Annotation and Nomenclature: A Zebrafish Example

Ingo Braasch, Julian Catchen and John Postlethwait
Annotation and Nomenclature: An Example: Zebrafish

The goal

The problem

Solutions
Annotation and Nomenclature: An Example: Zebrafish

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

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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 problem
Genome duplication
Gene losses

Solutions
Trees + conserved syntenies
The problem
Genome duplication
Gene losses

A. No gene loss

Ohnologs: paralogs from genome duplication

Susumu Ohno
The problem
Genome duplication
Gene losses

Ohnologs: paralogs from genome duplication
The problem
Genome duplication
Gene losses

A. No gene loss

B. With gene loss

Ohnologs gone missing
The problem
Genome duplication
Gene losses

B. With gene loss

C. With gene loss
The problem
Genome duplication
Gene losses

B. With gene loss

C. With gene loss

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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Teleosts can adjust to background color

Zhang found a novel agouti-related gene \textit{agrp2} necessary for background adaptation

Zhang et al. (2010) PNAS 107: they imply that this is a novel function that arose in teleosts
they imply that this is a novel function that arose in teleosts

Hypothesis 1
fish
bkd adapt
gain of function
TGD
no adapt

Hypothesis 2
fish
bkd adapt
TGD
loss of function
adapt

mouse
no adapt
Hypothesis 1

fish
bkd adapt
gain of function
TGD
no adapt
mouse
bkd adapt
no adapt

Hypothesis 2

fish
bkd adapt
TGD
loss of function
adapt
mouse
bkd adapt
TGD
no adapt

Tetrapods have 2 agouti related genes

Xenopus scaffold38
100
99
Xenopus scaffold283
98
94
Xenopus scaffold38
100
99
Human chr20
99
Mouse chr2
99
Chicken chr20
98
94
Chicken chr11
94
Human chr16
94
Mouse chr8
94

Asip

Agrp

Hypothesis 2
Tetrapods have 2 agouti related genes

Teleosts have 4

Tree suggests nomenclature problems

Hypothesis 1

fish mouse
bkd adapt no adapt

gain of function
TGD

Hypothesis 2

fish mouse
bkd adapt no adapt

loss of function
TGD

Check shared syntenies

Asip1 Asip Asip2 Asip

Agrp1 Agrp Agrp2 Agrp
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 Research19:1497-505

Adapting to background could have originated much earlier.

Hypothesis 1
- Proto-Asip/Agrp
  - Hypothesis 1: fish bkd adapt, mouse no adapt

Old nomenclature in light of evolution
- Teleost asip1 $\rightarrow$ asip1

Hypothesis 2
- Proto-Asip/Agrp
  - Hypothesis 2: fish bkd adapt, mouse no adapt

Bony vertebrate OGM
- Loss of function

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