# SUPPLEMENTARY INFORMATION

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**Supplementary model code**

The code used to implement analyses presented in SI tables 1-10 was as follows:

*SI Table 1*

i) Without phylogeny

Prior: list(R=list(V=1,nu=0.002))

Model: MCMCglmm(cbind(number of relatives, number of non-relatives) ~ log(extra-pair paternity+1), family ="multinomial2", nitt=600000, burnin=100000, thin=100)

ii) With phylogeny

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm((cbind(number of relatives, number of non-relatives) ~ log(extra-pair paternity+1), random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*SI Table 2 & 11*

i) Without phylogeny

Prior: list(R=list(V=1,nu=0.002))

Model: MCMCglmm(cbind(extra-pair offspring, within-pair offspring) ~ Cooperation, family ="multinomial2", nitt=600000, burnin=100000, thin=100)

ii) With phylogeny

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(cbind(extra-pair offspring, within-pair offspring) ~ Cooperation, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*SI Table 3*

i) Without phylogeny

Prior: list(R=list(V=1,nu=0.002))

Model: MCMCglmm(cbind(% extra-pair offspring, 100-% extra-pair offspring) ~ Cooperation, family ="multinomial2", nitt=600000, burnin=100000, thin=100)

ii) With phylogeny

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(cbind(% extra-pair offspring, 100-% extra-pair offspring) ~ Cooperation, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*SI Table 4*

Prior: list(R = list(V = diag(2), nu=1.002, fix=2), G = list(G1=list(V = diag(2), nu =1.002)))

Model: MCMCglmm(cbind(cbind(extra-pair offspring, within-pair offspring), Probability of Cooperation) ~ trait-1, random = ~us(trait):species, rcov = ~us(trait):units, family = c("multinomial2", "categorical"), nitt=7100000, burnin=100000, thin=1000)

*SI Table 5 & 12*

Prior: list(R = list(V = diag(2), nu=1.002, fix=2), G = list(G1=list(V = diag(2), nu =1.002)))

Model: MCMCglmm(cbind(cbind(extra-pair offspring, within-pair offspring), Probability of Cooperation) ~ trait-1, random = ~us(trait):animal, rcov = ~us(trait):units, pedigree=tree, family = c("multinomial2", "categorical"), nitt=7100000, burnin=100000, thin=1000)

*SI Table 7 & 14*

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(cbind(extra-pair offspring, within-pair offspring) ~ Cooperation category, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*SI Table 8*

i) Without phylogeny

Prior: list(R=list(V=1,nu=0.002))

Model: MCMCglmm(Z transformed rkin ~ extra-pair paternity+extra-pair paternity$^2$, mev=measurement error variance, family ="gaussian", nitt=600000, burnin=100000, thin=100)

ii) With phylogeny

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(Z transformed rkin ~ extra-pair paternity+extra-pair paternity$^2$, random = ~animal, mev=measurement error variance, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*SI Table 9*

i) Without phylogeny

Prior: list(R=list(V=1,nu=0.002))

Model: MCMCglmm(cbind(% cooperative nests, 100-% cooperative nests) ~ extra-pair paternity, family ="multinomial2", nitt=600000, burnin=100000, thin=100)

ii) With phylogeny

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(cbind(% cooperative nests, 100-% cooperative nests) ~ extra-pair paternity, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

The code used to implement analyses testing for confounding effects of breeding range and longevity was as follows:

*Breeding range*

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

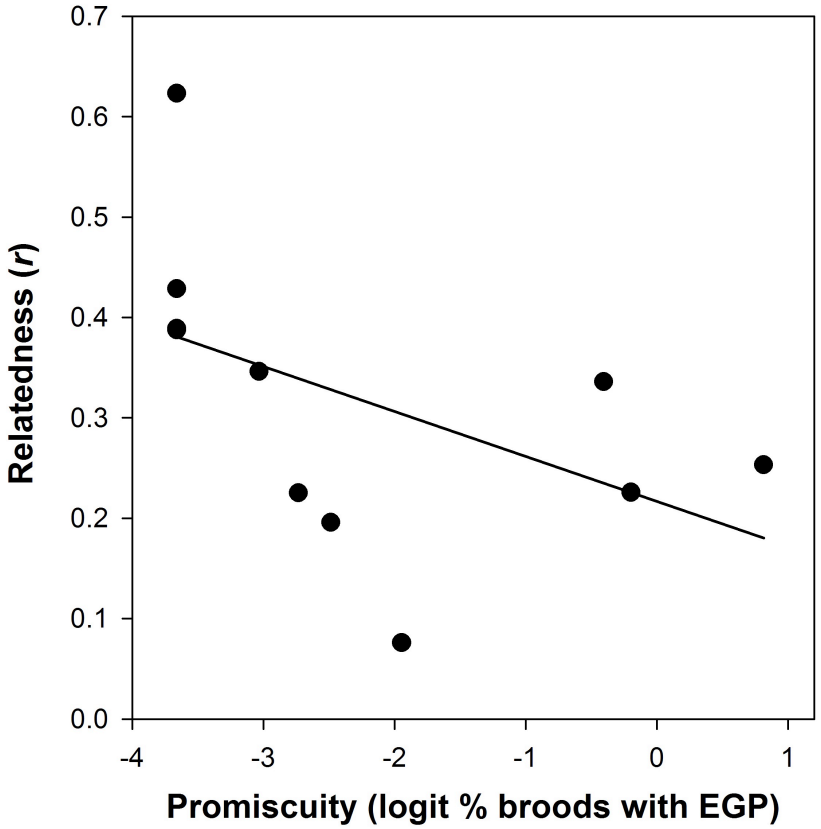
Model: MCMCglmm(cbind(extra-pair offspring, within-pair offspring) ~ cooperation+breeding range, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

*Longevity*

Prior: list(R=list(V=1,nu=0.002), G=list(G1=list(V=1, nu=0.002)

Model: MCMCglmm(cbind(extra-pair offspring, within-pair offspring) ~ cooperation+longevity, random = ~animal, pedigree=tree, family = "multinomial2", nitt=600000, burnin=100000, thin=100)

**Supplementary figure**




**SI Figure 1:** Relatedness between potential helpers and breeders and female promiscuity. Across cooperative species relatedness was negative correlated with promiscuity ($N_{species}$=11, $\beta$ = -0.27, CI = -0.57 to -0.01, P=0.03).

## Supplementary tables

**SI Table 1:** The relationship between mean relatedness between potential helpers and breeders (binomial response) and estimated rates of female promiscuity.

| **Fixed Terms** | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Promiscuity (log EPP+1): Without phylogeny | -0.24 | -0.52 | -0.02 | **0.02** |
| Promiscuity (log EPP+1): With phylogeny | -0.27 | -0.57 | -0.01 | **0.03** |
| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | 0.004 | 0.0003 | 0.85 | NA |
| Residual variation ($V_e$) | 0.007 | 0.0003 | 0.84 | NA |

Notes: 600,000 iterations with 100,000 burnin and thinning interval of 100. Model excluding phylogenetic effect: DIC = 1300.7. Model including phylogenetic effect: DIC = 1300.7. $N_{species}$=11.

**SI Table 2:** The differences in female promiscuity between non-cooperative and cooperative breeding birds.

| **Fixed Terms** | | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|---|
| Without phylogeny: | Cooperative | 0.04 | 0.02 | 0.08 | **0.0002**[1] |
| | Non-cooperative | 0.14 | 0.11 | 0.17 | |
| With phylogeny: | Cooperative | 0.05 | 0.02 | 0.17 | **0.004**[1] |
| | Non-cooperative | 0.15 | 0.05 | 0.30 | |
| **Random Terms** | | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | | 1.84 | 0.83 | 3.12 | NA |
| Residual variation ($V_e$) | | 1.30 | 0.87 | 1.78 | NA |
| Phylogenetic heritability ($h^2$) | | 0.61 | 0.38 | 0.77 | NA |

Notes: 600,000 iterations with 100,000 burnin and thinning interval of 100. Model excluding phylogenetic effect: DIC = 19,135. Model including phylogenetic effect: DIC = 19,123 (best model). $N_{species}$=267. [1]P values refer to difference between parameter estimates (cooperative versus non-cooperative).

**SI Table 3:** The differences in female promiscuity between non-cooperative and cooperative breeding birds including data on species where sample sizes were not reported (6 species).

| **Fixed Terms** | | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|---|
| Without phylogeny: | Cooperative | 0.02 | 0.008 | 0.06 | **0.001**[1] |
| | Non-cooperative | 0.10 | 0.08 | 0.14 | |
| With phylogeny: | Cooperative | 0.03 | 0.006 | 0.16 | **0.005**[1] |
| | Non-cooperative | 0.10 | 0.03 | 0.32 | |
| **Random Terms** | | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | | 2.55 | 1.29 | 4.94 | NA |
| Residual variation ($V_e$) | | 2.27 | 1.60 | 3.11 | NA |
| Phylogenetic heritability ($h^2$) | | 0.54 | 0.37 | 0.75 | NA |

Notes: 600,000 iterations with 100,000 burnin and thinning interval of 100. Model excluding phylogenetic effect: DIC = 19,715. Model including phylogenetic effect: DIC = 19,710. $N_{species}$=273. [1]P values refer to difference between parameter estimates (cooperative versus non-cooperative).

**SI Table 4:** The correlation between promiscuity and cooperative breeding in birds. The analysis was conducted using a multi-response model (trait 1 = promiscuity (binomial response), trait 2 = cooperative breeding (binary response: 0 = non-cooperative, 1 = cooperative).

| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Variance in promiscuity ($V_{a1}$) | 0.80 | 0.17 | 3.14 | NA |
| Variance in cooperative breeding ($V_{a2}$) | 0.58 | 0.07 | 62.17 | NA |
| Covariance between promiscuity and cooperative breeding ($Cov_{1,2}$) | -0.35 | -5.47 | 0.49 | NA |
| Residual variation for promiscuity ($V_{e1}$) | 2.45 | 0.23 | 3.25 | NA |
| Correlation between promiscuity and cooperative breeding ($r_{1,2}$) | -0.54 | -0.95 | 0.11 | **0.07** |

Notes: 7.1 million iterations with 100,000 burnin and thinning interval of 100. $N_{species}$=267. Model assuming cooperative breeding and promiscuity are independent (~idh(trait):species): DIC = 19336. Model assuming cooperative breeding and promiscuity are correlated (~us(trait):species): DIC = 19324 (best model).

**SI Table 5:** The phylogenetic correlation between promiscuity and cooperative breeding in birds. Analysis was conducted using a multi-response model (trait 1 = promiscuity (binomial response), trait 2 = cooperative breeding (binary response: 0 = non-cooperative, 1 = cooperative).

| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Phylogenetic variance in promiscuity ($V_{a1}$) | 2.11 | 1.06 | 3.39 | NA |
| Phylogenetic variance in cooperative breeding ($V_{a2}$) | 20.79 | 2.46 | 345.44 | NA |
| Phylogenetic covariance between promiscuity and cooperative breeding ($Cov_{1,2}$) | -4.26 | -17.74 | -1.07 | NA |
| Residual variation for promiscuity ($V_{e1}$) | 1.18 | 0.85 | 1.70 | NA |
| Phylogenetic heritability for promiscuity ($H^2_1$) | 0.66 | 0.47 | 0.79 | NA |
| Intraclass correlation coefficient for cooperative breeding ($IC_2$) | 0.97 | 0.72 | 0.99 | NA |
| Phylogenetic correlation between promiscuity and cooperative breeding ($r_{1,2}$) | -0.63 | -0.86 | -0.33 | **0.001** |

Notes: 7.1 million iterations with 100,000 burnin and thinning interval of 1000. Residual variation cannot be estimated for binary traits and therefore it is not possible to estimate phylogenetic heritability (proportion of phenotypic variation attributable to shared ancestry between species). However, the intraclass correlation coefficient (IC) can be calculated which gives an estimate of the degree of similarity between related species providing an analogous measure to heritability. $N_{species}$=267. Model assuming cooperative breeding and promiscuity evolve independently (~idh(trait):animal): DIC = 19258, Model estimating correlated evolution between cooperative breeding and promiscuity (~us(trait):animal): DIC = 19232 (best model).

**SI Table 6:** Estimation of evolutionary transition rates between cooperative breeding and different levels of promiscuity (low: less than or equal to the median extra-pair paternity (<=14%). High: higher than the median (>14%) extra-pair paternity) and comparison of models assuming independent evolution versus correlation evolution of cooperative breeding and promiscuity.

| Cooperation transition | Promiscuity Transition | Transition rate | Log-likelihood when restricted to 0 | Log-likelihood Change | DF | P |
|---|---|---|---|---|---|---|
| Cooperative | Low to High | 0.08 (0.0) | -237.53 | 1.79 | 1 | 0.06 |
| Cooperative | High to Low | 0.19 (0.33) | -238.96 | 3.22 | 1 | **0.01** |
| Non-cooperative | Low to High | 0.02 (0.42) | -245.01 | 9.27 | 1 | **<0.0001** |
| Non-cooperative | High to Low | 0.004 (0.008) | -237.74 | 2 | 1 | **0.05** |
| Cooperative to Non-cooperative | Low | 0.04 (0.08) | -243.33 | 7.59 | 1 | **<0.0001** |
| Non-cooperative to Cooperative | Low | 0.02 (0.34) | -249.75 | 14.01 | 1 | **<0.0001** |
| Cooperative to Non-cooperative | High | 0.04 (0.04) | -237.39 | 1.65 | 1 | 0.08 |
| Non-cooperative to Cooperative | High | 0.009 (0.027) | -238.98 | 3.24 | 1 | **0.01** |

Notes: $N_{species}$=267. Model assuming independent evolution of cooperative breeding and promiscuity: log-likelihood = -241.31. Model assuming correlated evolution of cooperative breeding and promiscuity: log-likelihood = -235.74. Model of correlated evolution had a significantly higher log-likelihood than the model assuming independent evolution: log-likelihood ratio test (LRT) =11.2, df=4, P=0.02. Whether transition rates were significantly different from 0 was tested using LRTs by comparing the log-likelihood of models estimating the transition rate with models that

assumed the transition rate was zero. We also ran the analysis using a covarion model that allows rates of evolution to vary across the tree, which gave qualitatively similar results (transition rates are presented in the brackets in the transition rate column).

**SI Table 7:** The differences in female promiscuity rates between ancestors giving rise to both cooperative and non-cooperative, only cooperative and only non-cooperative species.

| **Fixed Terms** | | **Parameter Estimate** | **Lower CI** | **Upper CI** | **P** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ancestor** | **Descendents** | **(β)** | | | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Non-cooperative | Only non-cooperative **(1)** | 0.19 | 0.07 | 0.34 | X | **0.002** | **0.001** | 0.08 | **0.005** | **0.01** |
| Non-cooperative | Both cooperative & non-cooperative **(2)** | 0.06 | 0.01 | 0.16 | | X | 0.09 | 0.71 | 0.13 | 0.37 |
| Non-cooperative | Only cooperative **(3)** | 0.01 | 0.001 | 0.08 | | | X | **0.04** | 0.52 | 0.82 |
| Cooperative | Only non-cooperative **(4)** | 0.08 | 0.01 | 0.24 | | | | X | 0.07 | 0.22 |
| Cooperative | Both cooperative & non-cooperative **(5)** | 0.01 | 0.001 | 0.10 | | | | | X | 0.16 |
| Cooperative | Only cooperative **(6)** | 0.02 | 0.005 | 0.16 | | | | | | X |
| **Random Terms** | | **Variance Component** | **Lower CI** | **Upper CI** | | | | | | |
| Phylogenetic variance ($V_a$) | | 1.47 | 0.75 | 2.77 | | | | NA | | |
| Residual variation ($V_e$) | | 1.31 | 0.86 | 1.75 | | | | NA | | |

Notes: P value is the proportion of iterations where the parameter estimate is greater than 0 (positive estimates) or less than 0 (negative estimates). 600,000 iterations with 100,00 burnin and thinning interval of 100. $N_{species}$=267, $N_{nodes}$=266.

**SI Table 8:** Meta-analysis of the relationship between kin discrimination (rkin) and female promiscuity. rKin (response) was Z-transformed prior to the analysis and data points were weighted against the inverse variance (1/(N-3) of each study of kin discrimination.

| **Fixed Terms** | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Promiscuity: Without phylogeny | 0.31 | -0.12 | 0.85 | 0.07 |
| Promiscuity$^2$: Without phylogeny | -0.29 | -0.62 | 0.02 | **0.03** |
| Promiscuity: With phylogeny | 0.37 | -0.16 | 0.91 | 0.07 |
| Promiscuity$^2$: With phylogeny | -0.31 | -0.67 | 0.01 | **0.03** |
| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | 0.002 | 0.0001 | 0.32 | NA |
| Residual variation ($V_e$) | 0.08 | 0.0003 | 0.34 | NA |

Notes: P value is the proportion of iterations where the parameter estimate is greater than 0 (positive estimates) or less than 0 (negative estimates). 600,000 iterations with 400,000 burnin and thinning interval of 10. Model excluding phylogenetic effect: DIC = 18.0. Model including phylogenetic effect: DIC = 12.79. $N_{species}$=15.

**SI Table 9:** The relationship between percentage of cooperative nests (binomial response) and rates of promiscuity.

| **Fixed Terms** | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Promiscuity: Without phylogeny | -0.15 | -0.35 | -0.01 | **0.01** |
| Promiscuity: With phylogeny | -0.15 | -0.29 | -0.02 | **0.01** |
| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | 0.50 | 0.09 | 36.30 | NA |
| Residual variation ($V_e$) | 20.53 | 4.24 | 53.61 | NA |

Notes: P value is the proportion of iterations where the parameter estimate is greater than 0 (positive estimates) or less than 0 (negative estimates). 600,000 iterations with 100,000 burnin and thinning interval of 10. Model excluding phylogenetic effect: DIC = 1648. Model including phylogenetic effect: DIC=1649. $N_{species}$=30.

**SI Table 10:** Inferred transitions to and from cooperative breeding across the bird phylogeny

| Ancestor | Estimated breeding system | Descendent | Estimated breeding system | Inferred Transition |
|---|---|---|---|---|
| Node1 | Noncooperative | Node2 | Noncooperative | Noncooperative to Noncooperative |
| Node2 | Noncooperative | Node3 | Noncooperative | Noncooperative to Noncooperative |
| Node3 | Noncooperative | Node4 | Noncooperative | Noncooperative to Noncooperative |
| Node4 | Noncooperative | Node5 | Noncooperative | Noncooperative to Noncooperative |
| Node5 | Noncooperative | Node6 | Noncooperative | Noncooperative to Noncooperative |
| Node6 | Noncooperative | Node7 | Noncooperative | Noncooperative to Noncooperative |
| Node7 | Noncooperative | Node8 | Noncooperative | Noncooperative to Noncooperative |
| Node8 | Noncooperative | Node9 | Noncooperative | Noncooperative to Noncooperative |
| Node9 | Noncooperative | Node10 | Noncooperative | Noncooperative to Noncooperative |
| Node10 | Noncooperative | Node11 | Noncooperative | Noncooperative to Noncooperative |
| Node11 | Noncooperative | Node12 | Noncooperative | Noncooperative to Noncooperative |
| Node12 | Noncooperative | Node13 | Noncooperative | Noncooperative to Noncooperative |
| Node13 | Noncooperative | Node14 | Noncooperative | Noncooperative to Noncooperative |
| Node14 | Noncooperative | Node15 | Noncooperative | Noncooperative to Noncooperative |
| Node15 | Noncooperative | Node16 | Noncooperative | Noncooperative to Noncooperative |
| Node16 | Noncooperative | Node17 | Noncooperative | Noncooperative to Noncooperative |
| Node17 | Noncooperative | Node18 | Noncooperative | Noncooperative to Noncooperative |
| Node18 | Noncooperative | Node19 | Noncooperative | Noncooperative to Noncooperative |
| Node19 | Noncooperative | Sialia mexicana | Cooperative | Noncooperative to Cooperative |
| Node19 | Noncooperative | Node20 | Noncooperative | Noncooperative to Noncooperative |
| Node20 | Noncooperative | Sialia currucoides | Noncooperative | Noncooperative to Noncooperative |
| Node20 | Noncooperative | Sialia sialis | Noncooperative | Noncooperative to Noncooperative |
| Node18 | Noncooperative | Node21 | Noncooperative | Noncooperative to Noncooperative |

| | | | | |
|---|---|---|---|---|
| Node21 | Noncooperative | Hylocichla mustelina | Noncooperative | Noncooperative to Noncooperative |
| Node21 | Noncooperative | Node22 | Noncooperative | Noncooperative to Noncooperative |
| Node22 | Noncooperative | Turdus migratorius | Noncooperative | Noncooperative to Noncooperative |
| Node22 | Noncooperative | Node23 | Noncooperative | Noncooperative to Noncooperative |
| Node23 | Noncooperative | Turdus grayi | Noncooperative | Noncooperative to Noncooperative |
| Node23 | Noncooperative | Turdus merula | Noncooperative | Noncooperative to Noncooperative |
| Node17 | Noncooperative | Node24 | Noncooperative | Noncooperative to Noncooperative |
| Node24 | Noncooperative | Erithacus rubecula | Noncooperative | Noncooperative to Noncooperative |
| Node24 | Noncooperative | Node25 | Noncooperative | Noncooperative to Noncooperative |
| Node25 | Noncooperative | Phoenicurus phoenicurus | Noncooperative | Noncooperative to Noncooperative |
| Node25 | Noncooperative | Node26 | Noncooperative | Noncooperative to Noncooperative |
| Node26 | Noncooperative | Node27 | Noncooperative | Noncooperative to Noncooperative |
| Node27 | Noncooperative | Ficedula albicollis | Noncooperative | Noncooperative to Noncooperative |
| Node27 | Noncooperative | Ficedula hypoleuca | Noncooperative | Noncooperative to Noncooperative |
| Node26 | Noncooperative | Luscinia svecica | Noncooperative | Noncooperative to Noncooperative |
| Node16 | Noncooperative | Node28 | Noncooperative | Noncooperative to Noncooperative |
| Node28 | Noncooperative | Node29 | Noncooperative | Noncooperative to Noncooperative |
| Node29 | Noncooperative | Node30 | Noncooperative | Noncooperative to Noncooperative |
| Node30 | Noncooperative | Sturnus unicolor | Noncooperative | Noncooperative to Noncooperative |
| Node30 | Noncooperative | Sturnus vulgaris | Noncooperative | Noncooperative to Noncooperative |
| Node29 | Noncooperative | Lamprotornis superbus | Cooperative | Noncooperative to Cooperative |
| Node28 | Noncooperative | Ramphocinclus brachyurus | Cooperative | Noncooperative to Cooperative |
| Node15 | Noncooperative | Node31 | Noncooperative | Noncooperative to Noncooperative |
| Node31 | Noncooperative | Node32 | Noncooperative | Noncooperative to Noncooperative |
| Node32 | Noncooperative | Node33 | Noncooperative | Noncooperative to Noncooperative |

| | | | | |
|---|---|---|---|---|
| Node33 | Noncooperative | Node34 | Noncooperative | Noncooperative to Noncooperative |
| Node34 | Noncooperative | Node35 | Noncooperative | Noncooperative to Noncooperative |
| Node35 | Noncooperative | Campylorhynchus nuchalis | Cooperative | Noncooperative to Cooperative |
| Node35 | Noncooperative | Campylorhynchus griseus | Cooperative | Noncooperative to Cooperative |
| Node34 | Noncooperative | Thryothorus ludovicianus | Noncooperative | Noncooperative to Noncooperative |
| Node33 | Noncooperative | Thryothorus leucotis | Noncooperative | Noncooperative to Noncooperative |
| Node32 | Noncooperative | Troglodytes aedon | Noncooperative | Noncooperative to Noncooperative |
| Node31 | Noncooperative | Sitta europaea | Noncooperative | Noncooperative to Noncooperative |
| Node14 | Noncooperative | Phainopepla nitens | Noncooperative | Noncooperative to Noncooperative |
| Node13 | Noncooperative | Node36 | Cooperative | Noncooperative to Cooperative |
| Node36 | Cooperative | Node37 | Noncooperative | Cooperative to Noncooperative |
| Node37 | Noncooperative | Node38 | Noncooperative | Noncooperative to Noncooperative |
| Node38 | Noncooperative | Node39 | Noncooperative | Noncooperative to Noncooperative |
| Node39 | Noncooperative | Node40 | Noncooperative | Noncooperative to Noncooperative |
| Node40 | Noncooperative | Node41 | Noncooperative | Noncooperative to Noncooperative |
| Node41 | Noncooperative | Node42 | Noncooperative | Noncooperative to Noncooperative |
| Node42 | Noncooperative | Node43 | Noncooperative | Noncooperative to Noncooperative |
| Node43 | Noncooperative | Node44 | Noncooperative | Noncooperative to Noncooperative |
| Node44 | Noncooperative | Node45 | Noncooperative | Noncooperative to Noncooperative |
| Node45 | Noncooperative | Volatinia jacarina | Noncooperative | Noncooperative to Noncooperative |
| Node45 | Noncooperative | Ramphocelus costaricensis | Noncooperative | Noncooperative to Noncooperative |
| Node44 | Noncooperative | Geospiza scandens | Noncooperative | Noncooperative to Noncooperative |
| Node43 | Noncooperative | Node46 | Noncooperative | Noncooperative to Noncooperative |
| Node46 | Noncooperative | Node47 | Noncooperative | Noncooperative to Noncooperative |
| Node47 | Noncooperative | Node48 | Noncooperative | Noncooperative to Noncooperative |

| | | | | |
|---|---|---|---|---|
| Node48 | Noncooperative | Passerina cyanea | Noncooperative | Noncooperative to Noncooperative |
| Node48 | Noncooperative | Passerina caerulea | Noncooperative | Noncooperative to Noncooperative |
| Node47 | Noncooperative | Cardinalis cardinalis | Noncooperative | Noncooperative to Noncooperative |
| Node46 | Noncooperative | Piranga olivacea | Noncooperative | Noncooperative to Noncooperative |
| Node42 | Noncooperative | Node49 | Noncooperative | Noncooperative to Noncooperative |
| Node49 | Noncooperative | Node50 | Noncooperative | Noncooperative to Noncooperative |
| Node50 | Noncooperative | Node51 | Noncooperative | Noncooperative to Noncooperative |
| Node51 | Noncooperative | Agelaius phoeniceus | Noncooperative | Noncooperative to Noncooperative |
| Node51 | Noncooperative | Molothrus ater | Noncooperative | Noncooperative to Noncooperative |
| Node50 | Noncooperative | Node52 | Noncooperative | Noncooperative to Noncooperative |
| Node52 | Noncooperative | Node53 | Noncooperative | Noncooperative to Noncooperative |
| Node53 | Noncooperative | Node54 | Noncooperative | Noncooperative to Noncooperative |
| Node54 | Noncooperative | Node55 | Noncooperative | Noncooperative to Noncooperative |
| Node55 | Noncooperative | Pipilo crissalis | Noncooperative | Noncooperative to Noncooperative |
| Node55 | Noncooperative | Node56 | Noncooperative | Noncooperative to Noncooperative |
| Node56 | Noncooperative | Junco hyemalis | Noncooperative | Noncooperative to Noncooperative |
| Node56 | Noncooperative | Node57 | Noncooperative | Noncooperative to Noncooperative |
| Node57 | Noncooperative | Zonotrichia albicollis | Noncooperative | Noncooperative to Noncooperative |
| Node57 | Noncooperative | Zonotrichia leucophrys | Noncooperative | Noncooperative to Noncooperative |
| Node54 | Noncooperative | Node58 | Noncooperative | Noncooperative to Noncooperative |
| Node58 | Noncooperative | Node59 | Noncooperative | Noncooperative to Noncooperative |
| Node59 | Noncooperative | Passerculus sandwichensis | Noncooperative | Noncooperative to Noncooperative |
| Node59 | Noncooperative | Node60 | Noncooperative | Noncooperative to Noncooperative |
| Node60 | Noncooperative | Melospiza melodia | Noncooperative | Noncooperative to Noncooperative |
| Node60 | Noncooperative | Melospiza georgiana | Noncooperative | Noncooperative to Noncooperative |

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| Node58 | Noncooperative | Node61 | Noncooperative | Noncooperative to Noncooperative |
| Node61 | Noncooperative | Ammodramus maritimus | Noncooperative | Noncooperative to Noncooperative |
| Node61 | Noncooperative | Ammodramus caudacutus | Noncooperative | Noncooperative to Noncooperative |
| Node53 | Noncooperative | Spizella pusilla | Noncooperative | Noncooperative to Noncooperative |
| Node52 | Noncooperative | Node62 | Noncooperative | Noncooperative to Noncooperative |
| Node62 | Noncooperative | Emberiza schoeniclus | Noncooperative | Noncooperative to Noncooperative |
| Node62 | Noncooperative | Node63 | Noncooperative | Noncooperative to Noncooperative |
| Node63 | Noncooperative | Emberiza calandra | Noncooperative | Noncooperative to Noncooperative |
| Node63 | Noncooperative | Emberiza citrinella | Noncooperative | Noncooperative to Noncooperative |
| Node49 | Noncooperative | Node64 | Noncooperative | Noncooperative to Noncooperative |
| Node64 | Noncooperative | Node65 | Noncooperative | Noncooperative to Noncooperative |
| Node65 | Noncooperative | Icterus galbula | Noncooperative | Noncooperative to Noncooperative |
| Node65 | Noncooperative | Dolichonyx oryzivorus | Noncooperative | Noncooperative to Noncooperative |
| Node64 | Noncooperative | Node66 | Noncooperative | Noncooperative to Noncooperative |
| Node66 | Noncooperative | Node67 | Noncooperative | Noncooperative to Noncooperative |
| Node67 | Noncooperative | Node68 | Noncooperative | Noncooperative to Noncooperative |
| Node68 | Noncooperative | Wilsonia pusilla | Noncooperative | Noncooperative to Noncooperative |
| Node68 | Noncooperative | Cardellina rubrifrons | Noncooperative | Noncooperative to Noncooperative |
| Node67 | Noncooperative | Node69 | Noncooperative | Noncooperative to Noncooperative |
| Node69 | Noncooperative | Node70 | Noncooperative | Noncooperative to Noncooperative |
| Node70 | Noncooperative | Wilsonia citrina | Noncooperative | Noncooperative to Noncooperative |
| Node70 | Noncooperative | Node71 | Noncooperative | Noncooperative to Noncooperative |
| Node71 | Noncooperative | Setophaga ruticilla | Noncooperative | Noncooperative to Noncooperative |
| Node71 | Noncooperative | Node72 | Noncooperative | Noncooperative to Noncooperative |
| Node72 | Noncooperative | Dendroica caerulescens | Noncooperative | Noncooperative to Noncooperative |

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| Node72 | Noncooperative | Node73 | Noncooperative | Noncooperative to Noncooperative |
| Node73 | Noncooperative | Dendroica petechia | Noncooperative | Noncooperative to Noncooperative |
| Node73 | Noncooperative | Dendroica pensylvanica | Noncooperative | Noncooperative to Noncooperative |
| Node69 | Noncooperative | Vermivora chrysoptera | Noncooperative | Noncooperative to Noncooperative |
| Node66 | Noncooperative | Geothlypis trichas | Noncooperative | Noncooperative to Noncooperative |
| Node41 | Noncooperative | Node74 | Noncooperative | Noncooperative to Noncooperative |
| Node74 | Noncooperative | Calcarius ornatus | Noncooperative | Noncooperative to Noncooperative |
| Node74 | Noncooperative | Calcarius pictus | Noncooperative | Noncooperative to Noncooperative |
| Node40 | Noncooperative | Node75 | Noncooperative | Noncooperative to Noncooperative |
| Node75 | Noncooperative | Node76 | Noncooperative | Noncooperative to Noncooperative |
| Node76 | Noncooperative | Node77 | Noncooperative | Noncooperative to Noncooperative |
| Node77 | Noncooperative | Carpodacus erythrinus | Noncooperative | Noncooperative to Noncooperative |
| Node77 | Noncooperative | Oenanthe oenanthe | Noncooperative | Noncooperative to Noncooperative |
| Node76 | Noncooperative | Node78 | Noncooperative | Noncooperative to Noncooperative |
| Node78 | Noncooperative | Node79 | Noncooperative | Noncooperative to Noncooperative |
| Node79 | Noncooperative | Carduelis tristis | Noncooperative | Noncooperative to Noncooperative |
| Node79 | Noncooperative | Node80 | Noncooperative | Noncooperative to Noncooperative |
| Node80 | Noncooperative | Node81 | Noncooperative | Noncooperative to Noncooperative |
| Node81 | Noncooperative | Carduelis cannabina | Noncooperative | Noncooperative to Noncooperative |
| Node81 | Noncooperative | Node82 | Noncooperative | Noncooperative to Noncooperative |
| Node82 | Noncooperative | Serinus canaria | Noncooperative | Noncooperative to Noncooperative |
| Node82 | Noncooperative | Serinus serinus | Noncooperative | Noncooperative to Noncooperative |
| Node80 | Noncooperative | Loxia curvirostra | Noncooperative | Noncooperative to Noncooperative |
| Node78 | Noncooperative | Node83 | Noncooperative | Noncooperative to Noncooperative |
| Node83 | Noncooperative | Carpodacus mexicanus | Noncooperative | Noncooperative to Noncooperative |

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| Node83 | Noncooperative | Loxioides bailleui | Noncooperative | Noncooperative to Noncooperative |
| Node75 | Noncooperative | Fringilla coelebs | Noncooperative | Noncooperative to Noncooperative |
| Node39 | Noncooperative | Anthus spinoletta | Noncooperative | Noncooperative to Noncooperative |
| Node38 | Noncooperative | Node84 | Noncooperative | Noncooperative to Noncooperative |
| Node84 | Noncooperative | Node85 | Noncooperative | Noncooperative to Noncooperative |
| Node85 | Noncooperative | Taeniopygia guttata | Noncooperative | Noncooperative to Noncooperative |
| Node85 | Noncooperative | Petronia petronia | Noncooperative | Noncooperative to Noncooperative |
| Node84 | Noncooperative | Node86 | Noncooperative | Noncooperative to Noncooperative |
| Node86 | Noncooperative | Passer domesticus | Noncooperative | Noncooperative to Noncooperative |
| Node86 | Noncooperative | Passer montanus | Noncooperative | Noncooperative to Noncooperative |
| Node37 | Noncooperative | Node87 | Noncooperative | Noncooperative to Noncooperative |
| Node87 | Noncooperative | Node88 | Noncooperative | Noncooperative to Noncooperative |
| Node88 | Noncooperative | Node89 | Noncooperative | Noncooperative to Noncooperative |
| Node89 | Noncooperative | Node90 | Noncooperative | Noncooperative to Noncooperative |
| Node90 | Noncooperative | Philetairus socius | Cooperative | Noncooperative to Cooperative |
| Node90 | Noncooperative | Node91 | Noncooperative | Noncooperative to Noncooperative |
| Node91 | Noncooperative | Euplectes orix | Noncooperative | Noncooperative to Noncooperative |
| Node91 | Noncooperative | Quelea quelea | Noncooperative | Noncooperative to Noncooperative |
| Node89 | Noncooperative | Bubalornis niger | Noncooperative | Noncooperative to Noncooperative |
| Node88 | Noncooperative | Prunella modularis | Noncooperative | Noncooperative to Noncooperative |
| Node87 | Noncooperative | Prunella collaris | Noncooperative | Noncooperative to Noncooperative |
| Node36 | Cooperative | Node92 | Noncooperative | Cooperative to Noncooperative |
| Node92 | Noncooperative | Nectarinia bouvieri | Noncooperative | Noncooperative to Noncooperative |
| Node92 | Noncooperative | Promerops cafer | Noncooperative | Noncooperative to Noncooperative |
| Node12 | Noncooperative | Node93 | Noncooperative | Noncooperative to Noncooperative |

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| Node93 | Noncooperative | Node94 | Noncooperative | Noncooperative to Noncooperative |
| Node94 | Noncooperative | Node95 | Noncooperative | Noncooperative to Noncooperative |
| Node95 | Noncooperative | Node96 | Noncooperative | Noncooperative to Noncooperative |
| Node96 | Noncooperative | Node97 | Noncooperative | Noncooperative to Noncooperative |
| Node97 | Noncooperative | Node98 | Noncooperative | Noncooperative to Noncooperative |
| Node98 | Noncooperative | Node99 | Noncooperative | Noncooperative to Noncooperative |
| Node99 | Noncooperative | Node100 | Noncooperative | Noncooperative to Noncooperative |
| Node100 | Noncooperative | Phylloscopus trochilus | Noncooperative | Noncooperative to Noncooperative |
| Node100 | Noncooperative | Phylloscopus fuscatus | Noncooperative | Noncooperative to Noncooperative |
| Node99 | Noncooperative | Phylloscopus sibilatrix | Noncooperative | Noncooperative to Noncooperative |
| Node98 | Noncooperative | Node101 | Noncooperative | Noncooperative to Noncooperative |
| Node101 | Noncooperative | Node102 | Noncooperative | Noncooperative to Noncooperative |
| Node102 | Noncooperative | Acrocephalus palustris | Noncooperative | Noncooperative to Noncooperative |
| Node102 | Noncooperative | Acrocephalus scirpaceus | Noncooperative | Noncooperative to Noncooperative |
| Node101 | Noncooperative | Node103 | Noncooperative | Noncooperative to Noncooperative |
| Node103 | Noncooperative | Node104 | Noncooperative | Noncooperative to Noncooperative |
| Node104 | Noncooperative | Node105 | Noncooperative | Noncooperative to Noncooperative |
| Node105 | Noncooperative | Acrocephalus arundinaceus | Noncooperative | Noncooperative to Noncooperative |
| Node105 | Noncooperative | Acrocephalus vaughani | Noncooperative | Noncooperative to Noncooperative |
| Node104 | Noncooperative | Acrocephalus sechellensis | Cooperative | Noncooperative to Cooperative |
| Node103 | Noncooperative | Node106 | Noncooperative | Noncooperative to Noncooperative |
| Node106 | Noncooperative | Node107 | Noncooperative | Noncooperative to Noncooperative |
| Node107 | Noncooperative | Acrocephalus bistrigiceps | Noncooperative | Noncooperative to Noncooperative |
| Node107 | Noncooperative | Acrocephalus melanopogon | Noncooperative | Noncooperative to Noncooperative |
| Node106 | Noncooperative | Node108 | Noncooperative | Noncooperative to Noncooperative |

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| Node108 | Noncooperative | Acrocephalus paludicola | Noncooperative | Noncooperative to Noncooperative |
| Node108 | Noncooperative | Acrocephalus schoenobaenus | Noncooperative | Noncooperative to Noncooperative |
| Node97 | Noncooperative | Node109 | Noncooperative | Noncooperative to Noncooperative |
| Node109 | Noncooperative | Node110 | Noncooperative | Noncooperative to Noncooperative |
| Node110 | Noncooperative | Node111 | Noncooperative | Noncooperative to Noncooperative |
| Node111 | Noncooperative | Turdoides plebejus | Cooperative | Noncooperative to Cooperative |
| Node111 | Noncooperative | Zosterops lateralis | Noncooperative | Noncooperative to Noncooperative |
| Node110 | Noncooperative | Turdoides bicolor | Cooperative | Noncooperative to Cooperative |
| Node109 | Noncooperative | Paradoxornis gularis | Noncooperative | Noncooperative to Noncooperative |
| Node96 | Noncooperative | Node112 | Noncooperative | Noncooperative to Noncooperative |
| Node112 | Noncooperative | Node113 | Noncooperative | Noncooperative to Noncooperative |
| Node113 | Noncooperative | Progne subis | Noncooperative | Noncooperative to Noncooperative |
| Node113 | Noncooperative | Node114 | Noncooperative | Noncooperative to Noncooperative |
| Node114 | Noncooperative | Node115 | Noncooperative | Noncooperative to Noncooperative |
| Node115 | Noncooperative | Riparia riparia | Noncooperative | Noncooperative to Noncooperative |
| Node115 | Noncooperative | Tachycineta bicolor | Noncooperative | Noncooperative to Noncooperative |
| Node114 | Noncooperative | Tachycineta albilinea | Noncooperative | Noncooperative to Noncooperative |
| Node112 | Noncooperative | Node116 | Noncooperative | Noncooperative to Noncooperative |
| Node116 | Noncooperative | Node117 | Noncooperative | Noncooperative to Noncooperative |
| Node117 | Noncooperative | Delichon urbica | Noncooperative | Noncooperative to Noncooperative |
| Node117 | Noncooperative | Petrochelidon spilodera | Noncooperative | Noncooperative to Noncooperative |
| Node116 | Noncooperative | Hirundo rustica | Noncooperative | Noncooperative to Noncooperative |
| Node95 | Noncooperative | Node118 | Noncooperative | Noncooperative to Noncooperative |
| Node118 | Noncooperative | Aegithalos caudatus | Cooperative | Noncooperative to Cooperative |
| Node118 | Noncooperative | Psaltriparus minimus | Cooperative | Noncooperative to Cooperative |

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| Node94 | Noncooperative | Node119 | Cooperative | Noncooperative to Cooperative |
| Node119 | Cooperative | Panurus biarmicus | Noncooperative | Cooperative to Noncooperative |
| Node119 | Cooperative | Alauda arvensis | Noncooperative | Cooperative to Noncooperative |
| Node93 | Noncooperative | Node120 | Noncooperative | Noncooperative to Noncooperative |
| Node120 | Noncooperative | Remiz pendulinus | Noncooperative | Noncooperative to Noncooperative |
| Node120 | Noncooperative | Node121 | Noncooperative | Noncooperative to Noncooperative |
| Node121 | Noncooperative | Node122 | Noncooperative | Noncooperative to Noncooperative |
| Node122 | Noncooperative | Baeolophus bicolor | Noncooperative | Noncooperative to Noncooperative |
| Node122 | Noncooperative | Node123 | Noncooperative | Noncooperative to Noncooperative |
| Node123 | Noncooperative | Node124 | Noncooperative | Noncooperative to Noncooperative |
| Node124 | Noncooperative | Lophophanes cristatus | Noncooperative | Noncooperative to Noncooperative |
| Node124 | Noncooperative | Node125 | Noncooperative | Noncooperative to Noncooperative |
| Node125 | Noncooperative | Node126 | Noncooperative | Noncooperative to Noncooperative |
| Node126 | Noncooperative | Poecile carolinensis | Noncooperative | Noncooperative to Noncooperative |
| Node126 | Noncooperative | Poecile atricapillus | Noncooperative | Noncooperative to Noncooperative |
| Node125 | Noncooperative | Poecile montanus | Noncooperative | Noncooperative to Noncooperative |
| Node123 | Noncooperative | Periparus ater | Noncooperative | Noncooperative to Noncooperative |
| Node121 | Noncooperative | Node127 | Noncooperative | Noncooperative to Noncooperative |
| Node127 | Noncooperative | Cyanistes caeruleus | Noncooperative | Noncooperative to Noncooperative |
| Node127 | Noncooperative | Node128 | Noncooperative | Noncooperative to Noncooperative |
| Node128 | Noncooperative | Pseudopodoces humilis | Noncooperative | Noncooperative to Noncooperative |
| Node128 | Noncooperative | Parus major | Noncooperative | Noncooperative to Noncooperative |
| Node11 | Noncooperative | Petroica goodenovii | Noncooperative | Noncooperative to Noncooperative |
| Node10 | Noncooperative | Node129 | Noncooperative | Noncooperative to Noncooperative |
| Node129 | Noncooperative | Node130 | Noncooperative | Noncooperative to Noncooperative |

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| Node130 | Noncooperative | Node131 | Noncooperative | Noncooperative to Noncooperative |
| Node131 | Noncooperative | Node132 | Noncooperative | Noncooperative to Noncooperative |
| Node132 | Noncooperative | Lanius bucephalus | Noncooperative | Noncooperative to Noncooperative |
| Node132 | Noncooperative | Gymnorhina tibicen | Cooperative | Noncooperative to Cooperative |
| Node131 | Noncooperative | Node133 | Noncooperative | Noncooperative to Noncooperative |
| Node133 | Noncooperative | Pachycephala pectoralis | Noncooperative | Noncooperative to Noncooperative |
| Node133 | Noncooperative | Node134 | Noncooperative | Noncooperative to Noncooperative |
| Node134 | Noncooperative | Node135 | Noncooperative | Noncooperative to Noncooperative |
| Node135 | Noncooperative | Node136 | Noncooperative | Noncooperative to Noncooperative |
| Node136 | Noncooperative | Node137 | Cooperative | Noncooperative to Cooperative |
| Node137 | Cooperative | Node138 | Cooperative | Cooperative to Cooperative |
| Node138 | Cooperative | Node139 | Cooperative | Cooperative to Cooperative |
| Node139 | Cooperative | Aphelocoma californica | Cooperative | Cooperative to Cooperative |
| Node139 | Cooperative | Aphelocoma coerulescens | Cooperative | Cooperative to Cooperative |
| Node138 | Cooperative | Node140 | Cooperative | Cooperative to Cooperative |
| Node140 | Cooperative | Calocitta formosa | Cooperative | Cooperative to Cooperative |
| Node140 | Cooperative | Cyanocorax morio | Cooperative | Cooperative to Cooperative |
| Node137 | Cooperative | Node141 | Cooperative | Cooperative to Cooperative |
| Node141 | Cooperative | Perisoreus canadensis | Noncooperative | Cooperative to Noncooperative |
| Node141 | Cooperative | Perisoreus infaustus | Noncooperative | Cooperative to Noncooperative |
| Node136 | Noncooperative | Node142 | Noncooperative | Noncooperative to Noncooperative |
| Node142 | Noncooperative | Node143 | Cooperative | Noncooperative to Cooperative |
| Node143 | Cooperative | Node144 | Cooperative | Cooperative to Cooperative |
| Node144 | Cooperative | Corvus corone | Cooperative | Cooperative to Cooperative |
| Node144 | Cooperative | Corvus brachyrhynchos | Cooperative | Cooperative to Cooperative |

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| Node143 | Cooperative | Corvus monedula | Noncooperative | Cooperative to Noncooperative |
| Node142 | Noncooperative | Pica pica | Noncooperative | Noncooperative to Noncooperative |
| Node135 | Noncooperative | Node145 | Cooperative | Noncooperative to Cooperative |
| Node145 | Cooperative | Lanius collurio | Noncooperative | Cooperative to Noncooperative |
| Node145 | Cooperative | Node146 | Noncooperative | Cooperative to Noncooperative |
| Node146 | Noncooperative | Lanius minor | Noncooperative | Noncooperative to Noncooperative |
| Node146 | Noncooperative | Lanius ludovicianus | Noncooperative | Noncooperative to Noncooperative |
| Node134 | Noncooperative | Node147 | Noncooperative | Noncooperative to Noncooperative |
| Node147 | Noncooperative | Grallina cyanoleuca | Noncooperative | Noncooperative to Noncooperative |
| Node147 | Noncooperative | Node148 | Cooperative | Noncooperative to Cooperative |
| Node148 | Cooperative | Corcorax melanorhamphos | Cooperative | Cooperative to Cooperative |
| Node148 | Cooperative | Struthidea cinerea | Cooperative | Cooperative to Cooperative |
| Node130 | Noncooperative | Node149 | Cooperative | Noncooperative to Cooperative |
| Node149 | Cooperative | Vireo solitarius | Noncooperative | Cooperative to Noncooperative |
| Node149 | Cooperative | Vireo olivaceus | Noncooperative | Cooperative to Noncooperative |
| Node129 | Noncooperative | Node150 | Noncooperative | Noncooperative to Noncooperative |
| Node150 | Noncooperative | Notiomystis cincta | Noncooperative | Noncooperative to Noncooperative |
| Node150 | Noncooperative | Philesturnus carunculatus | Noncooperative | Noncooperative to Noncooperative |
| Node9 | Noncooperative | Pomatostomus temporalis | Cooperative | Noncooperative to Cooperative |
| Node8 | Noncooperative | Node151 | Noncooperative | Noncooperative to Noncooperative |
| Node151 | Noncooperative | Node152 | Cooperative | Noncooperative to Cooperative |
| Node152 | Cooperative | Node153 | Cooperative | Cooperative to Cooperative |
| Node153 | Cooperative | Acanthiza pusilla | Noncooperative | Cooperative to Noncooperative |
| Node153 | Cooperative | Sericornis frontalis | Cooperative | Cooperative to Cooperative |
| Node152 | Cooperative | Node154 | Cooperative | Cooperative to Cooperative |

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| Node154 | Cooperative | Manorina melanocephala | Cooperative | Cooperative to Cooperative |
| Node154 | Cooperative | Node155 | Cooperative | Cooperative to Cooperative |
| Node155 | Cooperative | Petroica australis | Noncooperative | Cooperative to Noncooperative |
| Node155 | Cooperative | Manorina melanophrys | Cooperative | Cooperative to Cooperative |
| Node151 | Noncooperative | Node156 | Cooperative | Noncooperative to Cooperative |
| Node156 | Cooperative | Node157 | Cooperative | Cooperative to Cooperative |
| Node157 | Cooperative | Malurus coronatus | Cooperative | Cooperative to Cooperative |
| Node157 | Cooperative | Node158 | Cooperative | Cooperative to Cooperative |
| Node158 | Cooperative | Malurus cyaneus | Cooperative | Cooperative to Cooperative |
| Node158 | Cooperative | Malurus splendens | Cooperative | Cooperative to Cooperative |
| Node156 | Cooperative | Stipiturus malachurus | Noncooperative | Cooperative to Noncooperative |
| Node7 | Noncooperative | Node159 | Cooperative | Noncooperative to Cooperative |
| Node159 | Cooperative | Cercomacra melanaria | Noncooperative | Cooperative to Noncooperative |
| Node159 | Cooperative | Node160 | Noncooperative | Cooperative to Noncooperative |
| Node160 | Noncooperative | Node161 | Noncooperative | Noncooperative to Noncooperative |
| Node161 | Noncooperative | Node162 | Noncooperative | Noncooperative to Noncooperative |
| Node162 | Noncooperative | Node163 | Noncooperative | Noncooperative to Noncooperative |
| Node163 | Noncooperative | Sayornis phoebe | Noncooperative | Noncooperative to Noncooperative |
| Node163 | Noncooperative | Node164 | Noncooperative | Noncooperative to Noncooperative |
| Node164 | Noncooperative | Empidonax virescens | Noncooperative | Noncooperative to Noncooperative |
| Node164 | Noncooperative | Empidonax traillii | Noncooperative | Noncooperative to Noncooperative |
| Node162 | Noncooperative | Pyrocephalus rubinus | Noncooperative | Noncooperative to Noncooperative |
| Node161 | Noncooperative | Tyrannus tyrannus | Noncooperative | Noncooperative to Noncooperative |
| Node160 | Noncooperative | Node165 | Noncooperative | Noncooperative to Noncooperative |
| Node165 | Noncooperative | Elaenia flavogaster | Noncooperative | Noncooperative to Noncooperative |

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| Node165 | Noncooperative | Elaenia chiriquensis | Noncooperative | Noncooperative to Noncooperative |
| Node6 | Noncooperative | Node166 | Noncooperative | Noncooperative to Noncooperative |
| Node166 | Noncooperative | Node167 | Noncooperative | Noncooperative to Noncooperative |
| Node167 | Noncooperative | Node168 | Noncooperative | Noncooperative to Noncooperative |
| Node168 | Noncooperative | Node169 | Noncooperative | Noncooperative to Noncooperative |
| Node169 | Noncooperative | Tockus monteiri | Noncooperative | Noncooperative to Noncooperative |
| Node169 | Noncooperative | Upupa epops | Noncooperative | Noncooperative to Noncooperative |
| Node168 | Noncooperative | Node170 | Noncooperative | Noncooperative to Noncooperative |
| Node170 | Noncooperative | Colaptes auratus | Noncooperative | Noncooperative to Noncooperative |
| Node170 | Noncooperative | Node171 | Noncooperative | Noncooperative to Noncooperative |
| Node171 | Noncooperative | Node172 | Noncooperative | Noncooperative to Noncooperative |
| Node172 | Noncooperative | Picoides tridactylus | Noncooperative | Noncooperative to Noncooperative |
| Node172 | Noncooperative | Node173 | Noncooperative | Noncooperative to Noncooperative |
| Node173 | Noncooperative | Node174 | Noncooperative | Noncooperative to Noncooperative |
| Node174 | Noncooperative | Dendrocopos major | Noncooperative | Noncooperative to Noncooperative |
| Node174 | Noncooperative | Picoides borealis | Cooperative | Noncooperative to Cooperative |
| Node173 | Noncooperative | Dendrocopos medius | Noncooperative | Noncooperative to Noncooperative |
| Node171 | Noncooperative | Melanerpes portoricensis | Cooperative | Noncooperative to Cooperative |
| Node167 | Noncooperative | Node175 | Noncooperative | Noncooperative to Noncooperative |
| Node175 | Noncooperative | Dacelo novaeguineae | Cooperative | Noncooperative to Cooperative |
| Node175 | Noncooperative | Merops bullockoides | Cooperative | Noncooperative to Cooperative |
| Node166 | Noncooperative | Node176 | Cooperative | Noncooperative to Cooperative |
| Node176 | Cooperative | Cyanoliseus patagonus | Noncooperative | Cooperative to Noncooperative |
| Node176 | Cooperative | Forpus xanthopterygius | Noncooperative | Cooperative to Noncooperative |
| Node5 | Noncooperative | Node177 | Noncooperative | Noncooperative to Noncooperative |

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| Node177 | Noncooperative | Node178 | Noncooperative | Noncooperative to Noncooperative |
| Node178 | Noncooperative | Node179 | Noncooperative | Noncooperative to Noncooperative |
| Node179 | Noncooperative | Cuculus canorus | Noncooperative | Noncooperative to Noncooperative |
| Node179 | Noncooperative | Chrysococcyx klaas | Noncooperative | Noncooperative to Noncooperative |
| Node178 | Noncooperative | Clamator glandarius | Noncooperative | Noncooperative to Noncooperative |
| Node177 | Noncooperative | Centropus sinensis | Noncooperative | Noncooperative to Noncooperative |
| Node4 | Noncooperative | Apus apus | Noncooperative | Noncooperative to Noncooperative |
| Node3 | Noncooperative | Node180 | Noncooperative | Noncooperative to Noncooperative |
| Node180 | Noncooperative | Node181 | Noncooperative | Noncooperative to Noncooperative |
| Node181 | Noncooperative | Node182 | Noncooperative | Noncooperative to Noncooperative |
| Node182 | Noncooperative | Node183 | Noncooperative | Noncooperative to Noncooperative |
| Node183 | Noncooperative | Node184 | Noncooperative | Noncooperative to Noncooperative |
| Node184 | Noncooperative | Accipiter gentilis | Noncooperative | Noncooperative to Noncooperative |
| Node184 | Noncooperative | Buteo galapagoensis | Noncooperative | Noncooperative to Noncooperative |
| Node183 | Noncooperative | Aquila heliaca | Noncooperative | Noncooperative to Noncooperative |
| Node182 | Noncooperative | Node185 | Noncooperative | Noncooperative to Noncooperative |
| Node185 | Noncooperative | Node186 | Noncooperative | Noncooperative to Noncooperative |
| Node186 | Noncooperative | Node187 | Noncooperative | Noncooperative to Noncooperative |
| Node187 | Noncooperative | Falco naumanni | Noncooperative | Noncooperative to Noncooperative |
| Node187 | Noncooperative | Falco tinnunculus | Noncooperative | Noncooperative to Noncooperative |
| Node186 | Noncooperative | Node188 | Noncooperative | Noncooperative to Noncooperative |
| Node188 | Noncooperative | Falco eleonorae | Noncooperative | Noncooperative to Noncooperative |
| Node188 | Noncooperative | Falco columbarius | Cooperative | Noncooperative to Cooperative |
| Node185 | Noncooperative | Node189 | Noncooperative | Noncooperative to Noncooperative |
| Node189 | Noncooperative | Falco sparverius | Noncooperative | Noncooperative to Noncooperative |

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| Node189 | Noncooperative | Falco peregrinus | Noncooperative | Noncooperative to Noncooperative |
| Node181 | Noncooperative | Node190 | Noncooperative | Noncooperative to Noncooperative |
| Node190 | Noncooperative | Node191 | Noncooperative | Noncooperative to Noncooperative |
| Node191 | Noncooperative | Node192 | Noncooperative | Noncooperative to Noncooperative |
| Node192 | Noncooperative | Aegolius funereus | Noncooperative | Noncooperative to Noncooperative |
| Node192 | Noncooperative | Athene noctua | Noncooperative | Noncooperative to Noncooperative |
| Node191 | Noncooperative | Node193 | Noncooperative | Noncooperative to Noncooperative |
| Node193 | Noncooperative | Node194 | Noncooperative | Noncooperative to Noncooperative |
| Node194 | Noncooperative | Node195 | Noncooperative | Noncooperative to Noncooperative |
| Node195 | Noncooperative | Otus flammeolus | Noncooperative | Noncooperative to Noncooperative |
| Node195 | Noncooperative | Node196 | Noncooperative | Noncooperative to Noncooperative |
| Node196 | Noncooperative | Asio otus | Noncooperative | Noncooperative to Noncooperative |
| Node196 | Noncooperative | Otus asio | Noncooperative | Noncooperative to Noncooperative |
| Node194 | Noncooperative | Strix aluco | Noncooperative | Noncooperative to Noncooperative |
| Node193 | Noncooperative | Otus sunia | Noncooperative | Noncooperative to Noncooperative |
| Node190 | Noncooperative | Tyto alba | Noncooperative | Noncooperative to Noncooperative |
| Node180 | Noncooperative | Node197 | Noncooperative | Noncooperative to Noncooperative |
| Node197 | Noncooperative | Node198 | Noncooperative | Noncooperative to Noncooperative |
| Node198 | Noncooperative | Node199 | Noncooperative | Noncooperative to Noncooperative |
| Node199 | Noncooperative | Node200 | Noncooperative | Noncooperative to Noncooperative |
| Node200 | Noncooperative | Node201 | Noncooperative | Noncooperative to Noncooperative |
| Node201 | Noncooperative | Node202 | Noncooperative | Noncooperative to Noncooperative |
| Node202 | Noncooperative | Node203 | Noncooperative | Noncooperative to Noncooperative |
| Node203 | Noncooperative | Actitis hypoleucos | Noncooperative | Noncooperative to Noncooperative |
| Node203 | Noncooperative | Actitis macularia | Noncooperative | Noncooperative to Noncooperative |

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| Node202 | Noncooperative | Node204 | Noncooperative | Noncooperative to Noncooperative |
| Node204 | Noncooperative | Phalaropus tricolor | Noncooperative | Noncooperative to Noncooperative |
| Node204 | Noncooperative | Node205 | Noncooperative | Noncooperative to Noncooperative |
| Node205 | Noncooperative | Phalaropus fulicaria | Noncooperative | Noncooperative to Noncooperative |
| Node205 | Noncooperative | Phalaropus lobatus | Noncooperative | Noncooperative to Noncooperative |
| Node201 | Noncooperative | Node206 | Noncooperative | Noncooperative to Noncooperative |
| Node206 | Noncooperative | Philomachus pugnax | Noncooperative | Noncooperative to Noncooperative |
| Node206 | Noncooperative | Node207 | Noncooperative | Noncooperative to Noncooperative |
| Node207 | Noncooperative | Node208 | Noncooperative | Noncooperative to Noncooperative |
| Node208 | Noncooperative | Calidris maritima | Noncooperative | Noncooperative to Noncooperative |
| Node208 | Noncooperative | Tryngites subruficollis | Noncooperative | Noncooperative to Noncooperative |
| Node207 | Noncooperative | Calidris mauri | Noncooperative | Noncooperative to Noncooperative |
| Node200 | Noncooperative | Node209 | Noncooperative | Noncooperative to Noncooperative |
| Node209 | Noncooperative | Irediparra gallinacea | Noncooperative | Noncooperative to Noncooperative |
| Node209 | Noncooperative | Jacana jacana | Noncooperative | Noncooperative to Noncooperative |
| Node199 | Noncooperative | Node210 | Noncooperative | Noncooperative to Noncooperative |
| Node210 | Noncooperative | Node211 | Noncooperative | Noncooperative to Noncooperative |
| Node211 | Noncooperative | Node212 | Noncooperative | Noncooperative to Noncooperative |
| Node212 | Noncooperative | Node213 | Noncooperative | Noncooperative to Noncooperative |
| Node213 | Noncooperative | Alle alle | Noncooperative | Noncooperative to Noncooperative |
| Node213 | Noncooperative | Node214 | Noncooperative | Noncooperative to Noncooperative |
| Node214 | Noncooperative | Uria aalge | Noncooperative | Noncooperative to Noncooperative |
| Node214 | Noncooperative | Uria lomvia | Noncooperative | Noncooperative to Noncooperative |
| Node212 | Noncooperative | Cepphus grylle | Noncooperative | Noncooperative to Noncooperative |
| Node211 | Noncooperative | Fratercula arctica | Noncooperative | Noncooperative to Noncooperative |

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| Node210 | Noncooperative | Node215 | Noncooperative | Noncooperative to Noncooperative |
| Node215 | Noncooperative | Node216 | Noncooperative | Noncooperative to Noncooperative |
| Node216 | Noncooperative | Stercorarius pomarinus | Noncooperative | Noncooperative to Noncooperative |
| Node216 | Noncooperative | Stercorarius parasiticus | Noncooperative | Noncooperative to Noncooperative |
| Node215 | Noncooperative | Node217 | Noncooperative | Noncooperative to Noncooperative |
| Node217 | Noncooperative | Sterna hirundo | Noncooperative | Noncooperative to Noncooperative |
| Node217 | Noncooperative | Node218 | Noncooperative | Noncooperative to Noncooperative |
| Node218 | Noncooperative | Rissa tridactyla | Noncooperative | Noncooperative to Noncooperative |
| Node218 | Noncooperative | Node219 | Noncooperative | Noncooperative to Noncooperative |
| Node219 | Noncooperative | Larus occidentalis | Noncooperative | Noncooperative to Noncooperative |
| Node219 | Noncooperative | Larus canus | Noncooperative | Noncooperative to Noncooperative |
| Node198 | Noncooperative | Node220 | Noncooperative | Noncooperative to Noncooperative |
| Node220 | Noncooperative | Node221 | Noncooperative | Noncooperative to Noncooperative |
| Node221 | Noncooperative | Node222 | Noncooperative | Noncooperative to Noncooperative |
| Node222 | Noncooperative | Node223 | Noncooperative | Noncooperative to Noncooperative |
| Node223 | Noncooperative | Charadrius alexandrinus | Noncooperative | Noncooperative to Noncooperative |
| Node223 | Noncooperative | Node224 | Noncooperative | Noncooperative to Noncooperative |
| Node224 | Noncooperative | Eudromias morinellus | Noncooperative | Noncooperative to Noncooperative |
| Node224 | Noncooperative | Charadrius semipalmatus | Noncooperative | Noncooperative to Noncooperative |
| Node222 | Noncooperative | Vanellus chilensis | Noncooperative | Noncooperative to Noncooperative |
| Node221 | Noncooperative | Charadrius hiaticula | Noncooperative | Noncooperative to Noncooperative |
| Node220 | Noncooperative | Haematopus ostralegus | Noncooperative | Noncooperative to Noncooperative |
| Node197 | Noncooperative | Node225 | Noncooperative | Noncooperative to Noncooperative |
| Node225 | Noncooperative | Node226 | Noncooperative | Noncooperative to Noncooperative |
| Node226 | Noncooperative | Monias benschi | Cooperative | Noncooperative to Cooperative |

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| Node226 | Noncooperative | Node227 | Noncooperative | Noncooperative to Noncooperative |
| Node227 | Noncooperative | Node228 | Noncooperative | Noncooperative to Noncooperative |
| Node228 | Noncooperative | Node229 | Noncooperative | Noncooperative to Noncooperative |
| Node229 | Noncooperative | Node230 | Noncooperative | Noncooperative to Noncooperative |
| Node230 | Noncooperative | Node231 | Noncooperative | Noncooperative to Noncooperative |
| Node231 | Noncooperative | Phalacrocorax aristotelis | Noncooperative | Noncooperative to Noncooperative |
| Node231 | Noncooperative | Phalacrocorax carbo | Noncooperative | Noncooperative to Noncooperative |
| Node230 | Noncooperative | Node232 | Noncooperative | Noncooperative to Noncooperative |
| Node232 | Noncooperative | Sula dactylatra | Noncooperative | Noncooperative to Noncooperative |
| Node232 | Noncooperative | Sula granti | Noncooperative | Noncooperative to Noncooperative |
| Node229 | Noncooperative | Fregata minor | Noncooperative | Noncooperative to Noncooperative |
| Node228 | Noncooperative | Node233 | Noncooperative | Noncooperative to Noncooperative |
| Node233 | Noncooperative | Node234 | Noncooperative | Noncooperative to Noncooperative |
| Node234 | Noncooperative | Node235 | Noncooperative | Noncooperative to Noncooperative |
| Node235 | Noncooperative | Node236 | Noncooperative | Noncooperative to Noncooperative |
| Node236 | Noncooperative | Pygoscelis adeliae | Noncooperative | Noncooperative to Noncooperative |
| Node236 | Noncooperative | Pygoscelis antarctica | Noncooperative | Noncooperative to Noncooperative |
| Node235 | Noncooperative | Node237 | Noncooperative | Noncooperative to Noncooperative |
| Node237 | Noncooperative | Node238 | Noncooperative | Noncooperative to Noncooperative |
| Node238 | Noncooperative | Eudyptes pachyrhynchus | Noncooperative | Noncooperative to Noncooperative |
| Node238 | Noncooperative | Eudyptes schlegeli | Noncooperative | Noncooperative to Noncooperative |
| Node237 | Noncooperative | Spheniscus humboldti | Noncooperative | Noncooperative to Noncooperative |
| Node234 | Noncooperative | Node239 | Noncooperative | Noncooperative to Noncooperative |
| Node239 | Noncooperative | Node240 | Noncooperative | Noncooperative to Noncooperative |
| Node240 | Noncooperative | Node241 | Noncooperative | Noncooperative to Noncooperative |

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| Node241 | Noncooperative | Node242 | Noncooperative | Noncooperative to Noncooperative |
| Node242 | Noncooperative | Calonectris diomedea | Noncooperative | Noncooperative to Noncooperative |
| Node242 | Noncooperative | Puffinus tenuirostris | Noncooperative | Noncooperative to Noncooperative |
| Node241 | Noncooperative | Node243 | Noncooperative | Noncooperative to Noncooperative |
| Node243 | Noncooperative | Thalassoica antarctica | Noncooperative | Noncooperative to Noncooperative |
| Node243 | Noncooperative | Fulmarus glacialis | Noncooperative | Noncooperative to Noncooperative |
| Node240 | Noncooperative | Node244 | Noncooperative | Noncooperative to Noncooperative |
| Node244 | Noncooperative | Oceanites oceanicus | Noncooperative | Noncooperative to Noncooperative |
| Node244 | Noncooperative | Oceanodroma leucorhoa | Noncooperative | Noncooperative to Noncooperative |
| Node239 | Noncooperative | Node245 | Noncooperative | Noncooperative to Noncooperative |
| Node245 | Noncooperative | Node246 | Noncooperative | Noncooperative to Noncooperative |
| Node246 | Noncooperative | Diomedea exulans | Noncooperative | Noncooperative to Noncooperative |
| Node246 | Noncooperative | Phoebastria irrorata | Noncooperative | Noncooperative to Noncooperative |
| Node245 | Noncooperative | Node247 | Noncooperative | Noncooperative to Noncooperative |
| Node247 | Noncooperative | Thalassarche cauta | Noncooperative | Noncooperative to Noncooperative |
| Node247 | Noncooperative | Node248 | Noncooperative | Noncooperative to Noncooperative |
| Node248 | Noncooperative | Thalassarche chrysostoma | Noncooperative | Noncooperative to Noncooperative |
| Node248 | Noncooperative | Thalassarche melanophris | Noncooperative | Noncooperative to Noncooperative |
| Node233 | Noncooperative | Gavia immer | Noncooperative | Noncooperative to Noncooperative |
| Node227 | Noncooperative | Coragyps atratus | Noncooperative | Noncooperative to Noncooperative |
| Node225 | Noncooperative | Node249 | Noncooperative | Noncooperative to Noncooperative |
| Node249 | Noncooperative | Node250 | Noncooperative | Noncooperative to Noncooperative |
| Node250 | Noncooperative | Node251 | Noncooperative | Noncooperative to Noncooperative |
| Node251 | Noncooperative | Gallinula chloropus | Cooperative | Noncooperative to Cooperative |
| Node251 | Noncooperative | Tribonyx mortierii | Cooperative | Noncooperative to Cooperative |

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| Node250 | Noncooperative | Node252 | Cooperative | Noncooperative to Cooperative |
| Node252 | Cooperative | Porphyrio mantelli | Noncooperative | Cooperative to Noncooperative |
| Node252 | Cooperative | Porphyrio porphyrio | Noncooperative | Cooperative to Noncooperative |
| Node249 | Noncooperative | Grus canadensis | Noncooperative | Noncooperative to Noncooperative |
| Node2 | Noncooperative | Node253 | Noncooperative | Noncooperative to Noncooperative |
| Node253 | Noncooperative | Node254 | Noncooperative | Noncooperative to Noncooperative |
| Node254 | Noncooperative | Node255 | Noncooperative | Noncooperative to Noncooperative |
| Node255 | Noncooperative | Meleagris gallopavo | Noncooperative | Noncooperative to Noncooperative |
| Node255 | Noncooperative | Node256 | Noncooperative | Noncooperative to Noncooperative |
| Node256 | Noncooperative | Tetrao tetrix | Noncooperative | Noncooperative to Noncooperative |
| Node256 | Noncooperative | Node257 | Noncooperative | Noncooperative to Noncooperative |
| Node257 | Noncooperative | Centrocercus urophasianus | Noncooperative | Noncooperative to Noncooperative |
| Node257 | Noncooperative | Node258 | Noncooperative | Noncooperative to Noncooperative |
| Node258 | Noncooperative | Lagopus leucurus | Noncooperative | Noncooperative to Noncooperative |
| Node258 | Noncooperative | Lagopus lagopus | Noncooperative | Noncooperative to Noncooperative |
| Node254 | Noncooperative | Alectura lathami | Noncooperative | Noncooperative to Noncooperative |
| Node253 | Noncooperative | Node259 | Noncooperative | Noncooperative to Noncooperative |
| Node259 | Noncooperative | Node260 | Noncooperative | Noncooperative to Noncooperative |
| Node260 | Noncooperative | Hymenolaimus | Noncooperative | Noncooperative to Noncooperative |
| Node260 | Noncooperative | Node261 | Noncooperative | Noncooperative to Noncooperative |
| Node261 | Noncooperative | Anas platyrhynchos | Noncooperative | Noncooperative to Noncooperative |
| Node261 | Noncooperative | Anas strepera | Noncooperative | Noncooperative to Noncooperative |
| Node259 | Noncooperative | Node262 | Noncooperative | Noncooperative to Noncooperative |
| Node262 | Noncooperative | Node263 | Noncooperative | Noncooperative to Noncooperative |
| Node263 | Noncooperative | Node264 | Noncooperative | Noncooperative to Noncooperative |

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| Node264 | Noncooperative | Anser caerulescens | Noncooperative | Noncooperative to Noncooperative |
| Node264 | Noncooperative | Anser rossii | Noncooperative | Noncooperative to Noncooperative |
| Node263 | Noncooperative | Branta leucopsis | Noncooperative | Noncooperative to Noncooperative |
| Node262 | Noncooperative | Cygnus atratus | Noncooperative | Noncooperative to Noncooperative |
| Node1 | Noncooperative | Node265 | Noncooperative | Noncooperative to Noncooperative |
| Node265 | Noncooperative | Node266 | Noncooperative | Noncooperative to Noncooperative |
| Node266 | Noncooperative | Struthio camelus | Noncooperative | Noncooperative to Noncooperative |
| Node266 | Noncooperative | Dromaius novaehollandiae | Noncooperative | Noncooperative to Noncooperative |
| Node265 | Noncooperative | Tinamus major | Noncooperative | Noncooperative to Noncooperative |

**Supplementary tables of analyses excluding *Petroica australis***

**SI Table 11:** The differences in female promiscuity between non-cooperative and cooperative breeding birds.

| **Fixed Terms** | | **Parameter Estimate (β)** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|---|
| Without phylogeny: | Cooperative | 0.02 | 0.02 | 0.08 | **0.0004**[1] |
| | Non-cooperative | 0.08 | 0.11 | 0.17 | |
| With phylogeny: | Cooperative | 0.04 | 0.02 | 0.15 | **0.0008**[1] |
| | Non-cooperative | 0.14 | 0.06 | 0.30 | |
| **Random Terms** | | **Variance Component** | **Lower CI** | **Upper CI** | |
| Phylogenetic variance ($V_a$) | | 1.63 | 0.75 | 2.84 | NA |
| Residual variation ($V_e$) | | 1.33 | 0.84 | 1.72 | NA |
| Phylogenetic heritability ($h^2$) | | 0.55 | 0.38 | 0.76 | NA |

Notes: 600,000 iterations with 100,000 burnin and thinning interval of 100. Model excluding phylogenetic effect: DIC = 19,134. Model including phylogenetic effect: DIC = 19,121 (best model). $N_{species}$=266. [1]P values refer to difference between parameter estimates (cooperative versus non-cooperative).

**SI Table 12:** The phylogenetic correlation between promiscuity and cooperative breeding in birds. Analysis was conducted using a multi-response model (trait 1 = promiscuity (binomial response), trait 2 = cooperative breeding (binary response: 0 = non-cooperative, 1 = cooperative).

| **Random Terms** | **Variance Component** | **Lower CI** | **Upper CI** | **P** |
|---|---|---|---|---|
| Phylogenetic variance in promiscuity ($V_{a1}$) | 2.19 | 1.09 | 3.29 | NA |
| Phylogenetic variance in cooperative breeding ($V_{a2}$) | 70.53 | 9.57 | 479.62 | NA |
| Phylogenetic covariance between promiscuity and cooperative breeding ($Cov_{1,2}$) | -10.46 | -65.78 | -1.86 | NA |
| Residual variation for promiscuity ($V_{e1}$) | 1.28 | 0.82 | 1.67 | NA |
| Phylogenetic heritability for promiscuity ($H^2_1$) | 0.63 | 0.45 | 0.78 | NA |
| Intraclass correlation coefficient for cooperative breeding ($IC_2$) | 0.99 | 0.93 | 0.99 | NA |
| Phylogenetic correlation between promiscuity and cooperative breeding ($r_{1,2}$) | -0.58 | -0.83 | -0.31 | **<0.0001** |

Notes: 7.1 million iterations with 100,000 burnin and thinning interval of 1000. Residual variation cannot be estimated for binary traits and therefore it is not possible to estimate phylogenetic heritability (proportion of phenotypic variation attributable to shared ancestry between species). However, the intraclass correlation coefficient (IC) can be calculated which gives an estimate of the degree of similarity between related species providing an analogous measure to heritability[31]. $N_{species}$=266. Model assuming cooperative breeding and promiscuity evolve independently (~idh(trait):animal): DIC =19167, Model estimating correlated evolution between cooperative breeding and promiscuity (~us(trait):animal): DIC =19138 (best model).

**SI Table 13:** Estimation of evolutionary transition rates between cooperative breeding and different levels of promiscuity (low: less than or equal to the median extra-pair paternity (<=14%). High: higher than the median (>14%) extra-pair paternity) and comparison of models assuming independent evolution versus correlation evolution of cooperative breeding and promiscuity.

| Cooperation transition | Promiscuity Transition | Transition rate | Log-likelihood when restricted to 0 | Log-likelihood Change | DF | P |
|---|---|---|---|---|---|---|
| Cooperative | Low to High | 0.08 (0.0) | -235.76 | 1.91 | 1 | **0.05** |
| Cooperative | High to Low | 0.19 (0.34) | -236.49 | 2.63 | 1 | **0.02** |
| Non-cooperative | Low to High | 0.02 (0.57) | -243.02 | 9.16 | 1 | **<0.0001** |
| Non-cooperative | High to Low | 0.003 (0.007) | -235.90 | 2.04 | 1 | **0.04** |
| Cooperative to Non-cooperative | Low | 0.04 (0.07) | -238.91 | 5.05 | 1 | **0.001** |
| Non-cooperative to Cooperative | Low | 0.02 (0.46) | -248.64 | 14.78 | 1 | **<0.0001** |
| Cooperative to Non-cooperative | High | 0.05 (0.05) | -235.99 | 2.13 | 1 | **0.04** |
| Non-cooperative to Cooperative | High | 0.009 (0.03) | -236.64 | 2.78 | 1 | **0.02** |

Notes: $N_{species}$=266. Model assuming independent evolution of cooperative breeding and promiscuity: log-likelihood = -239.70. Model assuming correlated evolution of cooperative breeding and promiscuity: log-likelihood = -233.86. Model of correlated evolution had a significantly higher log-likelihood than the model assuming independent evolution: log-likelihood ratio test (LRT) =11.68, df=4, P=0.02. Whether transition rates were significantly different from 0 was tested using LRTs by comparing the log-likelihood of models estimating the transition rate with models that

assumed the transition rate was zero. We also ran the analysis using a covarion model that allows rates of evolution to vary across the tree, which gave qualitatively similar results (transition rates are presented in the brackets in the transition rate column).

**SI Table 14:** The differences in female promiscuity rates between ancestors giving rise to both cooperative and non-cooperative, only cooperative and only non-cooperative species.

| **Fixed Terms** | | **Parameter Estimate** | **Lower CI** | **Upper CI** | **P** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ancestor** | **Descendents** | **(β)** | | | **(6)** | **(4)** | **(5)** | **(3)** | **(1)** | **(2)** |
| Non-cooperative | Only non-cooperative **(6)** | 0.17 | 0.08 | 0.36 | X | **0.002** | **0.0002** | 0.07 | **0.02** | **0.01** |
| Non-cooperative | Both cooperative & non-cooperative **(4)** | 0.04 | 0.01 | 0.16 | | X | 0.08 | 0.71 | 0.28 | 0.36 |
| Non-cooperative | Only cooperative **(5)** | 0.009 | 0.001 | 0.08 | | | X | **0.05** | 0.69 | 0.81 |
| Cooperative | Only non-cooperative **(3)** | 0.07 | 0.01 | 0.24 | | | | X | 0.18 | 0.21 |
| Cooperative | Both cooperative & non-cooperative **(1)** | 0.01 | 0.001 | 0.17 | | | | | X | 0.36 |
| Cooperative | Only cooperative **(2)** | 0.03 | 0.005 | 0.16 | | | | | | X |
| **Random Terms** | | **Variance Component** | **Lower CI** | **Upper CI** | | | | | | |
| Phylogenetic variance ($V_a$) | | 1.49 | 0.77 | 2.75 | | | | NA | | |
| Residual variation ($V_e$) | | 1.18 | 0.84 | 1.69 | | | | NA | | |

Notes: P value is the proportion of iterations where the parameter estimate is greater than 0 (positive estimates) or less than 0 (negative estimates). 600,000 iterations with 100,00 burnin and thinning interval of 100. $N_{species}$=266, $N_{nodes}$=265.

**SI Table 10** – List of all species included in analyses for which genetic data was available on % broods containing chicks fathered by extra pair males (or extra group males, in cooperatively breeding species), sample sizes in brackets.

* Sample size unknown

| List of species included in analyses | | Breeding System | % Broods with Extra Group Paternity (n) | Point estimate for EGP study population | Species upper limit | Species lower limit | Kin discrimination (rKin)[1,2] |
|---|---|---|---|---|---|---|---|
| Seychelles Warbler | *Acrocephalus sechellensis* | Cooperative[3] | 40 (45) [4,5] | 73.3[3] | 73.3[3] | 0[3] | 0.633 |
| Long-tailed Tit | *Aegithalos caudatus* | Cooperative[6] | 12.5 (48)[7] | 52[6] | | | 0.882 |
| Scrub Jay | *Aphelocoma coerulescens* | Cooperative[8] | 0 (60)[9] | 55[10] | 80[11] | 27[11] | 0.406 |
| Mexican Jay | *Aphelocoma ultramarina* | Cooperative[8,12] | 62.75 (51)[13] | 100[12] | 100[12] | 100[12] | |
| White-throated Magpie-Jay | *Calocitta formosa* | Cooperative[11,14] | 9.38 (32)[14] | 100[14] | 100[11] | 0[11] | |
| Bicolored Wren | *Campylorhynchus griseus* | Cooperative[15,16] | 0 (99)[15] | 50[15] | >50[16] | 15[16] | |
| Stripe-backed Wren | *Campylorhynchus nuchalis* | Cooperative[17] | 4.6 (22)[18] | 67[17] | | | -0.208 |
| White-winged Chough | *Corcorax melanorhamphos* | Cooperative[19] | 0 (11)[19] | 100[19] | 100[19] | 100[19] | |
| American Crow | *Corvus brachyrhynchos* | Cooperative[20] | 21.7 (60)[20] | | 90[20] | 30[20] | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Carrion Crow | *Corvus corone* | Cooperative[21] | 0 (19)[22] | | 73.3[22] | 0[11,22] | 0.289 |
| Brown Jay | *Cyanocorax morio* | Cooperative[23,24] | 22 (18)[25] | 100[25] | 100[25] | 100[25] | |
| Laughing Kookaburra | *Dacelo novaeguineae* | Cooperative[26] | 0 (62)[26] | | 65.9[26] | | -0.156 |
| Merlin | *Falco columbarius* | Cooperative[27] | 0 (18)[28] | | 14[27] | 0[27] | |
| Common Moorhen | *Gallinula chloropus* | Cooperative[8] | 0 (42)[29] | 28[29] | 35[30] | 0[30] | |
| Australian Magpie | *Gymnorhina tibicen* | Cooperative[31] | 75.71 (70)[32,33] | | 100[33] | 0[33] | 0.045 |
| Superb Starling | *Lamprotornis superbus* | Cooperative[34] | 25 (100)[34] | 100[34] | 100[34] | | |
| Purple-crowned Fairy-wren | *Malurus coronatus* | Cooperative[35,36] | 5.8 (104)[37] | | 20[35] | 14[35] | |
| Superb Fairy-wren | *Malurus cyaneus* | Cooperative[38] | 69.28 (293)[39,40] | 60[36,40] | 60[36] | 0[36] | -0.288 |
| Splendid Fairy-wren | *Malurus splendens* | Cooperative[41] | 55.35 (159)[42] | 29[42] | 66[43] | 29[42] | |
| Noisy Miner | *Manorina melanocephala* | Cooperative[44,45] | 5.71 (35)[44] | 100[44] | 100[44,45] | 100[44,45] | |
| Bell Miner | *Manorina melanophrys* | Cooperative[46] | 7.69 (13)[46] | 100[46] | 100[46] | 100[46] | 0.376 |
| Acorn Woodpecker | *Melanerpes formicivorus* | Cooperative[47] | 0 (141)[48,49] | 77[48] | 85[47] | 23[47] | |
| White-fronted Bee-eater | *Merops bullockoides* | Cooperative[50,51] | 6.1 (65)[52] | 50[50] | 60[51] | 50[50] | 0.590 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Subdesert Mesite | *Monias benschi* | Cooperative[53] | 16.7 (12)[53] | | | | |
| Sociable Weaver | *Philetairus socius* | Cooperative[54] | 2.27 (44)[54] | 66[54] | 82[54] | 46[54] | |
| Green Woodhoopoe | *Phoeniculus purpureus* | Cooperative | 0*[55,56] | | 90.5[57] | 90.5[57] | 0.245 |
| Red-cockaded Woodpecker | *Picoides borealis* | Cooperative[58] | 0 (44)[59] | 44[59] | 44[59] | 30[58] | 0.062 |
| Grey-crowned Babbler | *Pomatostomus temporalis* | Cooperative[60,61] | 18.33 (60)[61] | 84[61] | 84[61] | 84[61] | |
| American Bushtit | *Psaltriparus minimus* | Cooperative[62] | 0 (10)[63] | 30[63] | 57[62] | 15[62] | |
| White-breasted Thrasher | *Ramphocinclus brachyurus* | Cooperative[64] | 13.3 (40)[64] | 37[64] | 42[64] | 30[64] | |
| White-browed Scrubwren | *Sericornis frontalis* | Cooperative[65] | 12.5 (32)[65] | 54[65] | 54[65] | 54[65] | -0.069 |
| Western Bluebird | *Sialia mexicana* | Cooperative[8,66] | 45.1 (51)[67] | 10.5[67] | 16[66] | 3[66] | 0.326 |
| Apostlebird | *Struthidea cinerea* | Cooperative[68] | 0 (15)[69] | 100[69] | 100[69] | 100[69] | |
| Pied Babbler | *Turdoides bicolor* | Cooperative[70] | 0 (67)[70] | 91[70] | | | |
| Tasmanian Native Hen | *Tribonyx mortierii* | Cooperative[71] | 0 (6)[71] | | | | |
| Arabian Babbler | *Turdoides squamiceps* | Cooperative[72] | 0 (44)[73] | 96[74] | 96[74] | 96[74] | -0.047 |
| Brown Thornbill | *Acanthiza pusilla* | Noncooperative[75] | 11.9 (67)[76] | | | | |

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|---|---|---|---|---|---|---|
| Northern Goshawk | *Accipiter gentilis* | Noncooperative[8] | 2.56 (64)[77] | | | |
| Great Reed Warbler | *Acrocephalus arundinaceus* | Noncooperative[75] | 6.73 (342)[78-80] | | | |
| Black-browed Reed Warbler | *Acrocephalus bistrigiceps* | Noncooperative[75] | 13.5 (37)[81] | | | |
| Moustashed Warbler | *Acrocephalus melanopogon* | Noncooperative[82] | 56 (25)[83] | | | |
| Aquatic Warbler | *Acrocephalus paludicola* | Noncooperative[75] | 70.97 (93)[79,84] | | | |
| Marsh Warbler | *Acrocephalus palustris* | Noncooperative[75] | 9.1 (33) [66] | | | |
| Sedge Warbler | *Acrocephalus schoenobaenus* | Noncooperative[75] | 20.16 (129)[85,86] | | | |
| Eurasian Reed Warbler | *Acrocephalus scirpaceus* | Noncooperative[75] | 15.4 (52)[87] | | | |
| Henderson Reed Warbler | *Acrocephalus vaughani* | Noncooperative[88] | 15.38 (13)[88] | | | |
| Common Sandpiper | *Actitis hypoleucos* | Noncooperative[89,90] | 19.05 (42)[89,90] | | | |
| Spotted Sandpiper | *Actitis macularius* | Noncooperative[8] | 20.6 (34)[91] | | | |
| Boreal Owl | *Aegolius funereu* | Noncooperative[8] | 0 (32)[92] | | | |
| Red-winged Blackbird | *Agelaius phoeniceus* | Noncooperative[75] | 49.17 (423)[93-96] | | | |
| Skylark | *Alauda arvensis* | Noncooperative[75] | 27 (52)[97] | | | |

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|---|---|---|---|---|---|---|
| Australian Brush Turkey | *Alectura lathami* | Noncooperative[75] | 70 (10)[98] | | | |
| Little Auk | *Alle alle* | Noncooperative[8] | 2 (90)[99,100] | | | |
| Saltmarsh Sparrow | *Ammodramus caudacutus* | Noncooperative[8] | 95 (50)[101] | | | |
| Seaside Sparrow | *Ammodramus maritimus* | Noncooperative[8] | 17 (18)[102] | | | |
| Mallard | *Anas platyrhynchos* | Noncooperative[8] | 3.02 (46)[103] | | | |
| Gadwall | *Anas strepera* | Noncooperative[104] | 27.6 (29)[104] | | | |
| Water Pipit | *Anthus spinoletta* | Noncooperative[75] | 12.4 (258)[105] | | | |
| Common Swift | *Apus apus* | Noncooperative[75] | 9.5 (42)[106] | | | |
| Eastern Imperial Eagle | *Aquila heliaca* | Noncooperative[75] | 0 (86)[107] | | | |
| Long Eared Owl | *Asio otus* | Noncooperative[8] | 0 (12)[108] | | | |
| Little Owl | *Athene noctua* | Noncooperative[75] | 0 (16)[109] | | | |
| Tufted Titmouse | *Baeolophus bicolor* | Noncooperative[8,110] | 22.2 (9)[111] | | | |
| Barnacle Goose | *Branta leucopsis* | Noncooperative[75] | 0 (71)[112,113] | | | |
| Red-billed Buffalo Weaver | *Bubalornis niger* | Noncooperative[114] | 68.4 (19)[114] | | | |

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|---|---|---|---|---|---|---|
| Galapagos Hawk | *Buteo galapagoensis* | Noncooperative[115] | 0 (16)[115] | | | |
| Common Goldeneye | *Bucephala clangula* | Noncooperative[8] | 0*[8] | | | |
| Barrow's Goldeneye | *Bucephala islandica* | Noncooperative[8] | 0*[8] | | | |
| Chestnut-collared Longspur | *Calcarius ornatus* | Noncooperative[8] | 32 (25)[116] | | | |
| Smith's Longspur | *Calcarius pictus* | Noncooperative[117] | 77.4 (31)[117] | | | |
| Purple Sandpiper | *Calidris maritima* | Noncooperative[8] | 3.7 (27)[118] | | | |
| Western Sandpiper | *Calidris mauri* | Noncooperative[8] | 7.5 (40)[89] | | | |
| Corys Shearwater | *Calonectris diomedea* | Noncooperative[75] | 0 (51)[119,120] | | | |
| Red-faced Warbler | *Cardellina rubrifrons* | Noncooperative[8] | 45.5 (11)[8] | | | |
| Northern Cardinal | *Cardinalis cardinalis* | Noncooperative[8] | 15.8 (19)[121] | | | |
| Eurasian Linnet | *Carduelis cannabina* | Noncooperative[75] | 9.09 (22)[122] | | | |
| American Goldfinch | *Carduelis tristis* | Noncooperative[8] | 26.7 (15)[123] | | | |
| Common Rosefinch | *Carpodacus erythrinus* | Noncooperative[124] | 33.87 (62)[125] | | | |
| House Finch | *Carpodacus mexicanus* | Noncooperative[8] | 14.89 (94)[126,127] | | | |

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| Sage Grouse | *Centrocercus urophasianus* | Noncooperative[8] | 20 (10)[128] | | | |
| Black Coucal | *Centropus grillii* | Noncooperative[75] | 37.1 (35)[129] | | | |
| Black Guillemot | *Cepphus grylle* | Noncooperative[8] | 0 (32)[130] | | | |
| Dusky Antbird | *Cercomacra tyrannina* | Noncooperative[75] | 0 (9)[131] | | | |
| Kentish Plover | *Charadrius alexandrinus* | Noncooperative[75] | 3.37 (89)[132] | | | |
| Ringed Plover | *Charadrius hiaticula* | Noncooperative[133] | 0 (21)[133] | | | |
| Eurasian Dotterel | *Charadrius morinellus* | Noncooperative[134] | 9.1 (22)[135] | | | |
| Semipalmated Plover | *Charadrius semipalmatus* | Noncooperative[8] | 4.2 (24)[136] | | | |
| Snow Goose | *Chen caerulescens* | Noncooperative[8] | 13 (23)[137] | | | |
| Ross's Goose | *Chen rossii* | Noncooperative[8] | 8.3 (24) [137] | | | |
| Horsfield's Bronze Cuckoo | *Chrysococcyx basalis* | Noncooperative[138] | 0 (11)[138] | | | |
| Palestine Sunbird | *Cinnyris osea* | Noncooperative[139] | 36.17 (47)[140] | | | |
| Great-spotted Cuckoo | *Clamator glandarius* | Noncooperative[75] | 18.2 (11)[141] | | | |
| Northern Flicker | *Colaptes auratus* | Noncooperative[8] | 16.9 (53)[142] | | | |

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| Eurasian Jackdaw | *Coloeus monedula* | Noncooperative[11] | 2.86 (35)[143,144] | | | |
| Black Vulture | *Coragyps atratus* | Noncooperative[8] | 0 (16)[145] | | | |
| Common Cuckoo | *Cuculus canorus* | Noncooperative[8] | 14.3 (21)[146] | | | |
| Blue Tit | *Cyanistes caeruleus* | Noncooperative[124] | 47.54 (812)[147-155] | | | |
| Burrowing Parrot | *Cyanoliseus patagonus* | Noncooperative[156] | 0 (49)[156] | | | |
| Black Swan | *Cygnus atratus* | Noncooperative[75] | 37.65 (85)[157] | | | |
| Whooper Swan | *Cygnus cygnus* | Noncooperative[75] | 0*[158] | | | |
| House Martin | *Delichon urbicum* | Noncooperative[75] | 33.33 (39)[159,160] | | | |
| Great Spotted Woodpecker | *Dendrocopos major* | Noncooperative[161] | 0 (36)[162] | | | |
| Middle Spotted Woodpecker | *Dendrocopos medius* | Noncooperative[161] | 0 (13) [162] | | | |
| Black-throated Blue Warbler | *Dendroica caerulescens* | Noncooperative[8] | 34.19 (117)[163] | | | |
| Chestnut-sided Warbler | *Dendroica pensylvanica* | Noncooperative[8] | 60.6 (33)[164] | | | |
| Yellow Warbler | *Dendroica petechia* | Noncooperative[8] | 51.41 (142)[165,166] | | | |
| Wandering Albatross | *Diomedea exulans* | Noncooperative[75] | 10.8 (222)[167,168] | | | |

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| Bobolink | *Dolichonyx oryzivorus* | Noncooperative[8,169,170] | 38 (191)[170] | | | |
| Emu | *Dromaius novaehollandiae* | Noncooperative[75] | 88.9 (18)[171] | | | |
| Lesser Elaenia | *Elaenia chiriquensis* | Noncooperative[75] | 66.7 (15)[172] | | | |
| Yellow-bellied Elaenia | *Elaenia flavogaster* | Noncooperative[75] | 7.7 (13)[172] | | | |
| Corn Bunting | *Emberiza calandra* | Noncooperative[124] | 6.7 (15)[173] | | | |
| Yellowhammer | *Emberiza citrinella* | Noncooperative[75] | 68.8 (32)[174] | | | |
| Reed Bunting | *Emberiza schoeniclus* | Noncooperative[75] | 67.24 (312)[175-178] | | | |
| Willow Flycatcher | *Empidonax traillii* | Noncooperative[8] | 23 (56)[179] | | | |
| Acadian Flycatcher | *Empidonax virescens* | Noncooperative[8] | 55.56 (72)[180-182] | | | |
| Eurasian Robin | *Erithacus rubecula* | Noncooperative[183] | 16.57 (6)[184] | | | |
| Fiordland Crested Penguin | *Eudyptes pachyrhynchus* | Noncooperative[75] | 0 (24)[185] | | | |
| Royal Penguin | *Eudyptes schlegeli* | Noncooperative[75] | 7.7 (13)[186] | | | |
| Red Bishop | *Euplectes orix* | Noncooperative[75] | 34.39 (253)[187,188] | | | |
| Eleonora's Falcon | *Falco eleonorae* | Noncooperative[75] | 0 (17)[189] | | | |

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|---|---|---|---|---|---|---|
| Lesser Kestrel | *Falco naumanni* | Noncooperative[161,190] | 9.68 (31)[190] | | | |
| Peregrine Falcon | *Falco peregrinus* | Noncooperative[8] | 0 (18)[191] | | | |
| American Kestrel | *Falco sparverius* | Noncooperative[8] | 9.5 (21)[192] | | | |
| Common Kestrel | *Falco tinnunculus* | Noncooperative[193] | 2.7 (75)[194] | | | |
| Collared Flycatcher | *Ficedula albicollis* | Noncooperative[183] | 39.35 (216)[195-198] | | | |
| Pied Flycatcher | *Ficedula hypoleuca* | Noncooperative[183] | 13.91 (460)[199-205] | | | |
| Green-rumped Parrotlet | *Forpus passerinus* | Noncooperative[75] | 14.4 (160)[206] | | | |
| Atlantic Puffin | *Fratercula arctica* | Noncooperative[8] | 0 (38)[207] | | | |
| Great Frigatebird | *Fregata minor* | Noncooperative[8] | 1.1 (92)[208] | | | |
| Chaffinch | *Fringilla coelebs* | Noncooperative[75] | 23.1 (13)[209] | | | |
| Northern Fulmar | *Fulmarus glacialis* | Noncooperative[8] | 0 (28)[210] | | | |
| Great Northern Loon | *Gavia immer* | Noncooperative[8] | 0 (47)[211] | | | |
| Common Cactus Finch | *Geospiza scandens* | Noncooperative[212] | 15.2 (66)[212] | | | |
| Common Yellowthroat | *Geothlypis trichas* | Noncooperative[8] | 43.48 (138)[213] | | | |

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| Australian Magpie Lark | *Grallina cyanoleuca* | Noncooperative[214] | 6 (47)[215] | | | |
| Sandhill Crane | *Grus canadensis* | Noncooperative[8] | 22 (18)[216] | | | |
| Eurasian Oystercatcher | *Haematopus ostralegus* | Noncooperative[217] | 3.9 (26)[218] | | | |
| Barn Swallow | *Hirundo rustica* | Noncooperative[8] | 42.22 (334)[219-224] | | | |
| Wood Thrush | *Hylocichla mustelina* | Noncooperative[75] | 16.58 (187)[180,225] | | | |
| Blue Duck | *Hymenolaimus malacorhynchos* | Noncooperative[75] | 0 (4)[226] | | | |
| Bulock's Oriole | *Icterus galbula bullockii* | Noncooperative[8] | 46 (48)[227] | | | |
| Comb-crested Jacana | *Irediparra gallinacea* | Noncooperative[228] | 11.1 (9)[228] | | | |
| Wattled Jacana | *Jacana jacana* | Noncooperative[75] | 17.9 (74)[229] | | | |
| Dark-eyed Junco | *Junco hyemalis* | Noncooperative[8] | 34.2 (38)[230] | | | |
| Willow Ptarmigan | *Lagopus lagopus* | Noncooperative[8] | 13.16 (38)[231] | | | |
| White-tailed Ptarmigan | *Lagopus leucura* | Noncooperative[8] | 15 (20)[232] | | | |
| Bull-headed Shrike | *Lanius bucephalus* | Noncooperative[75] | 16.7 (24)[233] | | | |
| Red-backed Shrike | *Lanius collurio* | Noncooperative[231] | 33.33 (84)[234,235] | | | |

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| Loggerhead Shrike | *Lanius ludovicianus* | Noncooperative[75] | 13.89 (36)[236] | | | |
| Lesser Grey Shrike | *Lanius minor* | Noncooperative[75] | 0 (36)[237] | | | |
| Herring Gull | *Larus argentatus* | Noncooperative[8] | 0 (22)[238] | | | |
| Common Gull | *Larus canus* | Noncooperative[8] | 8.3 (24)[239] | | | |
| Western Gull | *Larus occidentalis* | Noncooperative[75] | 0 (22)[240] | | | |
| European Crested Tit | *Lophophanes cristatus* | Noncooperative[75] | 30 (20)[241] | | | |
| Red Crossbill | *Loxia curvirostra* | Noncooperative[8] | 0 (34)[242] | | | |
| Palila | *Loxioides bailleui* | Noncooperative[243] | 0 (12)[243] | | | |
| Bluethroat | *Luscinia svecica* | Noncooperative[8] | 48.37 (459)[244-247] | | | |
| Black Grouse | *Lyrurus tetrix* | Noncooperative[248,249] | 3.39 (59)[248,249] | | | |
| Eastern Screech Owl | *Megascops asio* | Noncooperative[250] | 0 (23)[250] | | | |
| Flammulated Owl | *Megascops flammeolus* | Noncooperative[251] | 0 (17)[251] | | | |
| Wild Turkey | *Meleagris gallopavo* | Noncooperative[8,252] | 45 (31)[252] | | | |
| Swamp Sparrow | *Melospiza georgiana* | Noncooperative[75] | 41.6 (113)[253] | | | |

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| Song Sparrow | *Melospiza melodia* | Noncooperative[8] | 40.87 (345)[254-256] | | | |
| Northern Mockingbird | *Mimus polyglottos* | Noncooperative[8] | 6.9*[257] | | | |
| Brown-headed Cowbird | *Molothrus ater* | Noncooperative[8] | 24 (54)[258,259] | | | |
| Stitchbird | *Notiomystis cincta* | Noncooperative[260,261] | 80 (10)[260,261] | | | |
| Wilson's Storm Petrel | *Oceanites oceanicus* | Noncooperative[75] | 0 (63)[262] | | | |
| Leach's Storm Petrel | *Oceanodroma leucorhoa* | Noncooperative[8] | 0 (48)[263] | | | |
| Northern Wheatear | *Oenanthe oenanthe* | Noncooperative[8] | 22.22 (27)[264] | | | |
| Lanyu Scops Owl | *Otus elegans* | Noncooperative[265] | 1.9 (108)[265] | | | |
| Golden Whistler | *Pachycephala pectoralis* | Noncooperative[75] | 23.1 (65)[266] | | | |
| Bearded Tit | *Panurus biarmicus* | Noncooperative[75] | 29.5 (44)[267] | | | |
| Vinous-throated Parrotbill | *Paradoxornis webbianus* | Noncooperative[75] | 26 (50)[268] | | | |
| Tibetan Ground Tit | *Parus humilis* | Noncooperative[269] | 37.66 (77)[269] | | | |
| Great Tit | *Parus major* | Noncooperative[75] | 29.86 (422)[147,149,270-272] | | | |
| House Sparrow | *Passer domesticus* | Noncooperative[273-281] | 23.71 (987)[273-281] | | | |

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| Tree Sparrow | *Passer montanus* | Noncooperative[270] | 23.75 (80)[282-284] | | | |
| Savannah Sparrow | *Passerculus sandwichensis* | Noncooperative[8] | 62.96 (162)[285-287] | | | |
| Blue Grosbeak | *Passerina caerulea* | Noncooperative[8] | 70 (20)[288] | | | |
| Indigo Bunting | *Passerina cyanea* | Noncooperative[8] | 29.27 (123)[289,290] | | | |
| Coal Tit | *Periparus ater* | Noncooperative[75] | 70.97 (503)[291,292] | | | |
| Grey Jay | *Perisoreus canadensis* | Noncooperative[8] | 0 (8)[8] | | | |
| Siberian Jay | *Perisoreus infaustus* | Noncooperative[293,294] | 0 (15)[293,294] | | | |
| Fairy Martin | *Petrochelidon ariel* | Noncooperative[75] | 20 (70)[295] | | | |
| New Zealand Robin | *Petroica australis* | Noncooperative[296,297] | 0 (91)[296,297] | | | |
| Red-capped Robin | *Petroica goodenovii* | Noncooperative[75] | 37 (77)[298] | | | |
| Rock Sparrow | *Petronia petronia* | Noncooperative[75] | 57.1 (42)[299] | | | |
| Phainopepla | *Phainopepla nitens* | Noncooperative[75] | 0 (25)[300] | | | |
| European Shag | *Phalacrocorax aristotelis* | Noncooperative[75] | 12.6 (87)[301] | | | |
| Great Cormorant | *Phalacrocorax carbo* | Noncooperative[75] | 16.1 (62)[302] | | | |

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|---|---|---|---|---|---|---|
| Red Phalarope | *Phalaropus fulicarius* | Noncooperative[8] | 33.3 (18)[303] | | | |
| Red-necked Phalarope | *Phalaropus lobatus* | Noncooperative[8] | 6.4 (63)[304] | | | |
| Wilson's Phalarope | *Phalaropus tricolor* | Noncooperative[8] | 0 (17)[305] | | | |
| Saddleback | *Philesturnus carunculatus* | Noncooperative[75] | 0 (39)[296] | | | |
| Ruff | *Philomachus pugnax* | Noncooperative[75] | 51 (100)[306,307] | | | |
| Waved Albatross | *Phoebastria irrorata* | Noncooperative[308,309] | 17.65 (170)[308,309] | | | |
| Redstart | *Phoenicurus phoenicurus* | Noncooperative[75] | 10.5 (38)[310] | | | |
| Dusky Warbler | *Phylloscopus fuscatus* | Noncooperative[75] | 59 (46)[311] | | | |
| Wood Warbler | *Phylloscopus sibilatrix* | Noncooperative[75] | 0 (13)[312] | | | |
| Willow Warbler | *Phylloscopus trochilus* | Noncooperative[124] | 38.82 (85)[312-315] | | | |
| Eurasian Magpie | *Pica pica* | Noncooperative[75] | 16.98 (53)[316] | | | |
| Three-toed Woodpecker | *Picoides tridactylus* | Noncooperative[75] | 11.54 (52)[317,318] | | | |
| California Towhee | *Pipilo crissalis* | Noncooperative[8] | 42 (31)[319] | | | |
| Scarlet Tanager | *Piranga olivacea* | Noncooperative[8] | 29 (17)[320] | | | |

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|---|---|---|---|---|---|---|
| Black-capped Chickadee | *Poecile atricapillus* | Noncooperative[8] | 31.3 (115)[321,322] | | | |
| Carolina Chickadee | *Poecile carolinensis* | Noncooperative[8] | 56 (90)[323] | | | |
| Willow Tit | *Poecile montanus* | Noncooperative[75] | 23.44 (64)[324,325] | | | |
| Takahe | *Porphyrio hochstetteri* | Noncooperative[326] | 0 (9)[326] | | | |
| Pukeko | *Porphyrio porphyrio* | Noncooperative[327] | 0 (12)[328] | | | |
| Purple Martin | *Progne subis* | Noncooperative[8] | 24.39 (41)[329] | | | |
| Cape Sugarbird | *Promerops cafer* | Noncooperative[75] | 70.2 (104)[330] | | | |
| Alpine Accentor | *Prunella collaris* | Noncooperative[329] | 0 (43)[331,332] | | | |
| Dunnock | *Prunella modularis* | Noncooperative[333] | 2.2 (45)[334] | | | |
| Short-tailed Shearwater | *Puffinus tenuirostris* | Noncooperative[75] | 10.84 (83)[335] | | | |
| Adelie Penguin | *Pygoscelis adeliae* | Noncooperative[336] | 11.11 (18)[337] | | | |
| Chinstrap Penguin | *Pygoscelis antarcticus* | Noncooperative[75] | 0 (38)[338] | | | |
| Vermillion Flycatcher | *Pyrocephalus rubinus* | Noncooperative[75] | 50 (8)[339] | | | |
| Red-billed Quelea | *Quelea quelea* | Noncooperative[75] | 43.2 (37)[340] | | | |

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| Cherrie's Tanager | *Ramphocelus costaricensis* | Noncooperative[341] | 55 (31)[341] | | | |
| Eurasian Penduline Tit | *Remiz pendulinus* | Noncooperative[75] | 17.3 (52)[342] | | | |
| Sand Martin | *Riparia riparia* | Noncooperative[8] | 36.05 (86)[343,344] | | | |
| Black-legged Kittiwake | *Rissa tridactyla* | Noncooperative[8] | 0 (86)[345] | | | |
| Eastern Phoebe | *Sayornis phoebe* | Noncooperative[75] | 10.31 (194)[346,347] | | | |
| Island Canary | *Serinus canaria* | Noncooperative[75] | 0 (45)[348] | | | |
| European Serin | *Serinus serinus* | Noncooperative[75] | 13.24 (68)[349,350] | | | |
| American Redstart | *Setophaga ruticilla* | Noncooperative[8] | 47.66 (107)[351,352] | | | |
| Mountain Bluebird | *Sialia currucoides* | Noncooperative[8] | 71.74 (92)[353] | | | |
| Eastern Bluebird | *Sialia sialis* | Noncooperative[8] | 26 (100)[354,355] | | | |
| European Nuthatch | *Sitta europaea* | Noncooperative[75] | 37.5 (32)[356] | | | |
| Humboldt Penguin | *Spheniscus humboldti* | Noncooperative[75] | 0 (21)[357] | | | |
| Field Sparrow | *Spizella pusilla* | Noncooperative[8] | 20.57 (175)[8] | | | |
| Brown Skua | *Stercorarius antarcticus* | Noncooperative[358] | 0 (26)[358] | | | |

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| South Polar Skua | *Stercorarius maccormicki* | Noncooperative[359] | 7.7 (13)[359] | | | |
| Common Tern | *Sterna hirundo* | Noncooperative[8] | 2.27 (44)[360,361] | | | |
| Southern Emu Wren | *Stipiturus malachurus* | Noncooperative[36,362] | 15 (27)[362] | | | |
| Tawny Owl | *Strix aluco* | Noncooperative[75] | 2.7 (37)[363] | | | |
| Ostrich | *Struthio camelus* | Noncooperative[75] | 100 (4)[364] | | | |
| Spotless Starling | *Sturnus unicolor* | Noncooperative[75] | 36.49 (211)[365,366] | | | |
| Common Starling | *Sturnus vulgaris* | Noncooperative[8] | 40.4 (99)[367-369] | | | |
| Masked Booby | *Sula dactylatra* | Noncooperative[75] | 13 (13)[370] | | | |
| Nazca Booby | *Sula granti* | Noncooperative[371] | 0 (21)[371] | | | |
| Mangrove Swallow | *Tachycineta albilinea* | Noncooperative[75] | 25.8 (31)[372] | | | |
| Tree Swallow | *Tachycineta bicolor* | Noncooperative[8] | 79.94 (319)[373-377] | | | |
| Zebra Finch | *Taeniopygia guttata* | Noncooperative[75] | 5.71 (105)[378,379] | | | |
| Shy Albatross | *Thalassarche cauta* | Noncooperative[380] | 10.3 (32)[380] | | | |
| Grey-headed Albatross | *Thalassarche chrysostoma* | Noncooperative[168] | 7 (90)[168] | | | |

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|---|---|---|---|---|---|---|
| Black-browed Albatross | *Thalassarche melanophris* | Noncooperative[168] | 6 (90)[168] | | | |
| Antarctic Petrel | *Thalassoica antarctica* | Noncooperative[75] | 7.32 (41)[381] | | | |
| Buff-breasted Wren | *Thryothorus leucotis* | Noncooperative[16,382] | 3 (31)[383] | | | |
| Carolina Wren | *Thryothorus ludovicianus* | Noncooperative[8] | 0 (23)[384] | | | |
| Great Tinamou | *Tinamus major* | Noncooperative[75] | 78.94 (19)[385] | | | |
| Monteiro's Hornbill | *Tockus monteiri* | Noncooperative[75] | 7.5 (38)[386] | | | |
| House Wren | *Troglodytes aedon* | Noncooperative[8] | 34.1 (780)[387-391] | | | |
| Buff-breasted Sandpiper | *Tryngites subruficollis* | Noncooperative[8] | 40.4 (47)[392] | | | |
| Clay-colored Robin | *Turdus grayi* | Noncooperative[75] | 52.6 (19)[393] | | | |
| Blackbird | *Turdus merula* | Noncooperative[75] | 28.57 (7)[394] | | | |
| American Robin | *Turdus migratorius* | Noncooperative[8] | 71.9 (64)[395] | | | |
| Eastern Kingbird | *Tyrannus tyrannus* | Noncooperative[8] | 60.55 (109)[396,397] | | | |
| Barn Owl | *Tyto alba* | Noncooperative[8] | 1.9 (54)[398] | | | |
| Eurasian Hoopoe | *Upupa epops* | Noncooperative[161,399] | 13.9 (36)[399] | | | |

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|---|---|---|---|---|---|---|
| Common Murre | *Uria aalge* | Noncooperative[8] | 7.8 (77)[400] | | | |
| Thick-billed Murre | *Uria lomvia* | Noncooperative[8] | 7 (27)[401] | | | |
| Southern Lapwing | *Vanellus chilensis* | Noncooperative[134,402] | 18.8 (86)[402] | | | |
| Golden-winged Warbler | *Vermivora chrysoptera* | Noncooperative[8] | 55.5 (54)[403] | | | |
| Red-eyed Vireo | *Vireo olivaceus* | Noncooperative[8] | 57.1 (7)[404] | | | |
| Blue-headed Vireo | *Vireo solitarius* | Noncooperative[75] | 6.3 (16)[404] | | | |
| Blue Black Grassquits | *Volatinia jacarina* | Noncooperative[75] | 63.64 (11)[405] | | | |
| Hooded Warbler | *Wilsonia citrina* | Noncooperative[8] | 35.3 (119)[406] | | | |
| Wilson's Warbler | *Wilsonia pusilla* | Noncooperative[8] | 53 (17)[8] | | | |
| White-throated Sparrow | *Zonotrichia albicollis* | Noncooperative[8] | 31.3 (32)[407] | | | |
| White-crowned Sparrow | *Zonotrichia leucophrys* | Noncooperative[8] | 25.7 (35)[408] | | | |
| Capricorn Silvereye | *Zosterops lateralis* | Noncooperative[75] | 0 (53)[409] | | | |

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