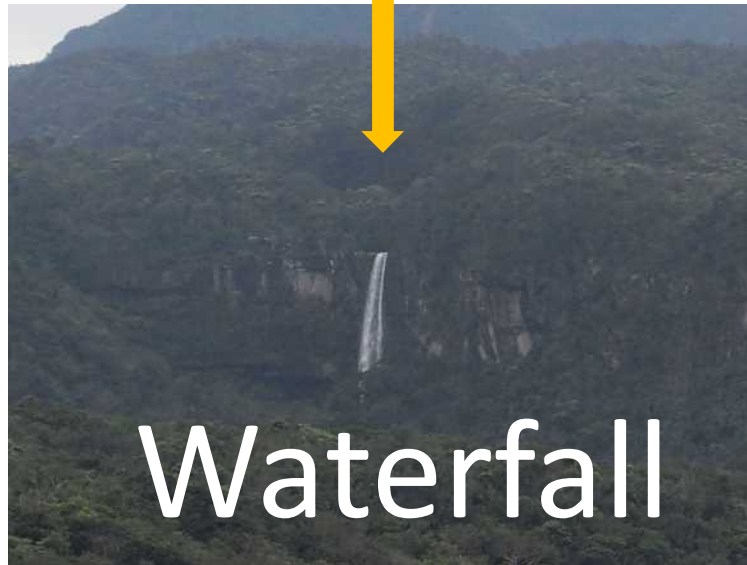




Fish



Cliff



Waterfall

Waterfalls drive parallel evolution in a freshwater goby



Yuichi Kano

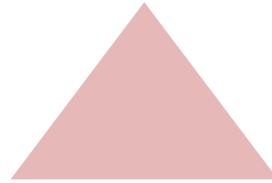
What is parallel evolution?

Usually.....



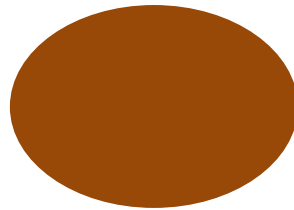
Isolation

A population



Isolation

color: gene
shape: morphology



Isolation

Time



Parallel evolution

A population

color: gene
shape: morphology



Isolation



Isolation



Isolation



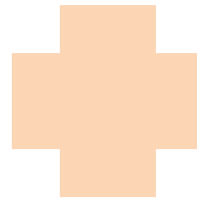
Time

Parallel evolution rather different from “convergence” but may be a type of convergence at very short time scale

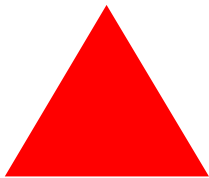
Convergence



Isolation



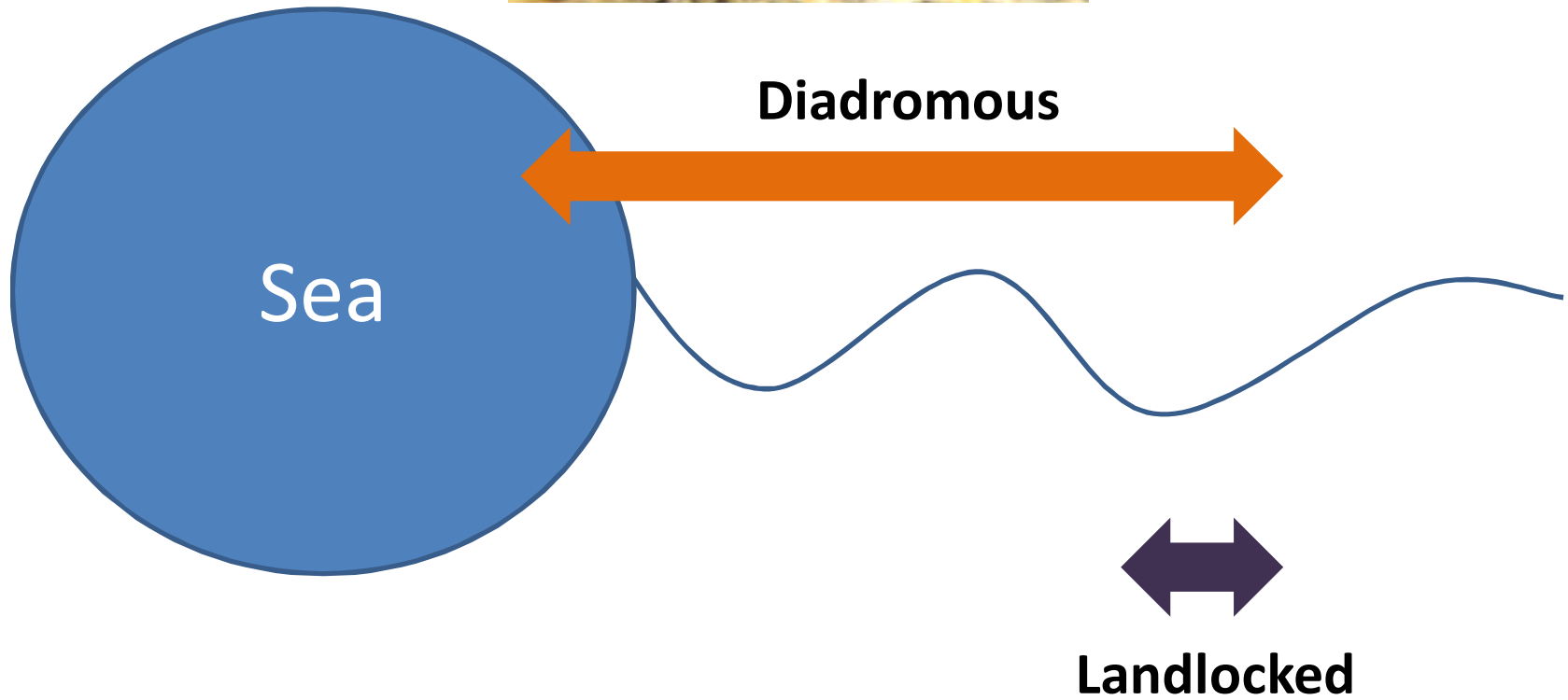
Isolation



Isolation

What is freshwater goby?

Life history of freshwater gobies





Rhinogobius brunneus
Diadromous



Landlocked

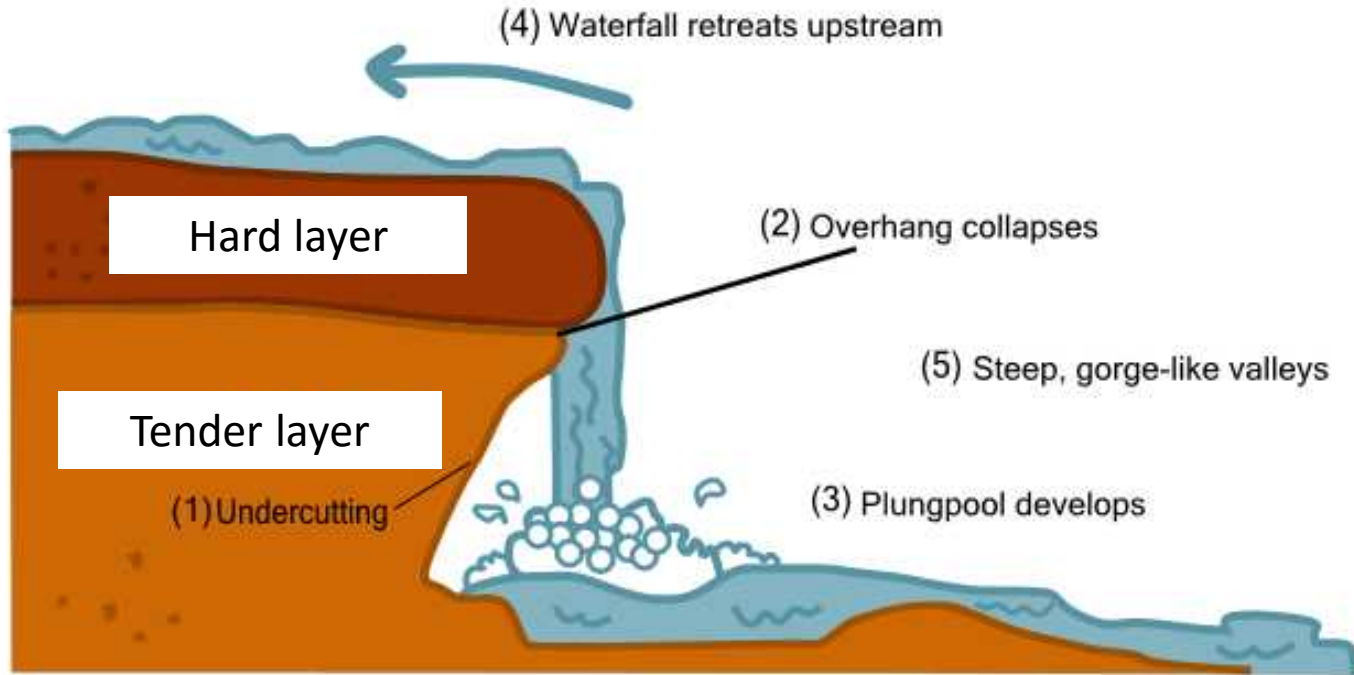


Rhinogobius sp. YB
Landlocked

What is waterfall?

Why is waterfall created

→ Heterogeneity of geological layer



Heterogeneity
of geological
layer



Variety of
erosion speed



Geological
step created

Waterfall height = Erosion history = Time

Iriomote Island



Tableland

Rhinogobius sp. YB



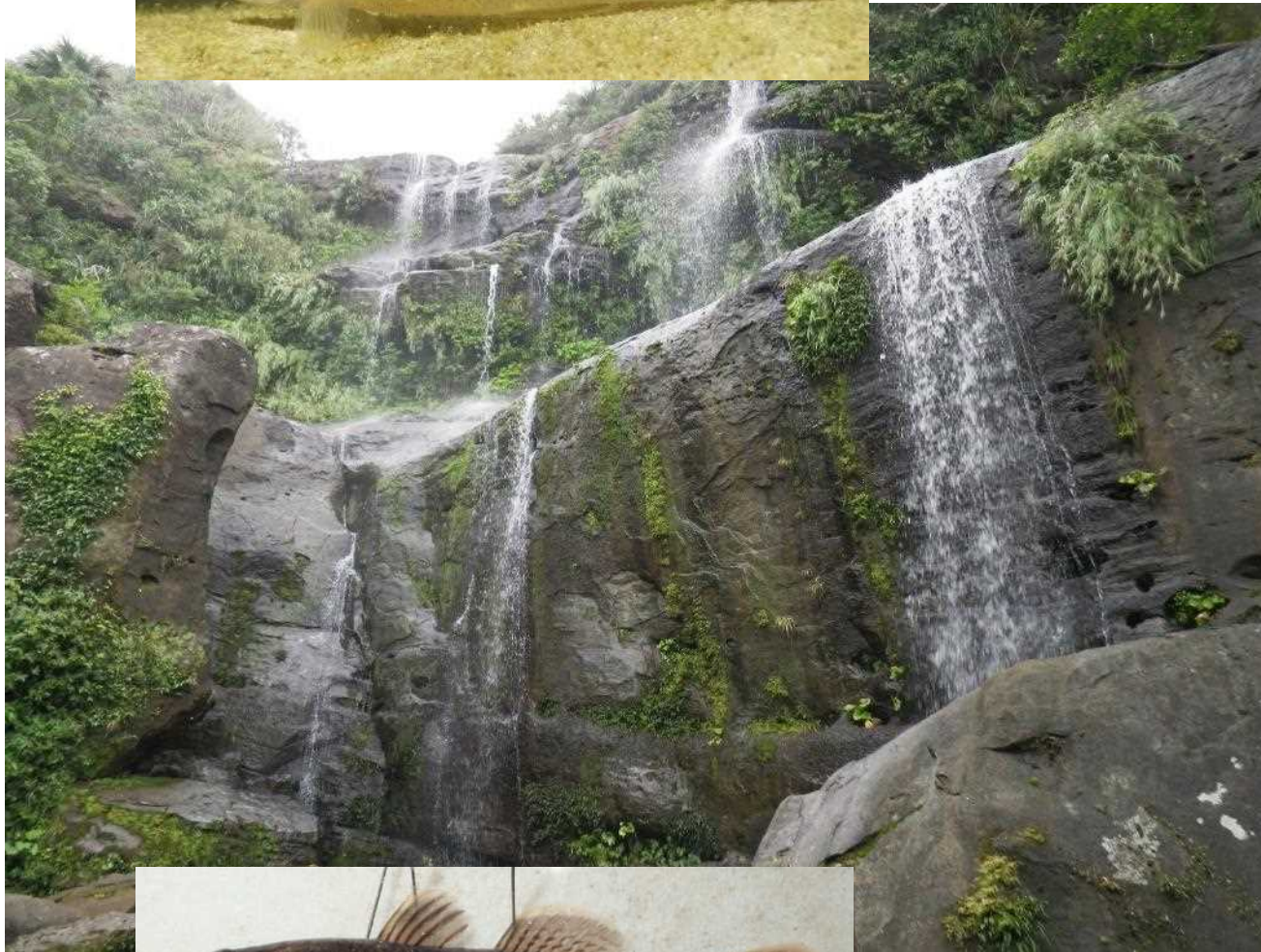
59m



Rhinogobius brunneus



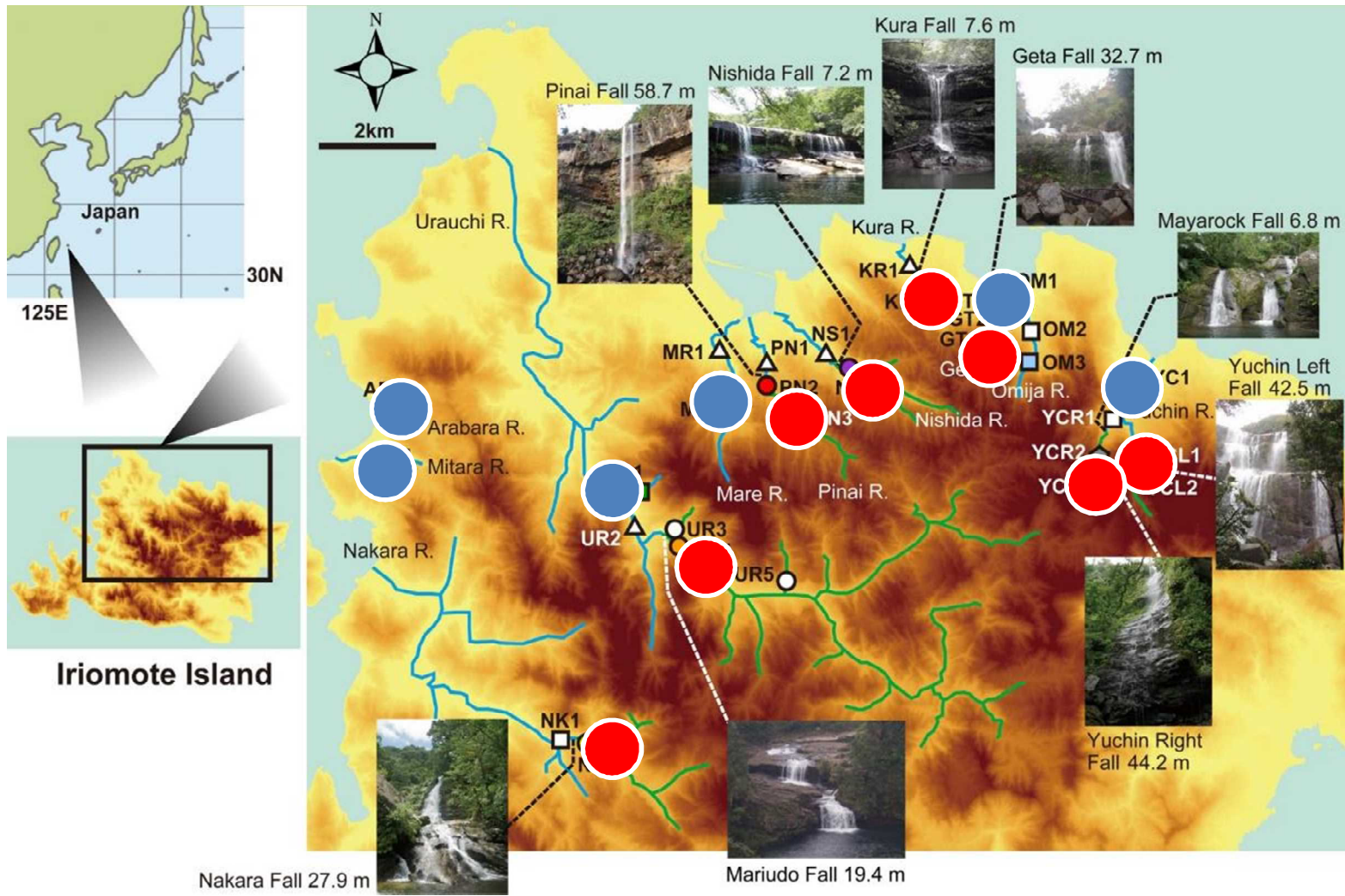
Rhinogobius sp. YB



43m



Rhinogobius brunneus



● *Rhinogobius sp. YB*

● *Rhinogobius brunneus*

Q. Why am I stay above waterfall?

R. sp. YB



A1. I (or my ancestors) climbed up the waterfall

A2. Human released me

A3. I (or my ancestors) went beyond drainage divide

A4. My ancestors had been originally here, followed by waterfall creation

Waterfall height

Morphology of
gobies

Gene of gobies

1. 西表島における滝上のキバラヨシノボリと地史

Waterfall height

with



Laser measure

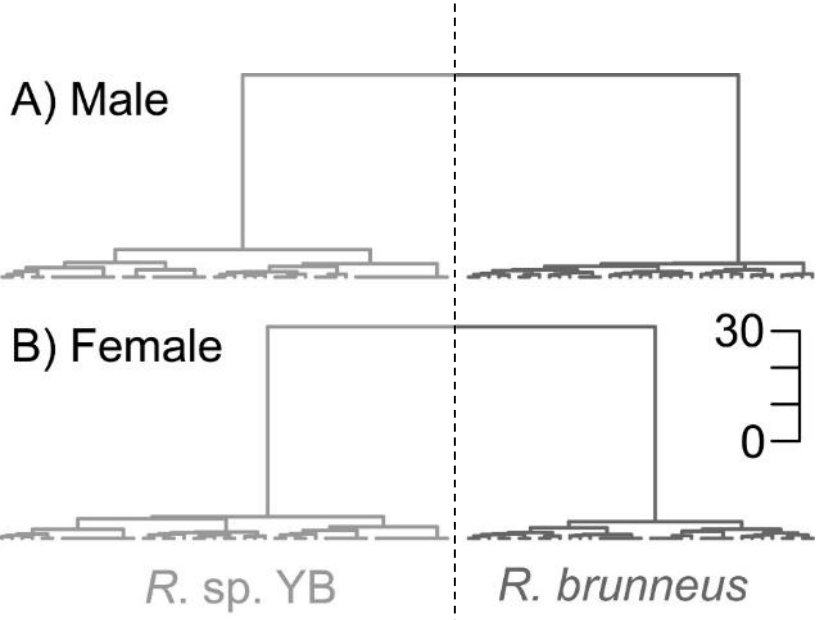


Lowest: Sangara waterfall, 7.2 m



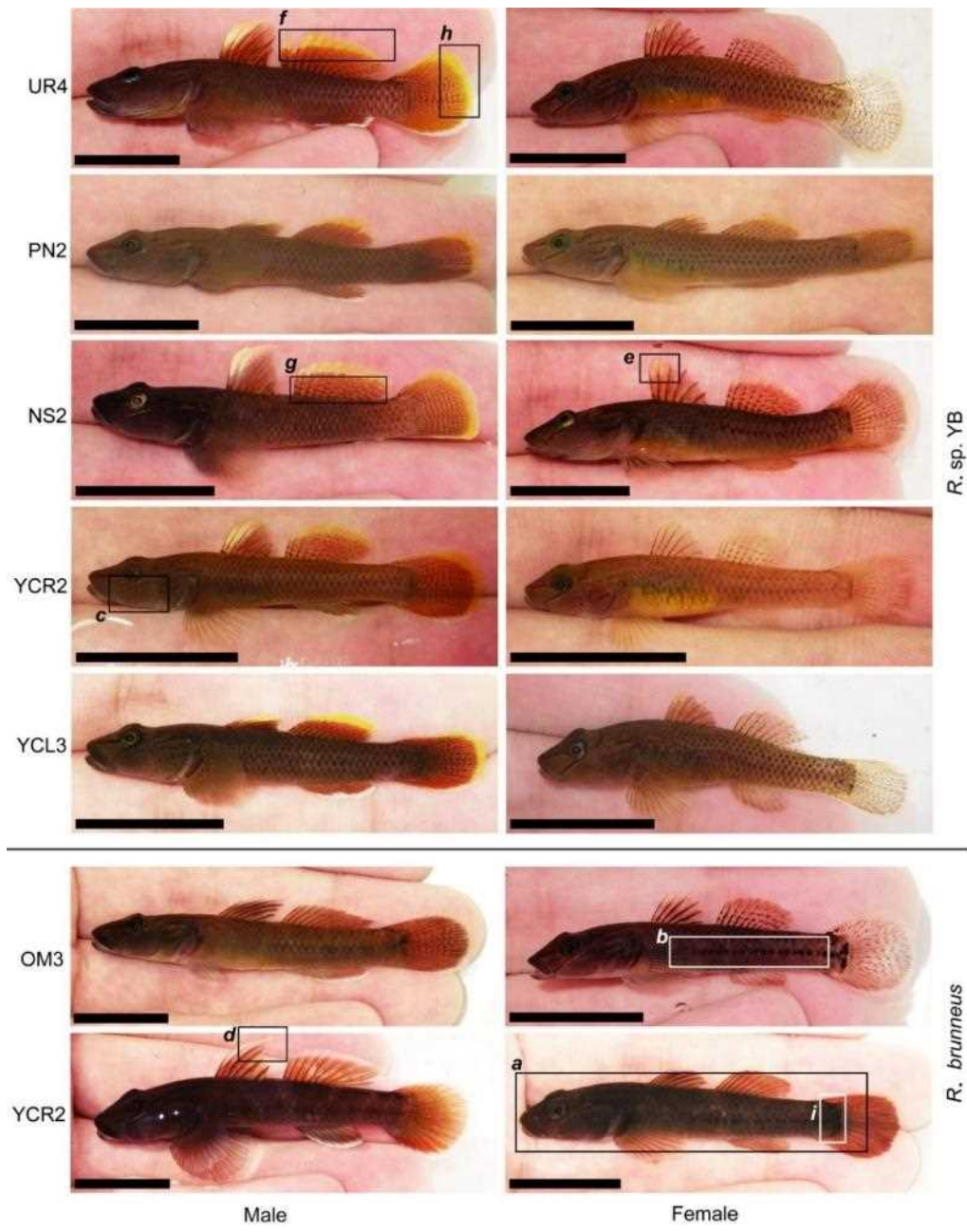
Highest: Pinai waterfall, 58.6 m

Morphology



R. sp. YB

R. brunneus

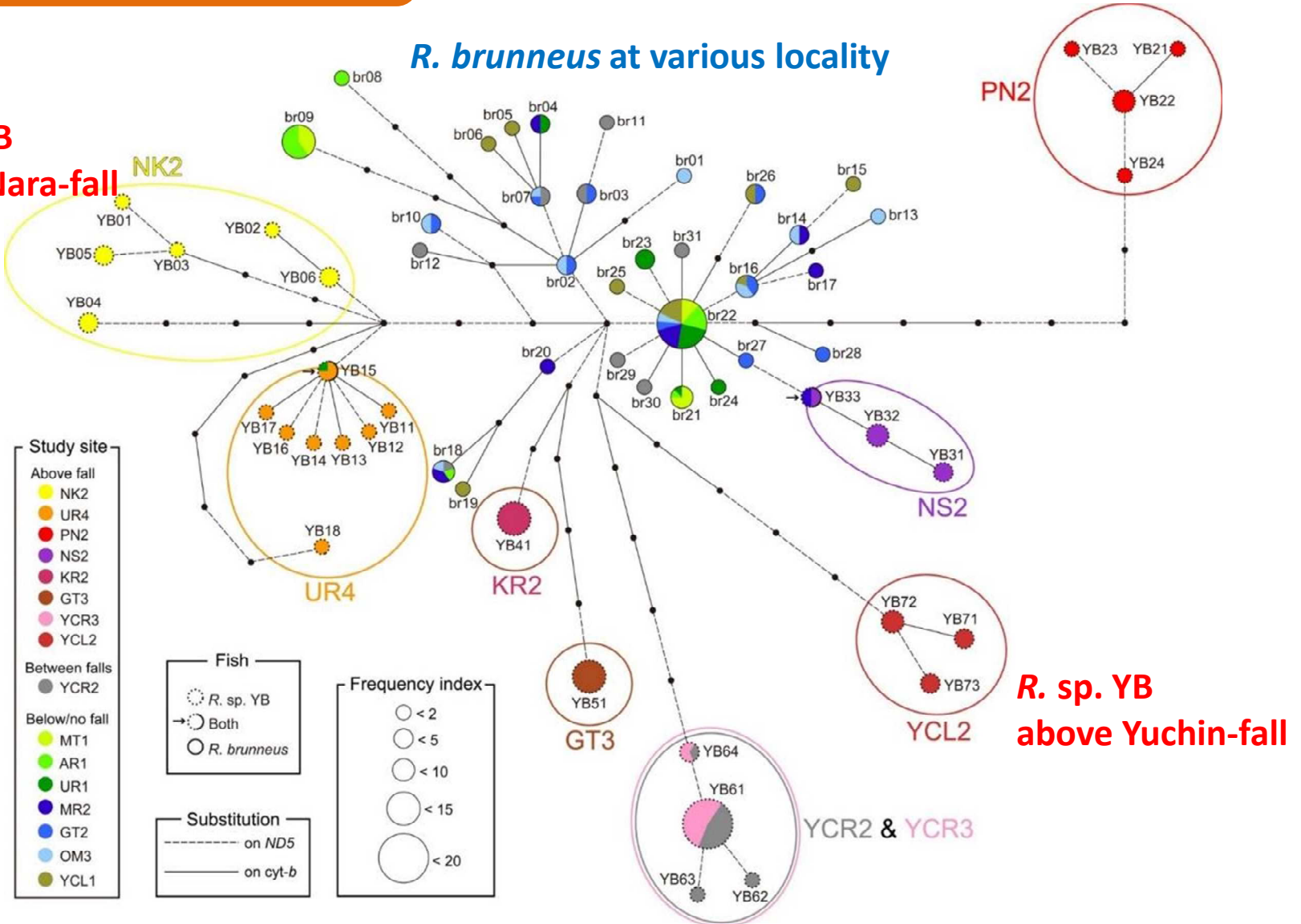


Gene

R. sp. YB
above Nara-fall

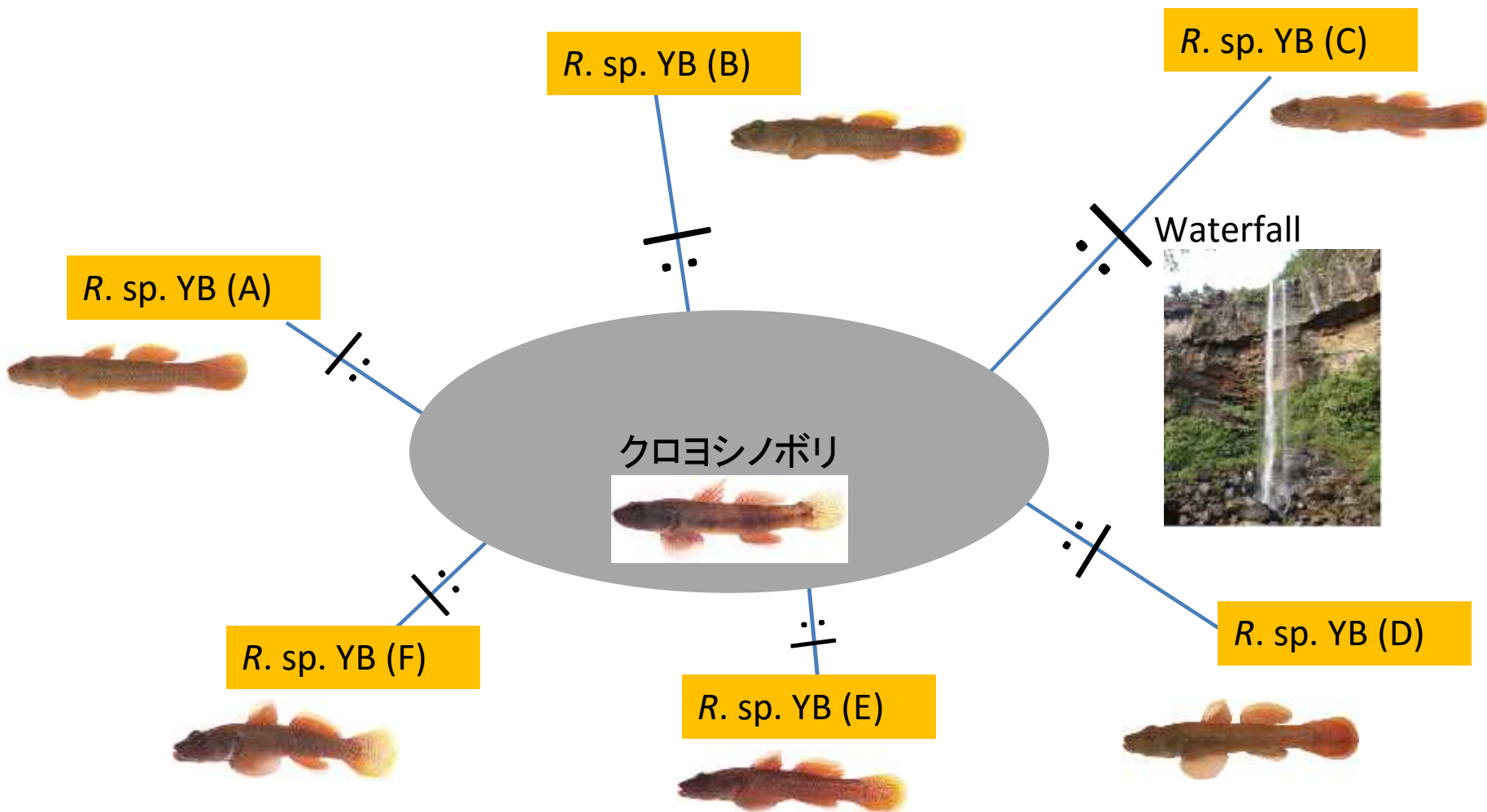
R. brunneus at various locality

R. sp. YB
above Pinai-fall



R. sp. YB
above Yuchin-fall

Gene




```
graph TD; A[Waterfall height] --- B[Morphology of gobies]; A --- C[Gene of gobies]; B --- C;
```

Waterfall height

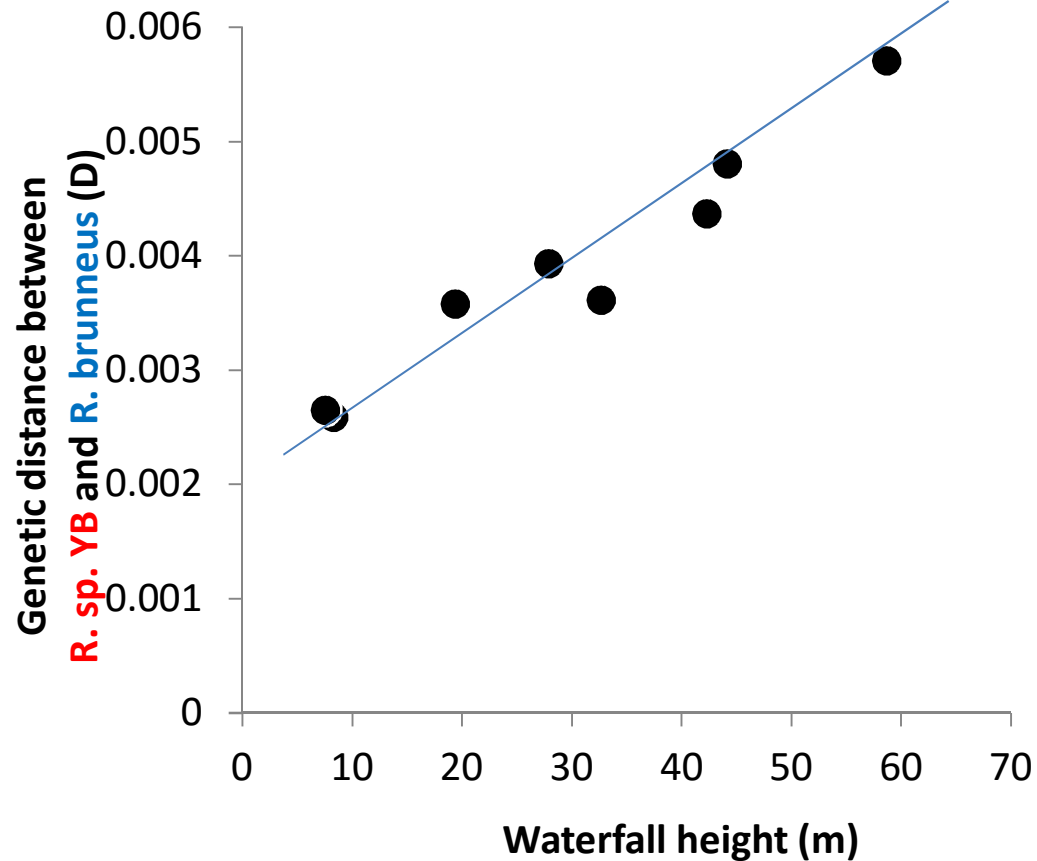
Morphology of
gobies

Gene of gobies

Gene

vs.

Waterfall height



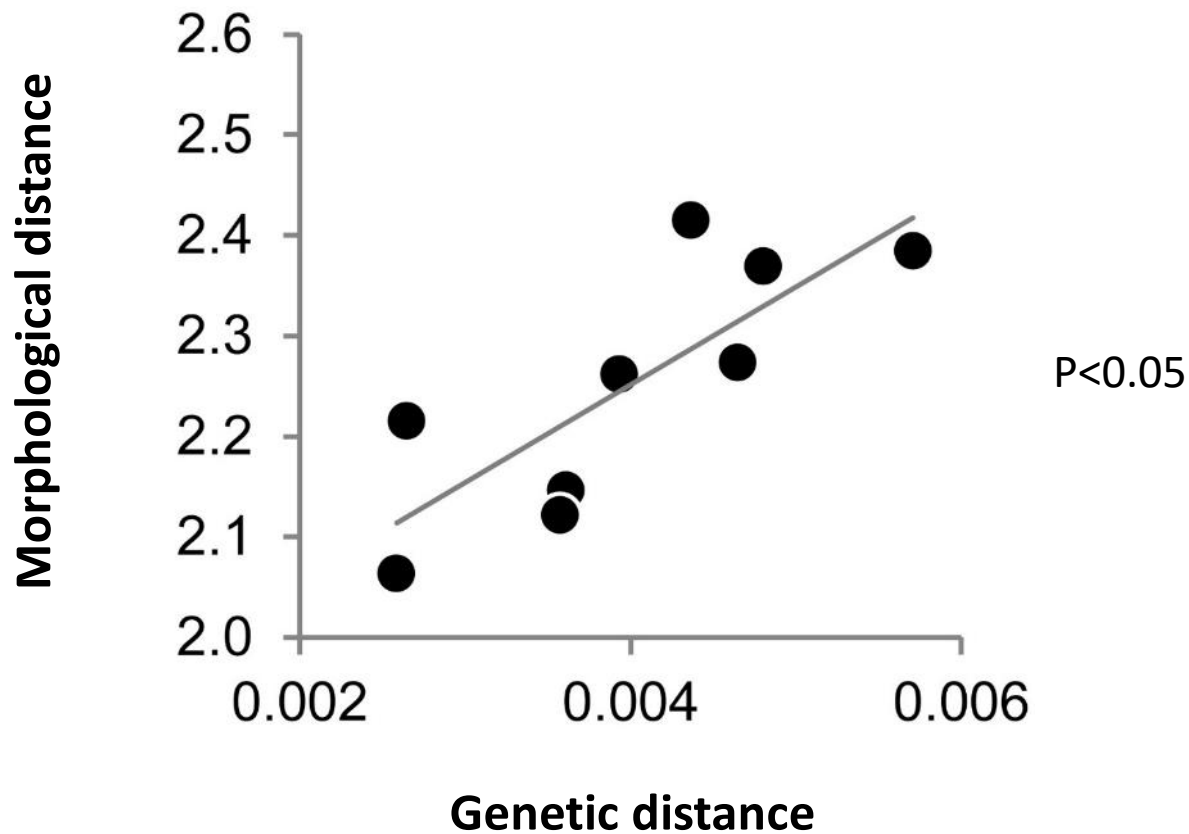
Waterfall height = Erosion history = Time

Gene

vs.

Morphology

Comparison between each
R. sp. YB and *R. brunneus*

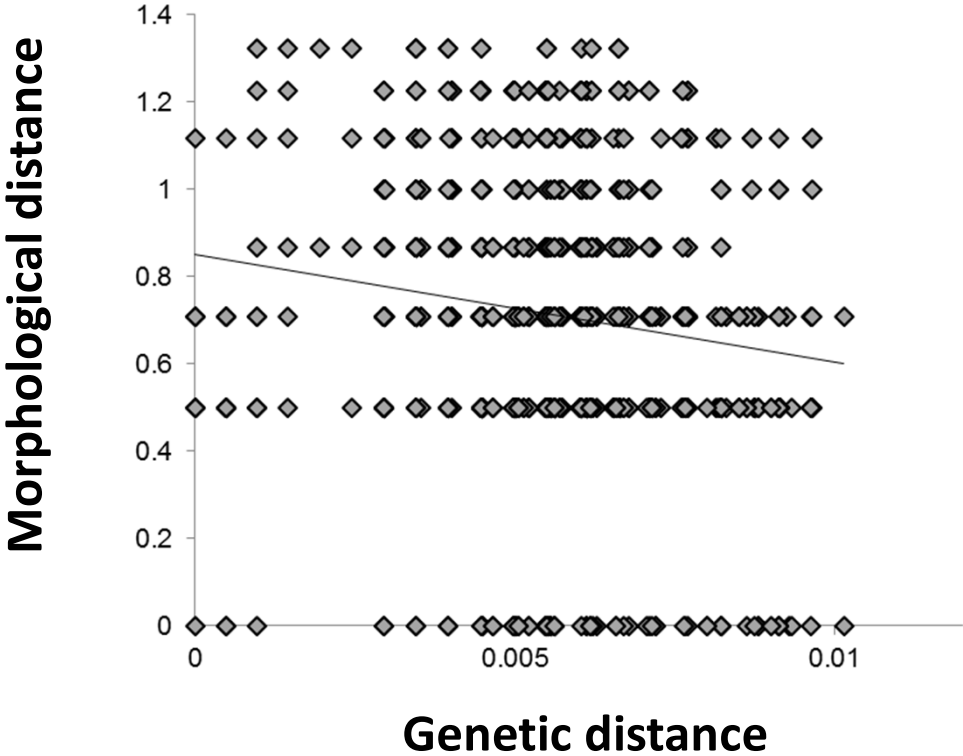


Gene

vs.

Morphology

Comparison between among
R. sp. YB populations



Long genetic distance make morphology similar
← converse to general phenomenon

Waterfall history estimated from gene information

erosion speed: 6.7cm/100 years



Lowest: Sangara Fall, 7.2 m

1,1000 years



Higest: Pinai Fall, 58.6 m

88,000 years

Another geological study estimated 3~10cm/100years

100,000 years ago.....

R. brunneus

R. brunneus



Current

R. sp. YB

R. sp. YB

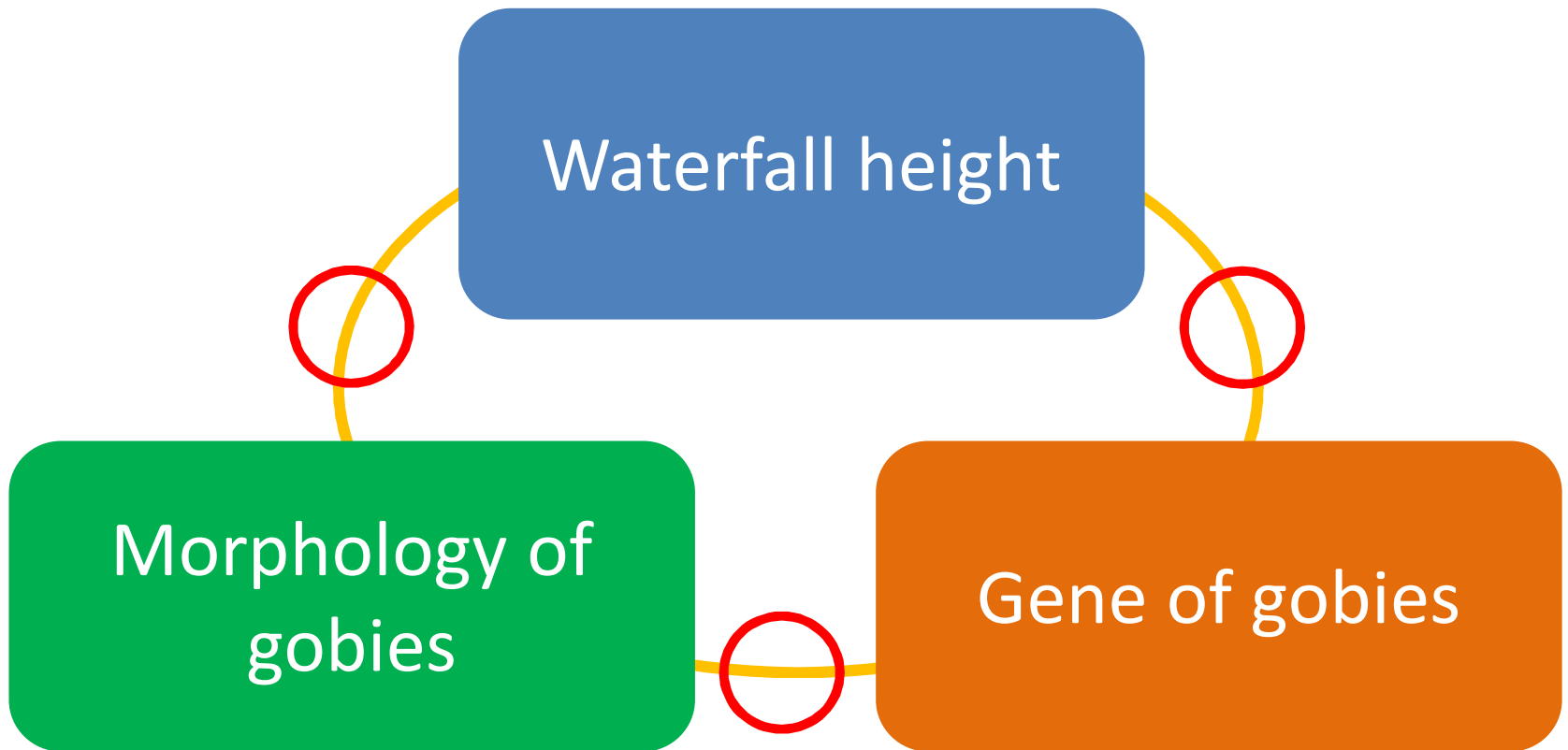
R. brunneus

R. brunneus



Summary

- Genetic distances are proportional to waterfall heights
- Waterfall heights express the period of isolated time
- Such isolation accelerated the parallel evolution of the goby



Life is HDD of the Earth!