



Sexual dimorphism in hormone-gut microbiome associations across reproductive states in wild giant pandas

Qinlong Dai ^{1,2,3#}, Xinyuan Cui ^{2#}, Chenyi Gao ^{2#}, Xiaoxiao Tang ¹,
Kaizhi Wen ², Minhui Shi ², Chen Zhang ², Yue Liu ², Xinru Yang ²,
Qiuyu Huang ², Lifeng Zhu ^{2,3*}

¹Shimian Management and Protection Station,
Giant Panda National Park, Sichuan, China

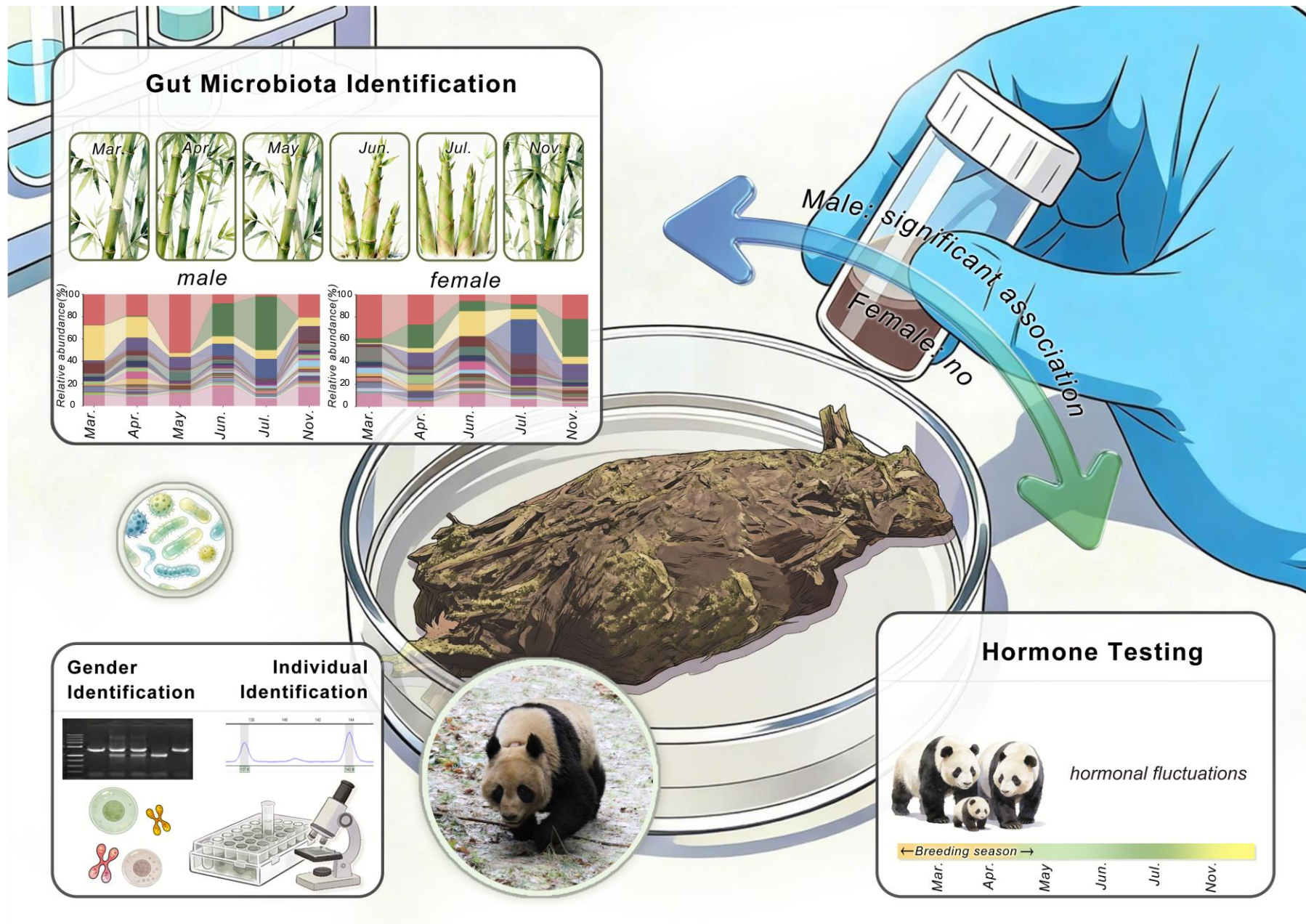
²School of Medicine, Nanjing University of Chinese Medicine, Nanjing, China

³Liziping Giant Panda's Ecology and Conservation Observation and
Research Station of Sichuan Province, Nanchong, China



Qinlong Dai, Xinyuan Cui, Chenyi Gao, Xiaoxiao Tang, Kaizhi Wen, Minhui Shi, Chen Zhang, et al. 2026.
Sexual dimorphism in hormone-gut microbiome associations across reproductive states in wild giant pandas.
iMetaOmics 3: e70108. <https://doi.org/10.1002/imo2.70108>

Overview and Highlights



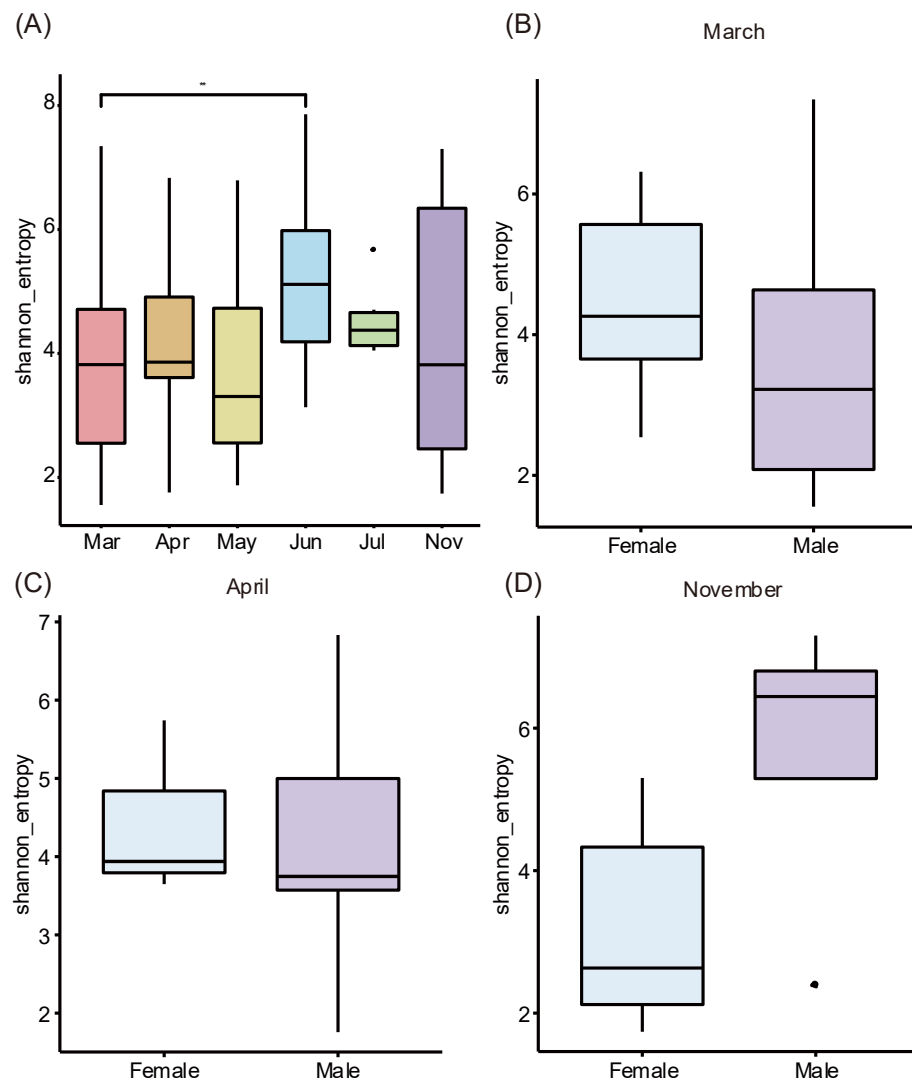
Result 1: Individual identification

Sample ID	Individual	Released individuals	Sex
1Mar04	I1	HY	Female
2Mar01	I2	TT	Male
2Mar02	I2	TT	Male
2Mar03	I2	TT	Male
2Mar05	I2	TT	Male
2Mar07	I2	TT	Male
2Mar08	I2	TT	Male
2Mar09	I2	TT	Male
2Mar11	I2	TT	Male
2Mar12	I2	TT	Male
2Mar15	I2	TT	Male
2Mar16	I2	TT	Male
2Mar31	I2	TT	Male
2Nov38	I2	TT	Male
3Mar10	I3	\	Male
4Mar13	I4	\	Female
4Nov16	I4	\	Female
4Nov19	I4	\	Female
5Mar20	I5	\	Female
5Mar23	I5	\	Female
5Mar26	I5	\	Female
6Mar27	I6	\	Female
7Mar32	I7	\	\
8Mar36	I8	\	Female
9Mar38	I9	\	\
10Mar40	I10	\	Male
11Mar24	I11	\	Male
11Mar28	I11	\	Male
11Apr02	I11	\	Male
11Apr08	I11	\	Male
12May01	I12	\	Male

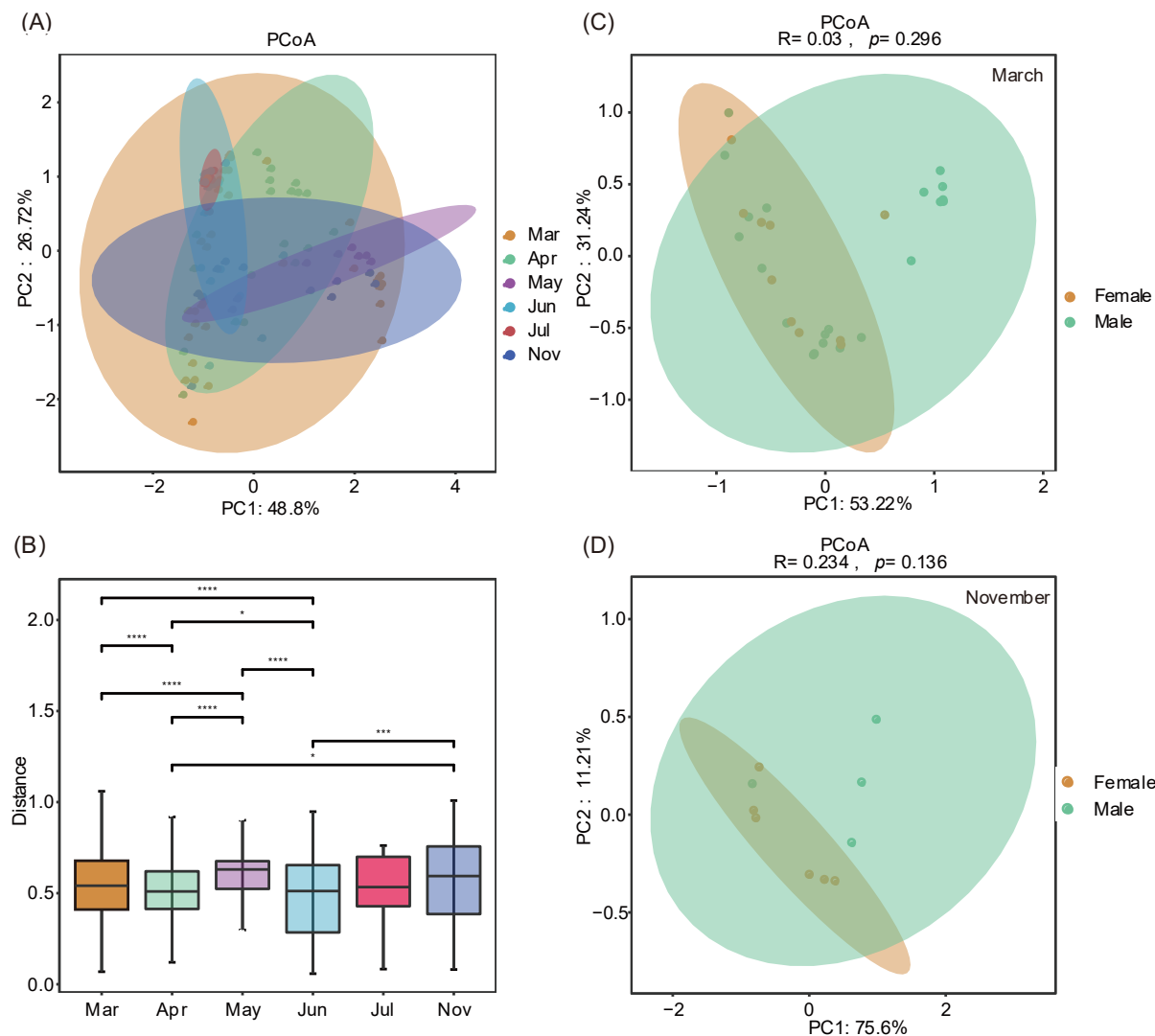
Sample ID	Individual	Released individuals	Sex
13May04	I13	\	Male
14Jun04	I14	\	\
15Jun05	I15	\	Male
16Jun03	I16	\	\
16Jun06	I16	\	\
17Jun11	I17	\	Male
18Jun13	I18	\	Female
19Jun18	I19	\	Male
20Jun16	I20	\	Male
20Jul01	I20	\	Male
21Jul03	I21	\	Male
22Mar17	I22	\	Male
22May02	I22	\	Male
22Jun01	I22	\	Male
22Jun02	I22	\	Male
22Jun09	I22	\	Male
22Jun12	I22	\	Male
22Jul02	I22	\	Male
22Jul04	I22	\	Male
22Jul05	I22	\	Male
23Jul06	I23	\	Female
24Nov03	I24	\	Male
26Nov07	I25	\	Female
27Nov61	I26	BX	Male
28Nov27	I27	\	Female
29Nov55	I28	\	Male
30Nov36	I29	\	Female
31Nov40	I30	\	Female
32Nov43	I31	\	Female
32Nov44	I31	\	Female
2Mar14	I32	TT	Male



Result 2: Seasonal Variations and Gender Differences in the Gut Microbiome



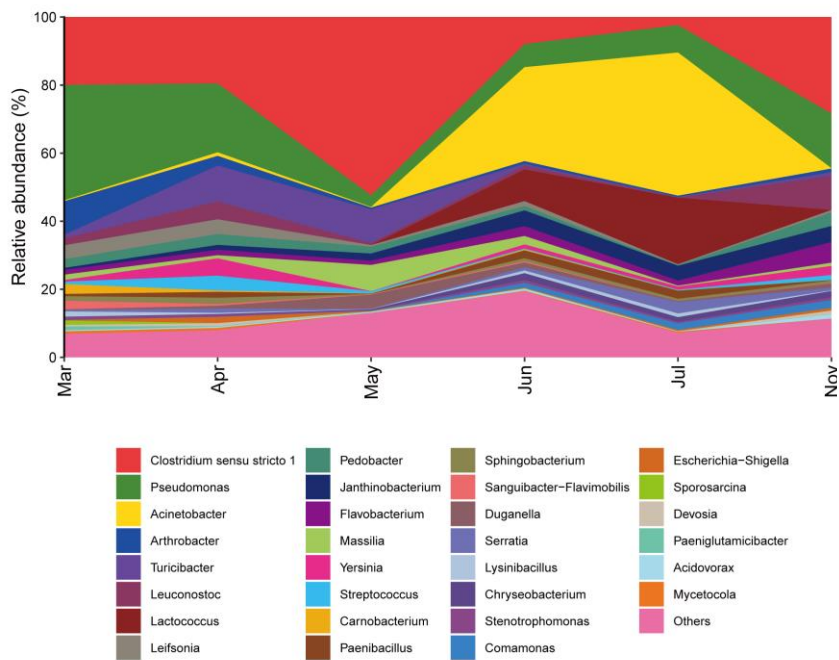
Differences in gut microbial α -diversity across months and between genders



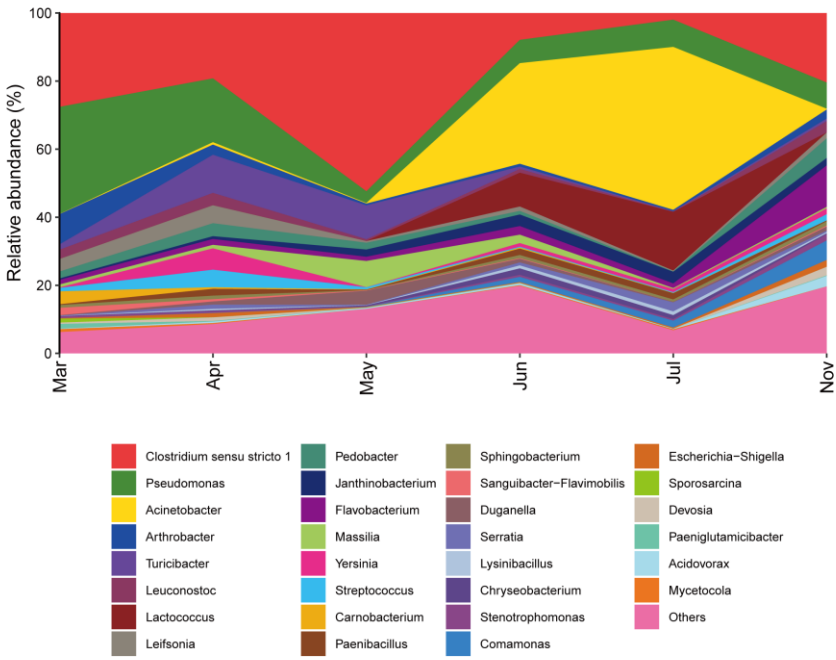
Differences in gut microbial β -diversity across months and between genders



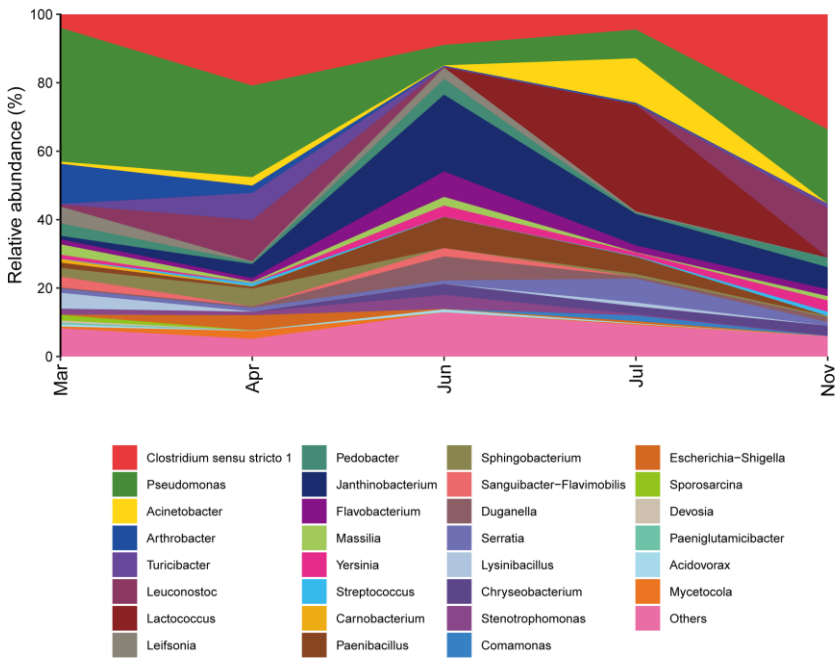
Result 2: Seasonal Variations and Gender Differences in the Gut Microbiome



Seasonal changes in the gut microbiome of all giant pandas



Seasonal changes in the gut microbiome of male giant pandas



Seasonal changes in the gut microbiome of female giant pandas

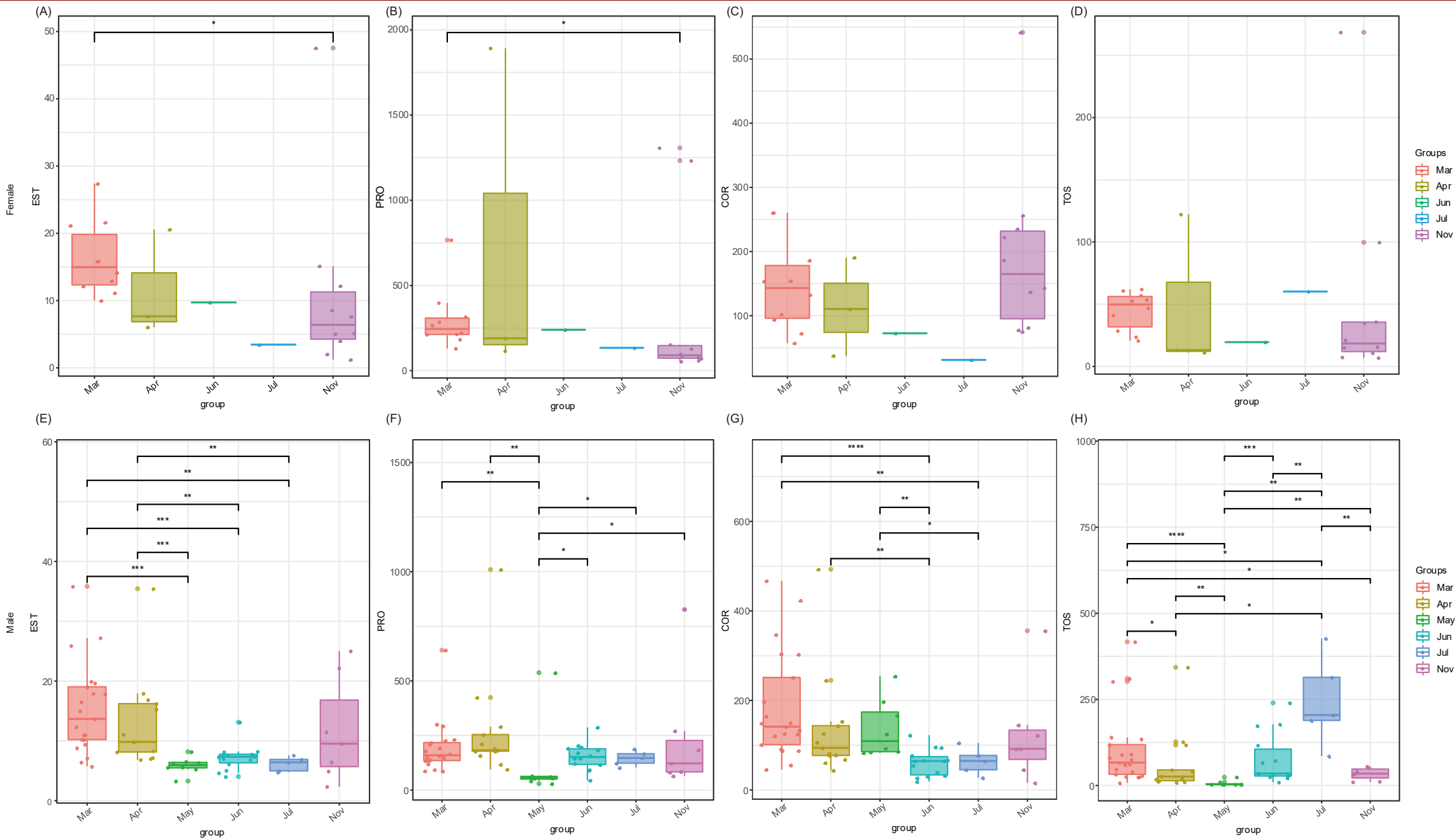


Result 2: Seasonal Variations and Gender Differences in the Gut Microbiome





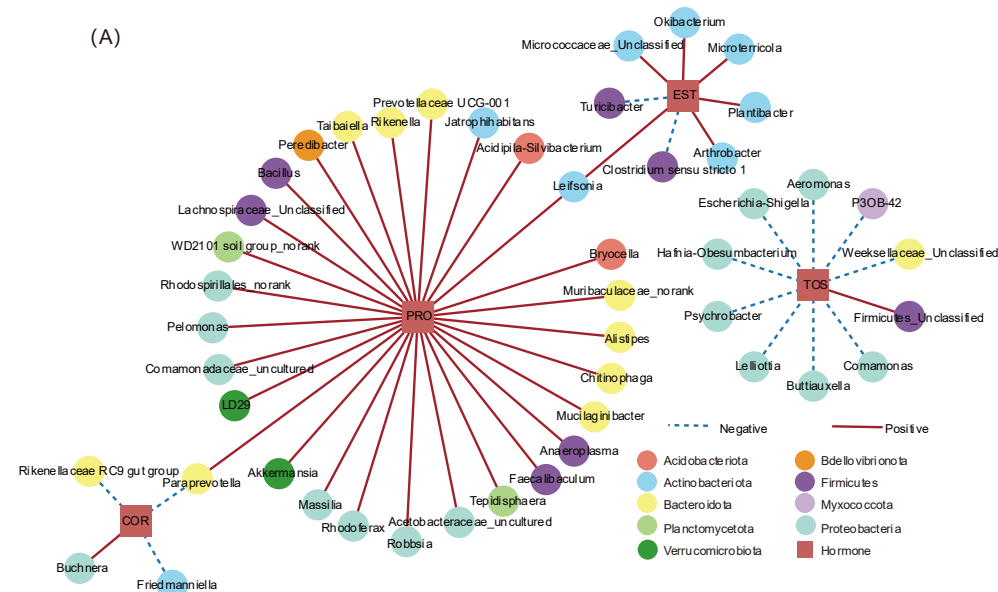
Result 3: Seasonal Variations in Giant Panda Hormone Levels



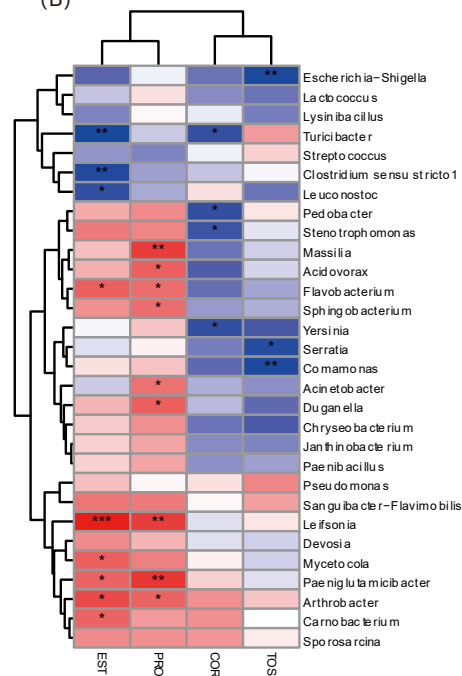


Result 4: Significant Associations Between Hormone Levels and Gut Microbial Features

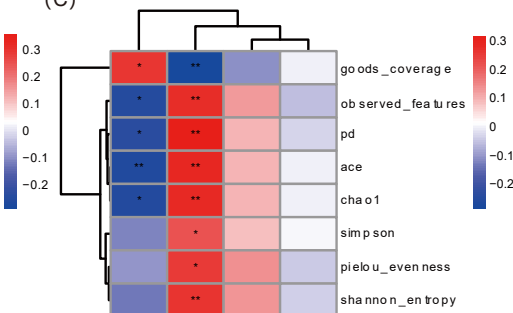
(A)



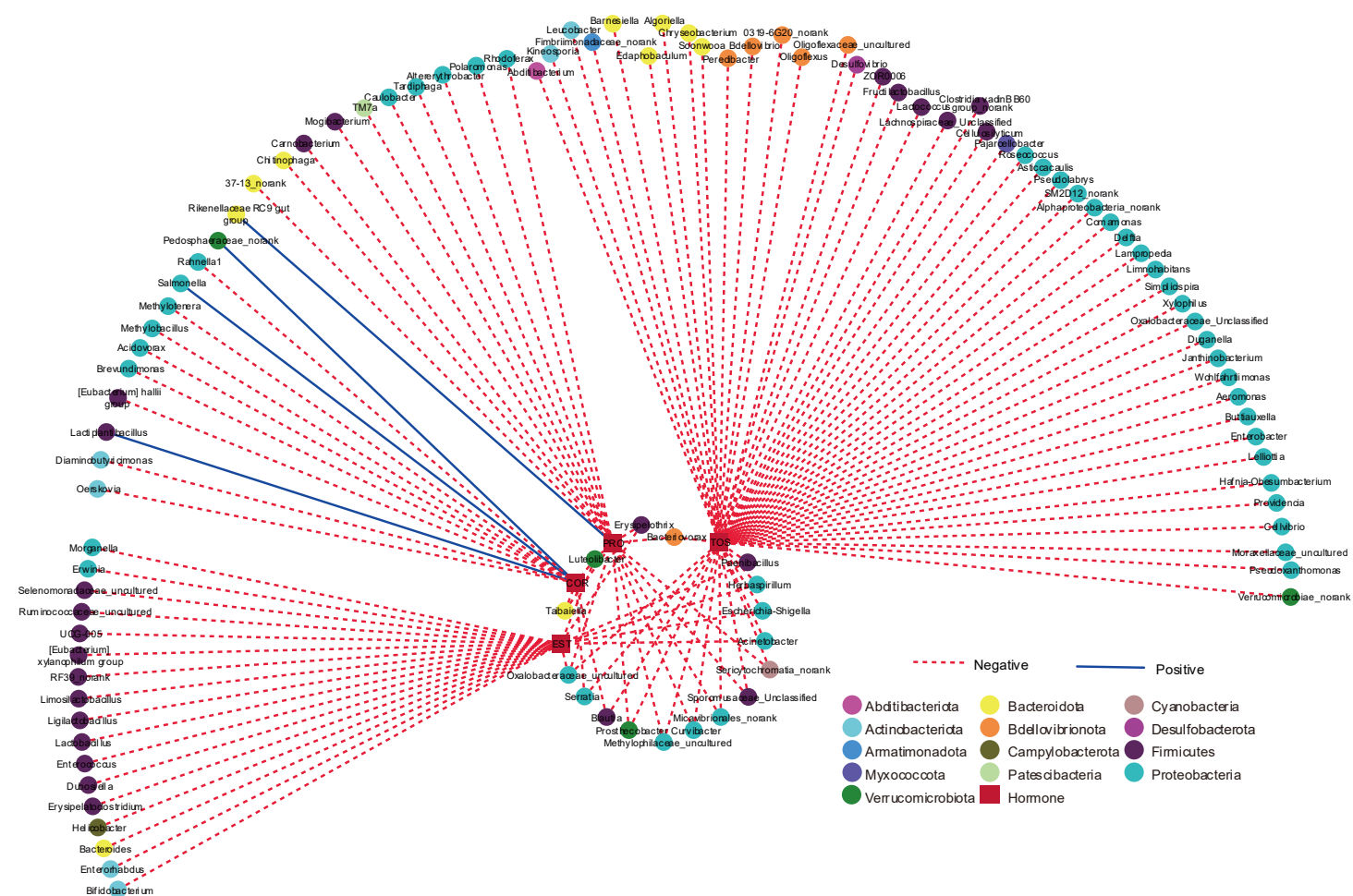
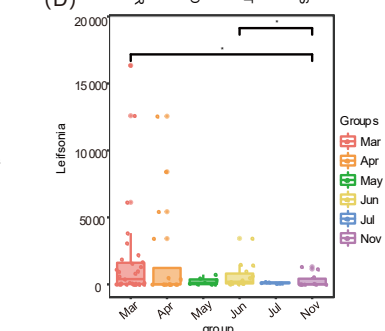
(B)



(C)



(D)

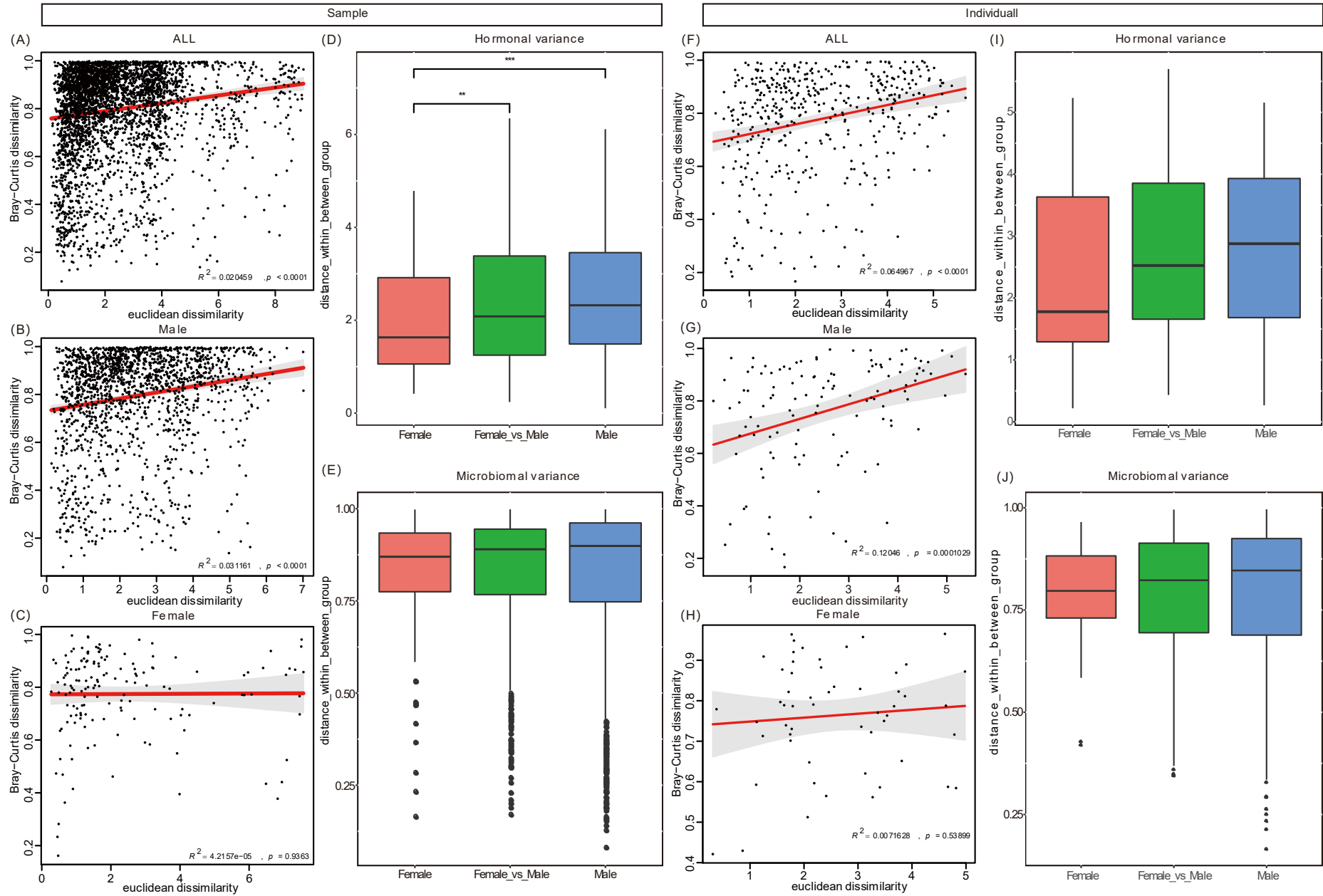


--- Negative --- Positive

Abditbacteriota Bacteroidota Cyanobacteria
Actinobacteriota Bdellovibrionota Desulfobacterota
Armatimonadota Campylobacterota Firmicutes
Myxococcota Patescibacteria Proteobacteria
Verrucomicrobiota Hormone



Result 5: Significant Microbiome-Hormone Coupling in Males





Summary

- ❑ The gut microbiome composition of giant pandas varied across seasons and genders.
- ❑ Hormone levels in giant pandas showed adaptive regulation in response to reproductive activity and metabolic status.
- ❑ The microbiome-hormone association was detected in giant pandas — significant in males, but not in females.

Qinlong Dai, Xinyuan Cui, Chenyi Gao, Xiaoxiao Tang, Kaizhi Wen, Minhui Shi, Chen Zhang, et al. 2026.
Sexual dimorphism in hormone-gut microbiome associations across reproductive states in wild giant pandas.
iMetaOmics 3: e70108. <https://doi.org/10.1002/imo2.70108>

iMeta: To be top journals in biology and medicine

WILEY



“iMeta” launched in 2022 by iMeta Science Society, **impact factor (IF) 33.2**, **ranking top 65/22400 in the world**. It aims to publish innovative and high-quality papers with broad and diverse audiences. Its scope is similar to *Cell*. The average citation is > 40 in 2025, similar to *Nature* and *Science*. Its unique features include video abstract, bilingual publication, and social media with 600,000 followers. Indexed by [SCIE/ESI](#), [PubMed](#), [Google Scholar](#) etc.

“iMetaOmics” launched in 2024, indexed by [ESCI](#), [PubMed](#), [Google Scholar](#), with a **target IF>15**, and its **scope is similar to** *Nature Communications*, *Science Advances*, *Advanced Science*, *Nucleic Acids Research*, etc.

“iMetaMed” launched in 2025, with a target IF>15, similar to *Med*, *Cell Reports Medicine*, *eBioMedicine*, *eClinicalMedicine* etc.



Society: <http://www.imeta.science>

Publisher: <https://wileyonlinelibrary.com/journal/imeta>

iMeta: <https://wiley.atyponrex.com/journal/IMT2>

Submission: iMetaOmics: <https://wiley.atyponrex.com/journal/IMO2>

iMetaMed: <https://wiley.atyponrex.com/journal/IMM3>



[iMetaScience](#)



[iMetaScience](#)



office@imeta.science

imetaomics@imeta.science



[Promotion Video](#)

Update
2026/3/30