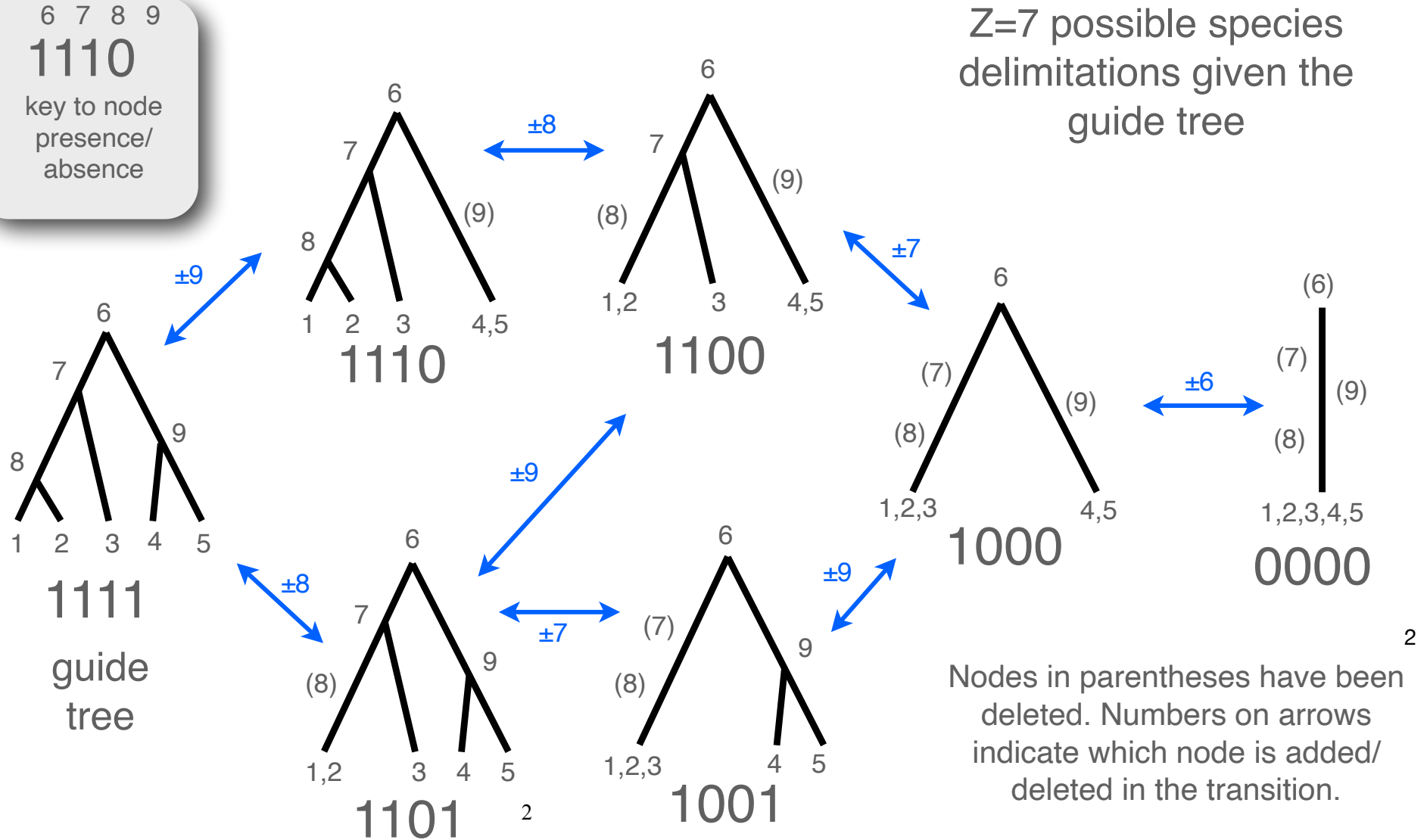


# Bayesian Species Delimitation (BPP program)

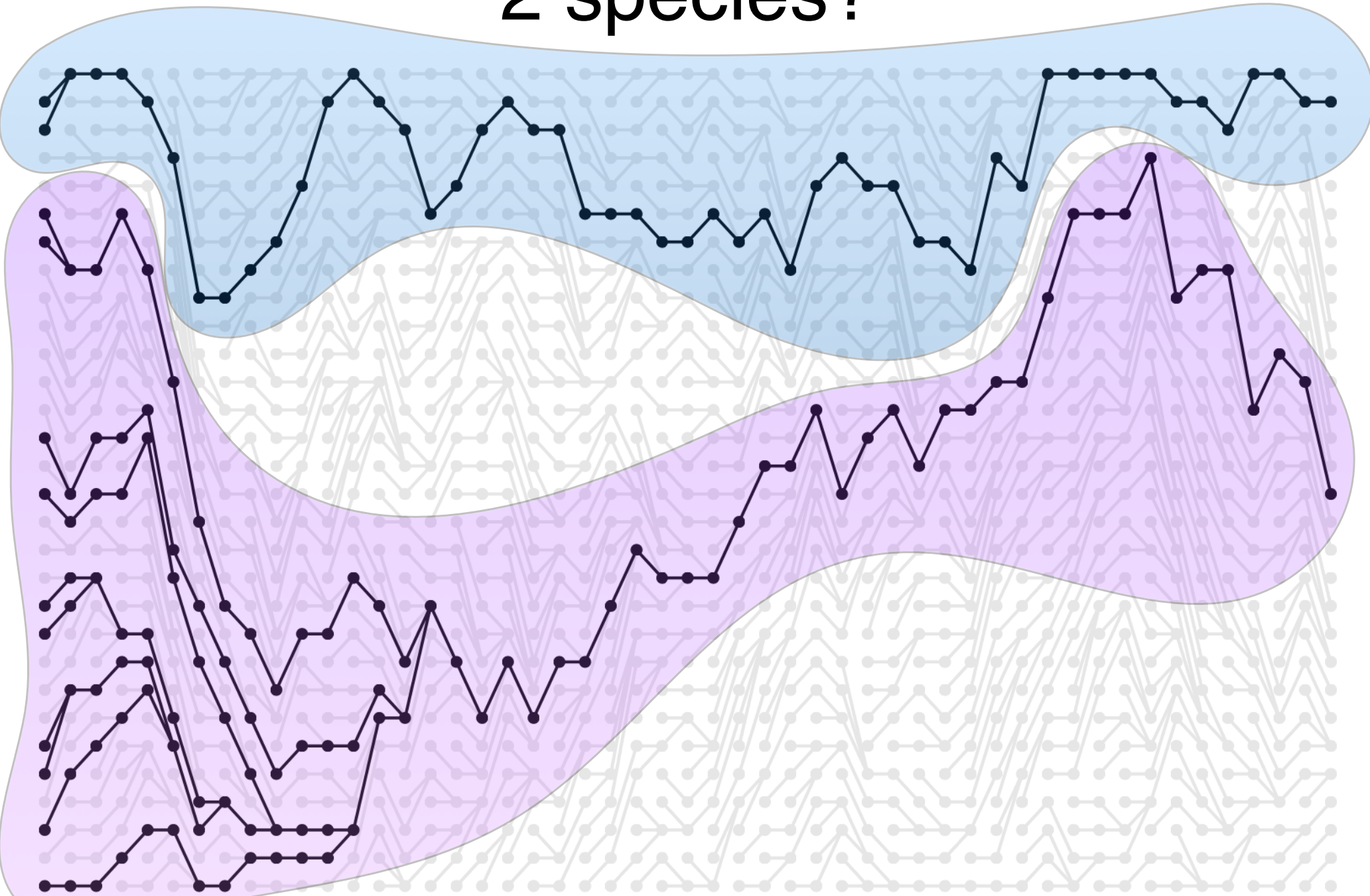
# Bayesian Species Delimitation (BPP program)

6 7 8 9  
**1110**  
 key to node  
 presence/  
 absence

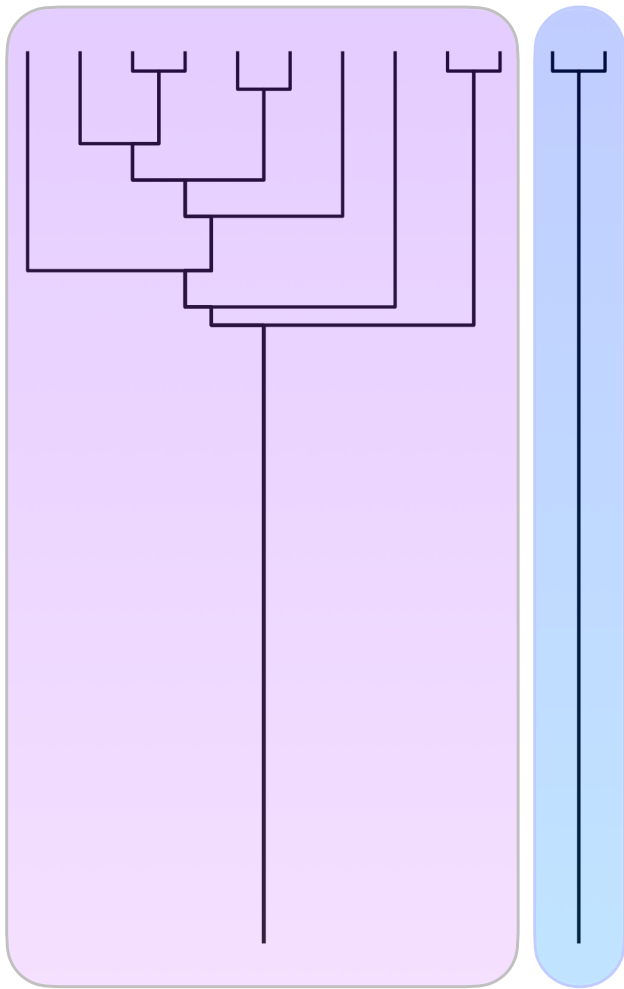


Yang and Rannala (2010)

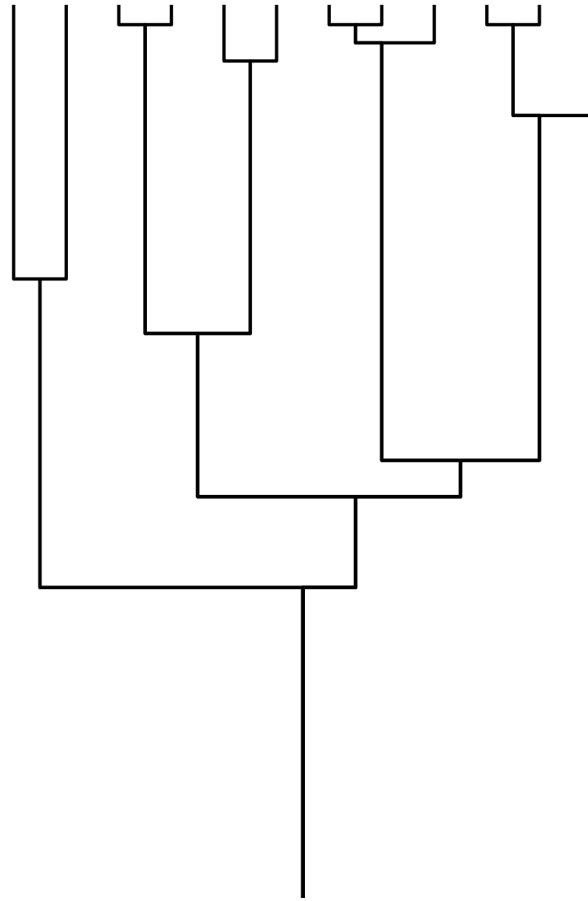
# 2 species?



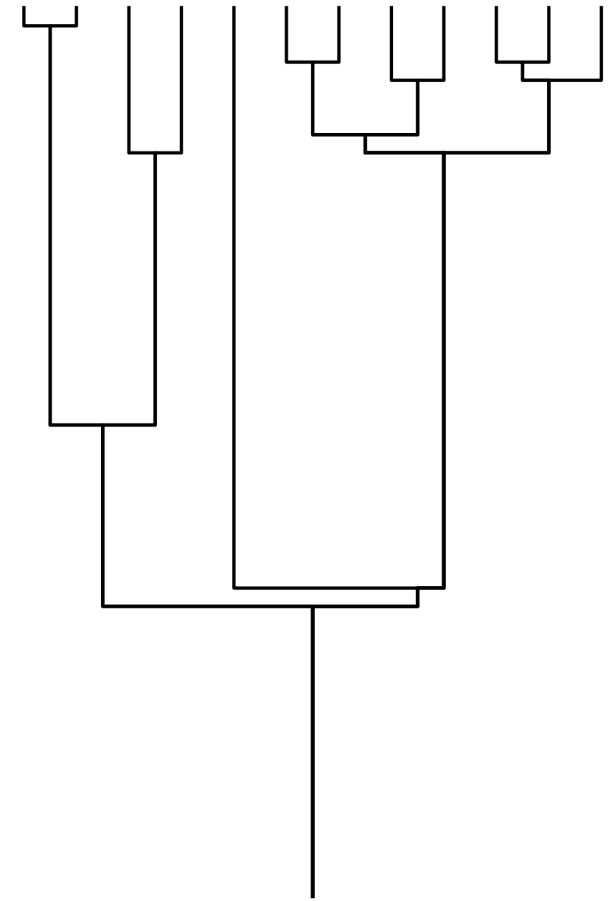
# Maybe just one species after all



gene 1



gene 2



gene 3

# Data vs Information

# What is information?

## TAKE AWAY PICKLE JARS

SPECIAL SOURS 10/15  
HOT SOUR CUKES 10/15  
BIG DILL KOSHER CUKES 10/15  
DILLY GREEN BEANS 10/15  
CANDY RED BEETS 10/15  
SWEET & SPICY CARROTS 10/15  
SOUR GREEN TOMATOES 10/15  
THYME JALAPENOS 10/15

## PRESERVES TO GO

ORANGE MARMALADE 9  
STRAWBERRY JAM 9  
SALTED BUTTER 9  
MAPLE BUTTER 9  
HOUSE MADE SYRUP 9

BAG OF BISCUITS  
4 BISCUITS FOR \$11

GROWLERS  
32oz / 64oz

## JACOB'S PICKLES

1 TYPE FOR 5, 4 TYPES FOR 12, 8 TYPES FOR 18

**SPECIAL SOURS**  
**HOT SOUR CUKES**  
**BIG DILL KOSHER CUKES**  
**DILLY GREEN BEANS**  
**CANDY RED BEETS**  
**SWEET & SPICY CARROTS**  
**SOUR GREEN TOMATOES**  
**THYME JALAPENOS**  
**PICKLED EGGS**  
FRESH ORGANIC EGGS, SPICY JALAPENO BRINE 7

## STARTERS

**FRIED PICKLES** SPICY RED MAYO 11  
**BISCUITS & FIXINS** HOUSE STRAWBERRY & ORANGE PRESERVES, CLOVER HONEY, SALTED BUTTER AND MAPLE BUTTER 9  
**MATZO BALL SOUP** NATURAL YOUNG CHICKEN, NOODLES, CARROTS, HARICOT VERTS, ONIONS 12  
**GRIT CRUSTED FRIED GREEN TOMATOES** PICNIC SAUCE 9  
**DEVEILED EGGS** PICKLED MUSTARD SEED, SMOKED PAPER, MICRO ARUGULA 12  
**POUTINE** SMOTHERED IN BROWN GRAVY, CHEESE, HOLLANDAISE DRIZZLE 15  
**BISCUITS AND GRAVY** SAUSAGE GRAVY OR MUSHROOM GRAVY 12  
**HOMEMADE SLOW COOKED MEATBALLS** HOMEMADE MARINARA, MOZZARELLA 14  
**OKRA & CHILES** SLICED PICKLED OKRA, RED PEPPER FLAKES, SCALLIONS, LIQUID SMOKE 11  
**STREET CORN** SPICY AIOLI, FRESH LIME, CRUMBLed PARMESAN 9

## SALADS

**SATUR FARMS GREENS FROM NORTH FORK L.I.**  
**BUTTERMILK FRIED CHICKEN CAESAR** ROMAINE, PARMESAN CHEESE, BISCUIT CROUTONS 18  
**GRILLED SALMON SALAD** BABY GREENS, SLICED ORANGES, RED ONION, CILANTRO, LIGHT ORANGE VINAIGRETTE 25  
**BUTTERMILK FRIED CHICKEN COUNTRY WEDGE** ICEBERG, BLUE CHEESE, DILLY RANCH, GRAPE TOMATOES, NITRATE FREE BACON 19  
**SPICED SHRIMP MARKET KALE SALAD** TOASTED ALMONDS, DRIED CRANBERRIES, RAISINS, CHERRIES AND HONEY-DIJON VINAIGRETTE WITH SHRIMP 24

CONSUMER ADVISORY: CONSUMPTION OF UNDERCOOKED MEAT, POULTRY, EGGS, OR SEAFOOD MAY INCREASE THE RISK OF FOODBORNE ILLNESSES. PLEASE INFORM YOUR SERVER IF ANYONE IN YOUR PARTY HAS A FOOD ALLERGY OR ANY SPECIAL DIETARY NEEDS.  
MAX SPLIT FOR CREDIT CARD 6 PER TABLE.  
NO SUBSTITUTIONS PLEASE.

## SOUTHERN BISCUIT SANDWICHES

**SERVED WITH GRAIN MILLER ORGANIC CHEESE GRITS**  
**HONEY CHICKEN AND PICKLES** BUTTERMILK FRIED CHICKEN, HOT SOURS, CLOVER HONEY 17  
**SOUTHERN B.L.T** BUTTERMILK FRIED CHICKEN, FRIED GREEN TOMATOES, PICKLE SLAW, PICNIC SAUCE, NITRATE FREE BACON 18  
**SAUSAGE GRAVY SMOTHERED CHICKEN** BUTTERMILK FRIED CHICKEN 17  
**MUSHROOM GRAVY SMOTHERED CHICKEN** BUTTERMILK FRIED CHICKEN, AGED VERMONT CHEDDAR 17  
**BBQ SMOTHERED PEPPER JACK CHICKEN** BUTTERMILK FRIED CHICKEN, HOUSE MADE CREAMY BBQ, VERMONT PEPPER JACK 17  
**HOT CHICKEN BISCUIT** BUTTERMILK FRIED CHICKEN, NASHVILLE HOT SAUCE, HOT SOUR PICKLES 17  
**CHICKEN BACON EGG & CHEESE** BUTTERMILK FRIED CHICKEN, NITRATE FREE BACON, EGG, PICNIC SAUCE, 2 YEAR AGED VERMONT CHEDDAR 18

## HOME COOKING

**CHICKEN & PANCAKES** BUTTERMILK FRIED CHICKEN, CRISPY NITRATE FREE BACON, HOMEMADE SYRUP 19  
**JACOB'S PATTY MELT** JACOB'S BEEF BURGER BLEND, TOASTED BUTTERMILK LOAF, MELTED CHEDDAR CHEESE, CRISPY ONIONS, LETTUCE, PICKLE SAUCE, BIG DILL KOSHER CUKES, FRESH CUT FRIES 17  
**CATFISH TACOS** GRILLED CATFISH, LIME CREMA, CILANTRO SLAW, FRESH LIME, PICKLED CARROT AND JALAPENOS 21  
**SHRIMP & BACON GRITS** WHOLE WILD SHRIMP, NITRATE FREE BACON, ORGANIC CHEESE GRITS 24  
**LOW COUNTRY MEATLOAF** SWEET AND SMOKEY MEATLOAF, WHIPPED POTATOES, FRIZZLED ONIONS, COLESLAW, BUTTERMILK BISCUIT SMOTHERED IN MAPLE BUTTER 23  
**BABY BACK RIBS** LOADED BAKED POTATO, PICKLE SLAW, BBQ SAUCE 26  
**TURKEY LEG** WHIPPED POTATOES, HOME MADE BISCUIT STUFFING, CRANBERRY COMPOTE, TURKEY GRAVY 21  
**BUTTERMILK FRIED CHICKEN THIGH BASKET** PORK SHOULDER BRAISED COLLARD GREENS, MASHED POTATOES WITH TURKEY GRAVY, BUTTERMILK BISCUIT WITH SWEET BUTTER 23  
**GUMBO** CAJUN SPICED SHRIMP, ANDOUILLE SAUSAGE, CAROLINA RICE, FRIED OKRA 28

## MAC & CHEESE

**CLASSIC MAC & CHEESE** 14 / 21  
**BUFFALO CHICKEN MAC & CHEESE** BLUE CHEESE DRIZZLE 16 / 24  
**CHEESEBURGER MAC & CHEESE** GROUND SALISBURY SIRLOIN, AGED VERMONT CHEDDAR BLEND, KETCHUP 16 / 24

## SIDES

**COLLARD GREENS & BLACK EYED PEAS** WITH BRAISED PORK SHOULDER 13  
**HOUSE FRIES** HOUSE KETCHUP, MAYO, PICKLE BRINE 12  
**PICKLE SLAW** 8  
**HOUSE SALAD** 10  
**ORGANIC CHEESE GRITS** 8  
**MASHED POTATOES & MUSHROOM GRAVY** 8

## BEER

a selection of american craft brews



## BISCUITS

baked from scratch



## PICKLES

handmade in small batches



## JAMS

housemade from whole fruits

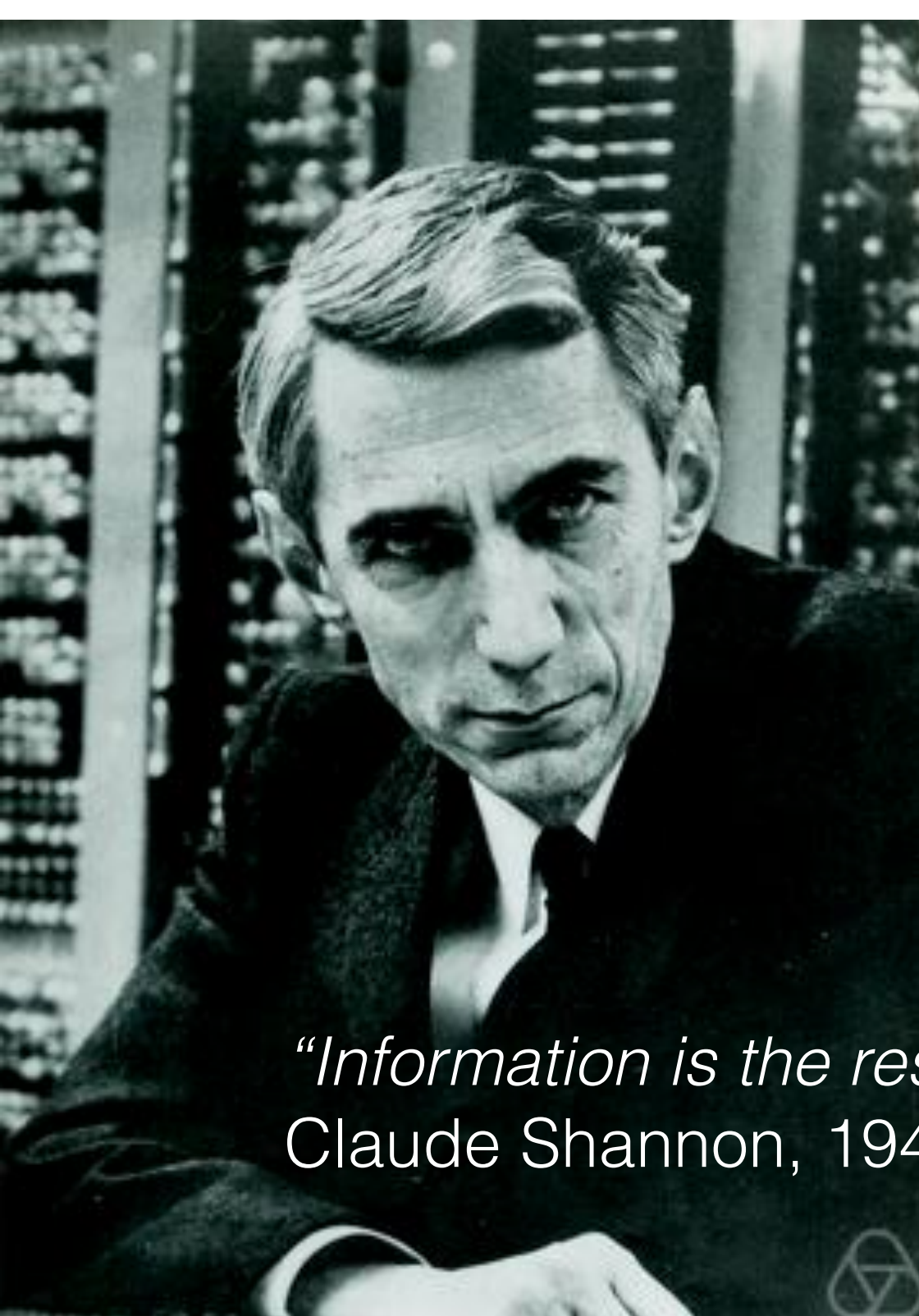


## MEATS

sustainably and humanely raised

JACOB'S PICKLES

509 AMSTERDAM  
NYC



*“Information is the resolution of uncertainty” —*  
Claude Shannon, 1948



# Information=Data?

14 taxa	20 characters	20 characters
<i>esotericum</i>	00000000000000000000	10000100100001111101
<i>heterosepalum</i>	00000000000000000000	00010111011110101000
<i>kellogii</i>	00000000000000000000	10000100100000111101
<i>majus</i>	00000000000000000000	01001000110000000110
<i>minimum</i>	00000000000000000000	00001100100000000010
<i>montanum</i>	00000000000000000000	01000000110000000110
<i>nuttallii</i>	00000000000000000000	00001000110000000010
<i>paronychioides</i>	00000000000000000000	10101000110000000110
<i>parryi</i>	00000000000000000000	00001111011110101000
<i>polygaloides</i>	00000000000000000000	10000100100001110101
<i>sawatchense</i>	00000000000000000000	00000000110000000110
<i>shastense</i>	00000000000000000000	10101100010000000000
<i>spergulariaeoides</i>	00000000000000000000	00001000110000000110
<i>tenue</i>	00000000000000000000	00001100010000100010



# Which has less information?

14 taxa	20 sites	20 sites
<i>esotericum</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>heterosepalum</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>kellogii</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>majus</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>minimum</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>montanum</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>nuttallii</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>paronychioides</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>parryi</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>polygaloides</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>sawatchense</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>shastense</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>spergulariaeoides</i>	AAAAAAAAAAAAAAAAAAAA	????????????????
<i>tenue</i>	AAAAAAAAAAAAAAAAAAAA	????????????????

# Which has less information?

14 taxa

esotericum  
heterosepalum  
kellogii  
majus  
minimum  
montanum  
nuttallii  
paronychioides  
parryi  
polygaloides  
sawatchense  
shastense  
spergulariaeoides  
tenue

20 constant sites

AAAAAAAAAAAAAAAAAAAA  
AAAAAAAAAAAAAAAAAAAA  
AAAAAAAAAAAAAAAAAAAA  
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AAAAAAAAAAAAAAAAAAAA

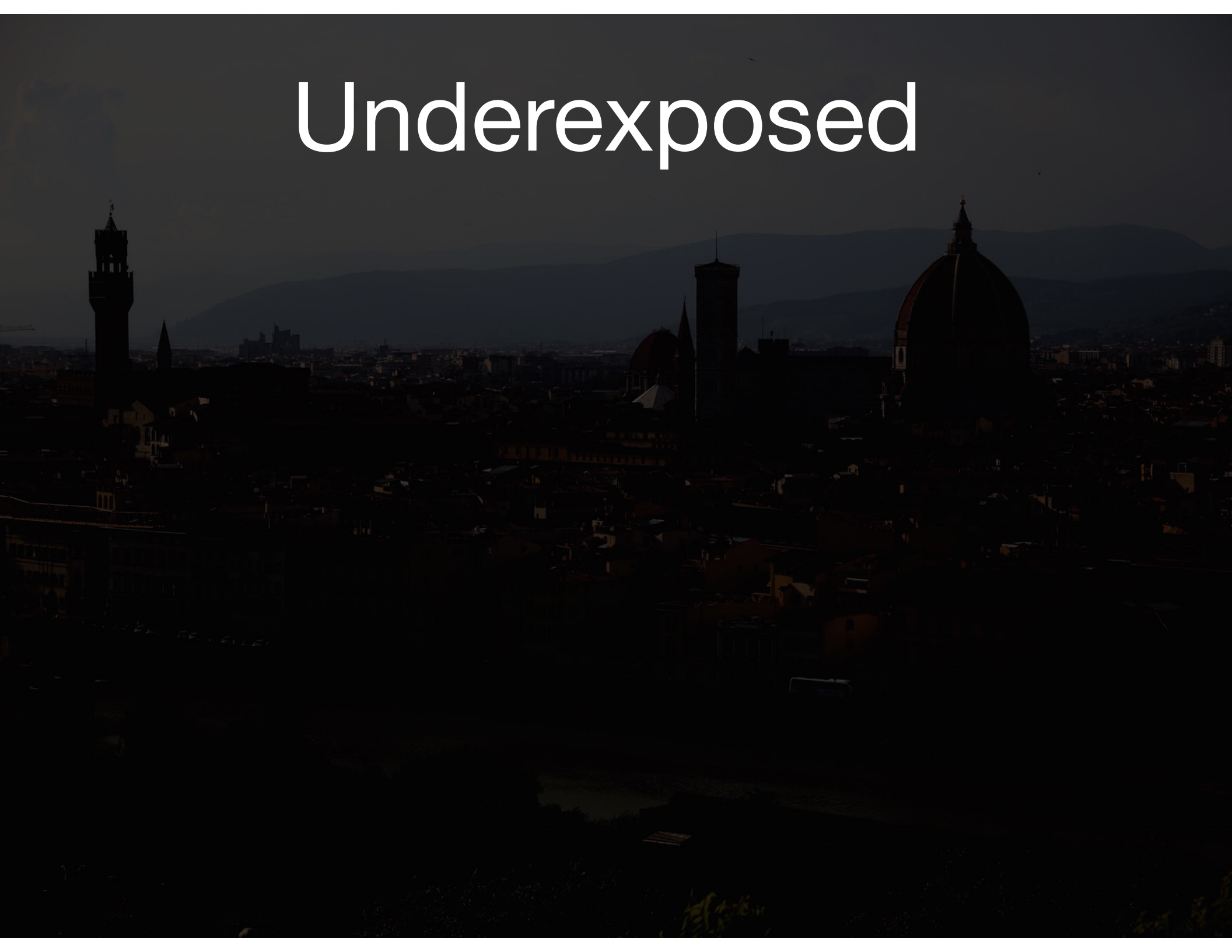
20 random sites

TAGAGCGCCCAGTCTTCCAG  
ATATCACGTACCCGAATTGT  
GGCATTGAAGAGAGGCTTTG  
TTCTGTGTTGACAAGTTAGT  
ATTTCCGAAAATCGTGTGCA  
GCATCGCATACTCCCCCTCG  
ATATTGCTTGAATCAAGAGC  
GTATTTTACAGGCCGGGCAA  
ATGTGATTATGAGAGTTTAT  
ATGGCAAGTACGAGTTTTCG  
TTCCGGATCCGTTATGCCAG  
CGAATGGGCCACACAATTTA  
AACCGAATGTGGTATTGGCG  
GACGACCCGGGGAACACGAA

# Overexposed

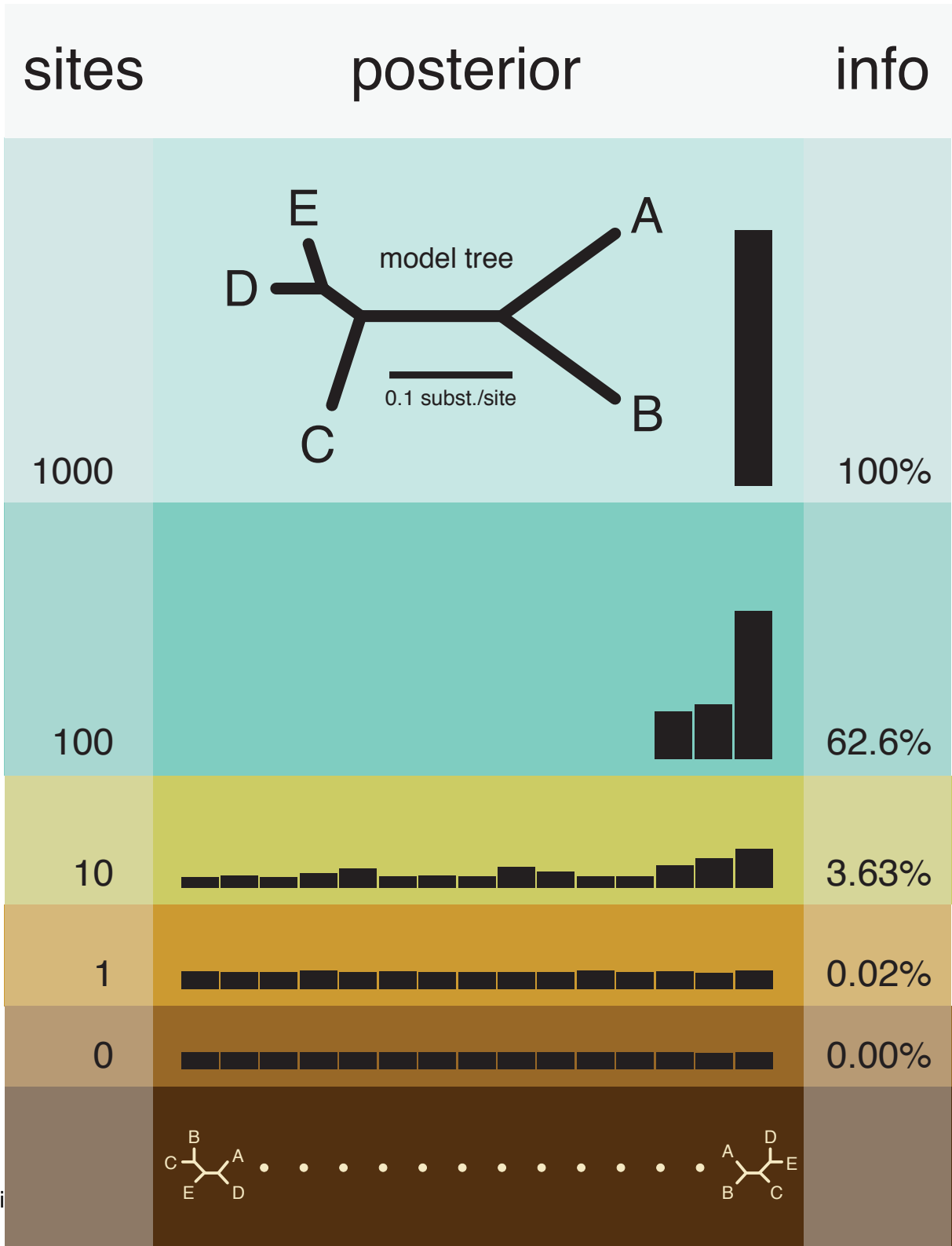


# Underexposed



# Just right





Lewis et al. 2016

# Information

Relative rate	%I
0.01	18
0.1	99
1	100
10	64
100	1.5

Percent missing	%I
0	100
50	98
100	0

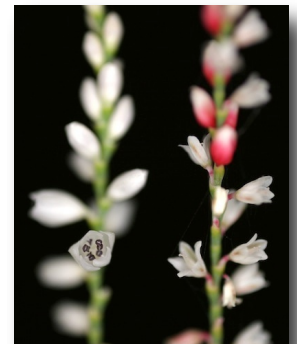
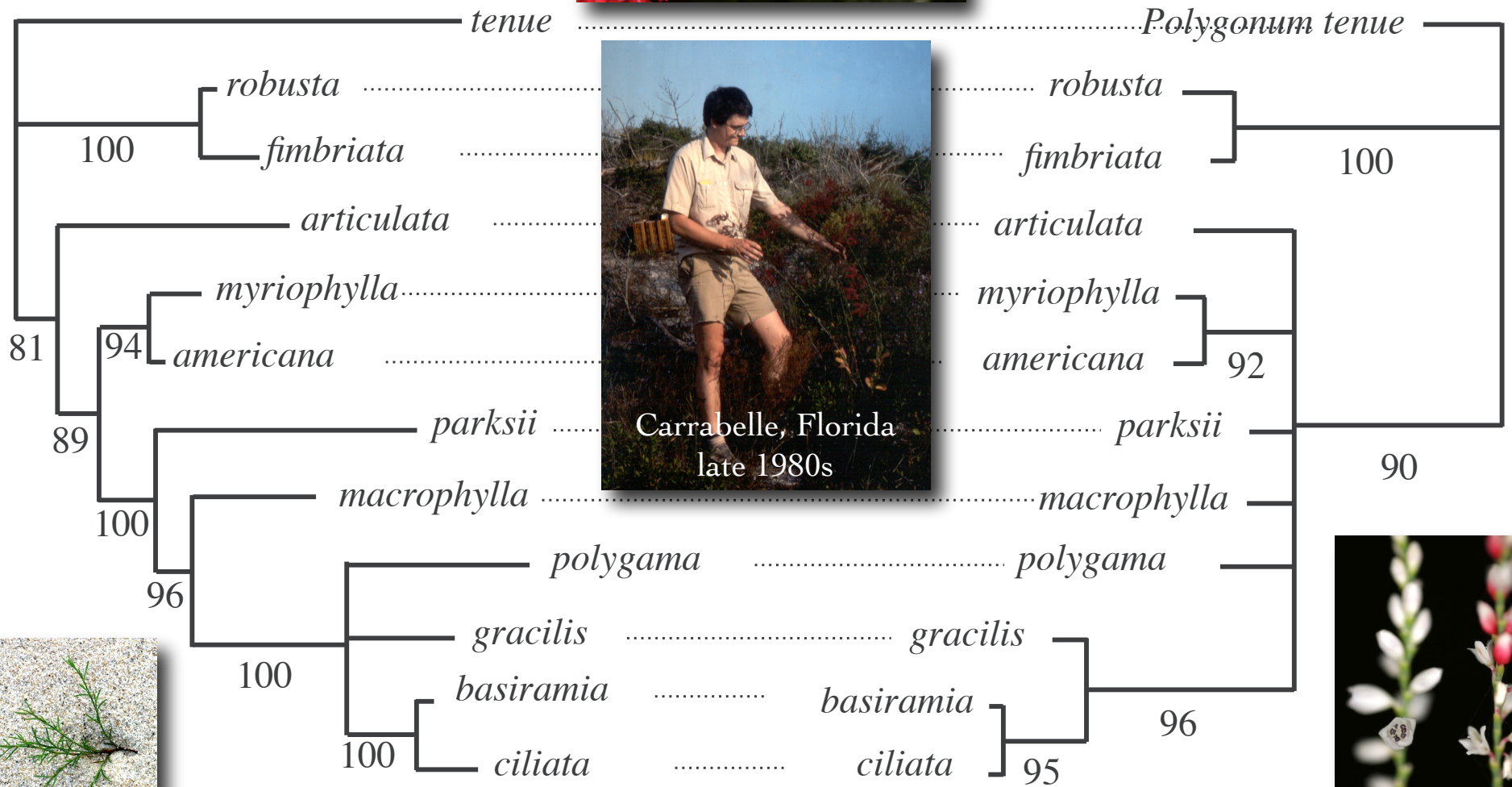
Rate variance	%I
1	100
10	97
100	13
1000	0

# Morphology vs. molecules in *Polygonella*

DNA (ITS+rbcL)  
 1877 characters  
 I = 90.4% (0.048/char.)

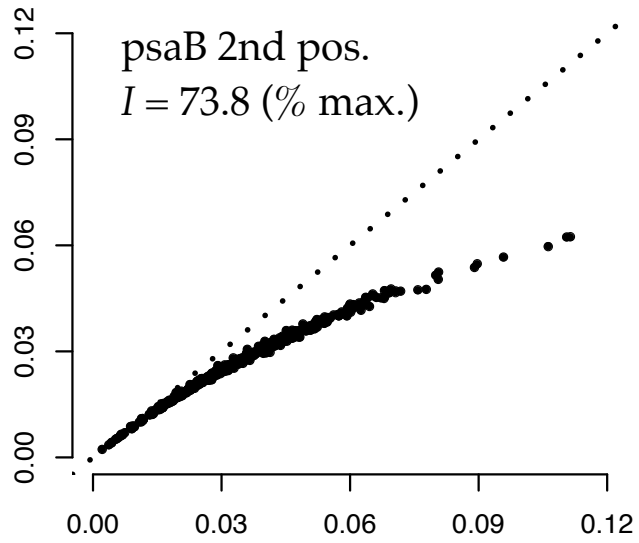


Morphology  
 39 characters  
 I = 73.6% (1.887/char.)

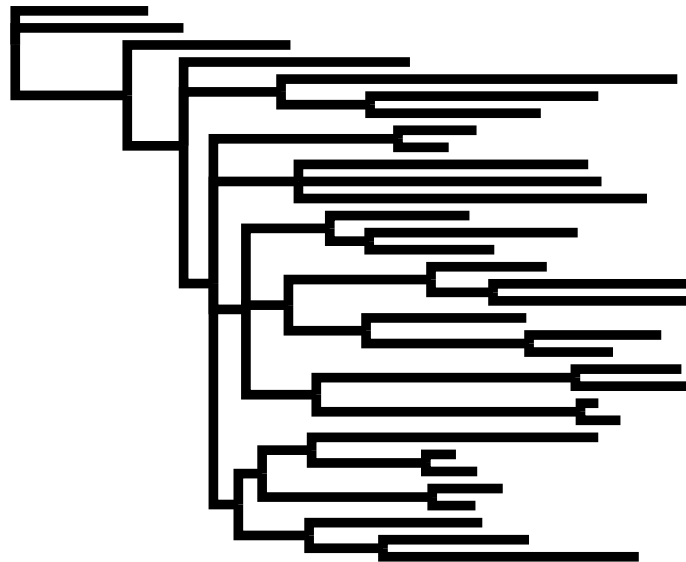
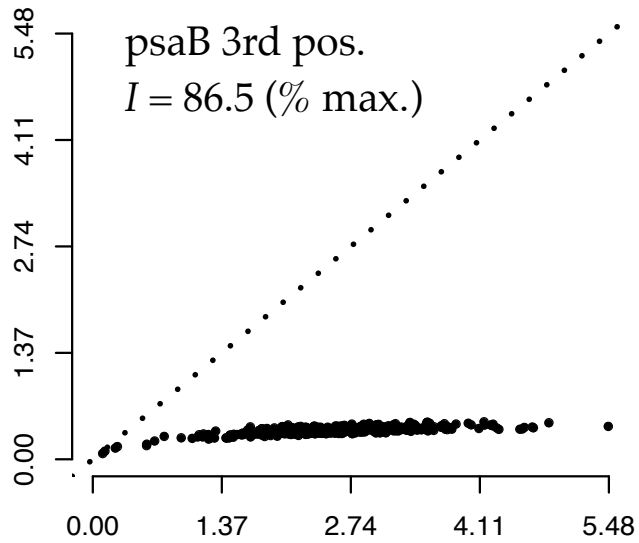




a.

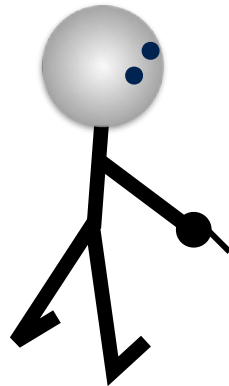
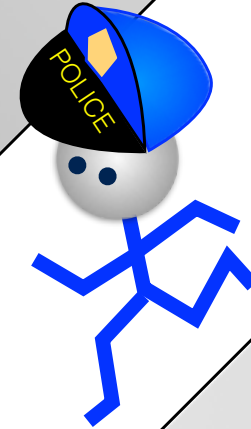
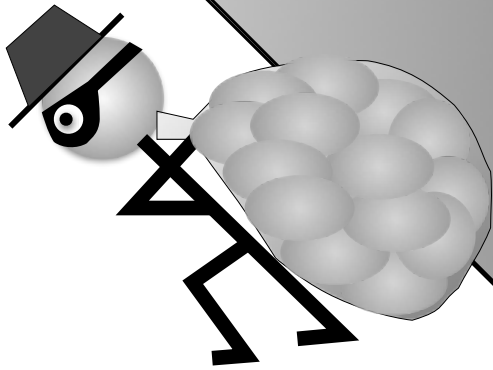


b.

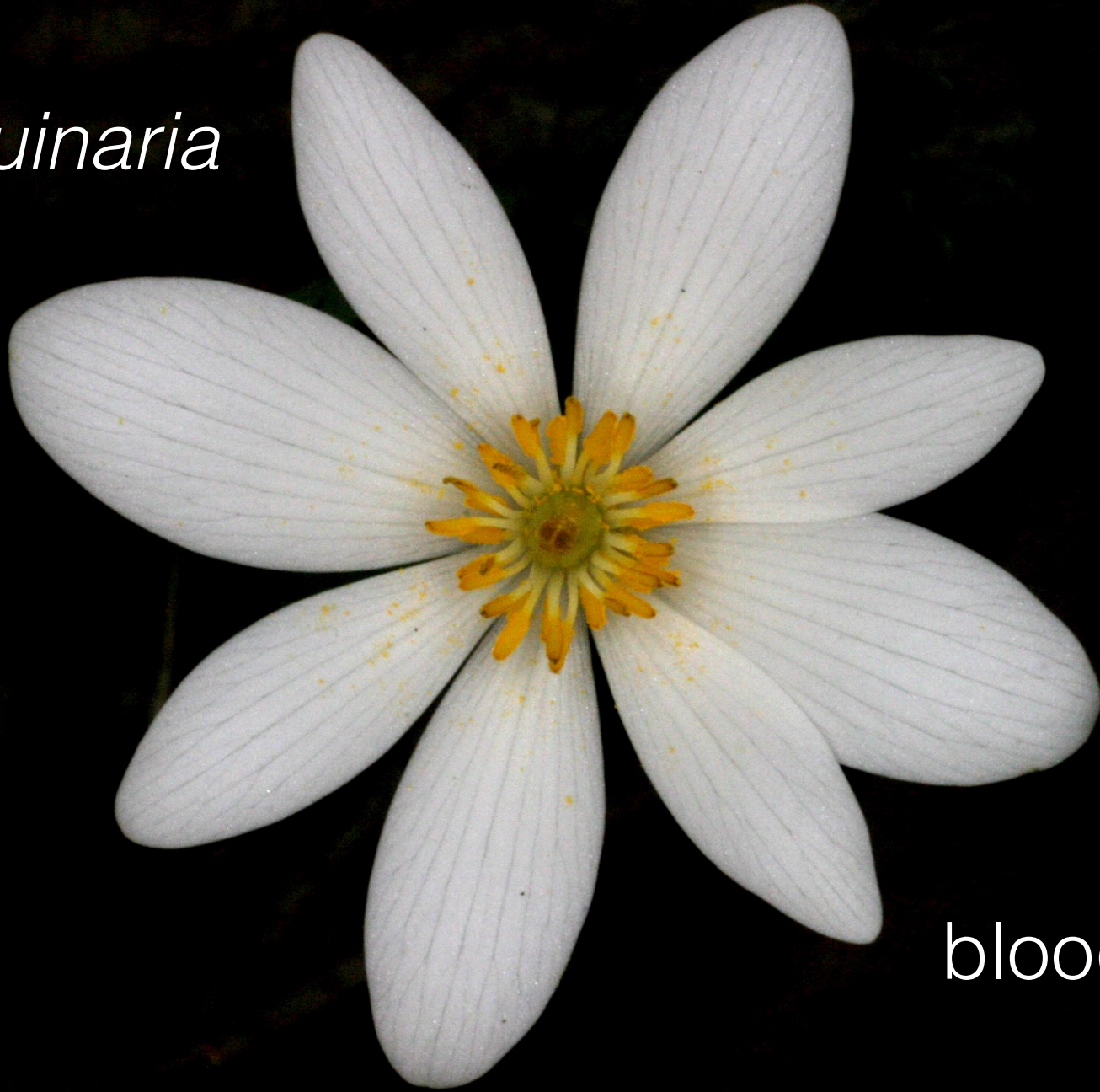


3rd  
positions  
have *more*  
information  
than 2nd  
positions

Information can be  
**false** information!

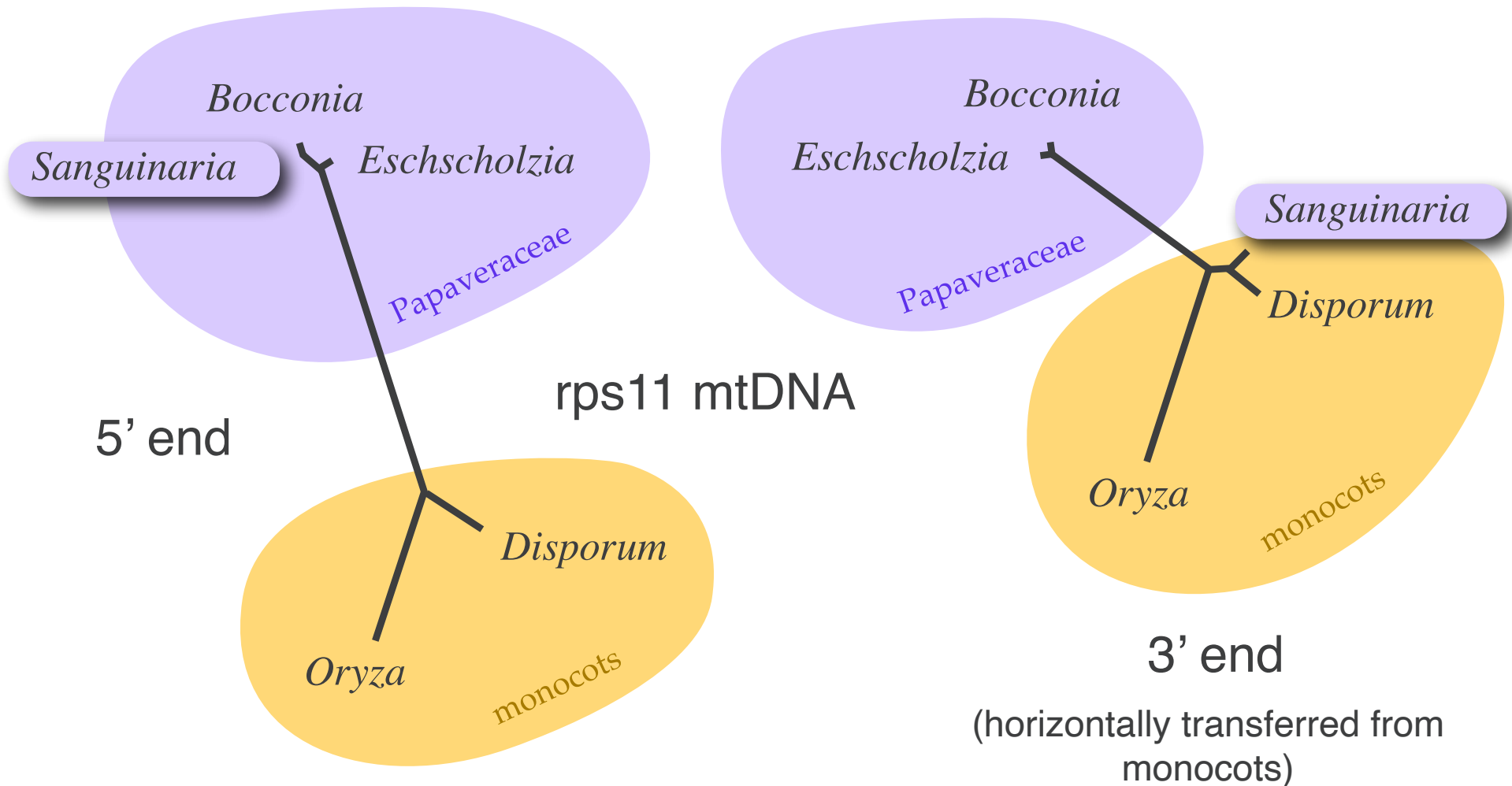


*Sanguinaria*

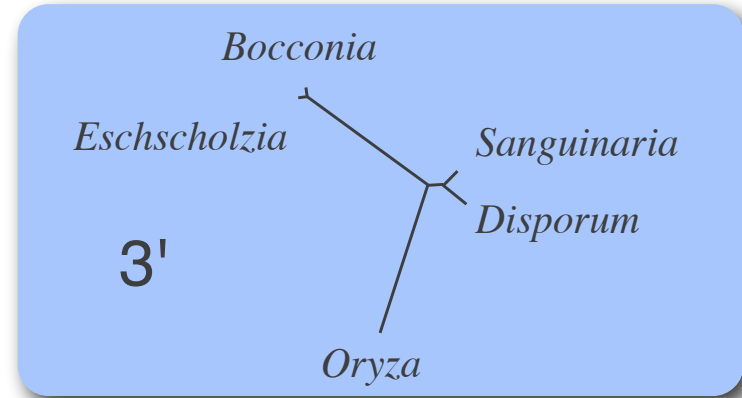
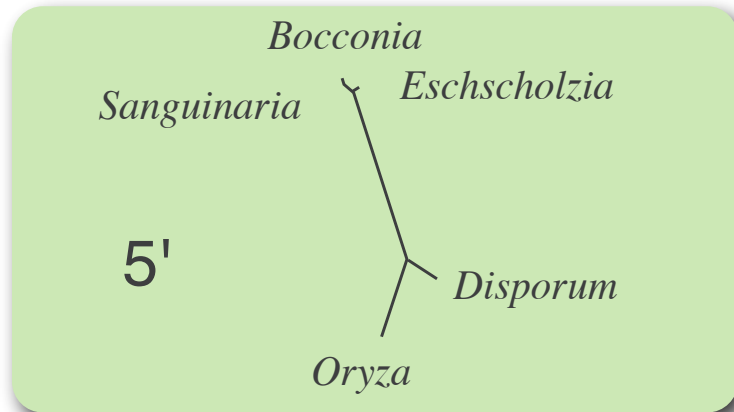


bloodroot

# Horizontal transfer results in conflicting information about the placement of bloodroot (*Sanguinaria*)



# Each data set strongly rejects the other's favorite tree, so a mediocre tree wins everything



Topology	5'	3'	Concatenated
<b>((S,D),O),E,B)</b>	---	<b>0.64</b>	---
((S,O),D),E,B)	---	0.18	---
<b>((O,D),S),E,B)</b>	0.11	0.18	<b>1</b>
(O,D,(B,(S,E)))	0.12	---	---
<b>(O,D,(E,(S,B)))</b>	<b>0.77</b>	---	---
<b>Info</b>	<b>74.2%</b>	<b>66.7%</b>	<b>100%</b>

# Dissonance is the difference between merged info and average info

Topology	5'	3'	Merged
<b>((S,D),O),E,B)</b>	---	<b>0.64</b>	0.32
((S,O),D),E,B)	---	0.18	0.09
((O,D),S),E,B)	0.11	0.18	0.14
(O,D,(B,(S,E)))	0.12	---	0.06
<b>(O,D,(E,(S,B)))</b>	<b>0.77</b>	---	0.39
Info	74.2%	66.7%	48.6%

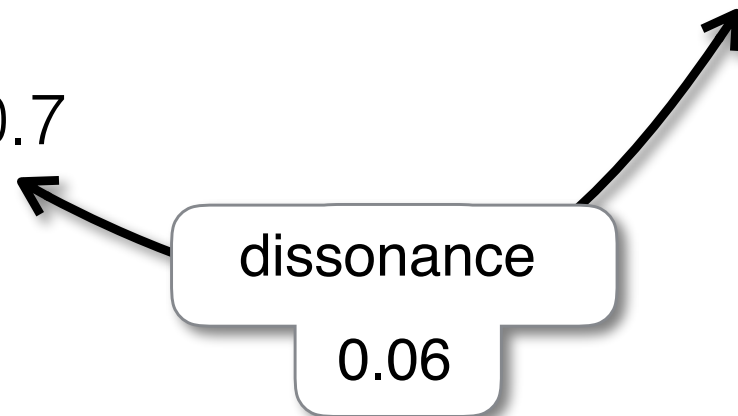
average info = 70.5



# What if instead of conflicting...

Topology	5'	3'	Merged
((S,D),O),E,B)	---	---	---
((S,O),D),E,B)	---	---	---
((O,D),S),E,B)	0.11	0.18	0.145
(O,D,(B,(S,E)))	0.12	0.18	0.150
(O,D,(E,(S,B)))	0.77	0.64	0.705
Info	74.2%	66.7%	70.1%

average info = 70.7



# Information can be partitioned by clade

