

## Supplementary Information S6: Genetic linkage analysis in California condors

### Linkage group 1

Linkage group 1 includes 1A, 1B and 1C. 1A has strong evidence of marker order, while 1B does not have strong ordering evidence and 1C has no ordering information within this group. 1A and 1B could not be ordered relative to each other, and 1c has conflicting evidence about linkage to 1A or 1B.

115Aa 120A 153F 195F 38F 63G 66A 64G 9Fb 188F 129H 17G

### Linkage group 1A

Ordering reliability: likelihood ratio (best order)/(2<sup>nd</sup> best order) = 239:1.

Sex\_averaged map (recomb. frac., Kosambi cM):

7	115Aa		0.0
		0.03	3.3
43	38F		3.3
		0.07	6.7
31	195F		10.0

\* denotes recomb. frac. held fixed in this analysis

log10\_like = 11.66

Sex-specific map (recomb. frac., Kosambi cM -- female, male ):

7	115Aa		0.0		0.0
		0.06	5.9	0.00	0.2
43	38F		5.9		0.2
		0.04	3.5	0.10	10.1
31	195F		9.4		10.3

\* denotes recomb. frac. held fixed in this analysis

log10\_like = 11.94

number of loci to flip = 2

Original order, & its log10\_likelihood, followed by  
flipped orders, with their relative log10\_likelihoods  
(= log10\_like[orig] - log10\_like[curr])

7	43	31	11.66
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43	7	-	2.38
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-	31	43	3.56
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### **Linkage group 1B**

Sex\_averaged map (recomb. frac., Kosambi cM):

8	120A		0.0
		0.01	1.3
115	66A		1.3
		0.02	2.4
52	63G		3.7
		0.00	0.0
21	153F		3.7
		0.06	5.8
1	101H		9.5

		0.08	7.9	
68	9Fb			17.4
		0.04	3.8	
27	17G			21.2

\* denotes recomb. frac. held fixed in this analysis

log10\_like = -5.34

Sex-specific map (recomb. frac., Kosambi cM -- female, male ):

8	120A			0.0		0.0
		0.00	0.0		0.03	2.9
115	66A			0.0		2.9
		0.01	1.4		0.04	3.5
52	63G			1.4		6.4
		0.00	0.0		0.00	0.0
21	153F			1.4		6.4
		0.02	2.2		0.03	2.6
1	101H			3.6		9.0
		0.00	0.0		0.21	22.9
68	9Fb			3.6		31.9
		0.04	3.9		0.03	3.4
27	17G			7.5		35.4

\* denotes recomb. frac. held fixed in this analysis

$\log_{10\_like} = -3.76$

115Aa

8	115	52	21	1	68	27
X	X	X		X	X	

-11.30

-14.11

-12.99

-12.36

-12.89

38F

8	115	52	21	1	68	27
X	X	X	X	X		

-7.74

-6.50

-6.50

-7.89

-7.90

195F

8	115	52	21	1	68	27
X	X			X	X	

-12.42

-13.20

-14.78

-15.24

number of loci to flip = 5

Original order, & its log10\_likelihood, followed by  
flipped orders, with their relative log10\_likelihoods  
(= log10\_like[orig] - log10\_like[curr])

8115	52	21	1	68	27	-5.34
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1	21	-115	8	-	-	1.04
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1	21	-	8115	-	-	1.76
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1	21115	52	8	-	-	2.16
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1	21	8	52115	-	-	2.87
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1	21115	8	52	-	-	2.85
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1	52	21115	8	-	-	1.04
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1	52	21	8115	-	-	1.76
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1	-	21	52	8	-	2.17
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1	8	21	52115	-	-	2.04
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1	-	21	8	52	-	2.85
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1	8	21115	52	-	-	2.74
1	52115	-	8	-	-	1.04
1	52	8	-115	-	-	1.76
1	-	-	-	8	-	2.16
1	8	-	-115	-	-	2.05
1	-	8	-	52	-	2.85
1	8115	-	52	-	-	2.75
1	52115	8	21	-	-	2.57
1	52	8115	21	-	-	1.76
1	8	-115	21	-	-	2.04
1	-	8	52	21	-	2.85
1	8115	52	21	-	-	2.74
52	1	21115	8	-	-	2.40
115	1	21	52	8	-	2.40
-	1	21	52115	-	-	2.40
52	1115	-	8	-	-	2.40
115	1	-	-	8	-	2.40
-	1	-	-115	-	-	2.41
-	1	-115	21	-	-	2.40
21	52	1115	8	-	-	2.40
21	-	1	52	8	-	2.40
52	21	1115	8	-	-	2.40
115	21	1	52	8	-	2.40
-	52	1	-115	-	-	2.16
-	-	1	-	52	-	2.16
-	52	1115	21	-	-	2.16
-	-	1	52	21	-	2.16
21	-	-	1	8	-	2.56

115	21	-	1	8	-	-	2.56
-	21	-	1115	-	-	-	2.16
-	21115	1	52	-	-	-	2.16
115	52	21	1	8	-	-	2.56
-	52	21	1115	-	-	-	2.16
-	-	21	1	52	-	-	2.16
-	-	-	1	21	-	-	2.76
21	52115	8	-	-	-	-	1.21
21	52	8115	-	-	-	-	1.61
21	-	-	8	-	-	-	0.77
21	8	-115	-	-	-	-	2.54
21	-	8	52	-	-	-	0.98
21	8115	52	-	-	-	-	1.92
52	21115	8	-	-	-	-	1.22
52	21	8115	-	-	-	-	1.61
115	21	-	8	-	-	-	0.78
-	21	-115	-	-	-	-	0.62
115	21	8	52	-	-	-	0.98
-	21115	52	-	-	-	-	-0.00
52	-	21	8	-	-	-	1.21
52	8	21115	-	-	-	-	1.61
115	52	21	8	-	-	-	0.77
-	52	21115	-	-	-	-	0.63
115	8	21	52	-	-	-	0.98
-	-	21	52	-	-	-	0.00
52	-	8	-	-	-	-	2.28
52	8115	-	-	-	-	-	1.61
115	52	8	-	-	-	-	1.76

-	52115	-	-	-	-		0.62
115	8	-	-	-	-	-	0.98
-	21	-115	68	1	-		2.79
-	21115	52	68	1	-		2.67
-	52	21115	68	1	-		2.79
-	-	21	52	68	1	-	2.68
-	52115	-	68	1	-		2.79
-	-	-	-	68	1	-	2.67
-	-	-	27	21	1	68	2.47
-	-	21	52	27	-	1	2.71
-	-	-	-	27	-	1	2.71
-	-	21	52	27	1	68	1.25
-	-	-	-	27	1	68	1.24
-	-	21	52	68	27	1	2.31
-	-	-	-	68	27	1	2.30
-	-	1	-	52	27	68	2.54
-	-	1	52	21	27	68	2.54
-	-	21	1	52	27	68	2.54
-	-	21	52	-	27	68	0.56
-	-	-	-	-	27	68	0.56

#### **Linkage group 1C**

129H 64G 188F

These three markers could be the same marker, but had conflicting evidence about linkage to group 1A or 1B.

#### **Linkage group 2**

Ordering reliability: likelihood ratio (best order)/(2<sup>nd</sup> best order) = 707:1.



39F 109D 41A

Sex\_averaged map (recomb. frac., Kosambi cM):

44	39F		0.0
		0.16	16.7
4	109D		16.7
		0.09	8.6
109	41A		25.3

\* denotes recomb. frac. held fixed in this analysis

log10\_like = -28.71

Sex-specific map (recomb. frac., Kosambi cM -- female, male ):

44	39F		0.0		0.0
		0.12	12.2	0.20	21.7
4	109D		12.2		21.7
		0.06	6.5	0.11	11.2
109	41A		18.7		32.9

\* denotes recomb. frac. held fixed in this analysis

log10\_like = -28.27

135A

44	4	109
	X	X

-38.05

-37.03

44 39F

4 109D

109 41A

number of loci to flip = 2

Original order, & its log10\_likelihood, followed by  
flipped orders, with their relative log10\_likelihoods  
(= log10\_like[orig] - log10\_like[curr])

44 4 109 -28.71

4 44 - 8.00

-109 4 2.85

### **Linkage group 3**

21F 79H D10 D6

no ordering info

### **Linkage group 4**

47G 92D 176A

no ordering info

**Linkage group 5**

157F 145A 167A

no ordering info

**Linkage group 6**

124D 157G 125G

no ordering info

**Linkage group 7**

20D 58F 74F

no ordering info

**Linkage group 8**

B7 H238

no ordering info

**Linkage group 9**

143H 111A

no ordering info

**Linkage group 10**

121A 33A

no ordering info

**Linkage group 11**

D24 58A

no ordering info

**Linkage group 12**

Ch262-87L14\_2                      D126

no ordering info

**Linkage group 13**

112G    D9

no ordering info