How many bases is that? ITS2 rDNA and ND1 mtDNA sequence diversity of gyliauchenid trematodes across the Indo-West Pacific

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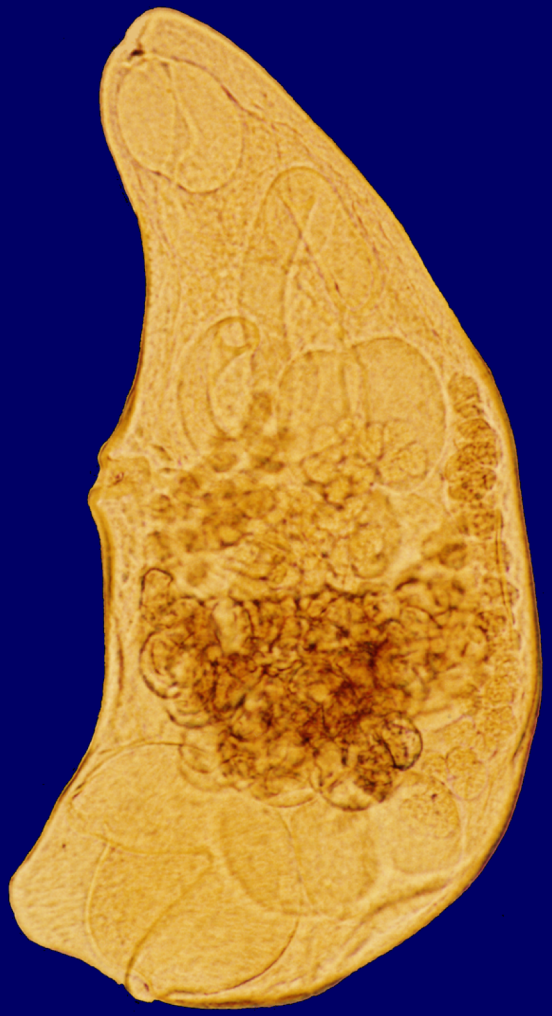
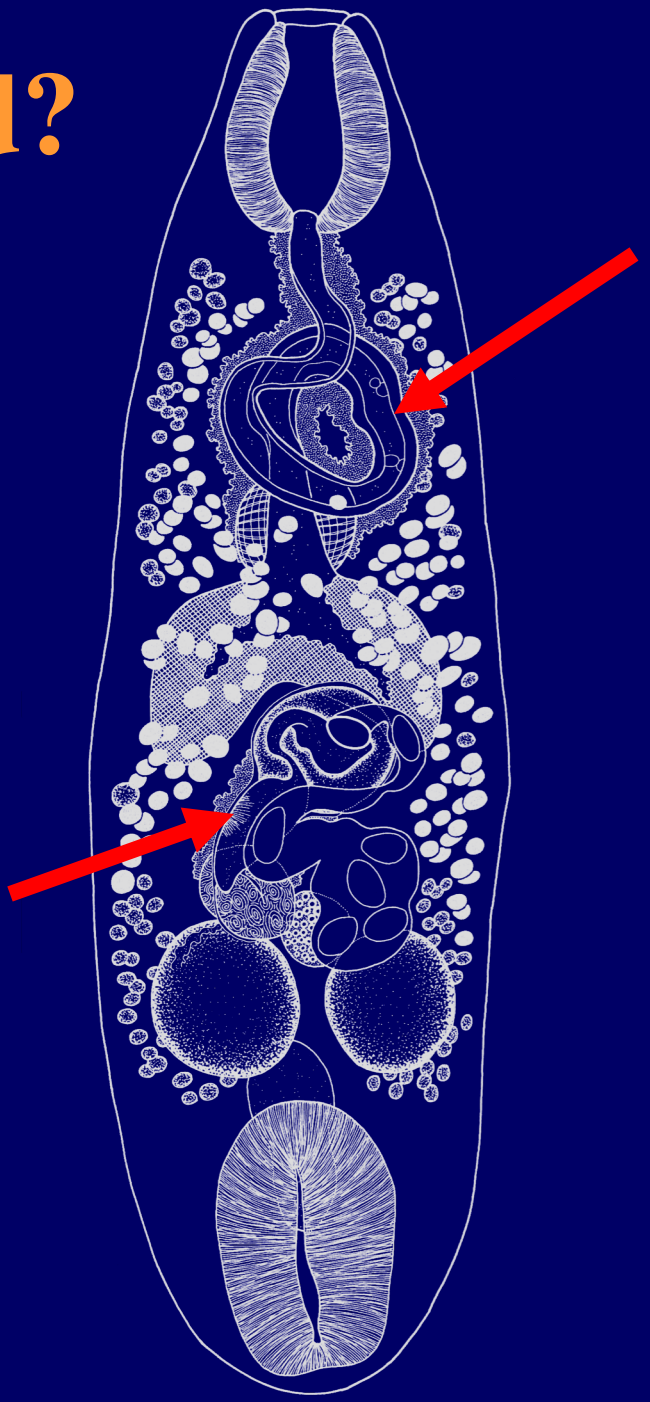
2. *Department of Microbiology and Parasitology, The University of Queensland, Australia.*



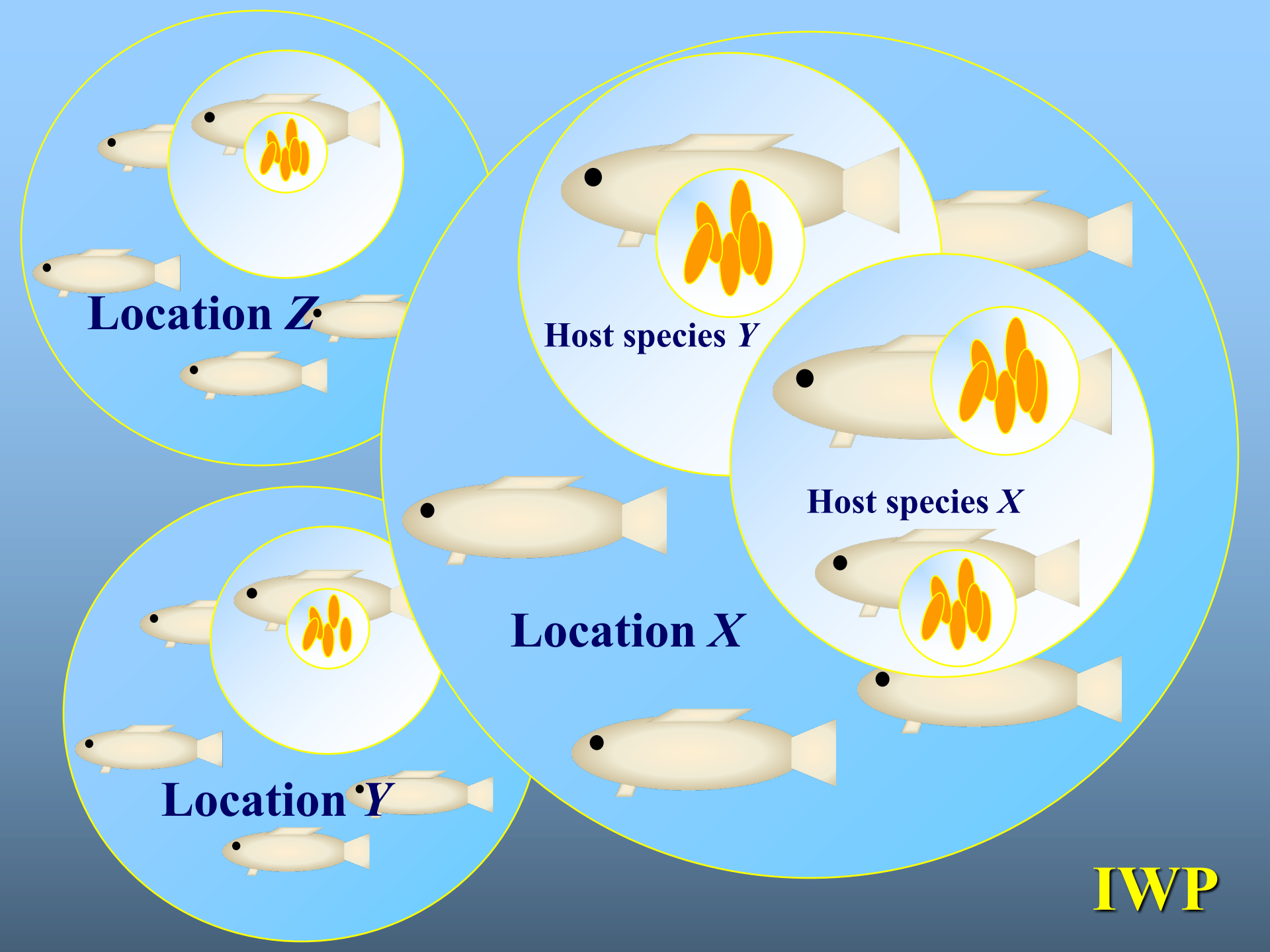
What is a gyliauchenid?

- Platyhelminthes, Digenea
- Indo-West Pacific distribution
- herbivorous fishes
- > 60 spp. in 16 genera
- defined by unusual specialisations of male genitalia and digestive tract



"Gyliauchenid Genome Project"

- aims to assess genetic diversity of gyliauchenids across IWP
- material from Japan, Lizard Island, Heron Island, Ningaloo, New Caledonia and Palau
- DNA extracted from 414 individual worms from 93 collection events (= 1 host at 1 location)
- 6 replicates per collection event (where possible)
- sequence rapidly evolving loci:
  ND1 mtDNA and ITS rDNA regions


Location Z
Host species Y
Host species X
Location X
Location Y
IWP


禁煙

Host-Location Combinations

			Location								
Host Family	Host Genus	Host Species	Heron Island	Kyushu	Lizard Island	New Caledonia	Ningaloo	Okinawa	Palau	Yaeyama	Grand Total
Acanthuridae	Zebrasoma	scopas	1		6						7
	Zebrasoma Total		1		6						7
Acanthuridae Total			1		6						7
Chaetodontidae	Chaetodon	citrinellus							1		1
		kleinii							3		3
	Chaetodon Total								4		4
Chaetodontidae Total									4		4
Pomacanthidae	Centropyge	vrolikii			2						2
	Centropyge Total				2						2
	Chaetodontoplus	meredithi	5								5
	Chaetodontoplus Total		5								5
	Pomacanthus	sexstriatus			6	2					8
	Pomacanthus Total				6	2					8
Pomacanthidae Total			5		8	2					15
Scaridae	Chlorurus	microrhinos			6	1					7
	Chlorurus Total				6	1					7
	Scarus	rivulatus			3						3
	Scarus Total				3						3
Scaridae Total					9	1					10
Siganidae	Siganus	argenteus			9			11	11		31
		canaliculatus				6					6
		corallinus			29			2	11		42
		doliatus				6			14		20
		fuscescens		61	9			18		6	94
		guttatus						2			2
		lineatus			16						16
		puellus	3		12				6		21
		punctatissimus			17				6		23
		punctatus	6		6			10	5		27
		spinus							12		12
		trispilos					12				12
		unimaculatus						16			16
		virgatus					10	16			26
		vulpinus			24				5		29
	Siganus Total		9	61	122	12	22	75	70	6	377
Siganidae Total			9	61	122	12	22	75	70	6	377
Zanclidae	Zanclus	cornutus	1								1
	Zanclus Total		1								1
Zanclidae Total			1								1
Grand Total			16	61	145	15	22	75	74	6	414

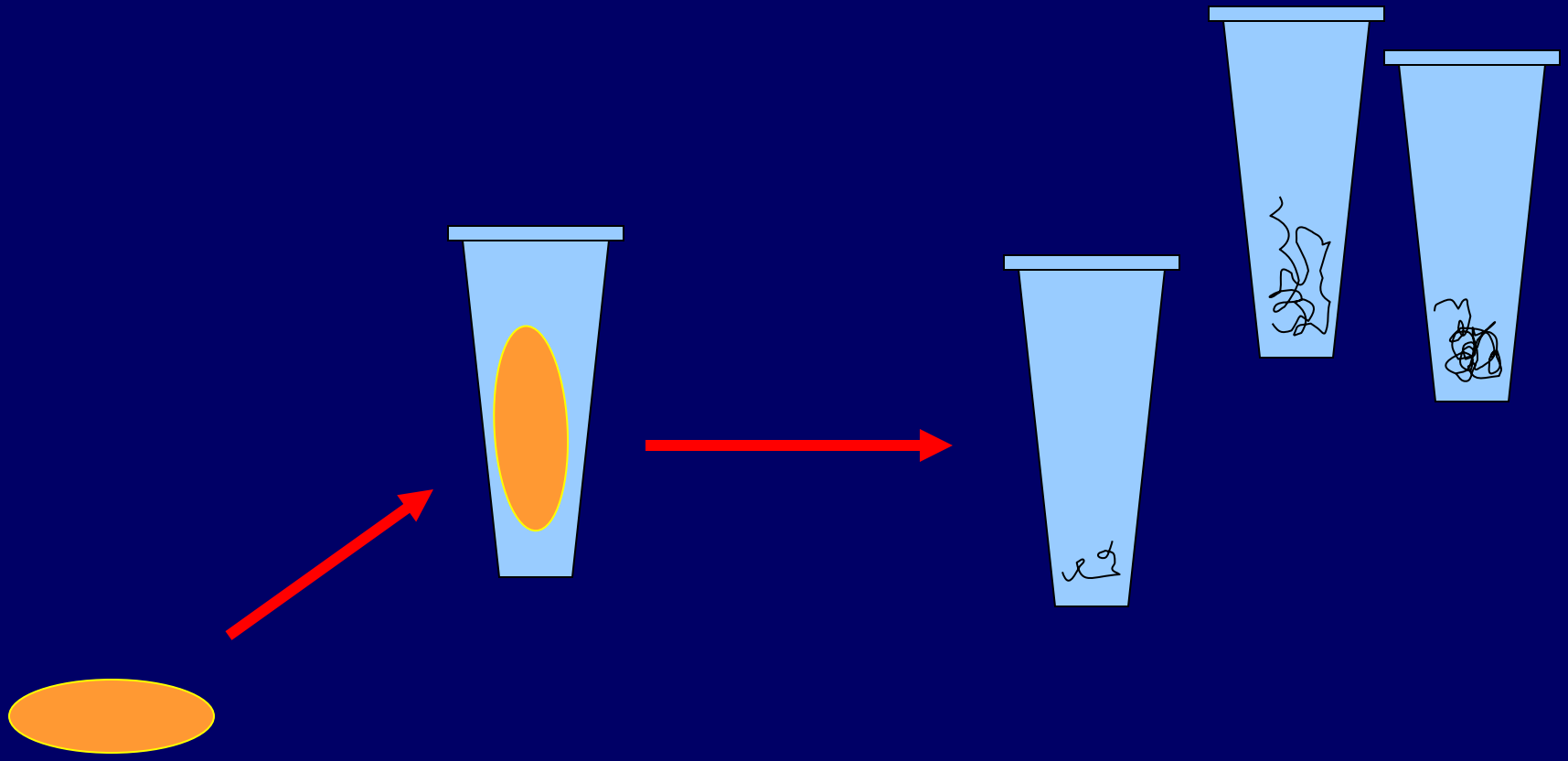
Host-Location Combinations

Host Family	Host Genus	Host Species	Location Heron Island	Kyushu	Lizard Island	New Caledonia	Ningaloo	Okinawa	Palau	Yaeyama	Grand Total
Acanthuridae	Zebrasoma	scopas	1		6						7
	Zebrasoma Total		1		6						7
Acanthuridae Total			1		6						7
Chaetodontidae	Chaetodon	citrinellus							1		1
		kleinii							3		3
	Chaetodon Total								4		4
Chaetodontidae Total									4		4
Pomacanthidae	Centropyge	vrolikii			2						2
	Centropyge Total				2						2
	Chaetodontoplus	meredithi	5								5
	Chaetodontoplus Total		5								5
	Pomacanthus	sexstriatus			6	2					8
	Pomacanthus Total				6	2					8
Pomacanthidae Total			5		8	2					15
Scaridae	Chlorurus	microrhinos			6	1					7
	Chlorurus Total				6	1					7
	Scarus	rivulatus			3						3
	Scarus Total				3						3
Scaridae Total					9	1					10
Siganidae	Siganus	argenteus			9			11	11		31
		canaliculatus				6					6
		corallinus			29			2	11		42
		doliatus				6			14		20
		fuscescens		61	9			18		6	94
		guttatus						2			2
		lineatus			16						16
		puellus	3		12				6		21
		punctatissimus			17				6		23
		punctatus	6		6			10	5		27
		spinus							12		12
		trispilos					12				12
		unimaculatus						16			16
		virgatus					10	16			26
		vulpinus			24				5		29
	Siganus Total		9	61	122	12	22	75	70	6	377
Siganidae Total			9	61	122	12	22	75	70	6	377
Zanclidae	Zanclus	cornutus	1								1
	Zanclus Total		1								1
Zanclidae Total			1								1
Grand Total			16	61	145	15	22	75	74	6	414

Grand total = 414

			Heron Island	Lizard Island	Ningaloo	New Caledonia	Palau	Okinawa	Kyushu	Yaeyama
Acanthuridae	*Zebrasoma*	*scopas*	•	•						
Chaetodontidae	*Chaetodon*	*citrinellus*					•			
		kleinii					•			
Pomacanthidae	*Centropyge*	*vrolikii*		•						
	Chaetodontoplus	*meredithi*	•							
	Pomacanthus	*sexstriatus*		•		•				
Scaridae	*Chlorurus*	*microrhinos*		•		•				
	Scarus	*rivulatus*		•						
Siganidae	*Siganus*	*argenteus*		•			•	•		
		canaliculatus				•				
		corallinus		•			•	•		
		doliatus				•	•			
		fuscescens		•				•	•	•
		guttatus						•		
		lineatus		•						
		puellus	•	•			•			
		punctatissimus		•			•			
		punctatus	•	•			•	•		
		spinus					•			
		trispilos			•					
		unimaculatus						•		
		virgatus			•			•		
		vulpinus		•			•			
Zanclidae	*Zanclus*	*cornutus*	•							

43 unique host/location combinations

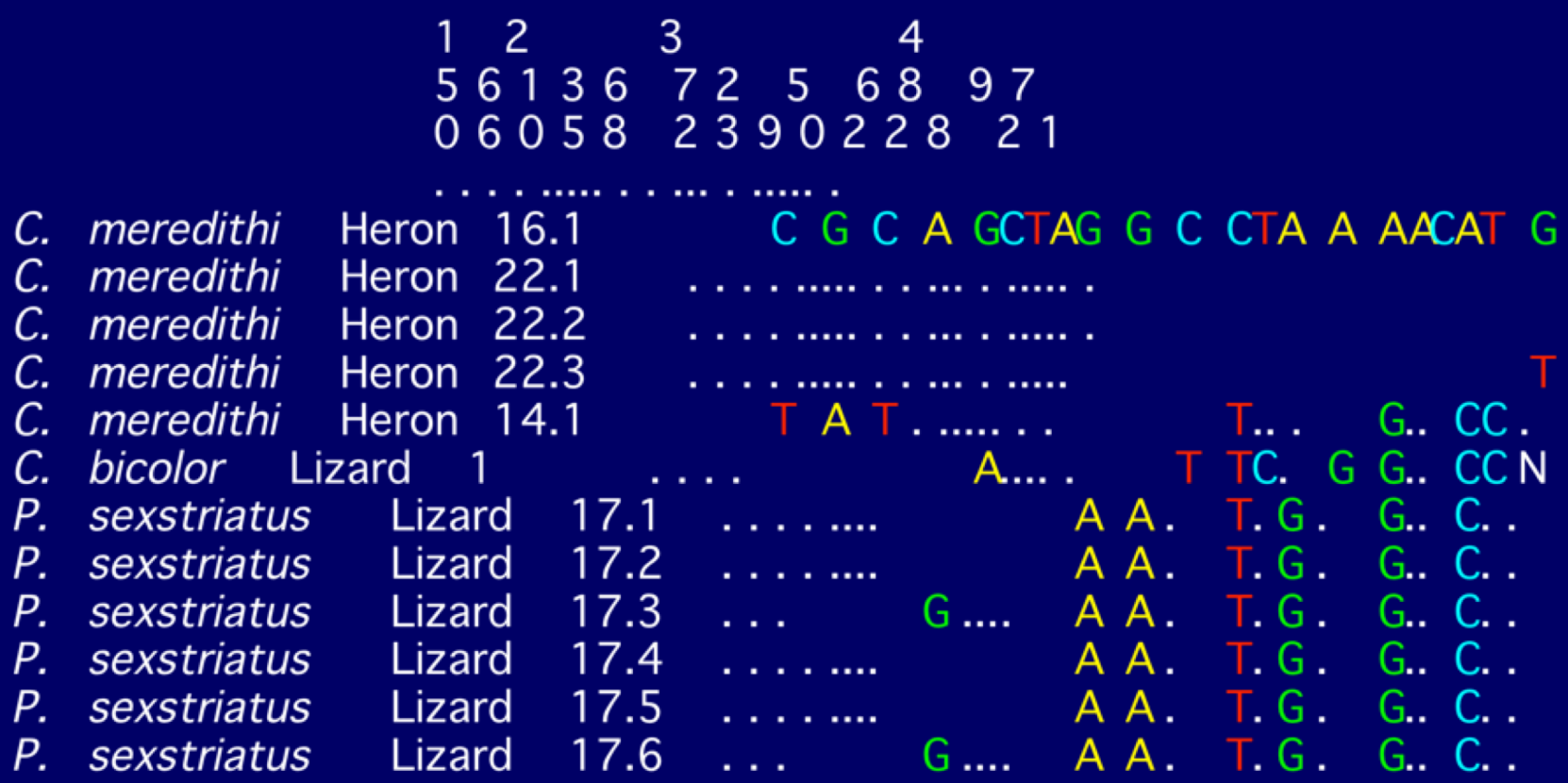


whole worm in
90% EtOH

ND1 mtDNA

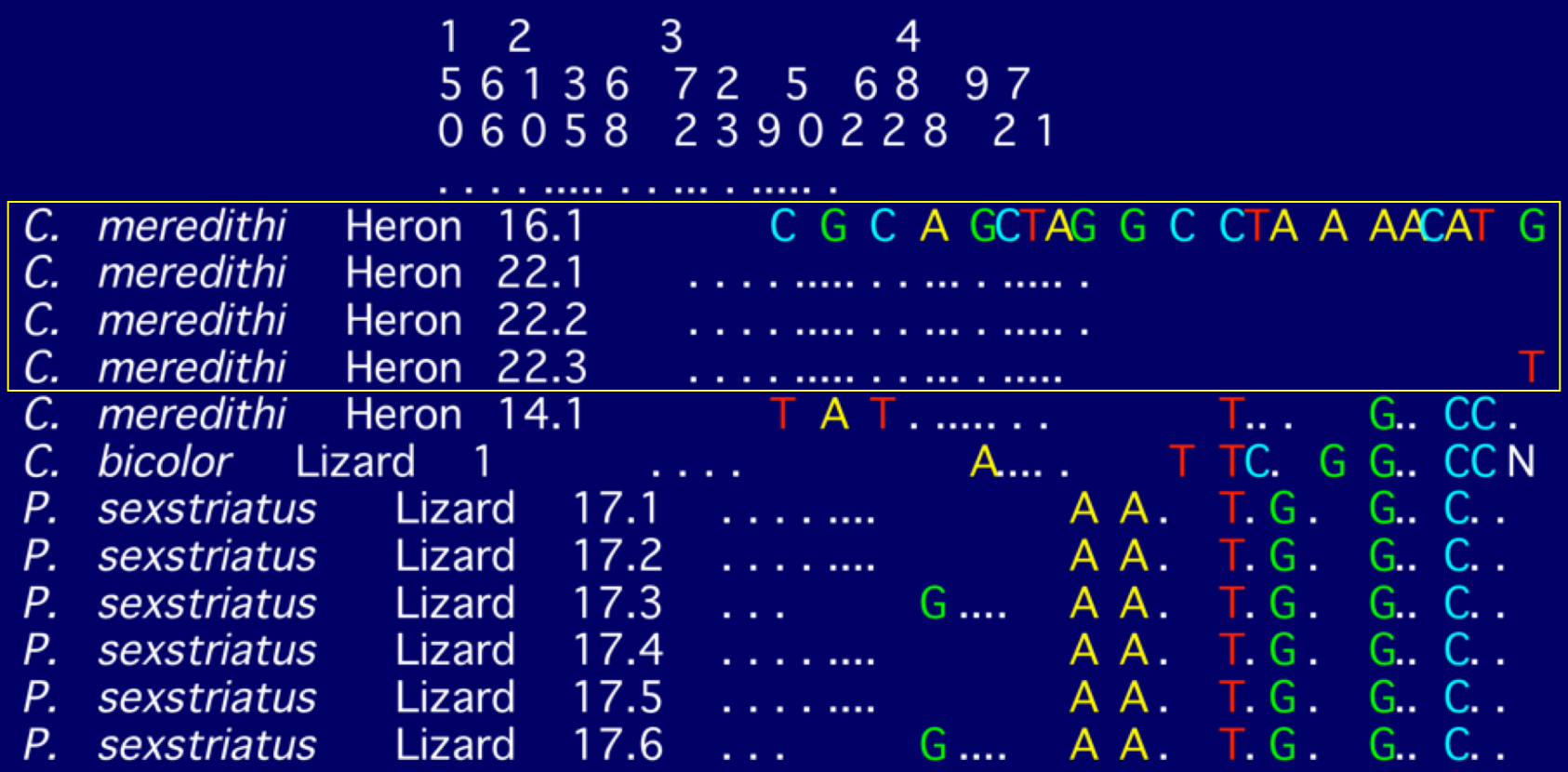
ITS2 rDNA

28S (D1-D3) rDNA



ITS2 rDNA ~ 475 bp

samples from pomacanthid fishes of the GBR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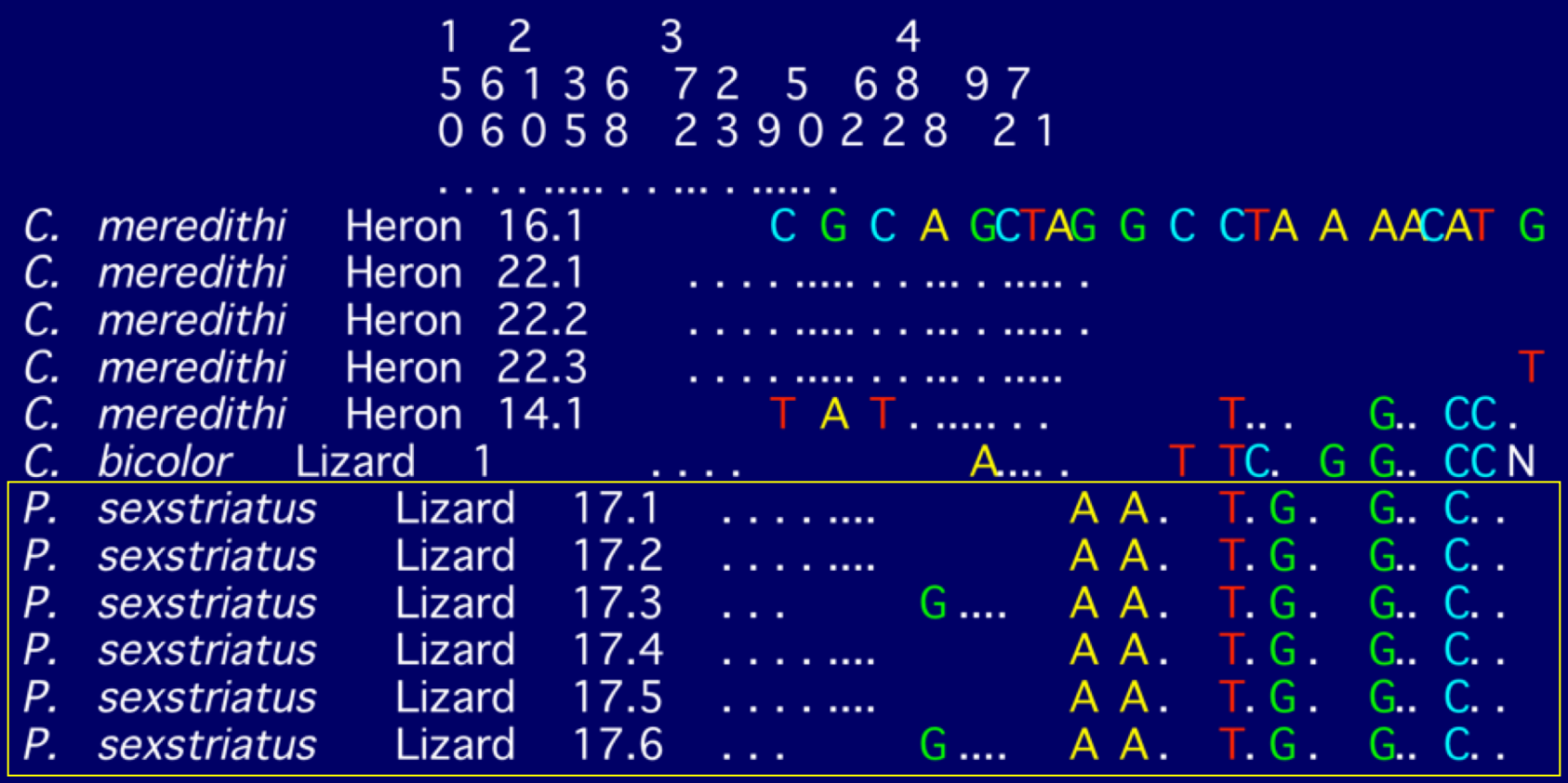
5 6 1 3 6 7 2 5 6 8 9 7
0 6 0 5 8 2 3 9 0 2 2 8 2 1
. . . .
C. meredithi Heron 16.1 C G C A GCTAG G C CTA A AACAT G
C. meredithi Heron 22.1 . . . .
C. meredithi Heron 22.2 . . . .
C. meredithi Heron 22.3 . . . . T
C. meredithi Heron 14.1 T A T . ... T.. . G.. CC .
C. bicolor Lizard 1 . . . . A.... . T TC. G G.. CC N
P. sexstriatus Lizard 17.1 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.2 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.3 . . . G .... A A . T. G . G.. C. .
P. sexstriatus Lizard 17.4 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.5 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.6 . . . G .... A A . T. G . G.. C. .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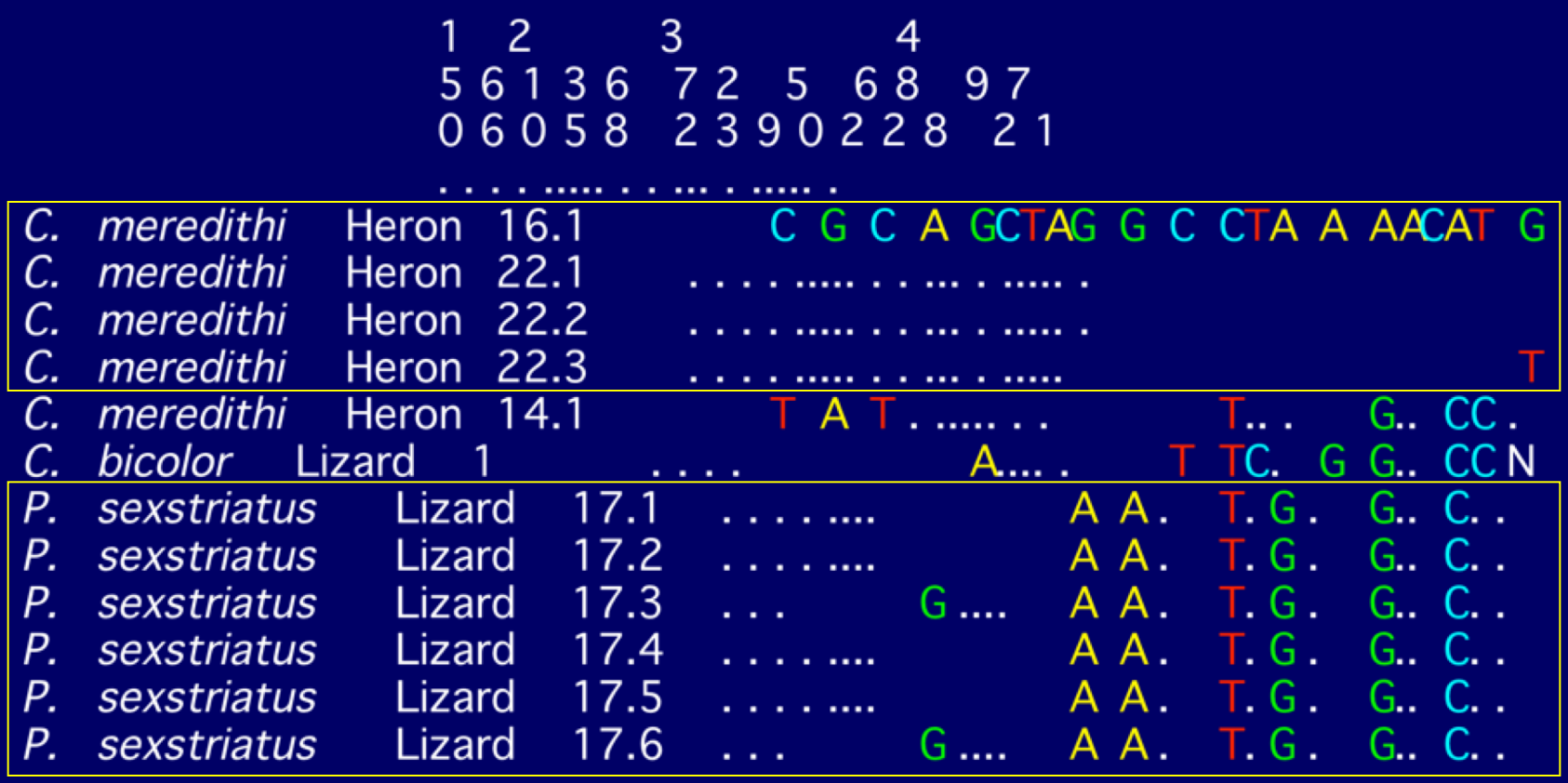
5 6 1 3 6 7 2 5 6 8 9 7
0 6 0 5 8 2 3 9 0 2 2 8 2 1
. . . .
C. meredithi Heron 16.1 C G C A GCTAG G C CTA A AACAT G
C. meredithi Heron 22.1 . . . .
C. meredithi Heron 22.2 . . . .
C. meredithi Heron 22.3 . . . . T
C. meredithi Heron 14.1 T A T . ... T.. . G.. CC .
C. bicolor Lizard 1 . . . . A.... . T TC. G G.. CC N
P. sexstriatus Lizard 17.1 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.2 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.3 . . . G .... A A . T. G . G.. C. .
P. sexstriatus Lizard 17.4 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.5 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.6 . . . G .... A A . T. G . G.. C. .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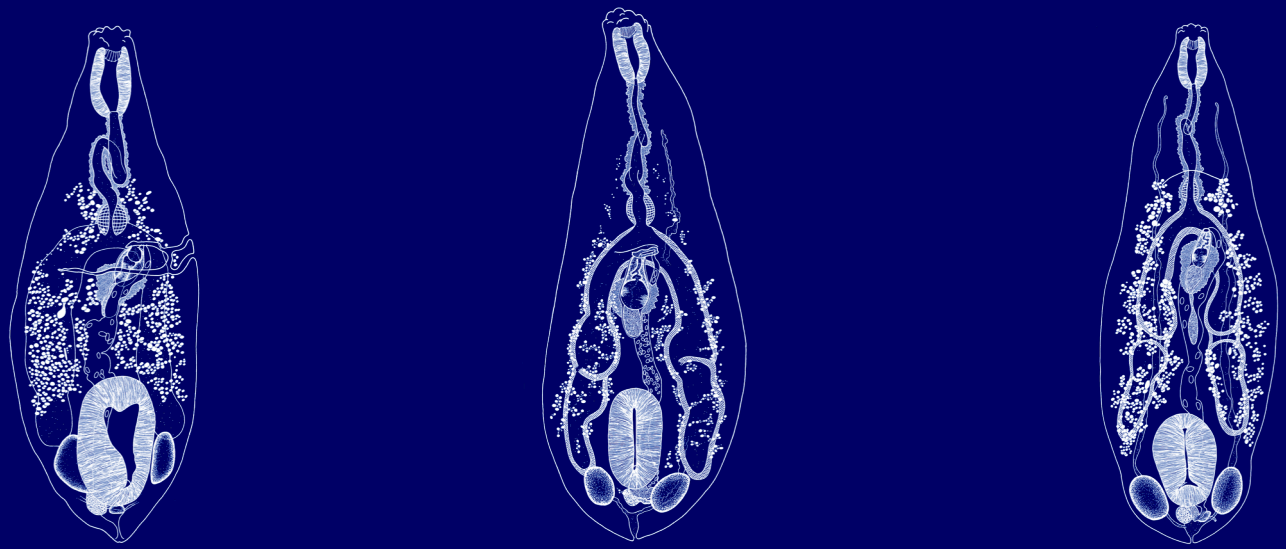
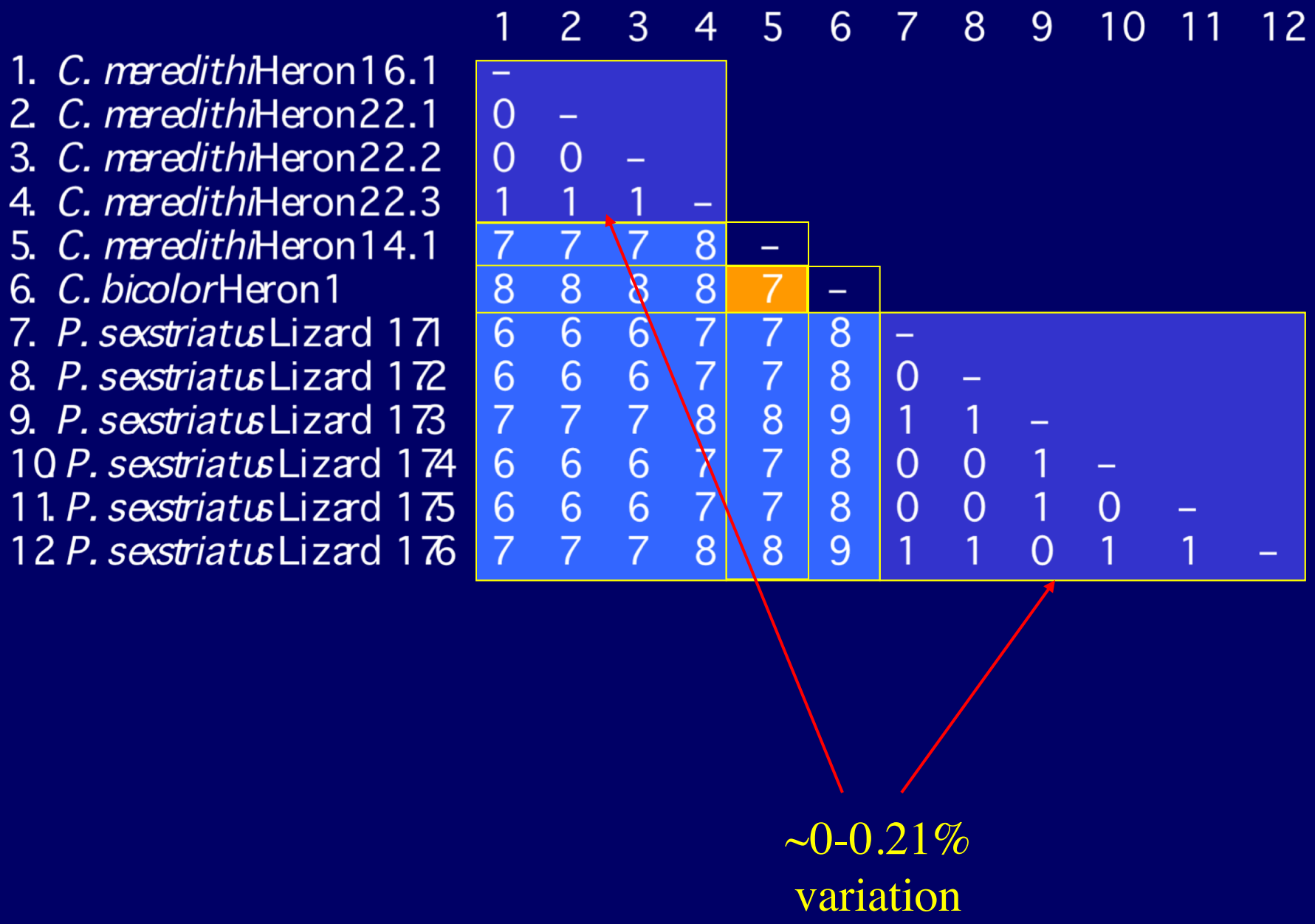
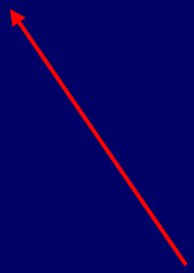
5 6 1 3 6 7 2 5 6 8 9 7
0 6 0 5 8 2 3 9 0 2 2 8 2 1
. . . .
C. meredithi Heron 16.1 C G C A GCTAG G C CTA A AACAT G
C. meredithi Heron 22.1 . . . .
C. meredithi Heron 22.2 . . . .
C. meredithi Heron 22.3 . . . . T
C. meredithi Heron 14.1 T A T . ... T.. . G.. CC .
C. bicolor Lizard 1 . . . . A.... . T TC. G G.. CC N
P. sexstriatus Lizard 17.1 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.2 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.3 . . . G .... A A . T. G . G.. C. .
P. sexstriatus Lizard 17.4 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.5 . . . . A A . T. G . G.. C. .
P. sexstriatus Lizard 17.6 . . . G .... A A . T. G . G.. C. .

	1	2	3	4	5	6	7	8	9	10	11	12
1. *C. meredithi* Heron 16.1	–											
2. *C. meredithi* Heron 22.1	0	–										
3. *C. meredithi* Heron 22.2	0	0	–									
4. *C. meredithi* Heron 22.3	1	1	1	–								
5. *C. meredithi* Heron 14.1	7	7	7	8	–							
6. *C. bicolor* Heron 1	8	8	8	8	7	–						
7. *P. sexstriatus* Lizard 17 1	6	6	6	7	7	8	–					
8. *P. sexstriatus* Lizard 17 2	6	6	6	7	7	8	0	–				
9. *P. sexstriatus* Lizard 17 3	7	7	7	8	8	9	1	1	–			
10. *P. sexstriatus* Lizard 17 4	6	6	6	7	7	8	0	0	1	–		
11. *P. sexstriatus* Lizard 17 5	6	6	6	7	7	8	0	0	1	0	–	
12. *P. sexstriatus* Lizard 17 6	7	7	7	8	8	9	1	1	0	1	1	–

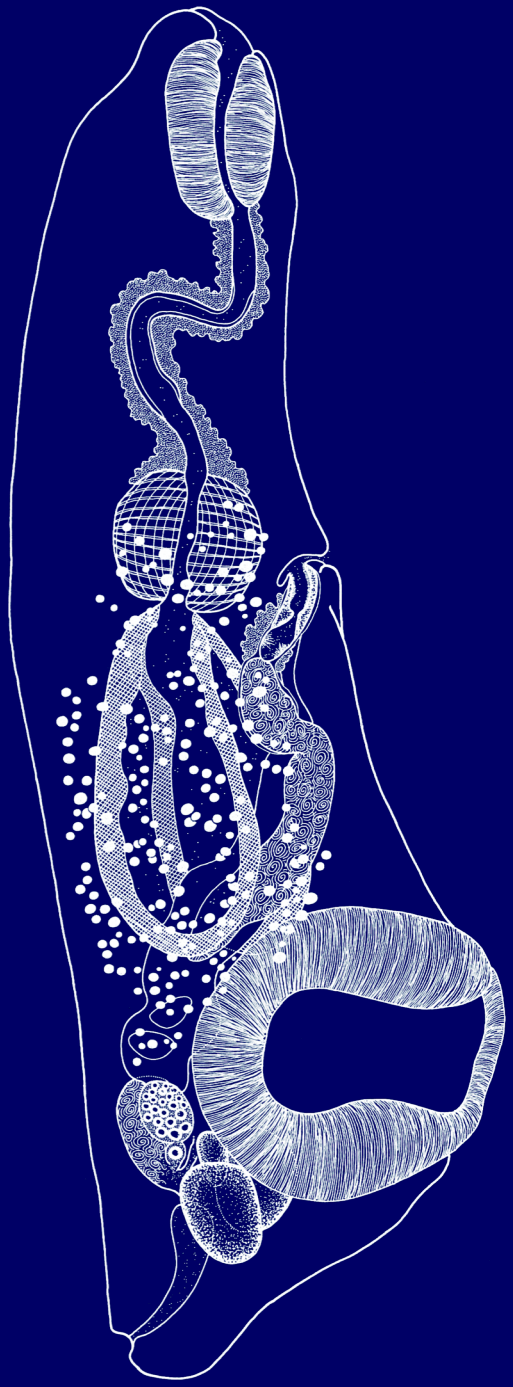



1 2 3 4 5 6 7 8 9 10 11 12
1. C. meredithi Heron16.1 –
2. C. meredithi Heron22.1 0 –
3. C. meredithi Heron22.2 0 0 –
4. C. meredithi Heron22.3 1 1 1 –
5. C. meredithi Heron14.1 7 7 7 8 –
6. C. bicolor Heron1 8 8 8 8 7 –
7. P. sexstriatus Lizard 171 6 6 6 7 7 8 –
8. P. sexstriatus Lizard 172 6 6 6 7 7 8 0 –
9. P. sexstriatus Lizard 173 7 7 7 8 8 9 1 1 –
10. P. sexstriatus Lizard 174 6 6 6 7 7 8 0 0 1 –
11. P. sexstriatus Lizard 175 6 6 6 7 7 8 0 0 1 0 –
12. P. sexstriatus Lizard 176 7 7 7 8 8 9 1 1 0 1 1 –
~0-0.21% variation

	1	2	3	4	5	6	7	8	9	10	11	12
1. *C. meredithi* Heron 16.1	–											
2. *C. meredithi* Heron 22.1	0	–										
3. *C. meredithi* Heron 22.2	0	0	–									
4. *C. meredithi* Heron 22.3	1	1	1	–								
5. *C. meredithi* Heron 14.1	7	7	7	8	–							
6. *C. bicolor* Heron 1	8	8	8	8	7	–						
7. *P. sexstriatus* Lizard 171	6	6	6	7	7	8	–					
8. *P. sexstriatus* Lizard 172	6	6	6	7	7	8	0	–				
9. *P. sexstriatus* Lizard 173	7	7	7	8	8	9	1	1	–			
10 *P. sexstriatus* Lizard 174	6	6	6	7	7	8	0	0	1	–		
11. *P. sexstriatus* Lizard 175	6	6	6	7	7	8	0	0	1	0	–	
12. *P. sexstriatus* Lizard 176	7	7	7	8	8	9	1	1	0	1	1	–



~1.26-1.89%
difference



C. meredithi Heron 16.1

C. meredithi Heron 22.1

C. meredithi Heron 22.2

C. meredithi Heron 22.3

C. meredithi Heron 14.

C. bicolor Lizard 1

P. sexstriatus Lizard 17.1

P. sexstriatus Lizard 17.2

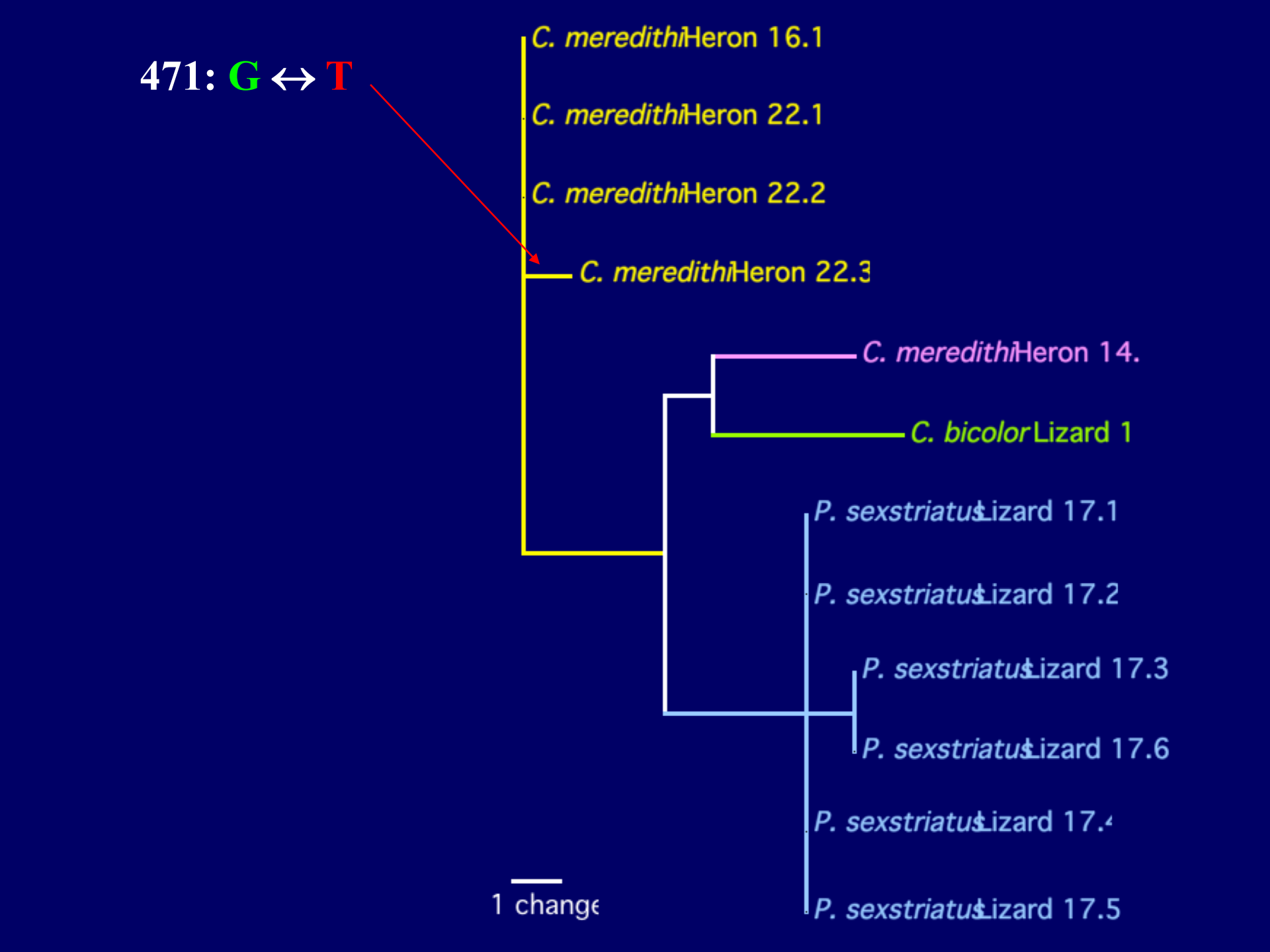
P. sexstriatus Lizard 17.3

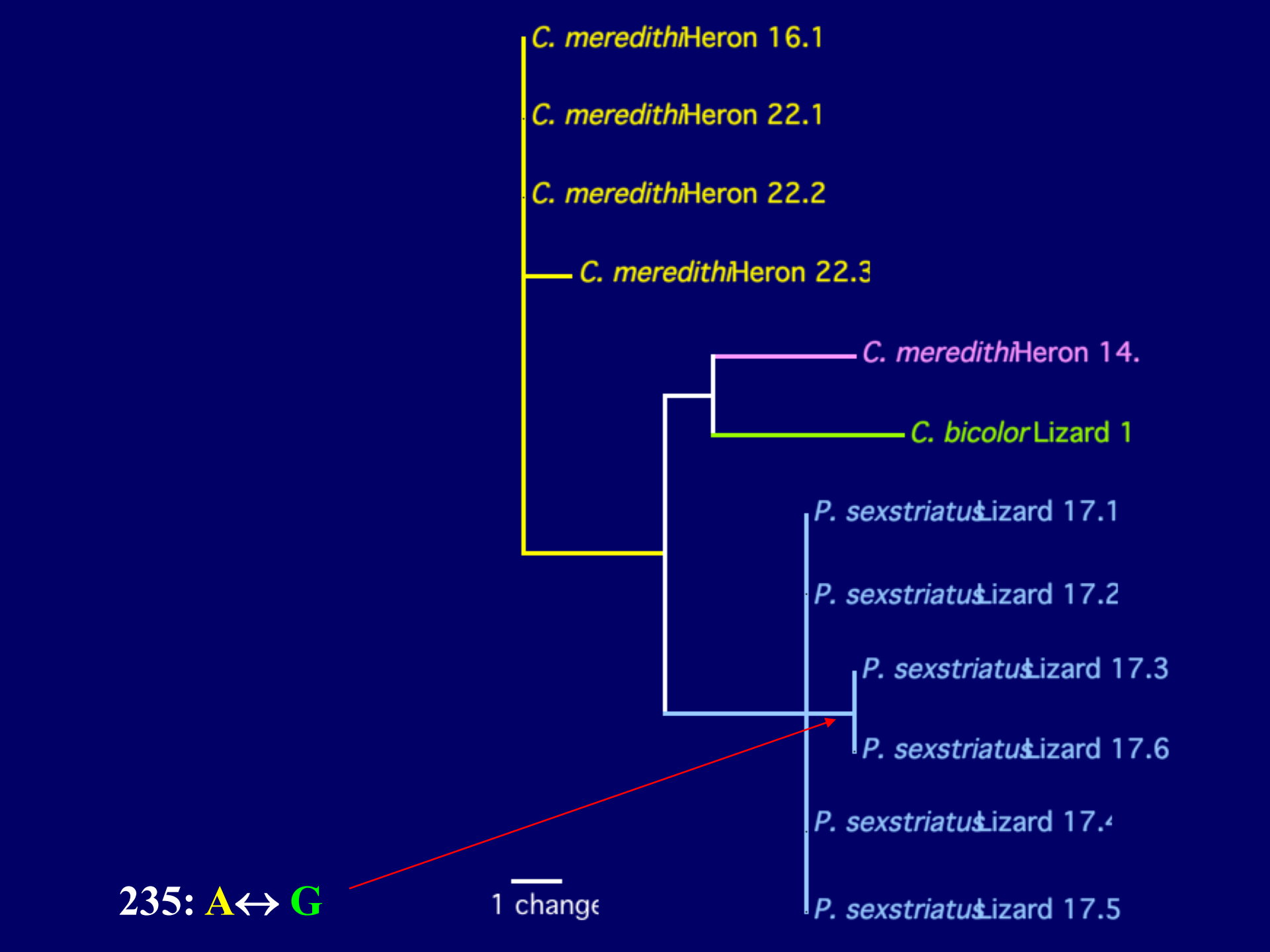
P. sexstriatus Lizard 17.6

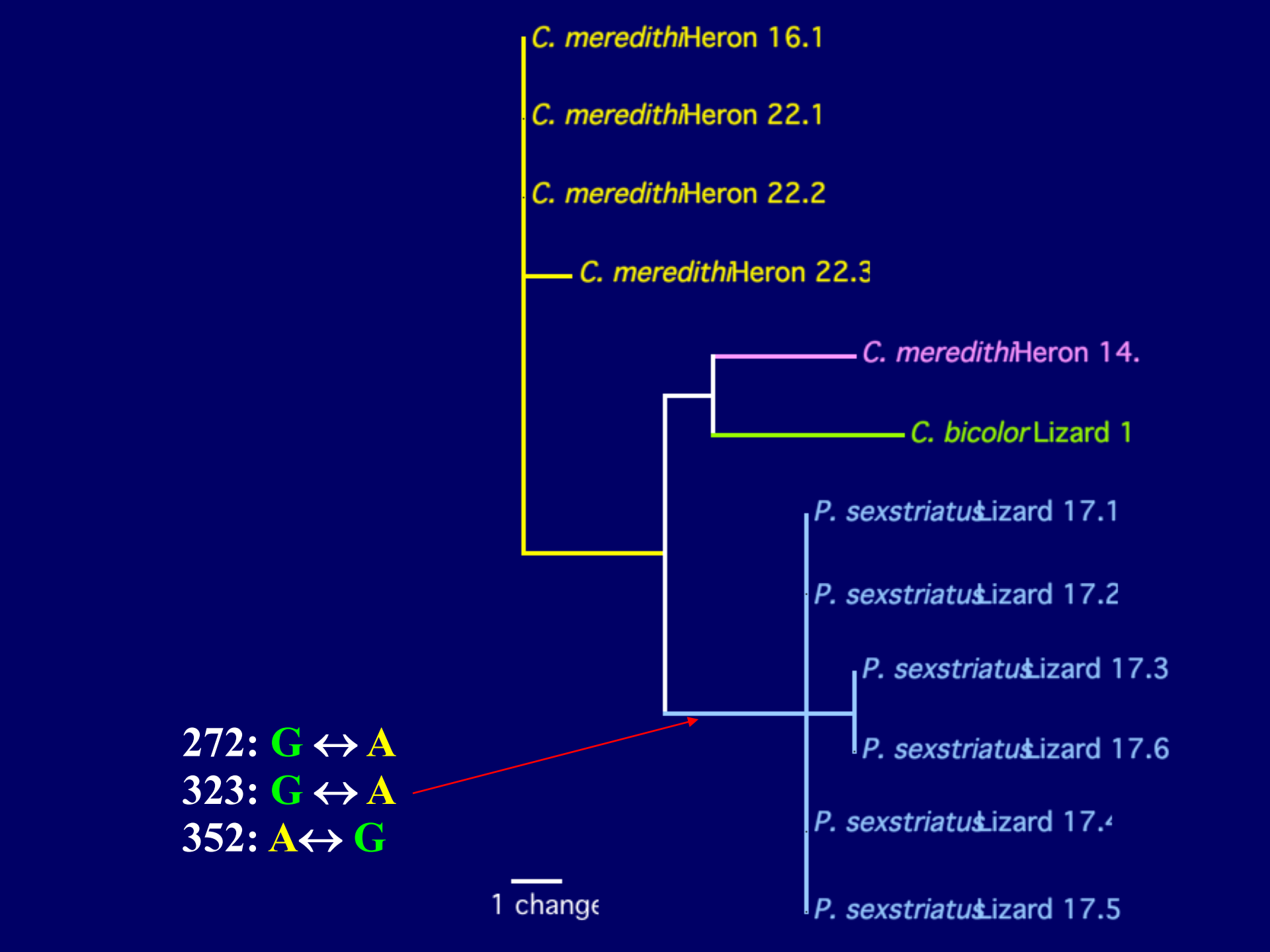
P. sexstriatus Lizard 17.4

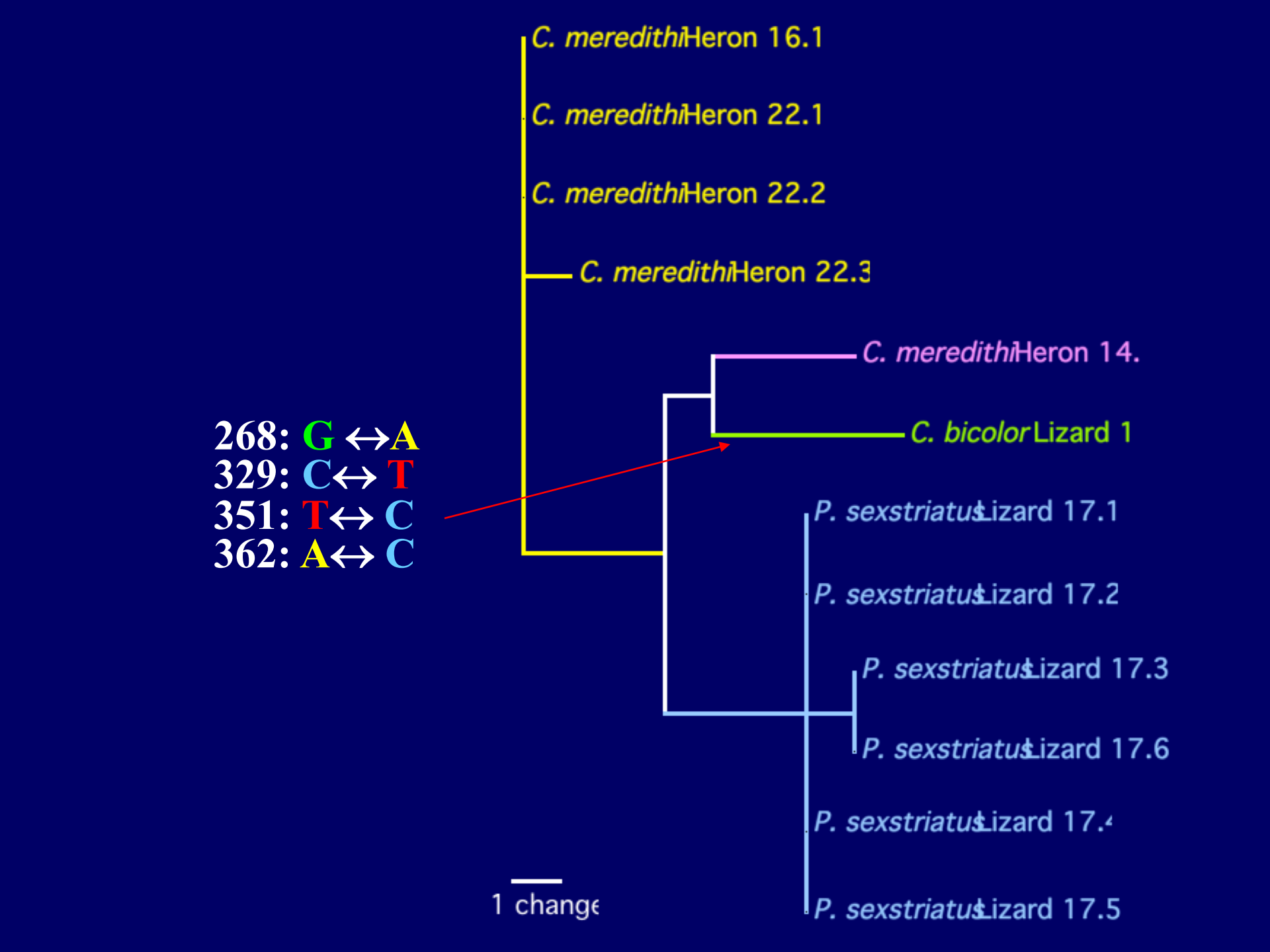
P. sexstriatus Lizard 17.5

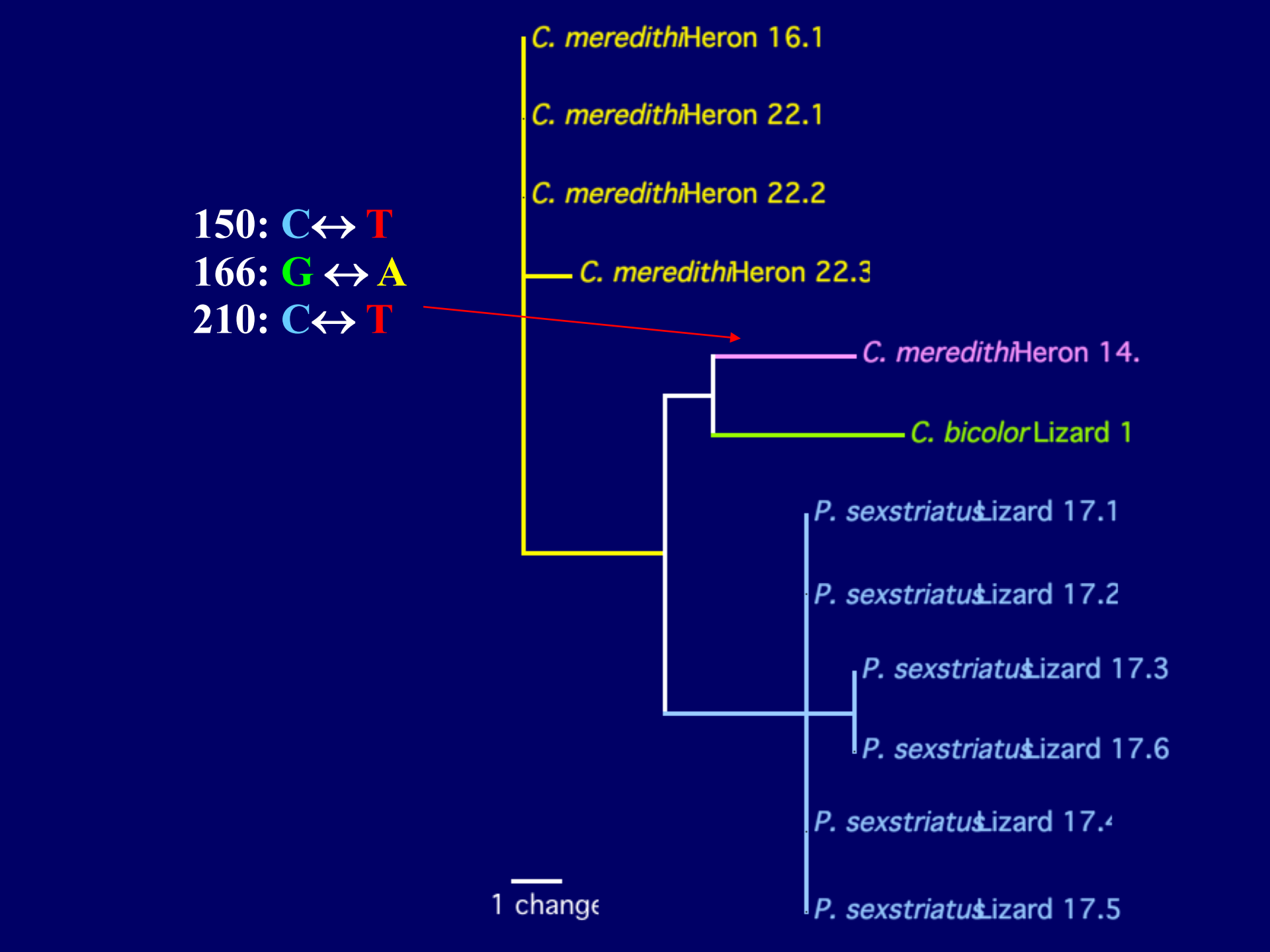
1 change

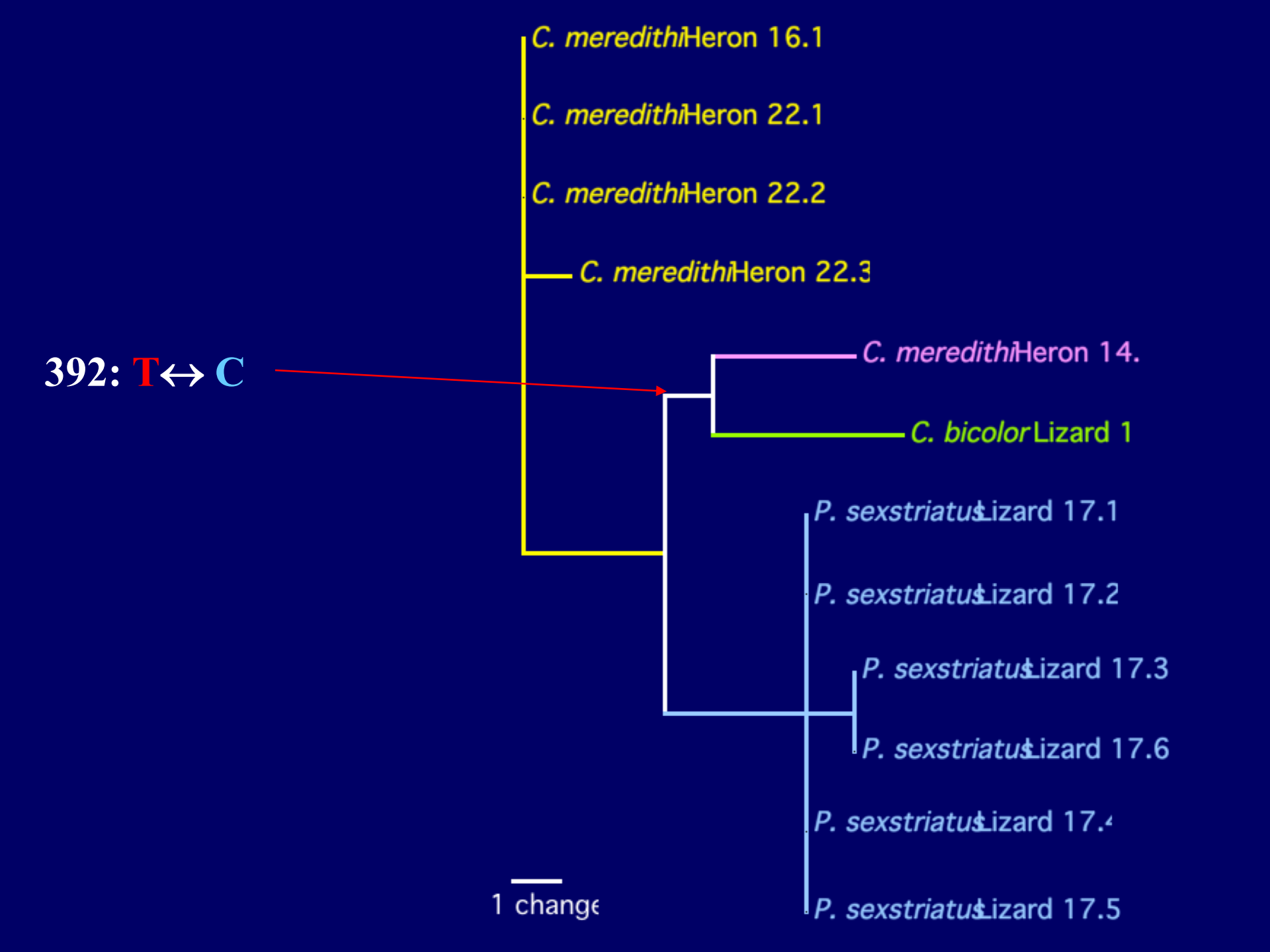

471: G ↔ T
C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change

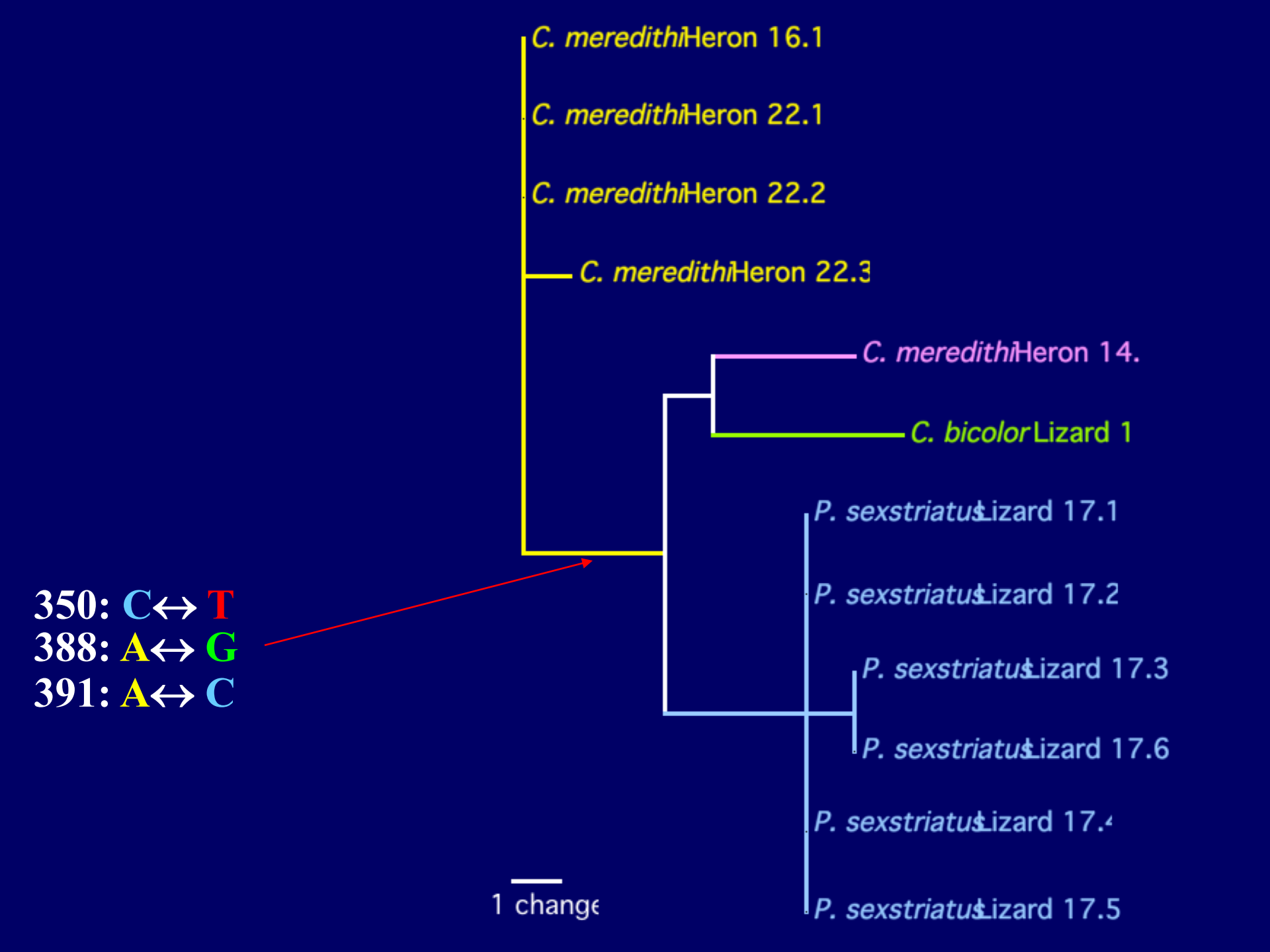

C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change
235: A↔ G

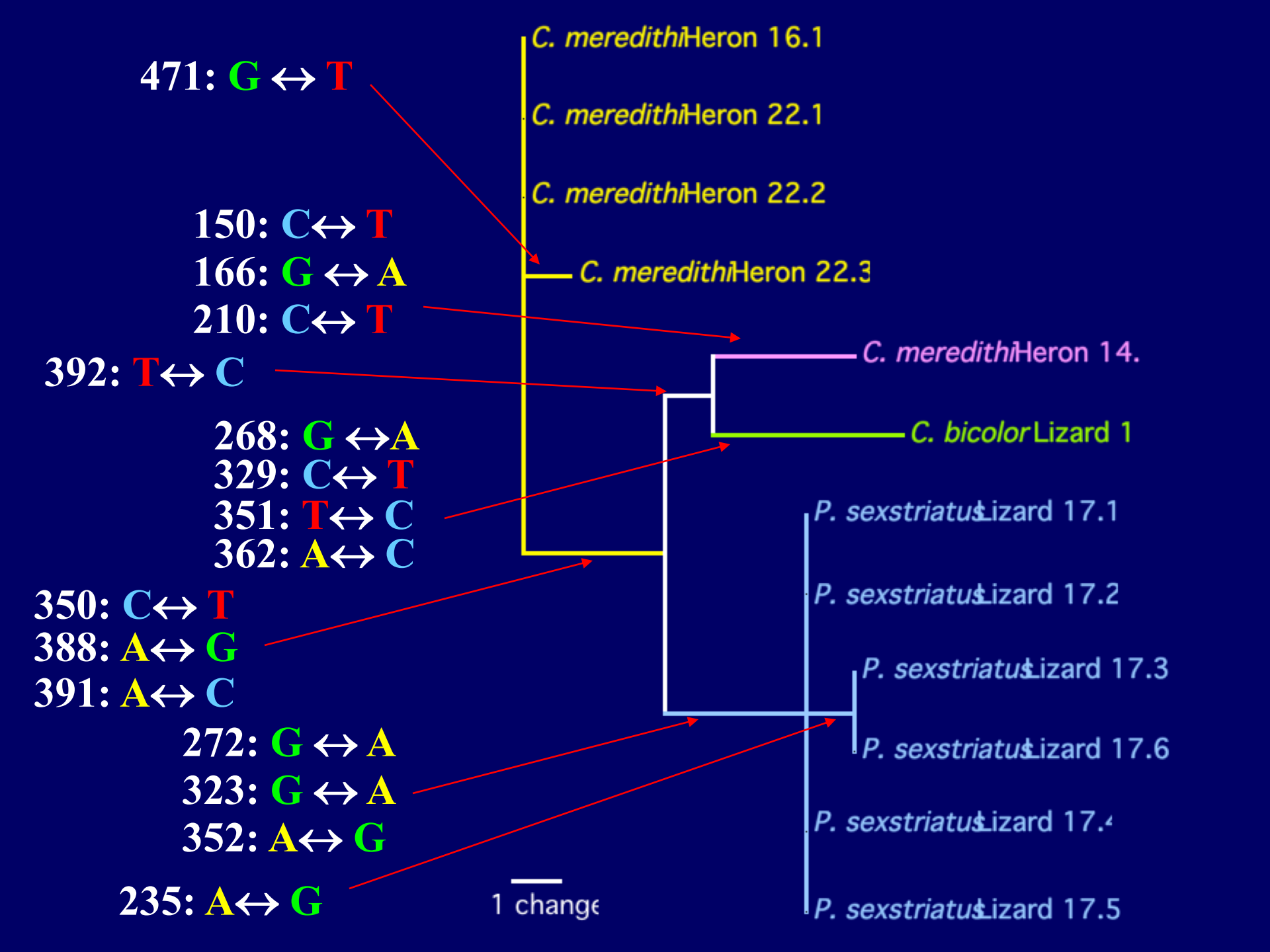

C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
272: G ↔ A
323: G ↔ A
352: A ↔ G
1 change

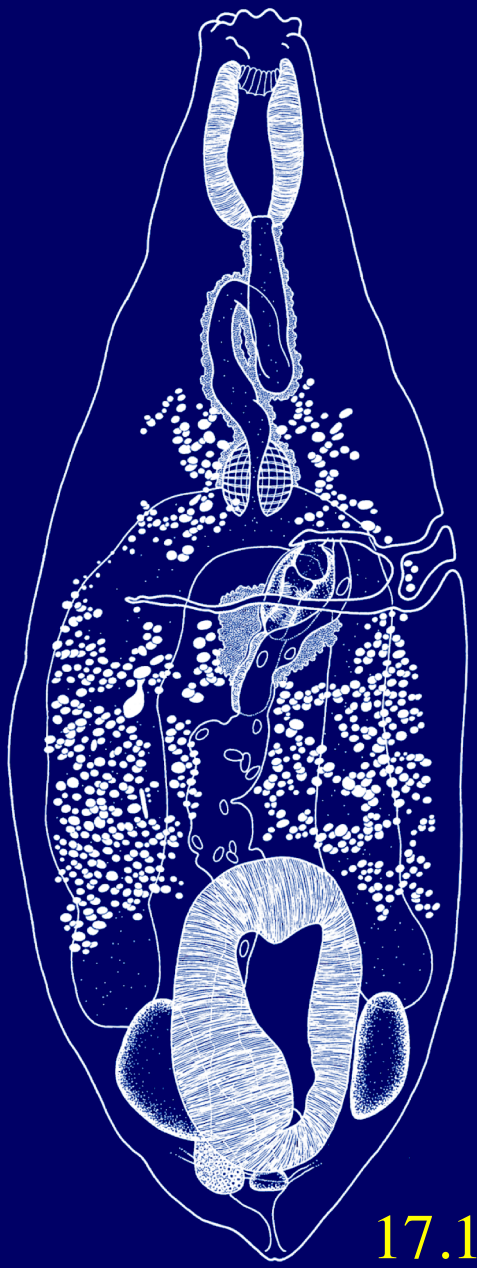

C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
268: G ↔A
329: C↔ T
351: T↔ C
362: A↔ C
1 change


150: C↔ T
166: G ↔ A
210: C↔ T
C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change


392: T↔ C
C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change


C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change
350: C↔ T
388: A↔ G
391: A↔ C

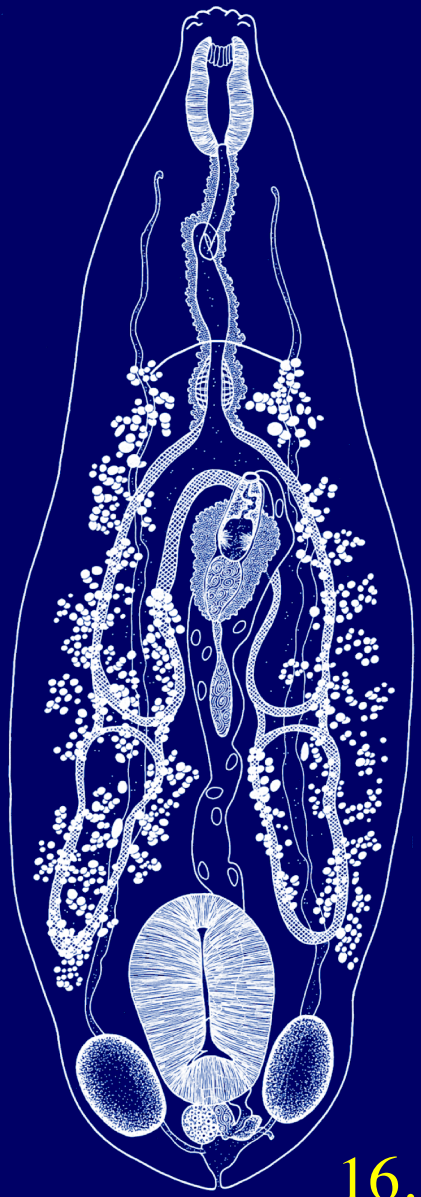

471: G ↔ T
150: C↔ T
166: G ↔ A
210: C↔ T
392: T↔ C
268: G ↔A
329: C↔ T
351: T↔ C
362: A↔ C
350: C↔ T
388: A↔ G
391: A↔ C
272: G ↔ A
323: G ↔ A
352: A↔ G
235: A↔ G
C. meredithiHeron 16.1
C. meredithiHeron 22.1
C. meredithiHeron 22.2
C. meredithiHeron 22.3
C. meredithiHeron 14.
C. bicolorLizard 1
P. sexstriatusLizard 17.1
P. sexstriatusLizard 17.2
P. sexstriatusLizard 17.3
P. sexstriatusLizard 17.6
P. sexstriatusLizard 17.4
P. sexstriatusLizard 17.5
1 change



17.1-17.6

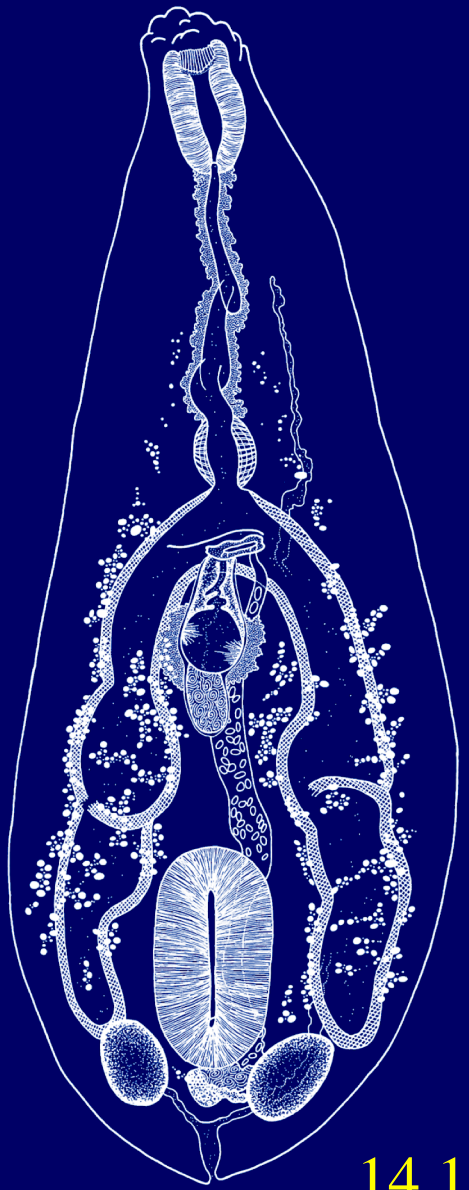
Pomacanthus sexstriatus, Lizard Island

Chaetodontoplus meredithi, Heron Island



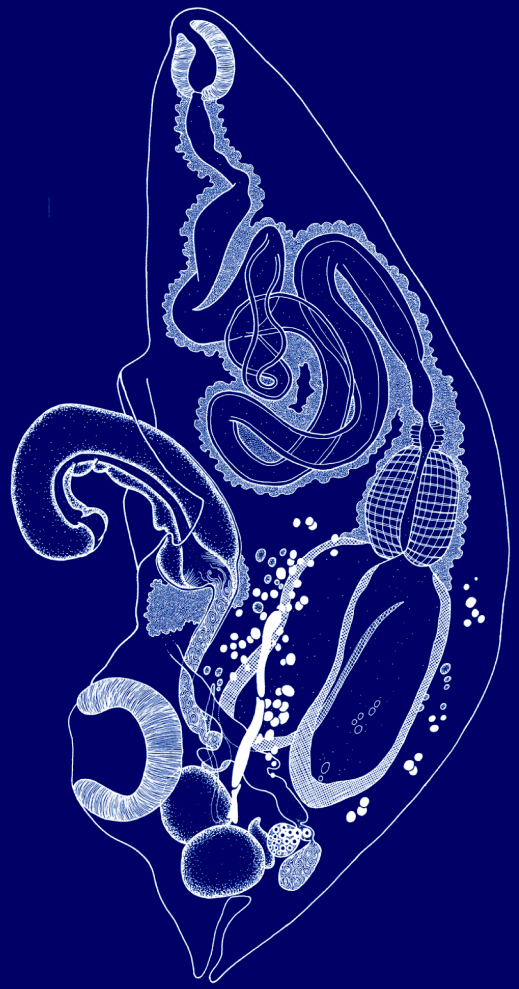
16.1

22.1-22.3



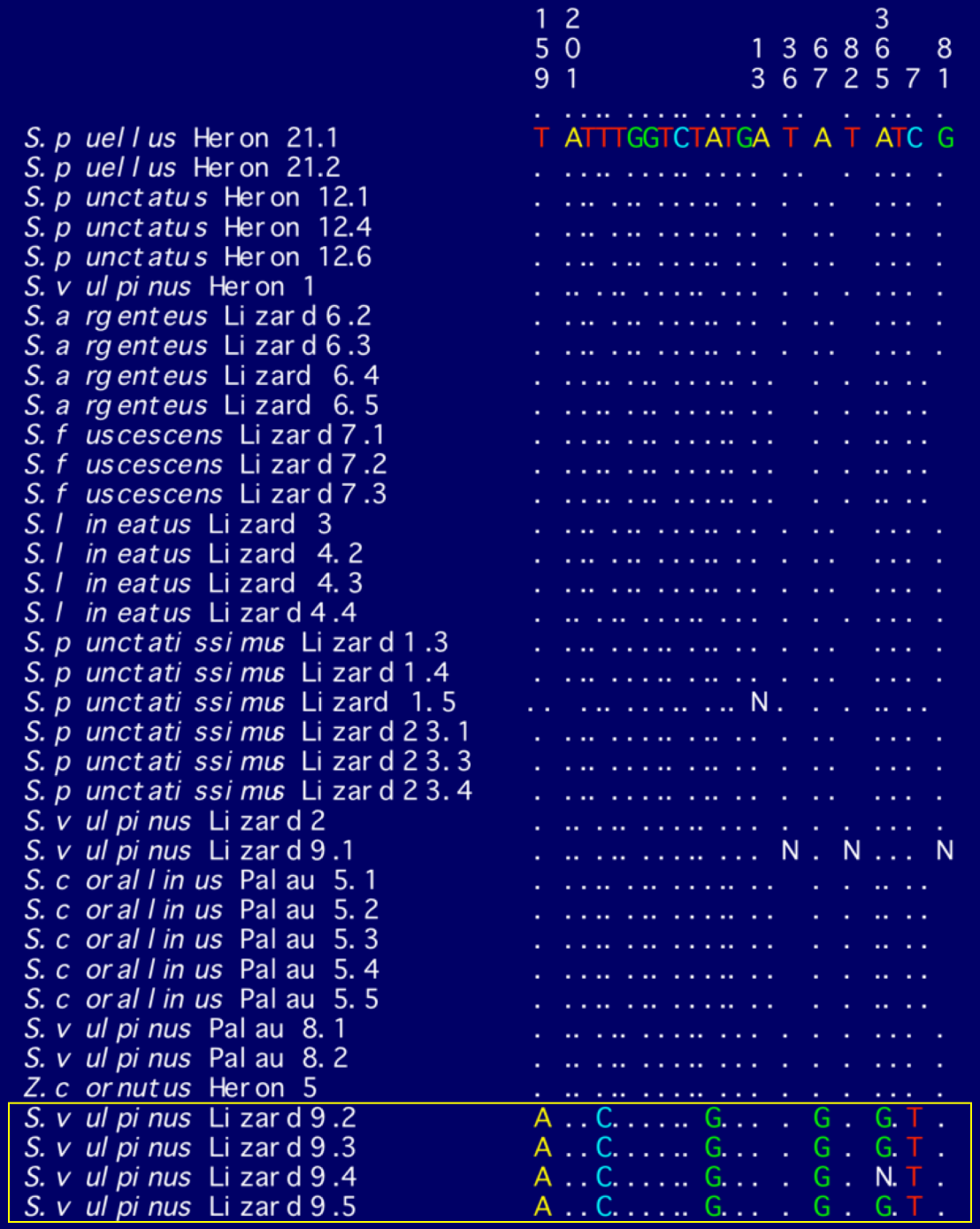
14.1

	1 2 5 9	0 1	1 3 3	3 6 6	6 7 7	8 2 2	3 6 5	5 7 7	8 1 1
S. puellus Heron 21.1	T	ATTTGGTCTATGA	T	A	T	T	ATC	G	
S. puellus Heron 21.2	.	. . . . .	.	.	.	.	. . .	.	
S. punctatus Heron 12.1	.	. . . . .	.	.	.	.	. . .	.	
S. punctatus Heron 12.4	.	. . . . .	.	.	.	.	. . .	.	
S. punctatus Heron 12.6	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Heron 1	.	. . . . .	.	.	.	.	. . .	.	
S. argenteus Lizard 6.2	.	. . . . .	.	.	.	.	. . .	.	
S. argenteus Lizard 6.3	.	. . . . .	.	.	.	.	. . .	.	
S. argenteus Lizard 6.4	.	. . . . .	.	.	.	.	. . .	.	
S. argenteus Lizard 6.5	.	. . . . .	.	.	.	.	. . .	.	
S. fuscescens Lizard 7.1	.	. . . . .	.	.	.	.	. . .	.	
S. fuscescens Lizard 7.2	.	. . . . .	.	.	.	.	. . .	.	
S. fuscescens Lizard 7.3	.	. . . . .	.	.	.	.	. . .	.	
S. lineatus Lizard 3	.	. . . . .	.	.	.	.	. . .	.	
S. lineatus Lizard 4.2	.	. . . . .	.	.	.	.	. . .	.	
S. lineatus Lizard 4.3	.	. . . . .	.	.	.	.	. . .	.	
S. lineatus Lizard 4.4	.	. . . . .	.	.	.	.	. . .	.	
S. punctatissimus Lizard 1.3	.	. . . . .	.	.	.	.	. . .	.	
S. punctatissimus Lizard 1.4	.	. . . . .	.	.	.	.	. . .	.	
S. punctatissimus Lizard 1.5	.	. . . . .	N	.	.	.	. .	.	
S. punctatissimus Lizard 23.1	.	. . . . .	.	.	.	.	. . .	.	
S. punctatissimus Lizard 23.3	.	. . . . .	.	.	.	.	. . .	.	
S. punctatissimus Lizard 23.4	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Lizard 2	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Lizard 9.1	.	. . . . .	N	.	N	.	. .	N	
S. coralinus Palau 5.1	.	. . . . .	.	.	.	.	. . .	.	
S. coralinus Palau 5.2	.	. . . . .	.	.	.	.	. . .	.	
S. coralinus Palau 5.3	.	. . . . .	.	.	.	.	. . .	.	
S. coralinus Palau 5.4	.	. . . . .	.	.	.	.	. . .	.	
S. coralinus Palau 5.5	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Palau 8.1	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Palau 8.2	.	. . . . .	.	.	.	.	. . .	.	
Z. cornutus Heron 5	.	. . . . .	.	.	.	.	. . .	.	
S. vulpinus Lizard 9.2	A	. . C	.	G	. .	.	G	.	G . T .
S. vulpinus Lizard 9.3	A	. . C	.	G	. .	.	G	.	G . T .
S. vulpinus Lizard 9.4	A	. . C	.	G	. .	.	G	.	N . T .
S. vulpinus Lizard 9.5	A	. . C	.	G	. .	.	G	.	G . T .

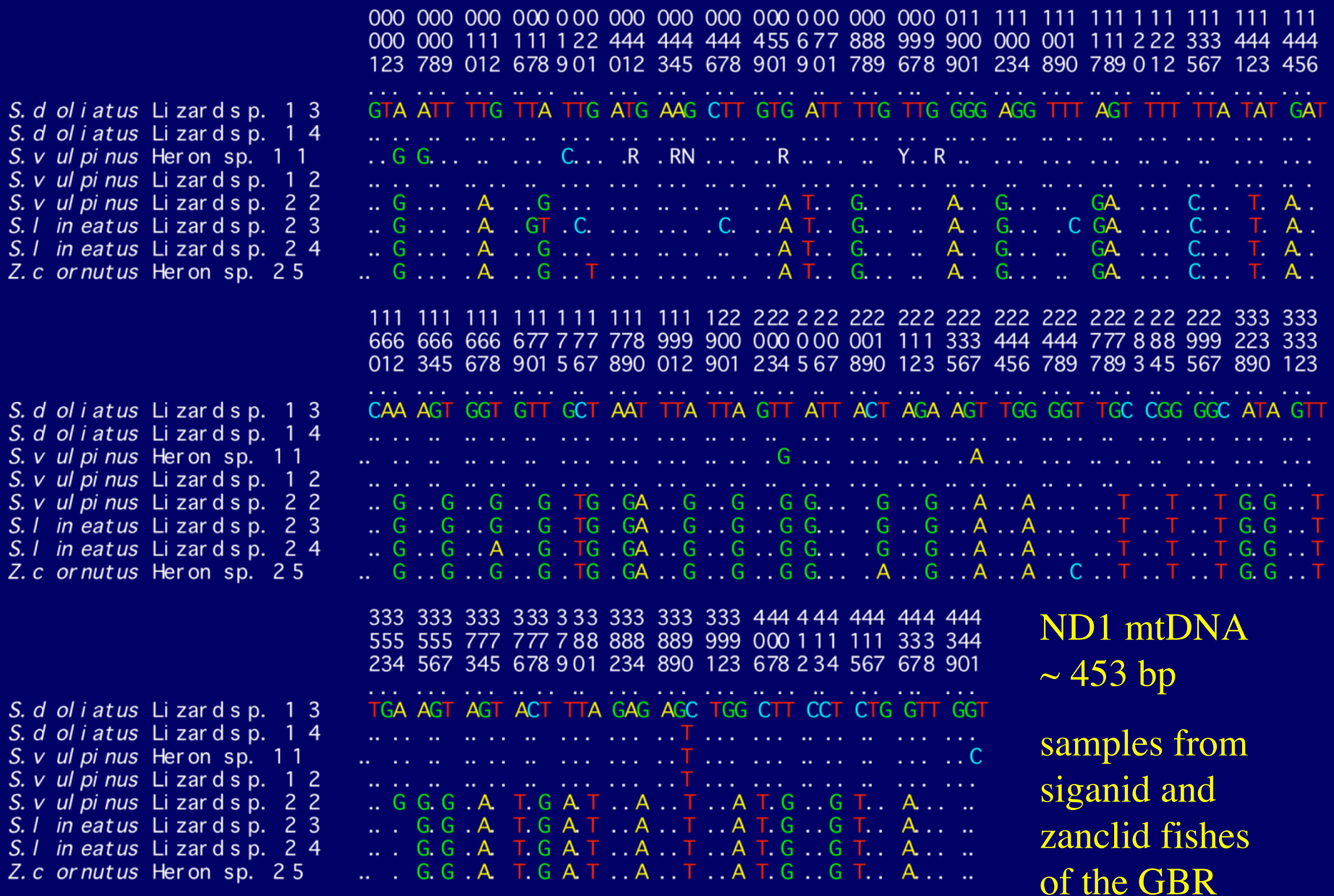


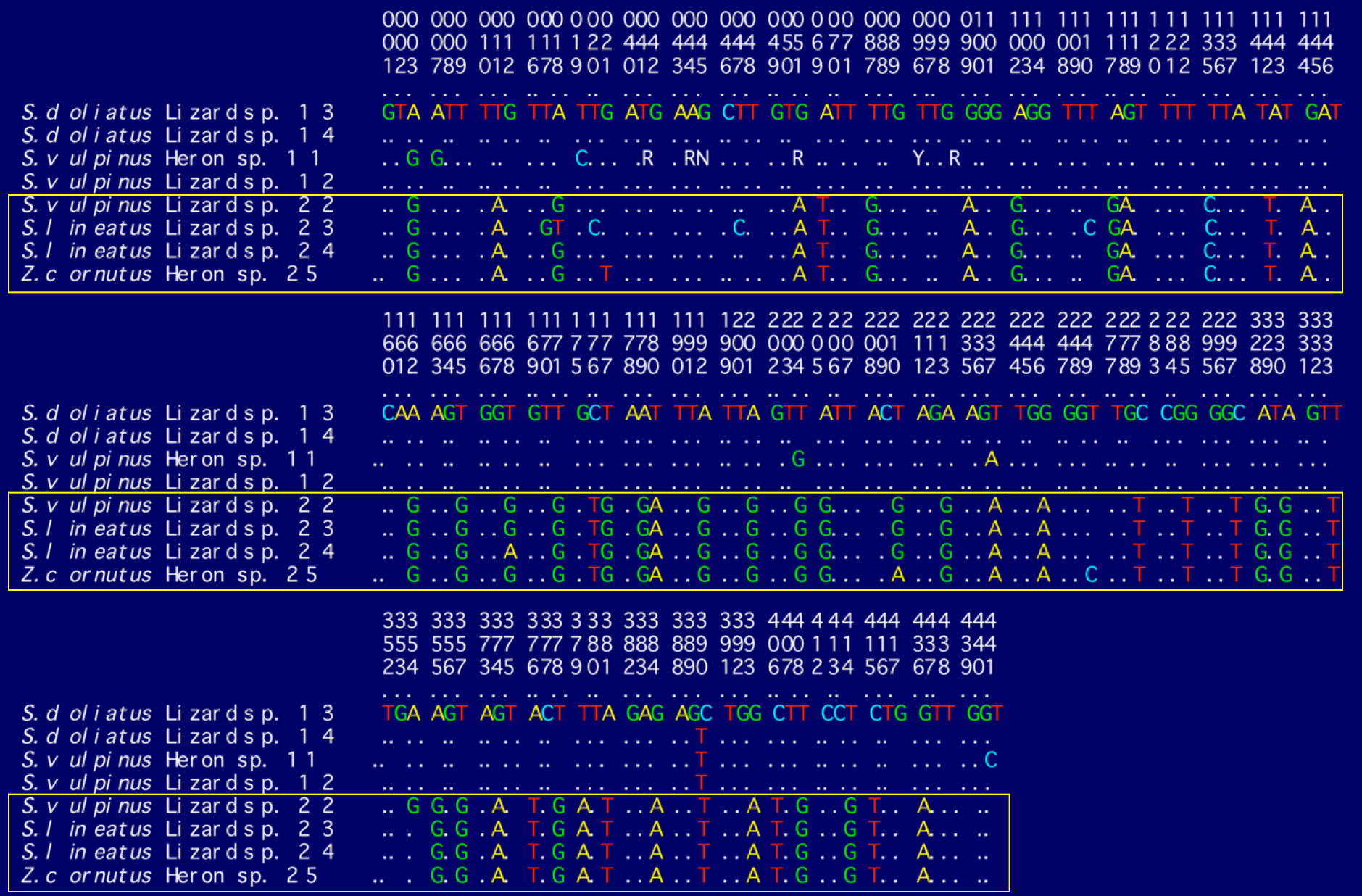
ITS2 rDNA ~ 455 bp

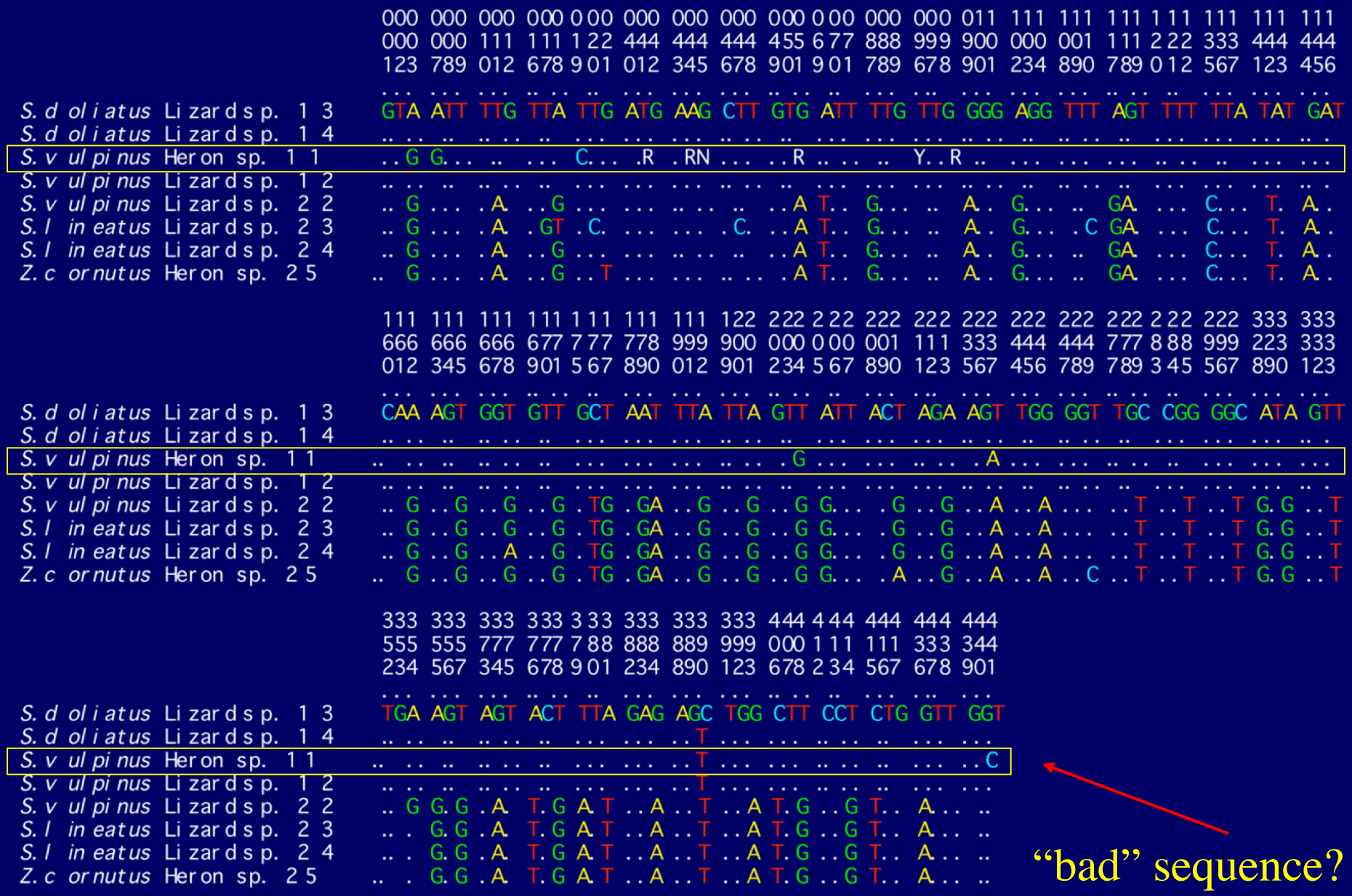
samples from siganid and zanclid fishes of the GBR

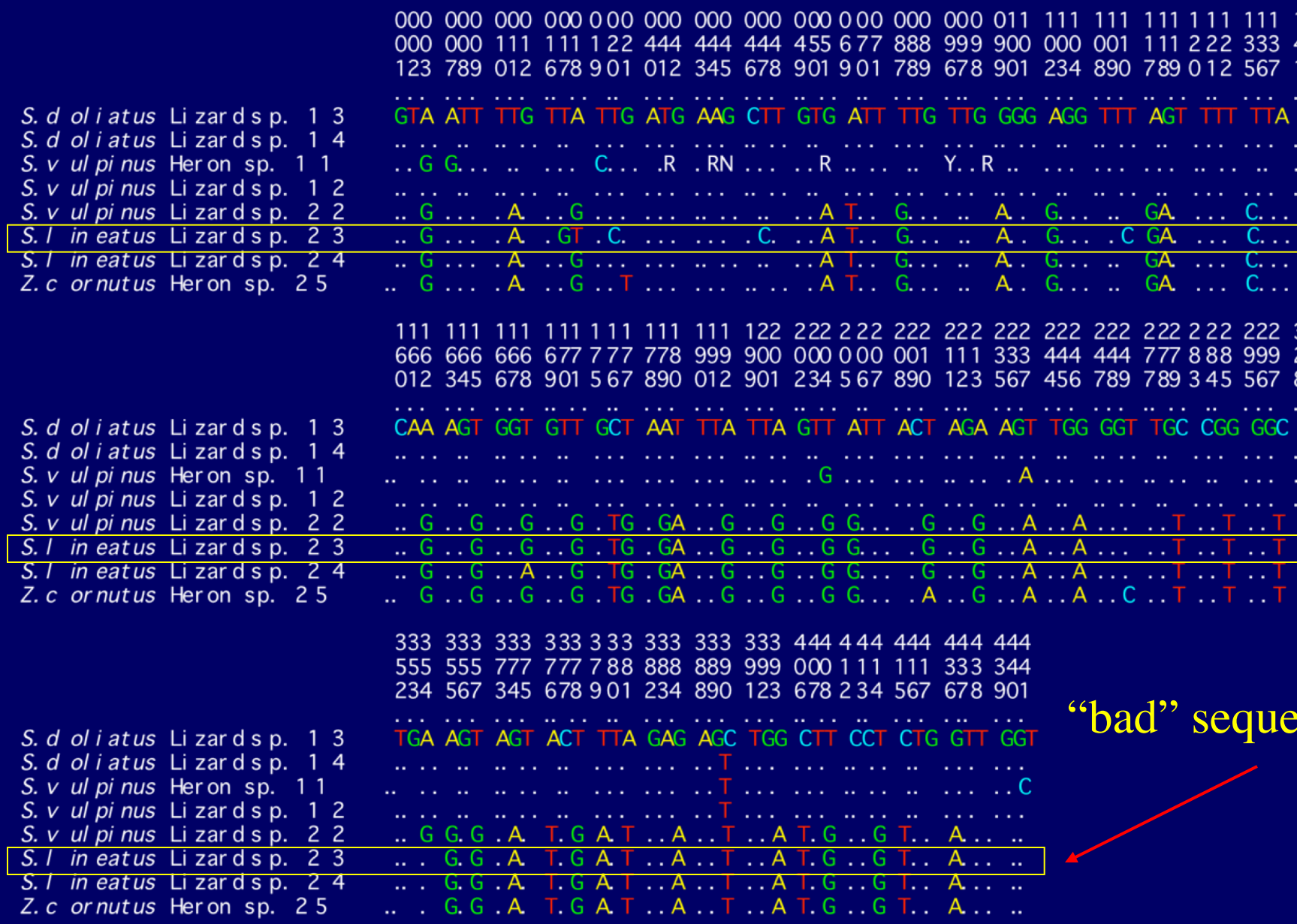


6 fixed differences
~1.3% difference


S. d oli atus Li zard s p. 1 3
S. d oli atus Li zard s p. 1 4
S. v ul pi nus Her on sp. 1 1
S. v ul pi nus Li zard s p. 1 2
S. v ul pi nus Li zard s p. 2 2
S. l in eatus Li zard s p. 2 3
S. l in eatus Li zard s p. 2 4
Z. c ornutus Her on sp. 2 5
ND1 mtDNA
~ 453 bp
samples from
siganid and
zanclid fishes
of the GBR


S. d oliatus Lizard sp. 13
S. d oliatus Lizard sp. 14
S. v ulpinus Heron sp. 11
S. v ulpinus Lizard sp. 12
S. v ulpinus Lizard sp. 22
S. l ineatus Lizard sp. 23
S. l ineatus Lizard sp. 24
Z. c ornutus Heron sp. 25


S. d oliatus Lizard sp. 13
S. d oliatus Lizard sp. 14
S. v ulpinus Heron sp. 11
S. v ulpinus Lizard sp. 12
S. v ulpinus Lizard sp. 22
S. l ineatus Lizard sp. 23
S. l ineatus Lizard sp. 24
Z. c ornutus Heron sp. 25
"bad" sequence?


S. d oliatus Lizard sp. 13
S. d oliatus Lizard sp. 14
S. v ulpinus Heron sp. 11
S. v ulpinus Lizard sp. 12
S. v ulpinus Lizard sp. 22
S. l ineatus Lizard sp. 23
S. l ineatus Lizard sp. 24
Z. c ornutus Heron sp. 25
"bad" sequence?

		1	2	3	4	5	6	7	8
1	*S. ddiatus* Lizard sp 1 #3	-							
2	*S. ddiatus* Lizard sp 1 #4	1	-						
3	*S. vulpinus* Heron sp. 1 #1	7	6	-					
4	*S. vulpinus* Lizard sp 1 #2	1	0	6	-				
5	*S. vulpinus* Lizard sp 2 #2	51	50	48	50	-			
6	*S. lineatus* Lizard sp 2 #3	54	53	51	53	6	-		
7	*S. lineatus* Lizard sp 2 #4	51	50	48	50	3	7	-	
8	*Z. cornutus* Heron sp. 2 #5	52	51	49	51	4	8	5	-

		1	2	3	4	5	6	7	8
1	*S. ddiatus* Lizard sp 1 #3	-							
2	*S. ddiatus* Lizard sp 1 #4	1	-						
3	*S. vulpinus* Heron sp. 1 #1	7	6	-					
4	*S. vulpinus* Lizard sp 1 #2	1	0	6	-				
5	*S. vulpinus* Lizard sp 2 #2	51	50	48	50	-			
6	*S. lineatus* Lizard sp 2 #3	54	53	51	53	6	-		
7	*S. lineatus* Lizard sp 2 #4	51	50	48	50	3	7	-	
8	*Z. cornutus* Heron sp. 2 #5	52	51	49	51	4	8	5	-

~0-1.55% variation

		1	2	3	4	5	6	7	8
1	*S. ddiatus* Lizard sp 1 #3	-							
2	*S. ddiatus* Lizard sp 1 #4	1	-						
3	*S. vulpinus* Heron sp. 1 #1	7	6	-					
4	*S. vulpinus* Lizard sp 1 #2	1	0	6	-				
5	*S. vulpinus* Lizard sp 2 #2	51	50	48	50	-			
6	*S. lineatus* Lizard sp 2 #3	54	53	51	53	6	-		
7	*S. lineatus* Lizard sp 2 #4	51	50	48	50	3	7	-	
8	*Z. cornutus* Heron sp. 2 #5	52	51	49	51	4	8	5	-

~0.66-1.77% variation

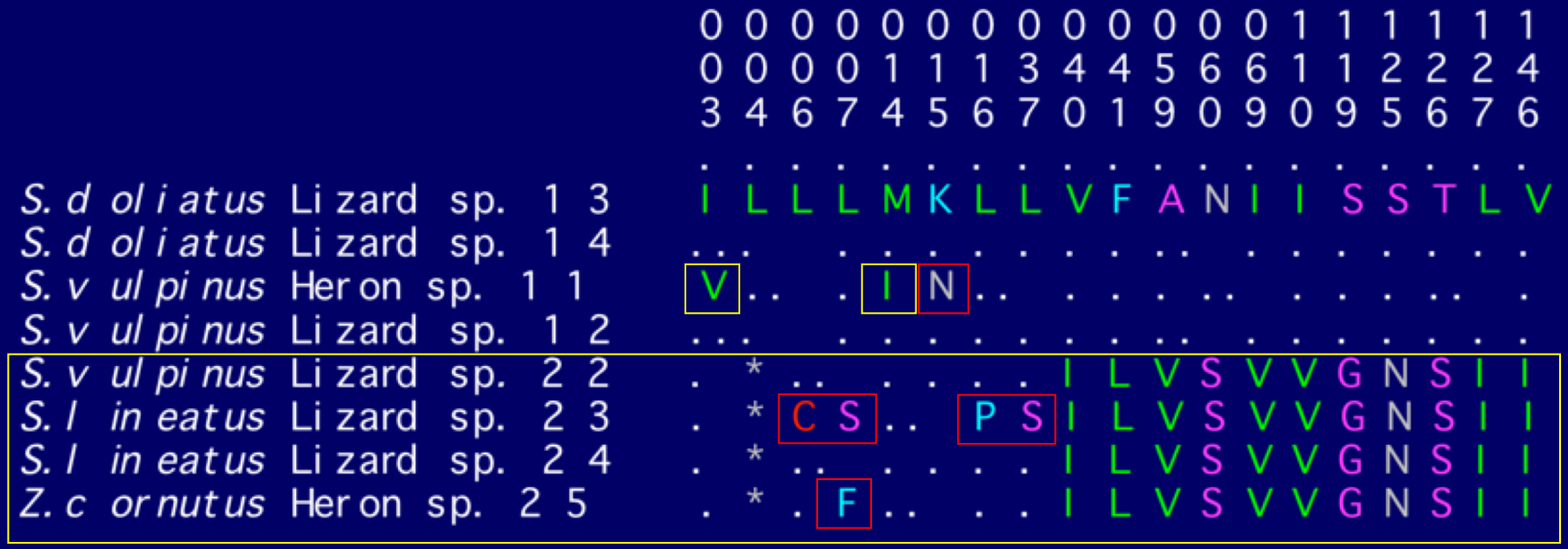
		1	2	3	4	5	6	7	8
1	*S. dd iatus* Lizard sp 1 #3	-							
2	*S. dd iatus* Lizard sp 1 #4	1	-						
3	*S. vulpinus* Heron sp. 1 #1	7	6	-					
4	*S. vulpinus* Lizard sp 1 #2	1	0	6	-				
5	*S. vulpinus* Lizard sp 2 #2	51	50	48	50	-			
6	*S. lineatus* Lizard sp 2 #3	54	53	51	53	6	-		
7	*S. lineatus* Lizard sp 2 #4	51	50	48	50	3	7	-	
8	*Z. cornutus* Heron sp. 2 #5	52	51	49	51	4	8	5	-

~10.60-11.92%
difference

ND1 mtDNA translated to amino acids ~ 151 αα

samples from siganid and zanclid fishes of the GBR


0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1
0 0 0 0 1 1 1 3 4 4 5 6 6 1 1 2 2 2 4
3 4 6 7 4 5 6 7 0 1 9 0 9 0 9 5 6 7 6
S. d ol i atus Li zard sp. 1 3 I L L L M K L L V F A N I I S S T L V
S. d ol i atus Li zard sp. 1 4
S. v ul pi nus Her on sp. 1 1 V I N
S. v ul pi nus Li zard sp. 1 2
S. v ul pi nus Li zard sp. 2 2 I L V S V V G N S I I
S. l in eatus Li zard sp. 2 3 C S P S I L V S V V G N S I I
S. l in eatus Li zard sp. 2 4 I L V S V V G N S I I
Z. c or nutus Her on sp. 2 5 F I L V S V V G N S I I



11 fixed differences

~7.28% difference

S. doliatus Lizard sp. 1 #3

S. doliatus Lizard sp. 1 #

S. vulpinus Lizard sp. 1 #2

S. vulpinus Heron sp. 1 #

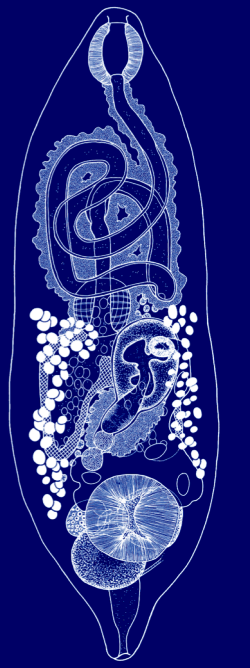
S. vulpinus Lizard sp. 2 #2

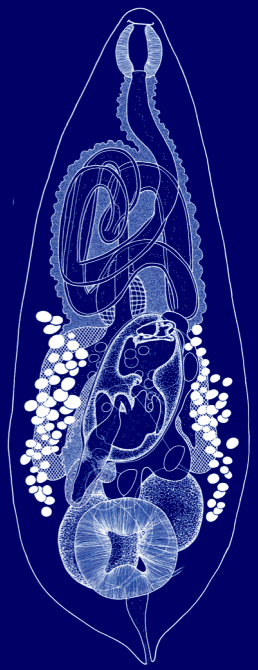
S. lineatus Lizard sp. 2 #

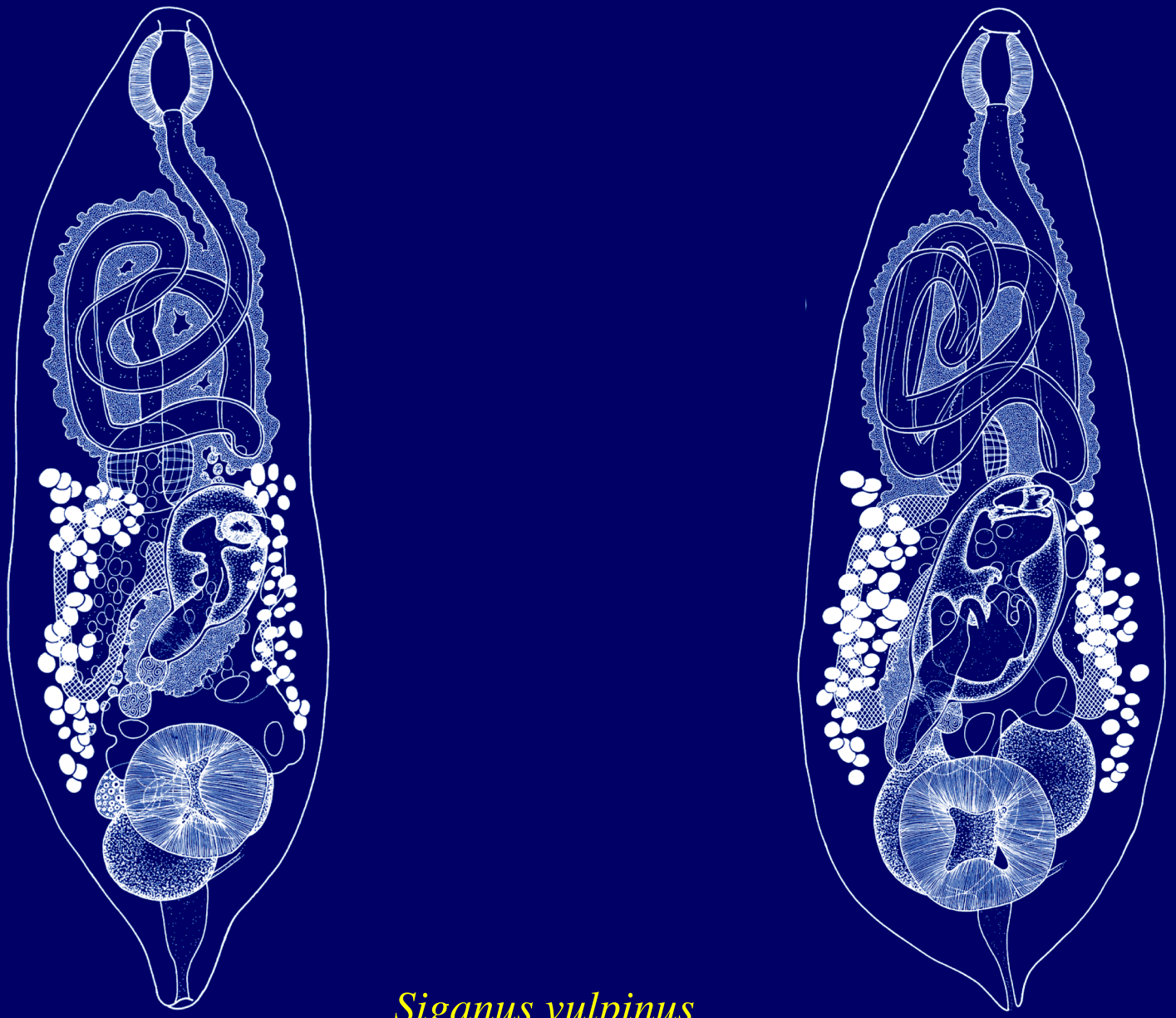
S. lineatus Lizard sp. 2 #4

Z. cornutus Heron sp. 2 #5

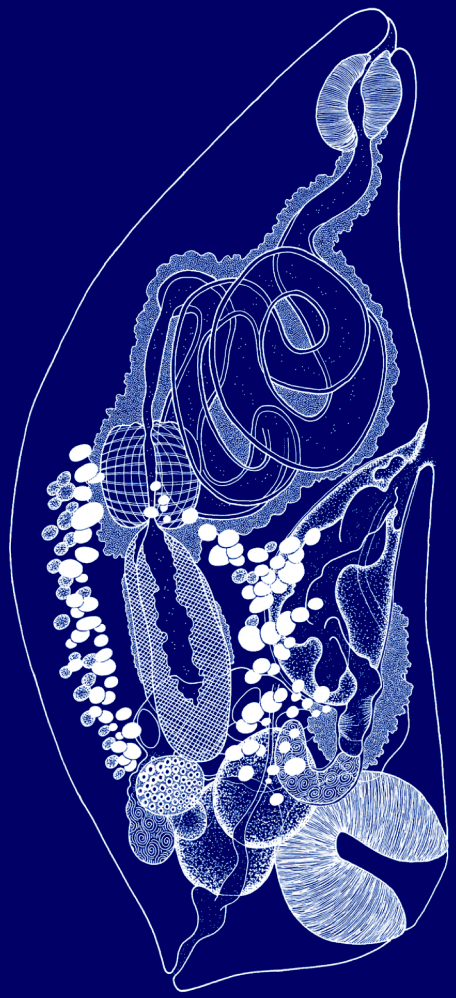
5 changes



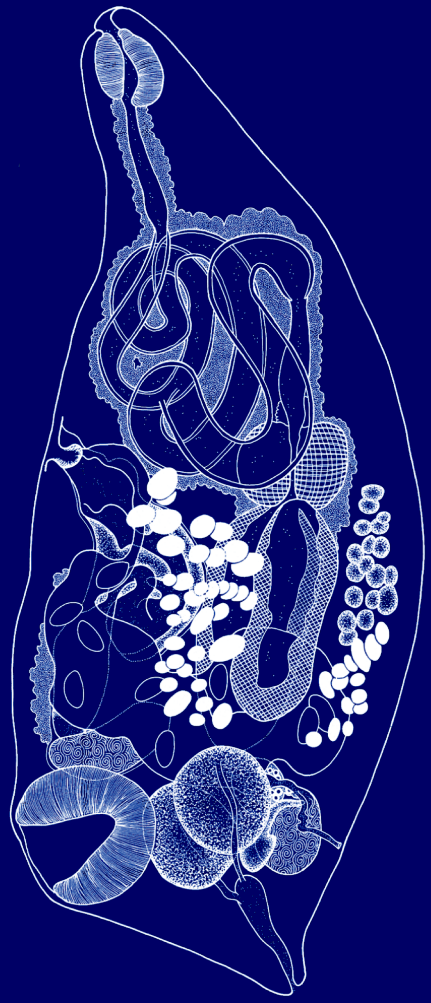




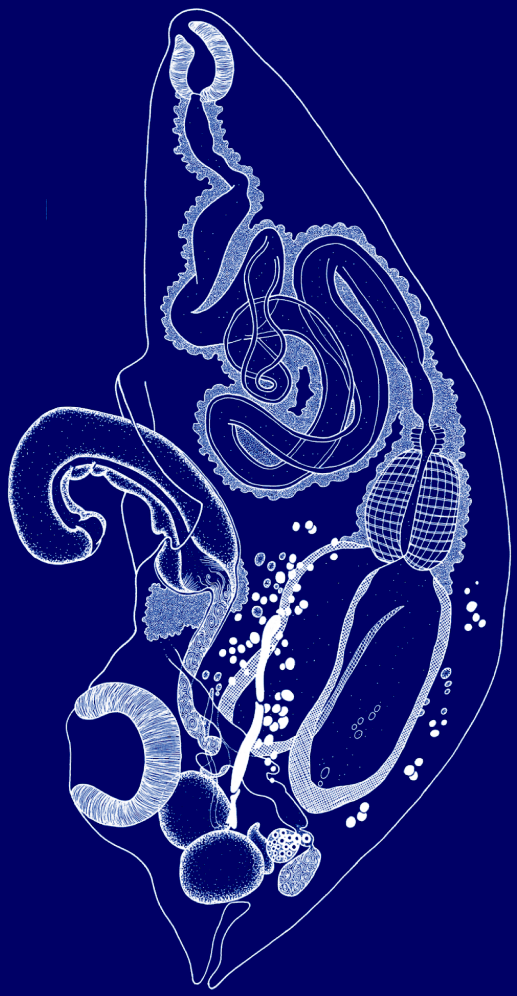
Siganus vulpinus
Lizard Island



Zanclus cornutus
Heron Island



Siganus vulpinus
Lizard Island



Siganus corallinus
Green Island

Species 1

Great Barrier Reef
- Lizard Island
  - *Siganus doliatus*
  - *Siganus vulpinus*
- Heron Island
  - *Siganus vulpinus*

ITS2 rDNA sequences: complete identity
ND1 mtDNA sequences: ≤1.77% variation

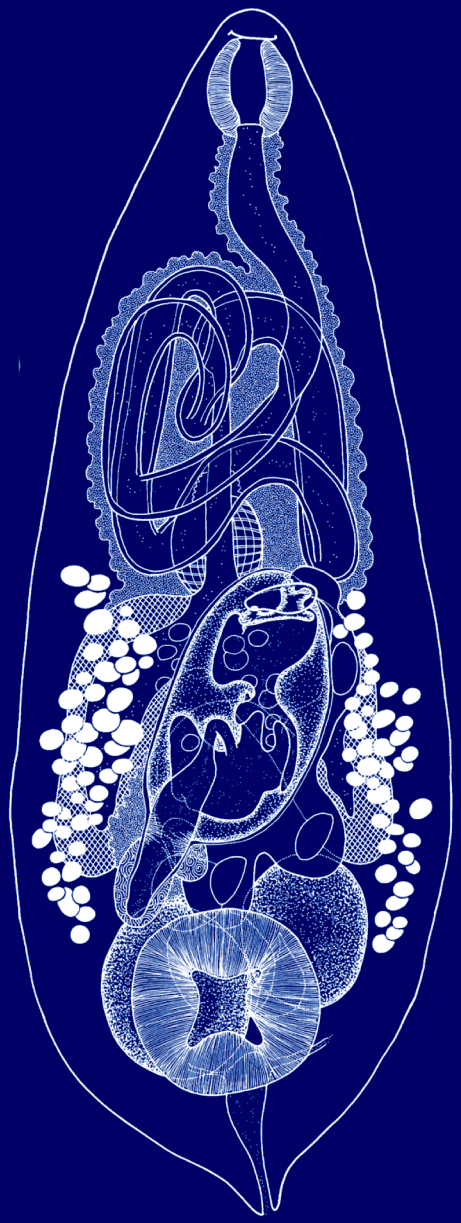
Species 2

Great Barrier Reef

- Lizard Island
  - *Siganus argenteus*
  - *Siganus fuscescens*
  - *Siganus lineatus*
  - *Siganus punctatissimus*
  - *Siganus vulpinus*
- Heron Island
  - *Siganus puellus*
  - *Siganus punctatus*
  - *Siganus vulpinus*
  - *Zanclus cornutus*

Micronesia

- Palau
  - *Siganus corallinus*
  - *Siganus vulpinus*



ITS2 rDNA sequences: complete identity

ND1 mtDNA sequences: ≤1.55% variation

Verdict: ITS2 rDNA

- pomacanthid worms:
  0-0.21% *intra*specific variation
  1.26-1.89% *inter*specific difference

- siganid worms:
  0% *intra*specific variation
  1.32% *inter*specific difference

- differences are fixed over wide host range
- differences are fixed over wide geographic areas
- low level of variation makes locus sensitive to errors in sequencing

Verdict: ND1 mtDNA

- siganid worms:
  0-1.77% *intra*specific variation
  10.60-11.92% *inter*specific difference

- differences are fixed over host range
- differences are fixed over geographic areas
- internal variation in addition to fixed differences
- magnitude of interspecific difference increases confidence in taxonomy

How many bases is that?

ITS2 rDNA:

about 5 fixed

ND1 mtDNA:

about 45 bp (or 10 αα)