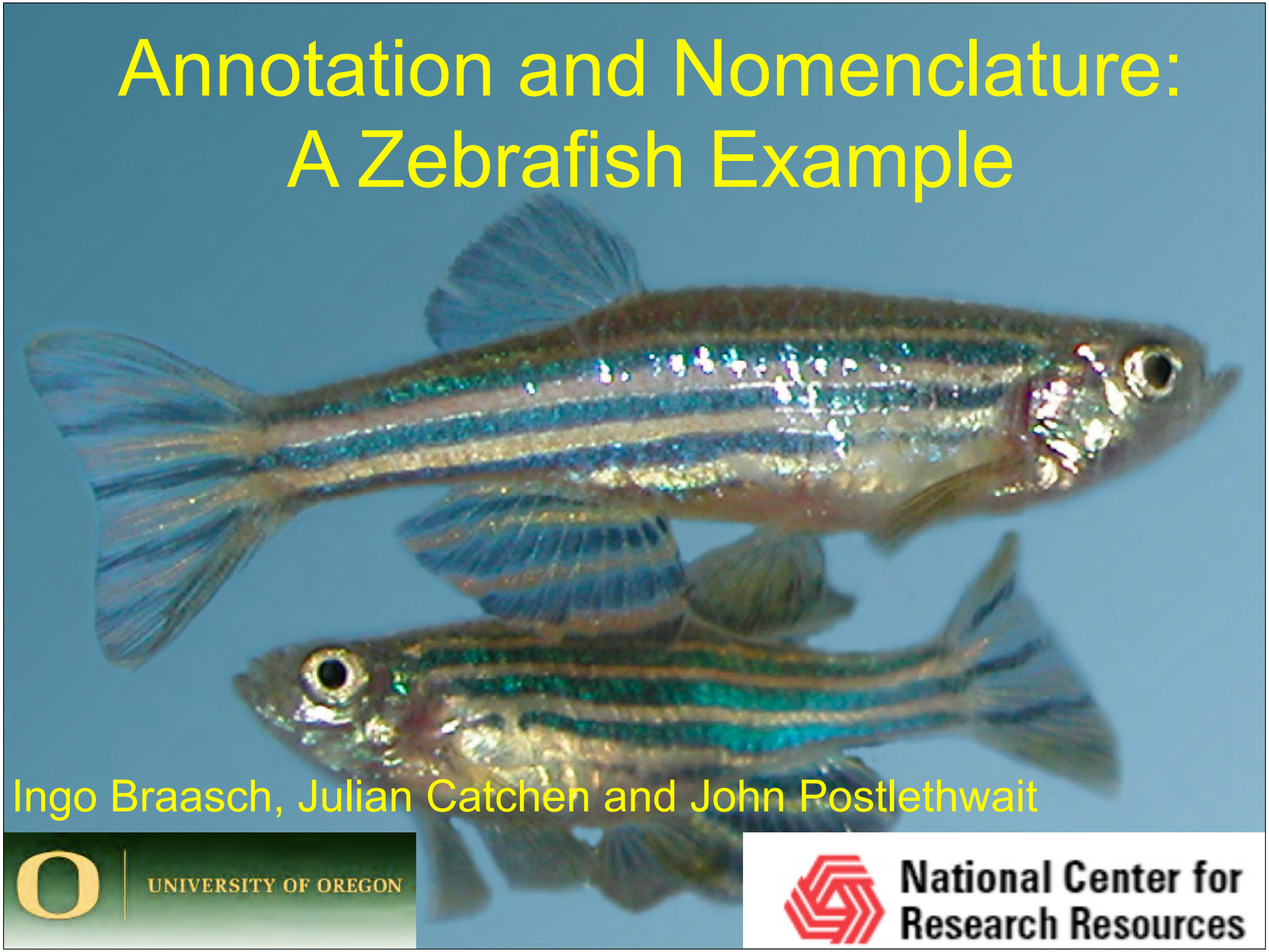
Annotation and Nomenclature: A Zebrafish Example



Ingo Braasch, Julian Catchen and John Postlethwait

UNIVERSITY OF OREGON

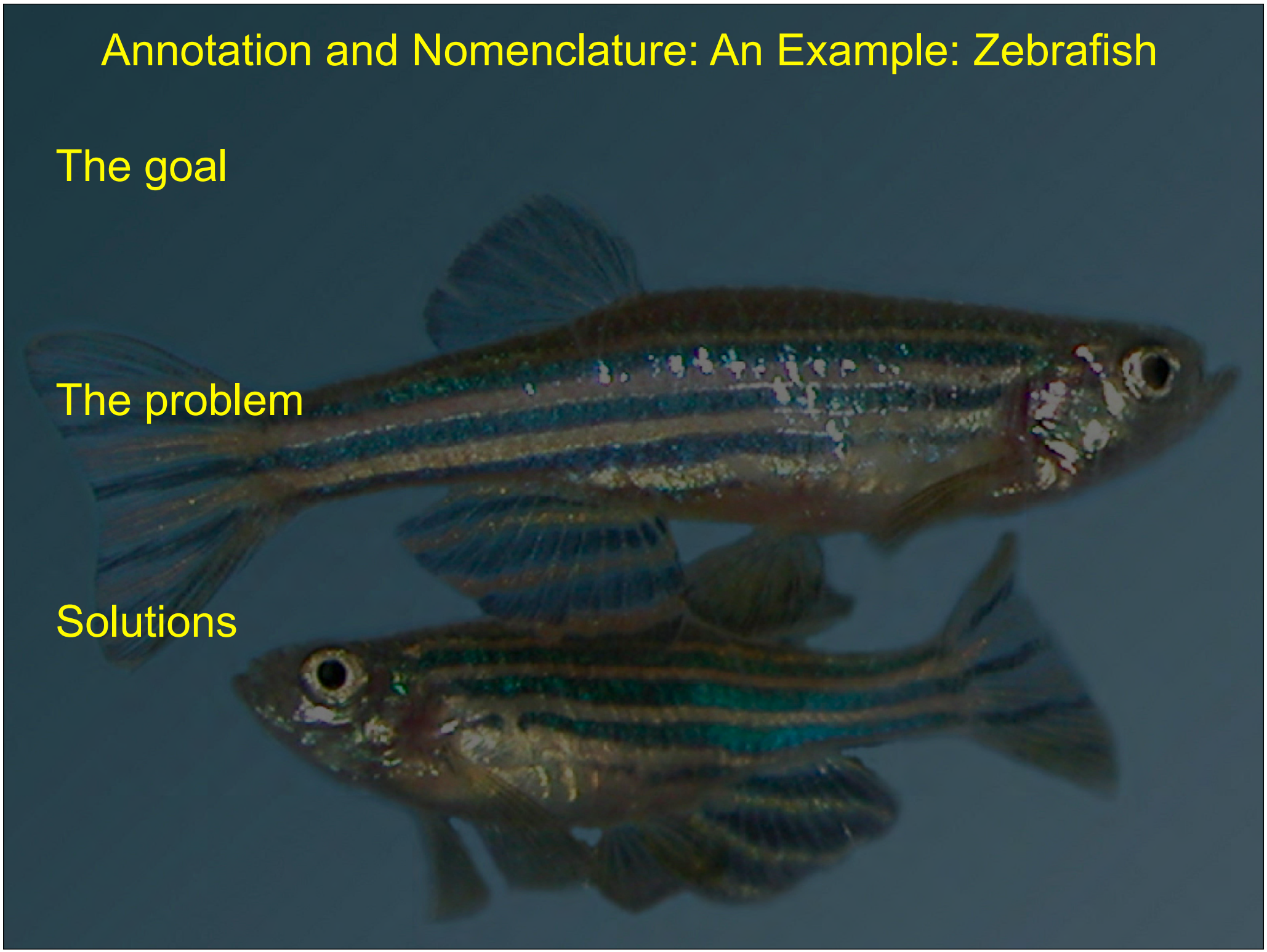
National Center for Research Resources

Annotation and Nomenclature: An Example: Zebrafish

The goal

The problem

Solutions



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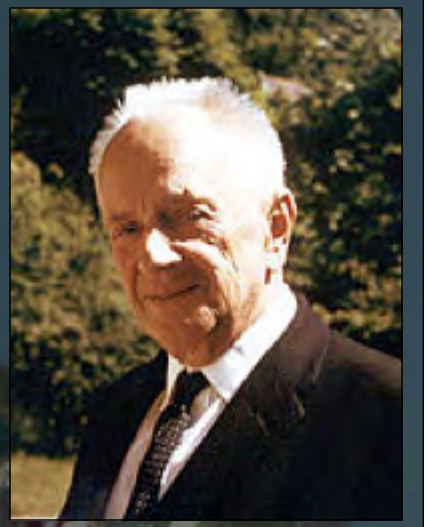


The goal

"Nothing in Biology Makes Sense Except in the Light of Evolution" Theodosius Dobzhansky

Amer Biol Teach (1973) 35: 125-129

The problem

Nomenclature should match evolutionary origins

Solutions

The goal

"Nothing in Biology Light of Evolution"

Amer Biol Teach (1973) 35: 125-129

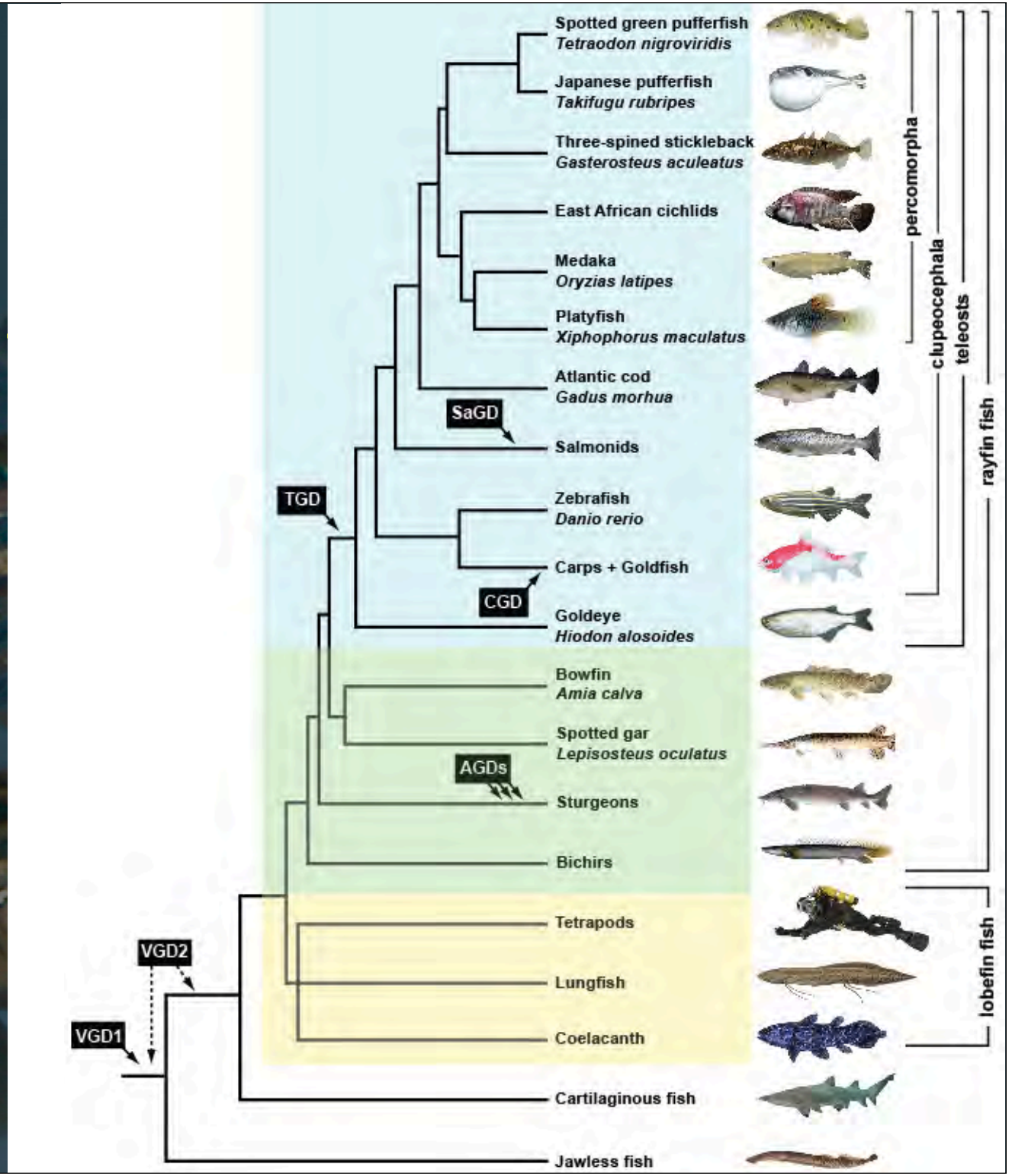
Nomenclature should match evolutionary origins

Gene names should connect fish genes to the human genome

The problem

Genome duplication

Gene losses



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The goal

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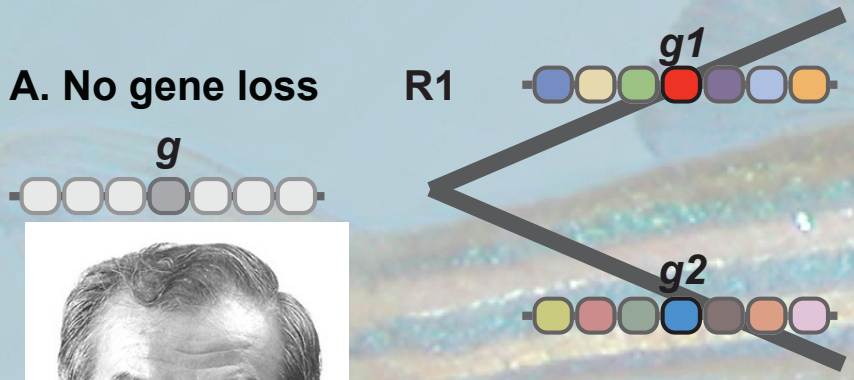
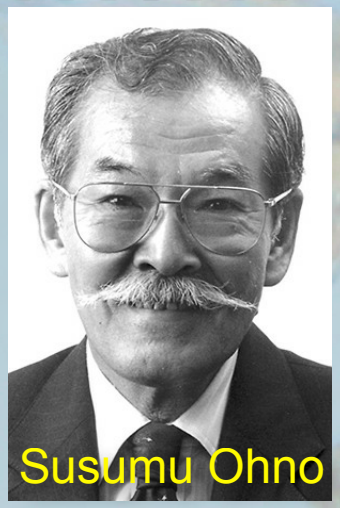
The problem
- Genome duplication
- Gene losses

Solutions
- Trees + conserved syntenies

The problem

Genome duplication
Gene losses



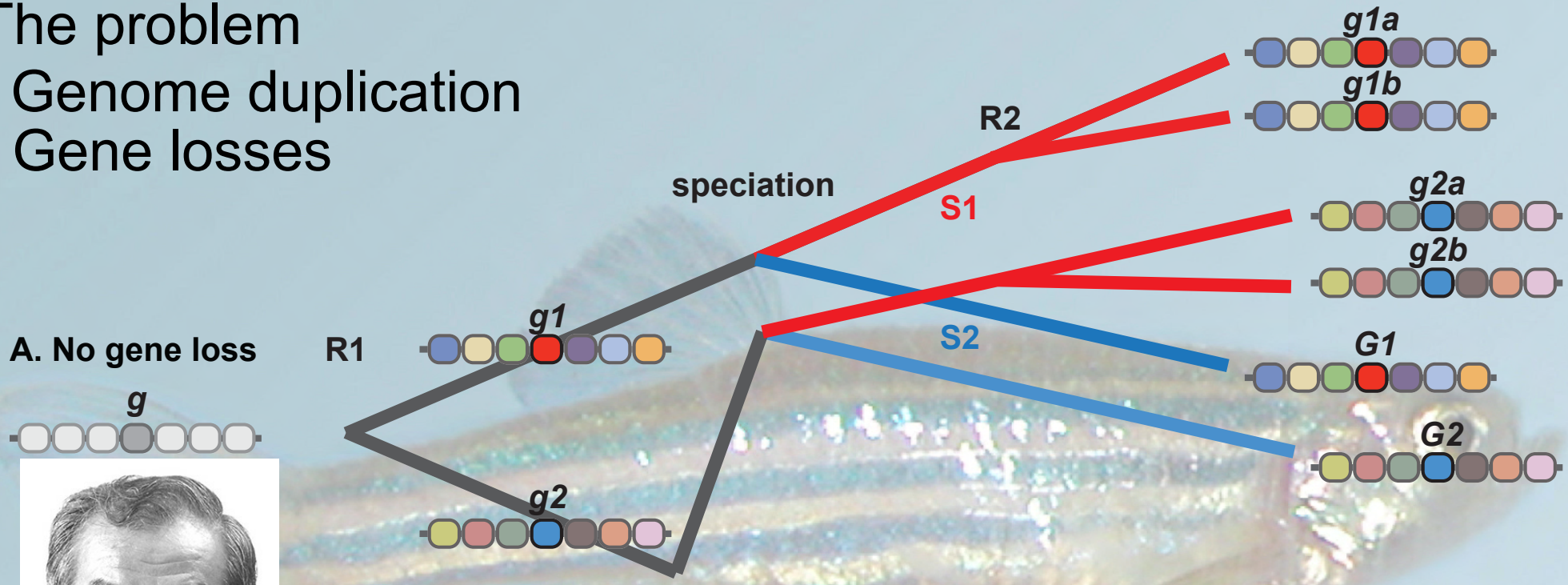


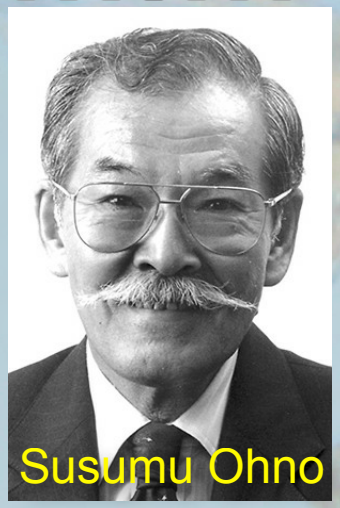
Ohnologs: paralogs from genome duplication

The problem

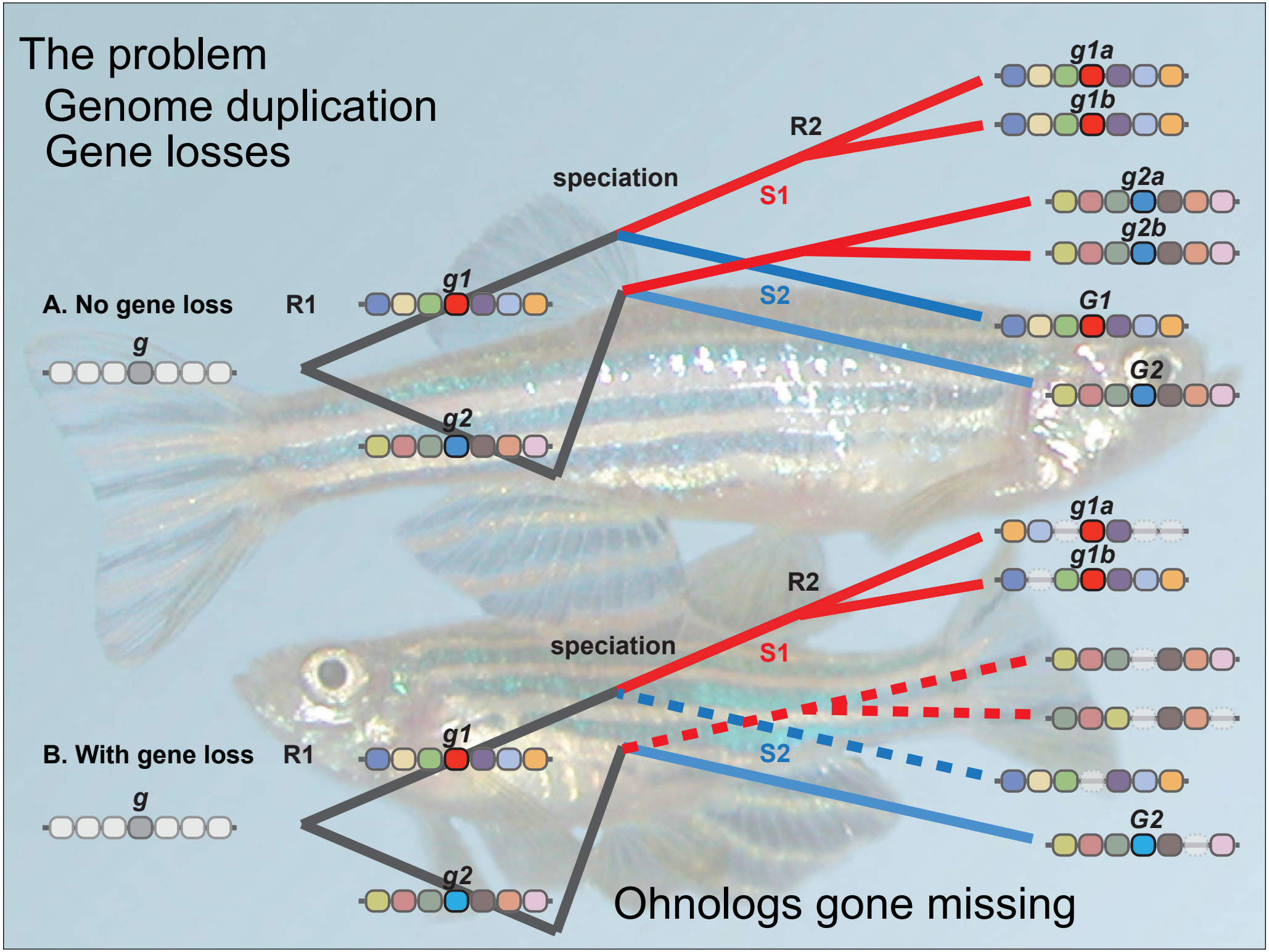
Genome duplication

Gene losses





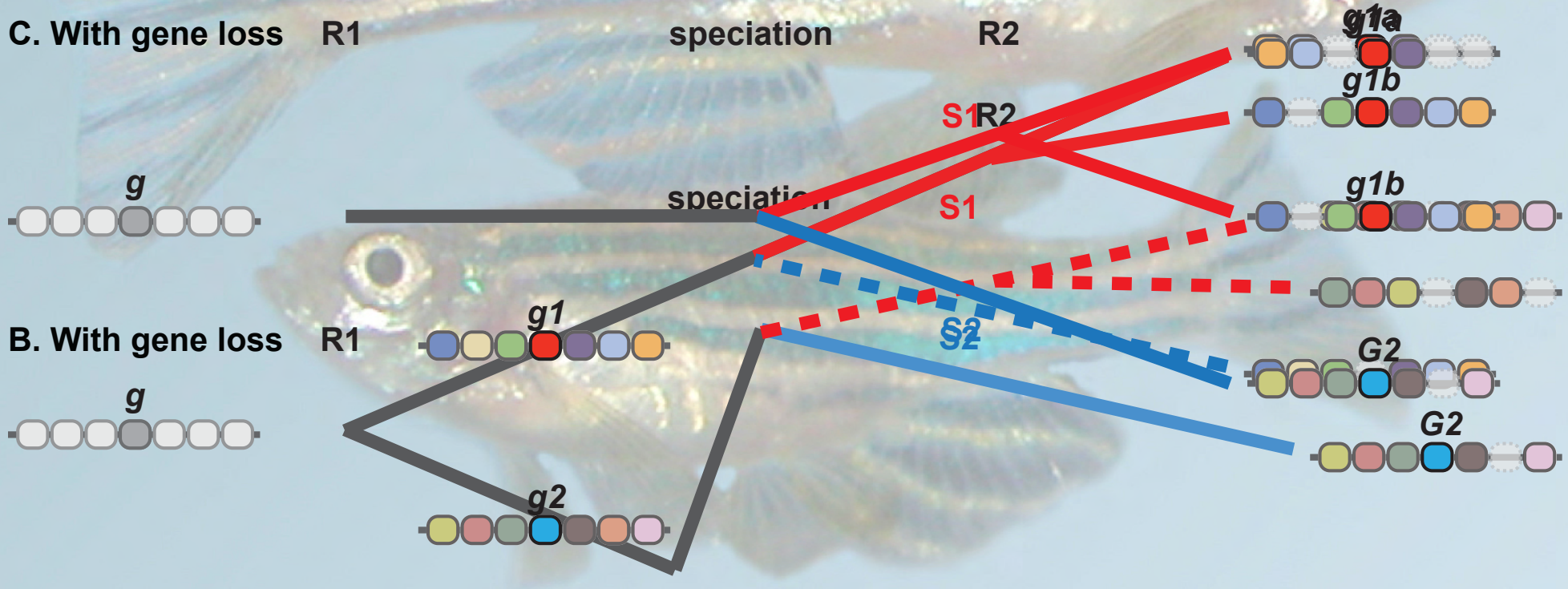
Ohnologs: paralogs from genome duplication


The problem
Genome duplication
Gene losses
A. No gene loss
g
R1
g1
g2
speciation
R2
S1
S2
g1a
g1b
g2a
g2b
G1
G2
B. With gene loss
g
R1
g1
g2
speciation
R2
S1
S2
g1a
g1b
G2
Ohnologs gone missing

The problem

Genome duplication

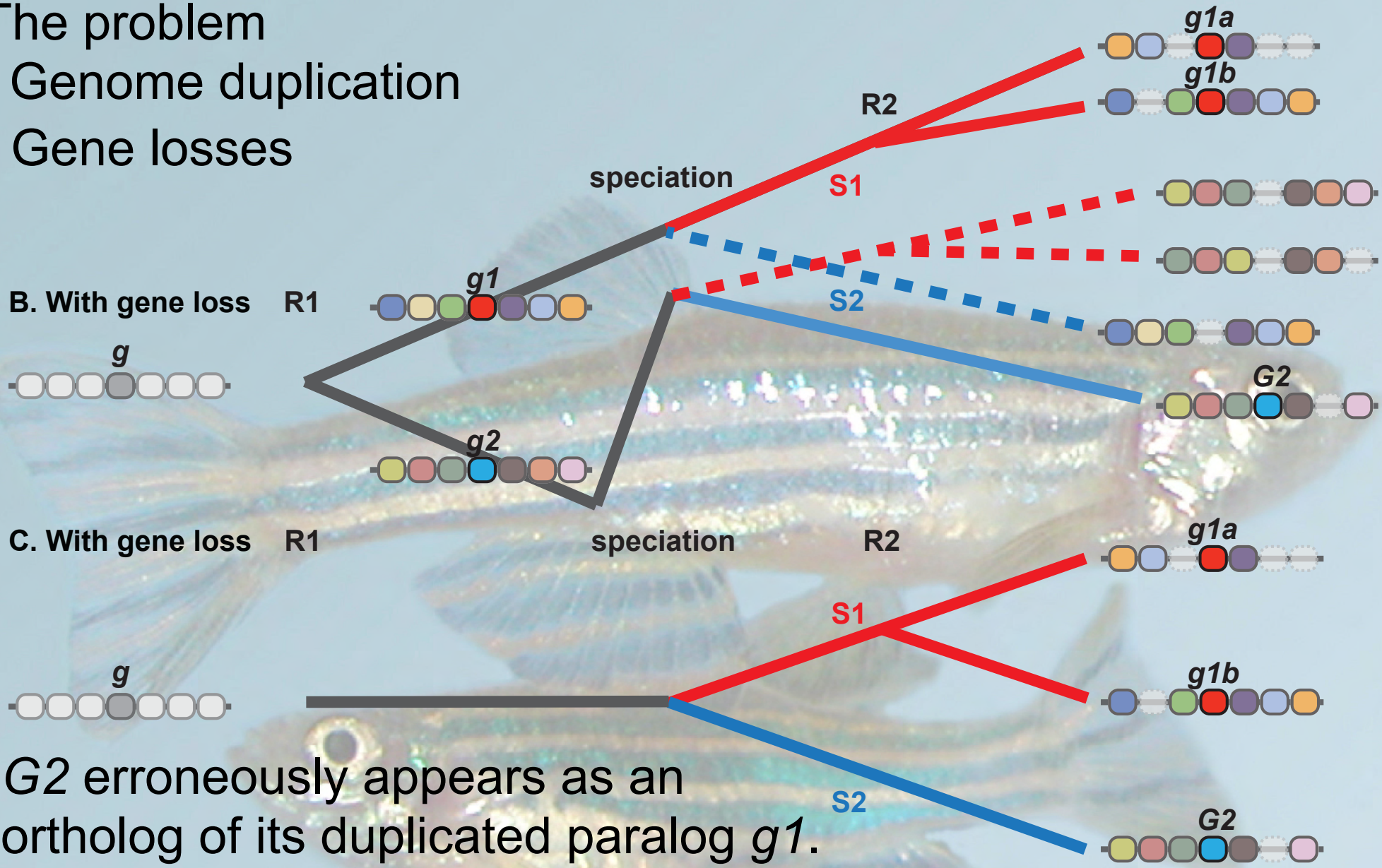
Gene losses



The problem

Genome duplication

Gene losses



G2 erroneously appears as an ortholog of its duplicated paralog *g1*.

Thus, the entire region must be used to determine origins and hence nomenclature.

=> conserved syntenies

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Trees + conserved syntenies

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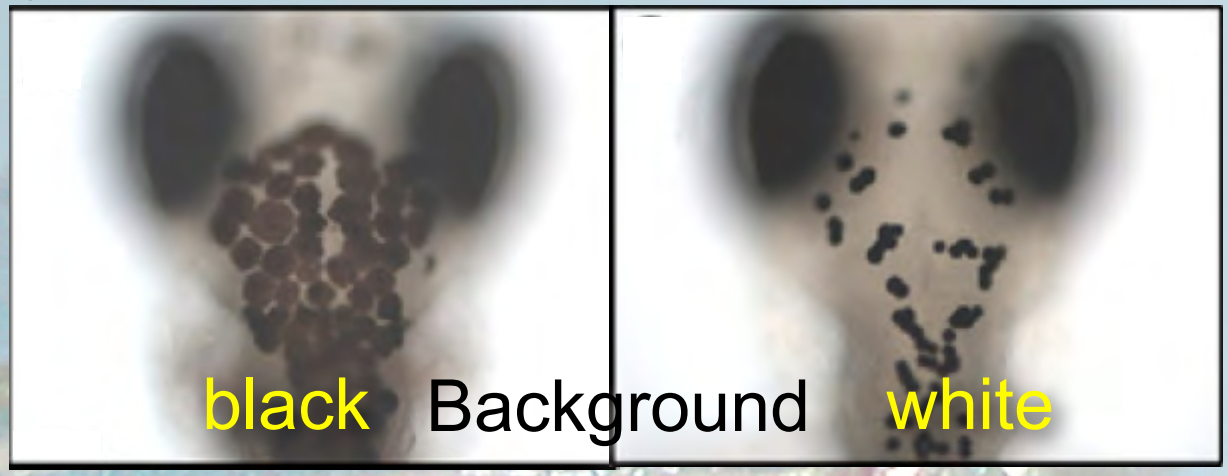
Solutions

Trees + conserved syntenies

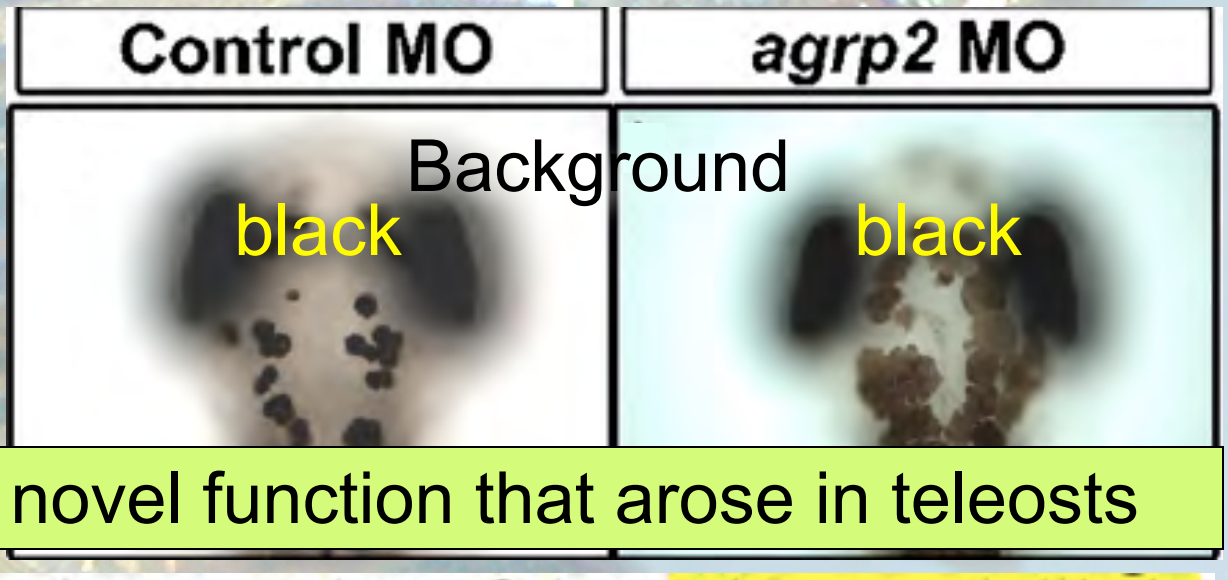
Solutions

Trees + conserved syntenies

Teleosts can adjust to background color



Zhang found a novel agouti-related gene *agrp2* necessary for background adaptation



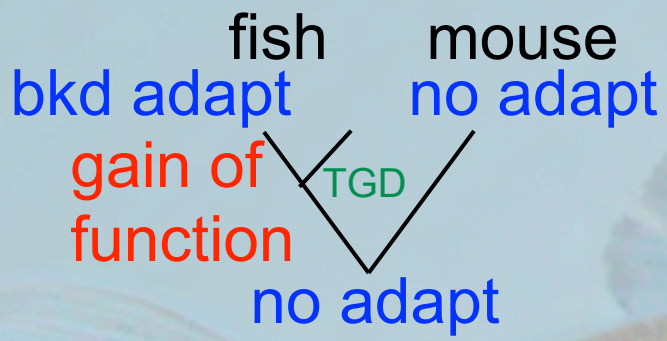
Zhang et al. (2010) PNAS 107:

they imply that this is a novel function that arose in teleosts

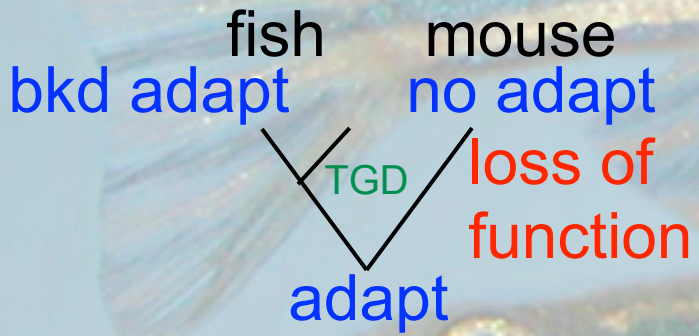
(22), and thus far seems unique to teleost fishes. This gene is likely to have arisen from the genome duplication that occurred during teleost phylogeny (35). In this study, we demonstrate a physio-

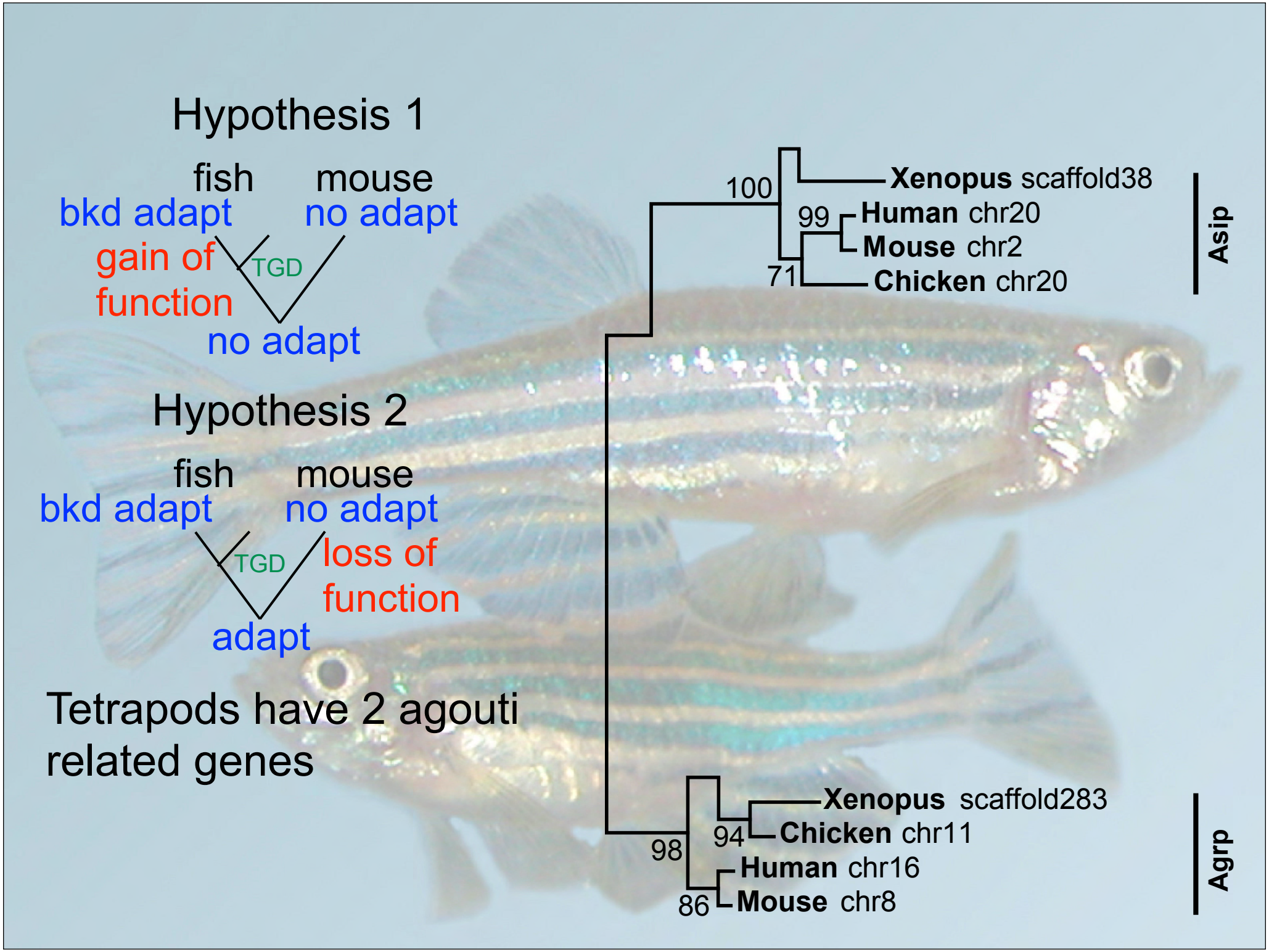
they imply that this is a novel function that arose in teleosts

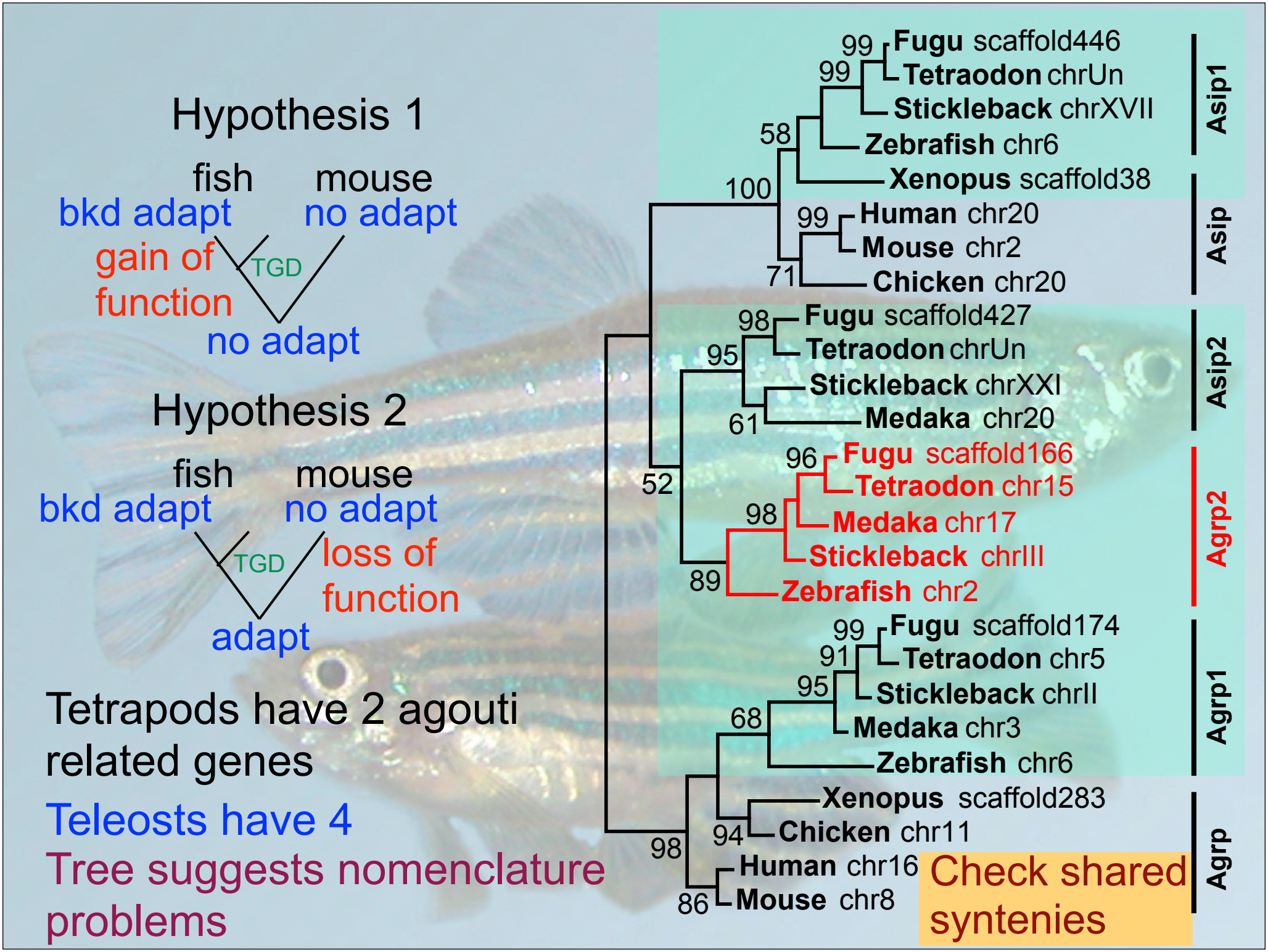
Hypothesis 1



Hypothesis 2

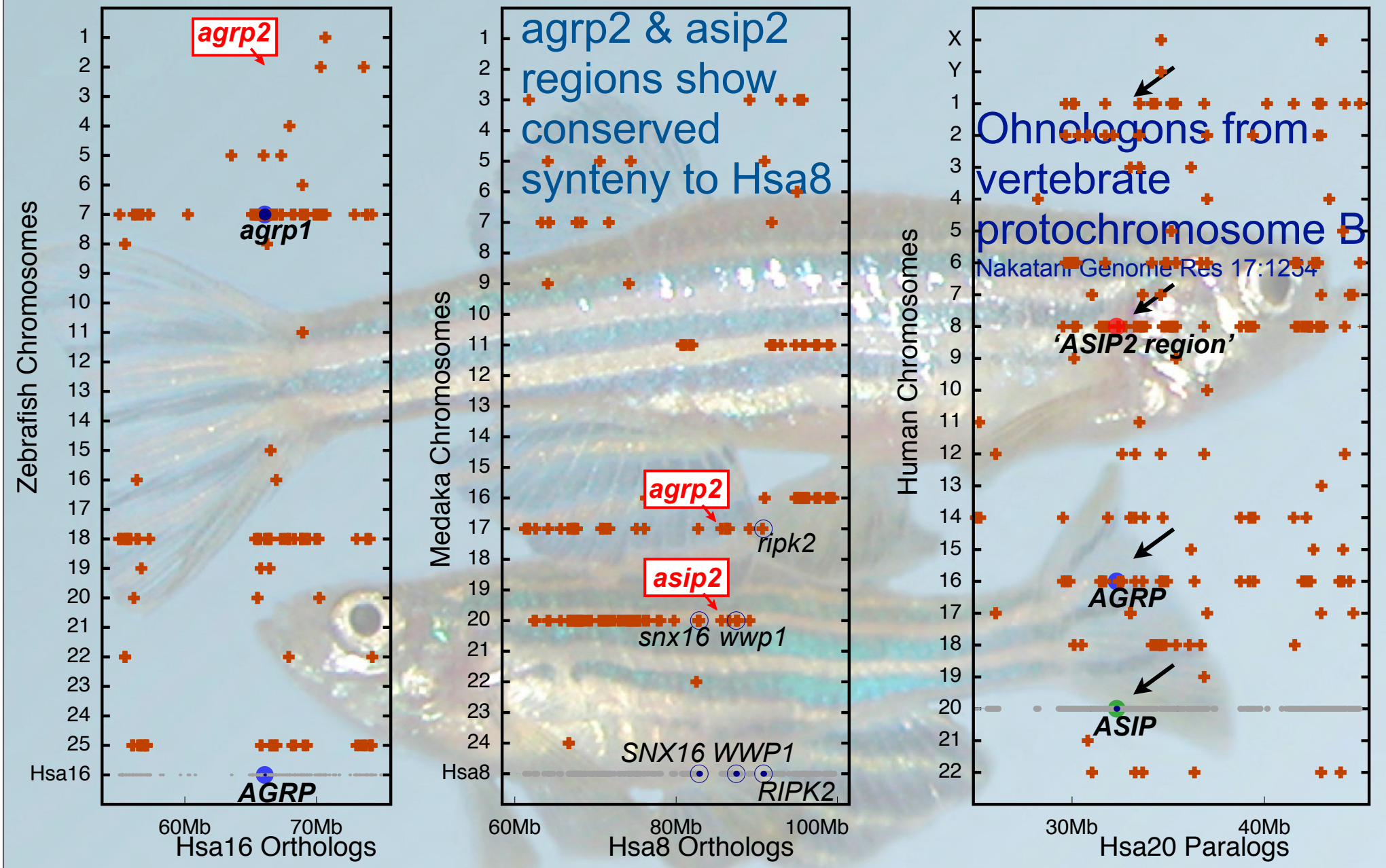



Hypothesis 1
fish
mouse
bkd adapt
no adapt
gain of function
TGD
no adapt
Hypothesis 2
fish
mouse
bkd adapt
no adapt
TGD
loss of function
adapt
Tetrapods have 2 agouti related genes
100
99
71
Xenopus scaffold38
Human chr20
Mouse chr2
Chicken chr20
Asip
98
94
86
Xenopus scaffold283
Chicken chr11
Human chr16
Mouse chr8
Agrp


Hypothesis 1
fish
mouse
bkd adapt
no adapt
gain of function
TGD
no adapt
Hypothesis 2
fish
mouse
bkd adapt
no adapt
TGD
loss of function
adapt
Tetrapods have 2 agouti related genes
Teleosts have 4
Tree suggests nomenclature problems
99 Fugu scaffold446
99 Tetraodon chrUn
Stickleback chrXVII
58 Zebrafish chr6
Xenopus scaffold38
100
99 Human chr20
Mouse chr2
71 Chicken chr20
Asip1
Asip
98 Fugu scaffold427
95 Tetraodon chrUn
Stickleback chrXXI
61 Medaka chr20
Asip2
96 Fugu scaffold166
52
Tetraodon chr15
98 Medaka chr17
Stickleback chrIII
89 Zebrafish chr2
Agrp2
99 Fugu scaffold174
91 Tetraodon chr5
95 Stickleback chrII
68 Medaka chr3
Zebrafish chr6
Agrp1
Xenopus scaffold283
94 Chicken chr11
98 Human chr16
86 Mouse chr8
Agrp
Check shared syntenies

agrp2 neighborhood does not share syntenies with teleost *agrp1* or with tetrapod *Agrp*

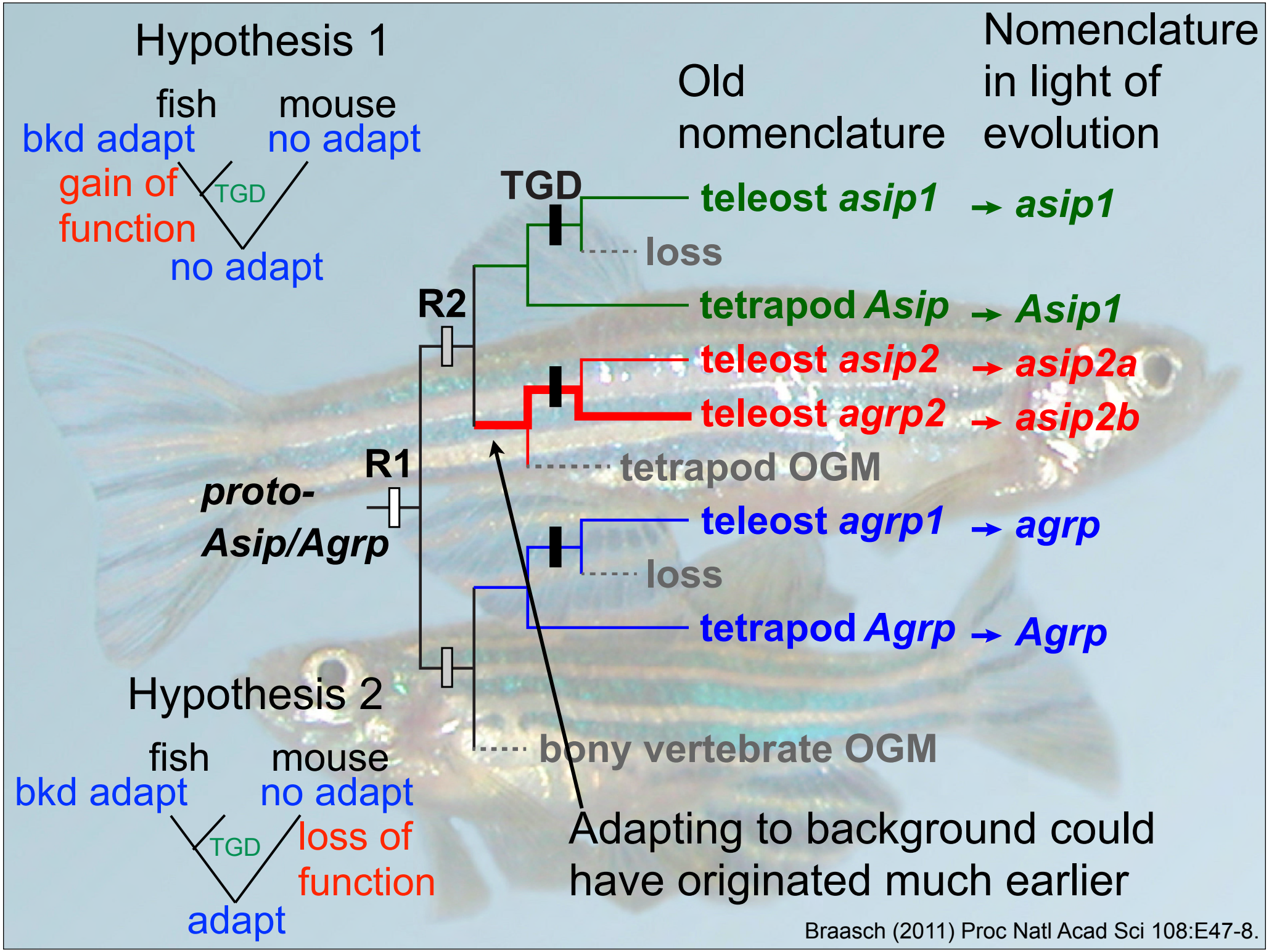
Check shared syntenies



http://teleost.cs.uoregon.edu/synteny_db/

Catchen 2009 *Genome Research*19:1497-505

Braasch (2011) Proc Natl Acad Sci 108:E47-8.


Hypothesis 1
fish
mouse
bkd adapt
no adapt
gain of function
TGD
no adapt
Old nomenclature
Nomenclature in light of evolution
TGD
teleost asip1 → asip1
loss
R2
tetrapod Asip → Asip1
teleost asip2 → asip2a
teleost agrp2 → asip2b
tetrapod OGM
R1
proto-Asip/Agrp
teleost agrp1 → agrp
loss
tetrapod Agrp → Agrp
bony vertebrate OGM
Hypothesis 2
fish
mouse
bkd adapt
no adapt
TGD
loss of function
adapt
Adapting to background could have originated much earlier
Braasch (2011) Proc Natl Acad Sci 108:E47-8.

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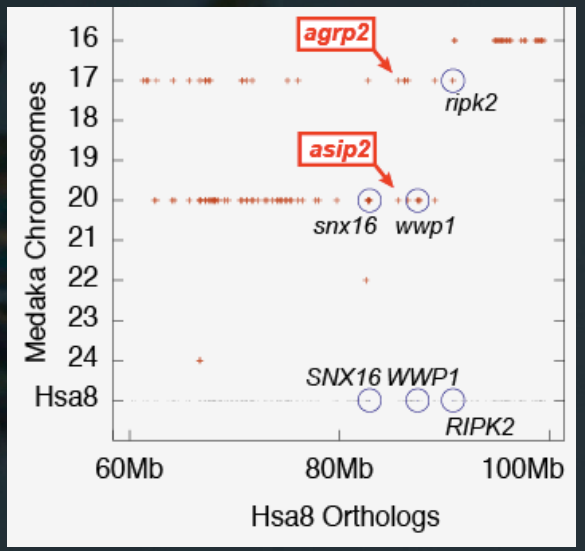
Solutions

Trees + conserved syntenies



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