Host avian species and environmental conditions influence the microbial ecology of brood parasitic Brown-headed Cowbird nestlings: What rules the roost?

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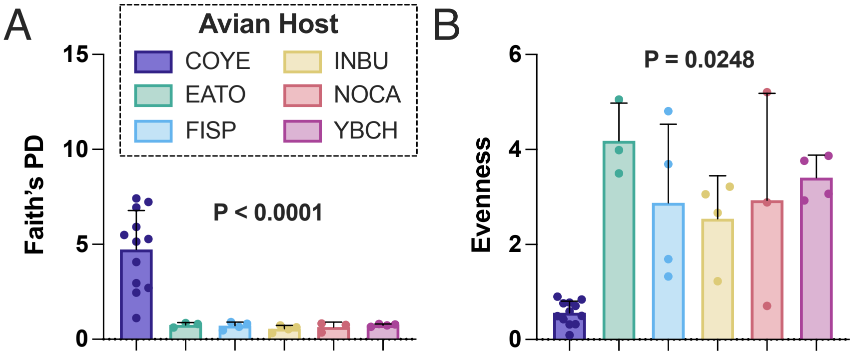
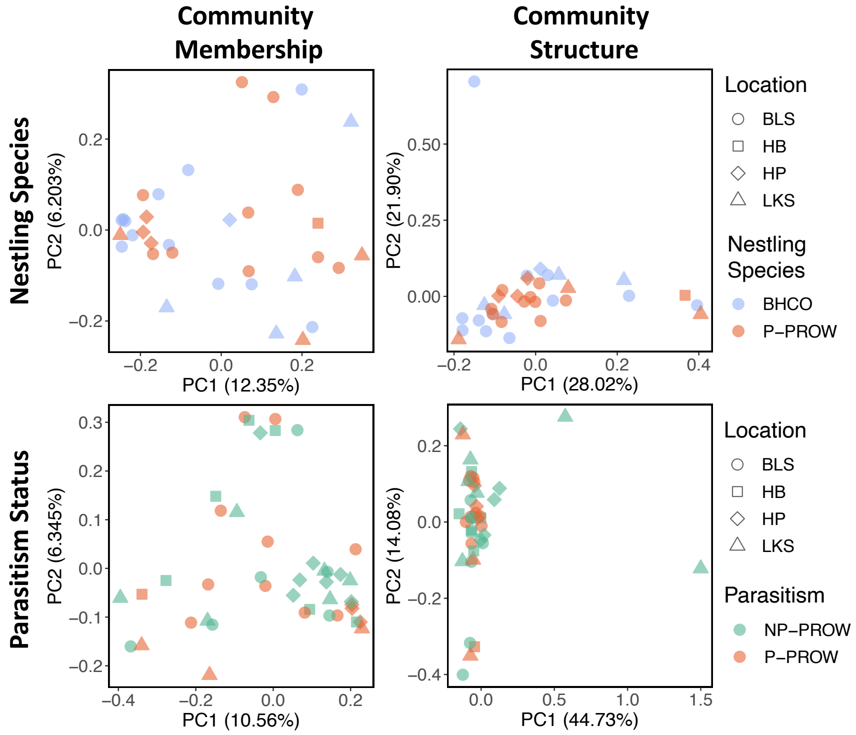
Abstract

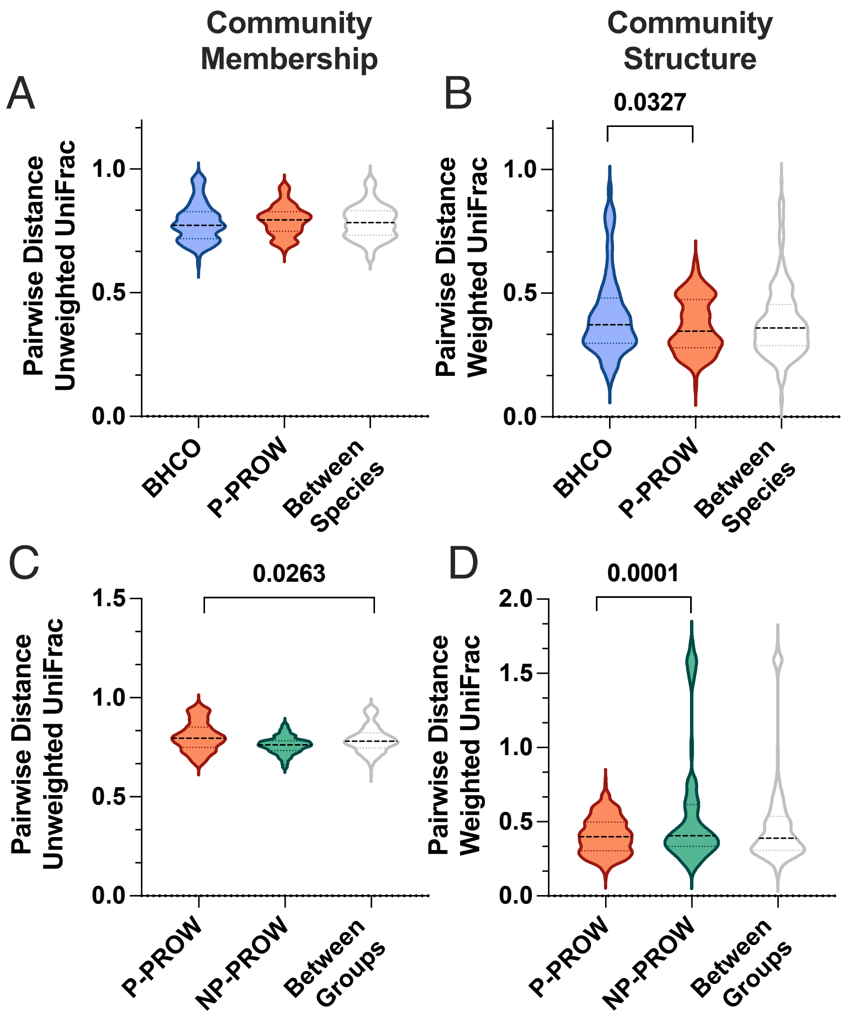
The role of species interactions, as well as genetic and environmental factors, all likely contribute to the composition and structure of the gut microbiome, however disentangling these independent actors under field conditions represents a challenge for a functional understanding of gut microbial ecology. Avian brood parasites provide unique opportunities to investigate these questions, as brood parasitism results in parasite and host nestlings being raised in the same nest, by the same parents. Here we utilized obligate brood parasite Brown-headed Cowbird nestlings (BHCO; Molothrus ater) raised by several different host passerine species to better understand, via 16S rRNA sequencing, the microbial ecology of brood parasitism. First, we compared fecal microbial communities of Prothonotary Warbler nestlings (PROW; Protonotaria citrea) that were either parasitized or non-parasitized by BHCO, and communities among BHCO nestlings from PROW nests. We found that parasitism by BHCO significantly altered both the community membership and community structure of the PROW nestling host-associated bacterial microbiome (HABM), perhaps due to the stressful nest environment generated by brood parasitism. In a second dataset, we compared fecal HABMs from BHCO nestlings raised by 6 different host passerines species. Here, we found that the HABM of BHCO nestlings was significantly influenced by the parental host species and the presence of an interspecific nestmate. Thus, early rearing environment is important in determining the HABM of brood parasite nestlings, and their companion nestlings. Future work may aim to understand the functional effects of this HABM variability on nestling performance and fitness.

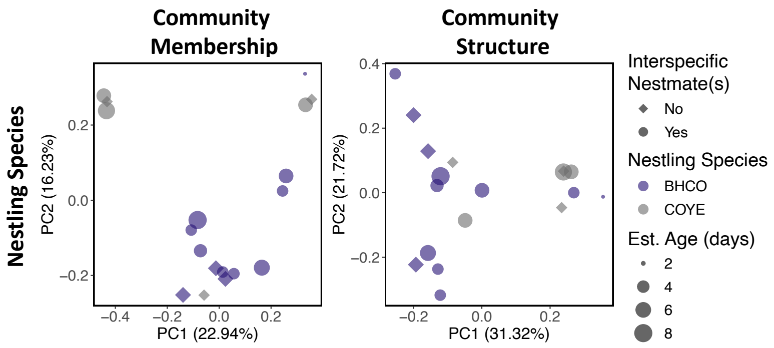
Hosted file

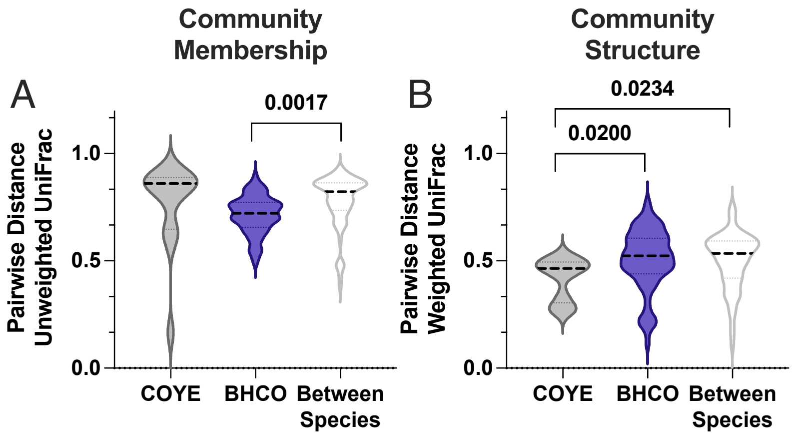
`CowbirdManuscript_MEC.docx` available at https://authorea.com/users/669945/articles/670171-host-avian-species-and-environmental-conditions-influence-the-microbial-ecology-of-brood-parasitic-brown-headed-cowbird-nestlings-what-rules-the-roost

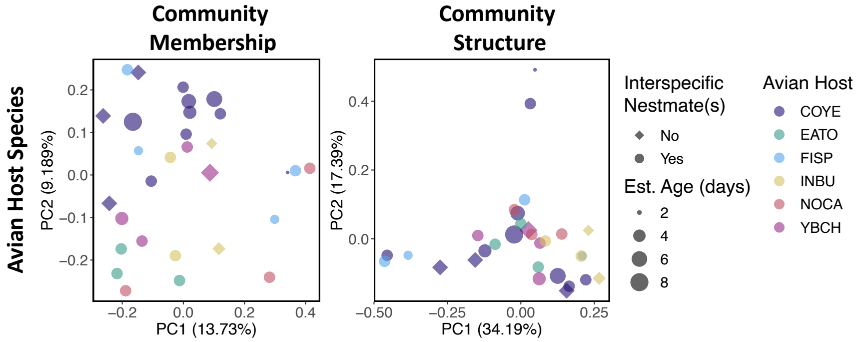

A
B
Avian Host
COYE
EATO
FISP
INBU
NOCA
YBCH
Faith's PD
15
10
5
0
P < 0.0001
Evenness
6
4
2
0
P = 0.0248

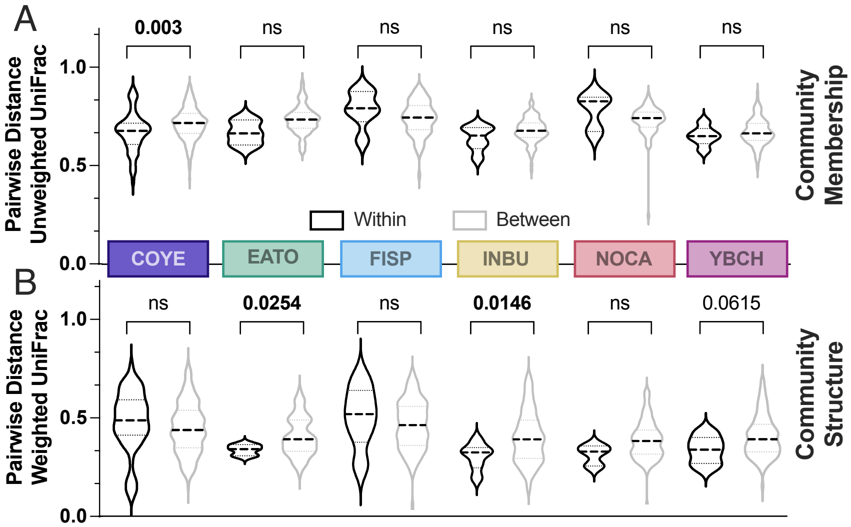

Community Membership
Community Structure
Nestling Species
Parasitism Status
PC1 (12.35%)
PC2 (6.203%)
PC1 (28.02%)
PC2 (21.90%)
PC1 (10.56%)
PC2 (6.345%)
PC1 (44.73%)
PC2 (14.08%)
−0.2
0.0
0.2
0.4
0.25
0.50
0.00
0.3
0.1
−0.1
−0.4
0.5
1.0
1.5
Location
BLS
HB
HP
LKS
Nestling Species
BHCO
P−PROW
Parasitism
NP−PROW
P−PROW

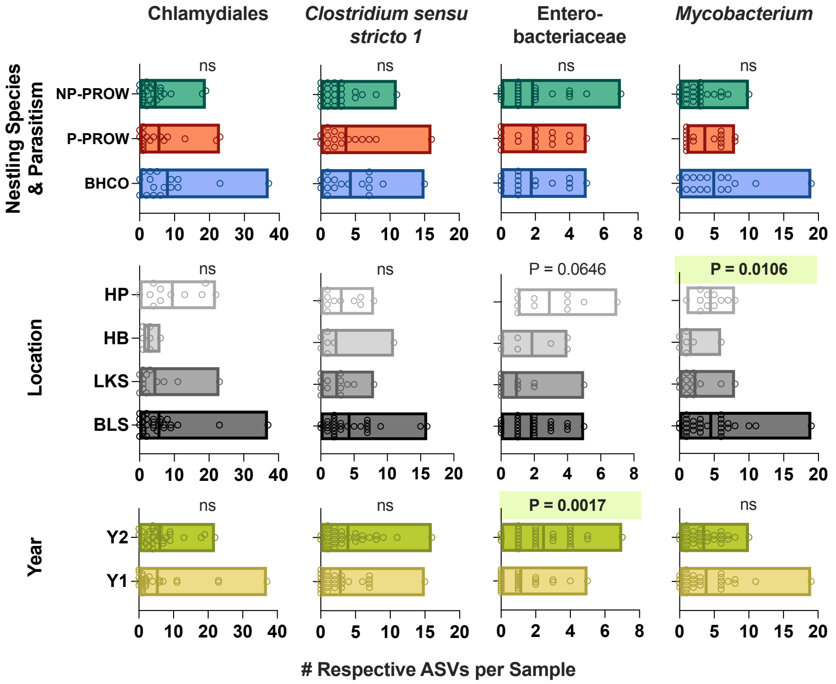

Community Membership
Community Structure
A
B
0.0327
Pairwise Distance Unweighted UniFrac
Pairwise Distance Weighted UniFrac
1.0
0.5
0.0
BHCO
P-PROW
Between Species
C
D
0.0263
0.0001
1.5
2.0
P-PROW
NP-PROW
Between Groups


Community Membership
Community Structure
Nestling Species
PC2 (16.23%)
PC1 (22.94%)
PC2 (21.72%)
PC1 (31.32%)
−0.4
−0.2
0.0
0.2
0.4
Interspecific Nestmate(s)
No
Yes
Nestling Species
BHCO
COYE
Est. Age (days)
2
4
6
8


Community Membership
Community Structure
A
B
0.0017
0.0234
0.0200
Pairwise Distance Unweighted UniFrac
Pairwise Distance Weighted UniFrac
1.0
0.5
0.0
COYE
BHCO
Between Species


Community Membership
Community Structure
Avian Host Species
PC2 (9.189%)
PC1 (13.73%)
PC2 (17.39%)
PC1 (34.19%)
0.2
0.1
0.0
−0.1
−0.2
0.4
0.2
0.0
−0.50
−0.25
0.00
0.25
Interspecific Nestmate(s)
No
Yes
Est. Age (days)
2
4
6
8
Avian Host
COYE
EATO
FISP
INBU
NOCA
YBCH


A
B
0.003
ns
0.0254
0.0146
0.0615
Pairwise Distance Unweighted UniFrac
Pairwise Distance Weighted UniFrac
1.0
0.5
0.0
Within
Between
COYE
EATO
FISP
INBU
NOCA
YBCH
Community Membership
Community Structure



Chlamydiales
Clostridium sensu stricto 1
Entero-bacteriaceae
Mycobacterium
Nestling Species & Parasitism
NP-PROW
P-PROW
BHCO
ns
ns
ns
ns
0 10 20 30 40
0 5 10 15 20
0 2 4 6 8
0 5 10 15 20
Location
HP
HB
LKS
BLS
ns
ns
P = 0.0646
P = 0.0106
Year
Y2
Y1
ns
ns
P = 0.0017
ns
Respective ASVs per Sample