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Sero epidemiological study of Sheeppox and Goatpox disease in small ruminants in Karnataka

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Abstract

The sheeppox and goatpox diseases are caused by sheeppox virus and goatpox virus, respectively, in sheep and goats. These diseases cause economic loss to the farming community due to high morbidity and mortality. The current study reports the seroprevalence of sheep and goatpox in Karnataka. A total of 1800 serum samples were collected from 30 different districts of Karnataka using a stratified random sampling method. The serum samples were screened by an in-house developed indigenous iELISA kit. Among 1800 samples, 95 samples were positive for capripoxvirus antibodies, with a combined seroprevalence of 5.28 percent in sheep and goats. Among the 1039 goat sera, 56 were found positive with a seropositivity rate of 5.39%. Whereas, out of 761 sheep sera, 39 were seropositive with a 5.12 percent seroprevalence.

Geographically, the Belagavi division showed the highest seroprevalence of 11.19 percent, followed by Kalaburagi and Bengaluru with 5.55 and 3.52 percent, respectively. The Mysuru division of Karnataka showed the least seroprevalence (1.88%). The Belagavi and Haveri districts reported a high rate of seroprevalence of SGP with 20.0% each, followed by Bagalkot with 15.0%, and then Gadag and Kalaburagi with 11.67 percent. Whereas, Chamarajnagar, Dakshina Kannada, Uttara Kannada, Kodagu, and Udupi districts reported nil seroprevalence.

In conclusion, the study revealed seroprevalence of sheep and goatpox disease, which highlights the need for vaccination and continued surveillance of the disease in the future.

Keywords: Sheeppox, goatpox, iELISA, seroprevalence

Introduction

Sheeppox and goatpox (SGP) are infectious and economically significant viral diseases of sheep and goats caused by sheeppox and goatpox viruses of the family *Poxviridae*, subfamily *Chordopoxvirinae*, and genus *Capripoxvirus* (Manjunatha Reddy *et al.*, 2024) ^[13]. These are highly contagious diseases that spread mostly by direct contact with lesions or contaminated feed, fodder, water, and wool. The virus is excreted in nasal and ocular secretions, milk, and possibly through urine.

The prevention and control of pox disease mainly depend on quick and reliable diagnosis (Manjunatha Reddy *et al.*, 2015; 2017; 2023; Sumana *et al.*, 2020) ^[15, 14, 21 22]. The diagnosis of SGP depends on clinical signs and laboratory confirmation. The clinical signs of severe sheeppox and goatpox are highly characteristic. However, in their mild form, they can be confused with parapoxvirus infections causing orf, urticaria from multiple insect bites, contagious ecthyma (Babu *et al.*, 2018) ^[4], bluetongue, peste des petits ruminants, photosensitization, dermatophilosis, parasitic pneumonia, caseous lymphadenitis, and mange (Hurisa *et al.*, 2018). Hence, confirmatory laboratory diagnostic methods are useful.

Laboratory diagnosis is carried out either by identifying the antigen through targeting different genes (Sumana *et al.*, 2020; Manjunatha Reddy *et al.*, 2023) ^[21, 22, 16] or by detecting antibodies (Manjunatha Reddy *et al.*, 2025). Among serological tests, virus neutralization test (VNT), indirect fluorescent antibody test (IFAT), and enzyme-linked immunosorbent assay (ELISA) are commonly used. Indirect ELISA has been developed and validated to detect antibodies to CaPV for mass screening of populations to determine the prevalence of infection (Manjunatha Reddy *et al.*, 2025) ^[17].

Seroprevalence studies of sheep and goatpox infections are crucial to understand disease dynamics, map geographical distribution, and assess disease prevalence and immunity status.

Such studies are required for identifying high-risk areas and populations to assess the economic impact and to formulate control and preventive measures by guiding targeted vaccination strategies.

Materials and Methods

Sample collection

Sampling strategy and sample size for seroprevalence study

The sample size was calculated by using the stratified

random sampling method (Fig 1). Accordingly, 30 serum samples from apparently healthy sheep or goats with a history of not being vaccinated against SGP from each district of Karnataka in two intervals with a gap of 10 months were collected. As per WOA (OIE) guidelines, the collected samples were labeled and placed in a sterilized universal carrier and transported to virology laboratory, ICAR-NIVEDI, Bengaluru. All collected samples were screened by in house iELISA, kit developed by ICAR-NIVEDI

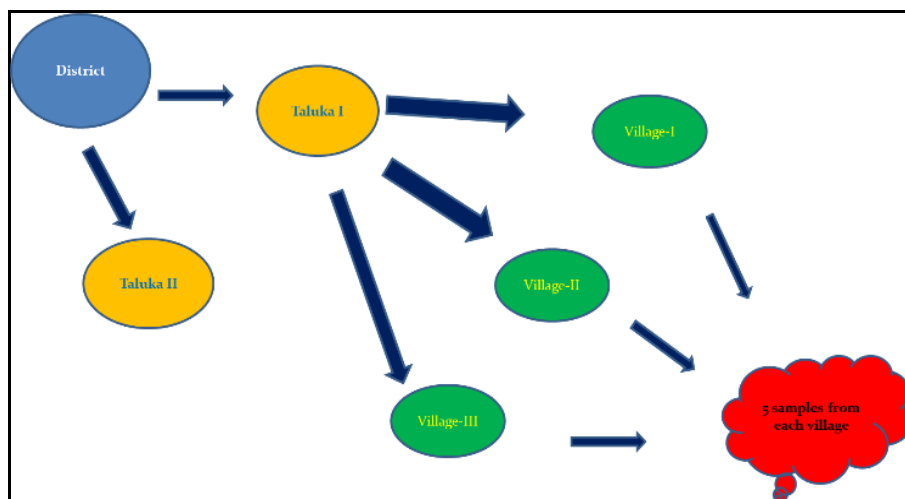


Fig 1: Stratified random sampling method for sample collection for a seroprevalence study

Indirect ELISA for detection of antibodies

An in-house developed iELISA was used for the serological study (Manjunatha Reddy *et al.*, 2025) [17]. Briefly, antigen-coated ELISA plates (Polysorp) were taken out from the refrigerator and washed three times with wash buffer. To block the unbound sites of the ELISA plate wells, 100 μ L of blocking buffer (PBST with 3% skim milk powder) was added to all the wells using a multichannel pipette and incubated at 37 °C for one hour. After one hour of incubation, the plates were washed thrice with wash buffer, and 100 μ L of 1:100 diluted test and control sera in blocking buffer was added to all the wells and incubated at 37 °C for one hour. After incubation, the plates were washed thrice using wash buffer, and 100 μ L of 1:5000 diluted anti-sheep/goat conjugate was added to all the wells and incubated at 37 °C for one hour, followed by washing thrice

with wash buffer. After washing, 100 μ L of OPD substrate solution was added to each well and incubated at 37 °C for 15 minutes. After the optimum color (yellow) developed, 50 μ L of stop solution (1 M H₂SO₄) was added. The readings were taken at 492 nm using an ELISA plate reader.

Results

Upon screening of 1800 samples collected from all the districts of Karnataka, by iELISA, 95 samples were found positive for anti SGP antibodies, yielding an overall seroprevalence of 5.28 percent. Among 1800 samples, 1039 were from goats and 761 from sheep in which 56 and 39 samples found seropositive with 5.39 and 5.12 percents seroprevalence in goats and sheep respectively (Fig.2). Statistical analysis of influence of species on the rate of seroprevalence is insignificant ($P > 0.05$).

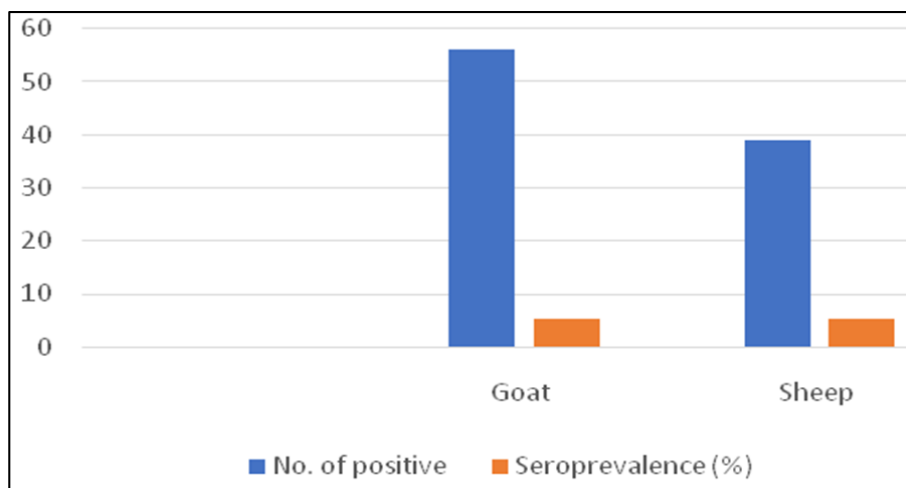


Fig 2: Species-wise seroprevalence of sheep and goatpox in Karnataka during October 2022-September 2023

Among the divisions, Belagavi division stood first with a seroprevalence of 11.19 percent followed by Kalaburgi and Bengaluru with 5.55 and 3.52 percents respectively. Mysuru division placed last with 1.88 percent of seroprevalence rate (Fig. 3& Table 1.).

Table 1: Division-wise seroprevalence of sheep and goatpox in the Karnataka state during October 2022-September 2023

Division/Clusters	Sample size (n)	Positive samples (n)	Seroprevalence (%)
Belagavi	420	47	11.19
Kalburgi	360	20	5.55
Mysuru	480	09	1.88
Bangaluru	540	19	3.52
Total	1800	95	5.28

Chi-square, df. 43.89, 3, P value< 0.0001. Significant at 5 percent level of significance.

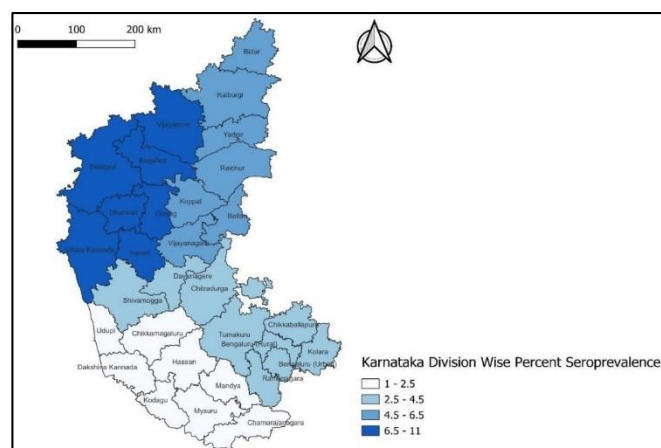


Fig 3: Division-wise seroprevalence of sheep and goatpox disease in Karnataka during October 2022-September 2023

Belagavi and Haveri districts reported a high rate of seroprevalence of SGP, with 20.00 percent each, followed by Bagalkot with 15.00 percent. The third position was shared by Gadag and Kalaburgi, with 11.67 percent.

Whereas, Chamarajanagar, Dakshina Kannada, Uttara Kannada, Kodagu, and Udupi districts reported nil seroprevalence (Fig. 4 & Table 2).

Table 2: District-wise breakup of seroprevalence of sheep and goatpox in the Karnataka state during October 2022-September 2023 (Total n = 60 samples collected from each district)

District	Total population (N)	Total positives	Percent seroprevalence
Bagalkot	916168	4	6.67
B. Urban	1006782	9	15.0
B. South	1459420	12	20.0
Belagabi	458174	12	20.0
Bellary	587555	7	11.67
Bidar	153938	3	5.00
Vijayapura	19192	0	0
Chamrajnagar	1571060	2	3.33
Chikballapura	558587	7	11.67
Chikmagalur	797945	2	3.33
Chitradurga	940351	5	8.33
Udupi	693940	1	1.67
Davanagere	1571060	3	5.00
Dharwad	279954	0	0
Gadag	139002	1	1.67
Gulbarga	32504	0	0
Hassan	328445	2	3.33
Haveri	8253	0	0
Kodagu	693563	3	5.00
Kolar	411669	3	5.00
Koppal	3107	0	0
Mandya	145337	1	1.67
Mysore	213944	1	1.67
Raichur	801585	2	3.33
Ramanagara	1737145	2	3.33
Shimoga	317796	2	3.33
Tumkur	577605	4	6.67
Udupi	278118	2	3.33
Uttara_Kannada	102245	3	5.00
Yadgir	1717934	2	3.33
Total	18522378	95	5.28

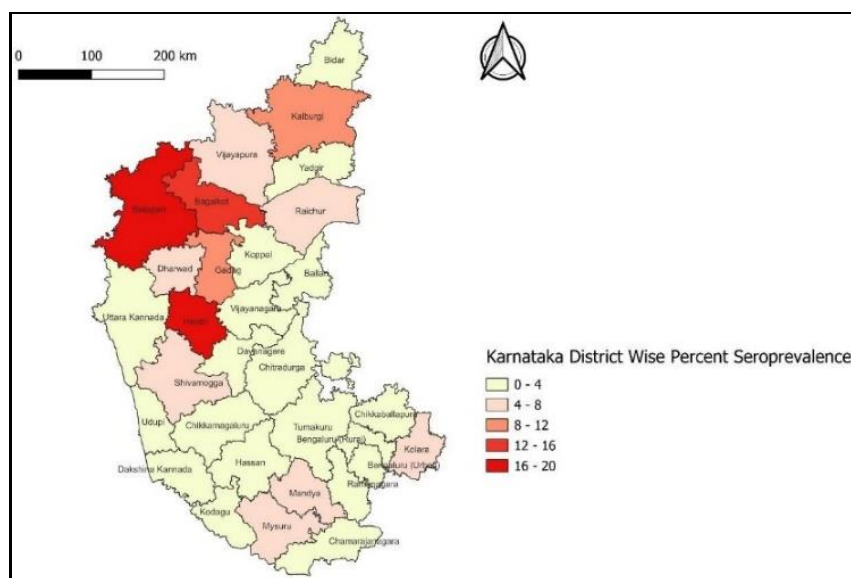


Fig 4: District-wise breakup of seroprevalence of sheep and goatpox in Karnataka during October 2022-September 2023

In the current study, we found that the rate of seroprevalence of SGP in Karnataka between divisions and districts was statistically significant.

Discussion

In the current investigation, we used an in-house iELISA kit developed by NIVEDI, Bengaluru, to screen 1800 serum

samples collected from all 30 districts of Karnataka and found an overall seroprevalence of 5.28 percent for sheep and goatpox in Karnataka.

In a study conducted in sheep with 772 serum samples, the lowest seroprevalence was observed in Chamara Nagar (3%). Whereas, irrespective of population density, the other three districts (Tumakuru, Koppal, and Kolar) revealed high seropositivity for sheeppox disease, ranging from 29 to 31% (Manjunatha Reddy *et al.*, 2024) [13].

Seroprevalence and associated risk factors in the occurrence of pox infection among sheep and goats in selected districts (Asayita and Mille) of the Afar region, Ethiopia, during the study period from February to April 2020 were reported by Dubie *et al.* (2022) [8] using VNT. The study revealed an overall seroprevalence of 15.36 percent, of which 14.5 percent of sheep and 15.69 percent of goats were exposed to poxvirus infection, indicating that both species were equally exposed.

Whereas, Elshafie and Ali (2008) [9] reported a higher seroprevalence in the Kassala, Algash, Nahr Atbara, and Seitit areas during the year 2006, which was attributed to varied animal movement and the introduction of new animals into the herd.

Further, Kassa *et al.* (2024) [12] reported the seroprevalence of SGP in selected districts of Wolaita Zone, Southern Ethiopia, to be 4.95 percent, with five times higher prevalence in sheep than goats, implying that sheep are more likely to contract poxvirus infection than goats. This finding contradicts the report by Assefa *et al.* (2019) [2], who opined that capripoxvirus is not host-specific and that the majority of strains cause disease in both species.

However, in the present study, we found that both species are equally affected (goats: 5.39% and sheep: 5.12%), and species-specific seroprevalence of SGP was statistically insignificant ($P > 0.05$). The higher seroprevalence of 71.36 percent of goatpox in selected districts of Assam reported by Pariat *et al.* (2020) [18] using iELISA was attributed to preferential sampling in districts where clinical goatpox was reported.

A cross-sectional seroprevalence study by Adedeji *et al.* (2021) [1] elucidated the household animal factors operating in high-risk areas in northern Nigeria using a multi-stage sampling method. The apparent weighted seroprevalence was 2 percent ($N = 1800$) using a commercial iELISA kit. They also opined that iELISA detects antibodies against specific immunogenic capripoxvirus (CaPV) antigens, whereas VNT detects antibodies with the ability to neutralize CaPV and is more sensitive than iELISA.

However, Fenti *et al.* (2017) attributed the higher seroprevalence of 15.5 percent of SGP detected using VNT to its greater sensitivity. Whereas, Sajid *et al.* (2012) [20] reported an SGP prevalence of 5.67 percent in Punjab based on the observation of typical pox lesions on the body and internal organs of carcasses.

The seroprevalence of 5.28 percent observed in our study of sheep and goatpox, based on samples collected from all 31 districts of Karnataka, aligns with moderate levels of exposure in the region.

The recombinant protein antigen-based iELISA used in the present study was found to have the advantage of minimal batch-to-batch variation in the antigen, besides obviating the need for maintenance of live virus strains. This finding is in agreement with Bowden *et al.* (2008) [7], who also reported

the superiority of recombinant protein antigen-based iELISA for the serodiagnosis of SGP.

Whereas, Babiuk *et al.* (2009) [3] opined that although VNT could detect seroconversion by both virulent and non-virulent strains, whole antigen-based iELISA detected seroconversion only by virulent strains. However, a recent study has shown that serum neutralization test (SNT) and iELISA can complement each other in measuring seroconversion and immune response against capripoxviruses (Bayyappa *et al.*, 2025) [5].

We found a significant difference in the seroprevalence of SGP among different divisions and districts of Karnataka, without any significant difference between species. The varied seroprevalence of 8.88 percent in sheep and 31.47 percent in goats reported by Hota *et al.* (2018) [10] in different agroclimatic zones of Odisha was found to be significant ($P < 0.05$) for goats but not for sheep. The higher seroprevalence was attributed to the lack of vaccination against SGP. Similar observations were also reported by Bhanuprakash *et al.* (2008), who documented a seroprevalence of 68.3 percent of SGP across northern states of India. Additionally, comorbid chronic diseases such as paratuberculosis may interfere with the outcome of other diseases in small ruminants (Reddy *et al.*, 2012) [19].

It can be concluded that these infections are endemic in Karnataka State. Therefore, control measures should be designed to reduce the occurrence of these infections through mass vaccination. There is also a need for frequent serosurveillance, epidemiological investigations, and molecular characterization of sheep and goatpox viruses.

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References

- Adedeji AJ, Ijoma SI, Atai RB, Dogonyaro BB, Adole JA, Maurice NA, *et al.* Household and animal factors associated with sheeppox and goatpox seroprevalence and identification of high-risk areas in selected states of northern Nigeria. *Prev Vet Med.* 2021;196:105473.
- Assefa A, Weilinda B, Abunna F. Isolation and characterization of pox virus circulating in sheep and goats from outbreak cases of Adea Berga district, West Shoa zone, Oromia, Ethiopia. *Int J Curr Res Acad Rev.* 2019;7(6):1-21.
- Babiuk S, Bowden TR, Parkyn G, Dalman B, Hoa DM, Long NT, *et al.* Yemen and Vietnam capripoxviruses demonstrate a distinct host preference for goats compared with sheep. *J Gen Virol.* 2009;90(1):105-114.
- Babu TS, Rathnamma D, Isloor SI, Chandranaik BM, Veeregowda BM, Reddy GM. Diagnosis of orf virus infection in sheep and goats by virus isolation, polymerase chain reaction and sequencing. *Indian J Anim Res.* 2018;52(1):176-187.
- Bayyappa MRG, Pabbineedi SM, Nagaraj S, Bijalwan S, Tadakod S, Uma CR, *et al.* Spatiotemporal epidemiology of lumpy skin disease and evaluation of

- the heterologous goatpox vaccine: insights into immunogenicity and impact. *Vaccines*. 2025;13(6):641.
6. Bora DP, Venkatesan G, Arya S, Pariat AO, Kumar A, Ingtipi S, *et al.* Molecular evidence and sequence analysis of goatpox virus isolates from Assam, India: an emerging viral disease of goats. *Proc Natl Acad Sci India B Biol Sci*. 2021;91(3):607-614.
 7. Bowden TR, Babiuk SL, Parkyn GR, Copps JS, Boyle DB. Capripoxvirus tissue tropism and shedding: a quantitative study in experimentally infected sheep and goats. *Virology*. 2008;371(2):380-393.
 8. Dubie T, Dagnew B, Hamid M, Bizuayehu F, Fentahun G. Seroprevalence and associated risk factors of pox infection among sheep and goats in selected districts of Afar region, Ethiopia. *Heliyon*. 2022;8(12).
 9. Elshafie IE, Ali AS. Participatory epizootiological approaches and seroprevalence of sheep pox in selected localities in Kassala State, Sudan. *J Vet Res*. 2008;23:47-58.
 10. Hota A, Biswal S, Sahoo N, Venkatesan G, Arya S, Kumar A, *et al.* Seroprevalence of capripoxvirus infection in sheep and goats among different agro-climatic zones of Odisha, India. *Vet World*. 2018.
 11. Hurisa TT, Jing Z, Jia H, Chen G, He XB. A review on sheeppox and goatpox: insight of epidemiology, diagnosis, treatment and control measures in Ethiopia. *J Infect Dis Epidemiol*. 2018;4:057.
 12. Kassa F, Fesseha H, Mathewos M, Getachew S, Hundessa N, Aliye S, *et al.* Seroprevalence and risk factors of sheep and goat pox virus in selected districts of Wolaita zone, southern Ethiopia. *J Vet Sci*. 2024;25(4):e57.
 13. Manjunatha Reddy GB, Krishnappa VK, Siddalingaiah CD, Rao S, Nayakvadi S, Harlipura Basavarajappa CK, *et al.* Epidemiological, pathological, and molecular studies on sheeppox disease outbreaks in Karnataka, India. *Microorganisms*. 2024;12(7):1373.
 14. Manjunatha Reddy GB, Sumana K, Apsana R, Yogisharadhya R, Prajapati A, Patil SS, *et al.* Investigation of malignant form of sheeppox outbreak in fattening lambs in Mandya, Karnataka. *Indian J Vet Pathol*. 2017;41(3):184-188.
 15. Manjunatha Reddy GB, Sumana K, Srinivasbabu JY, Balamurugan V, Hemadri, Patil SS, *et al.* Pathological and molecular characterization of capripox virus outbreak in sheep and goats in Karnataka. *Indian J Vet Pathol*. 2015;39(1):11-14.
 16. Manjunatha Reddy GB, Sumana K, Yogisharadhya R, Mohan HV, Lavanya VK, Chethankumar BH, *et al.* Structural and sequence analysis of the RPO30 gene of sheeppox and goatpox viruses from India. *Vet Q*. 2023;44(1):1-12.
 17. Manjunatha Reddy GB, Sudeep N, Apsana R, Sumana K, Sai Mounica P, Yogisharadhya R, *et al.* Development and validation of recombinant A27L-based indirect ELISA for sheeppox and goatpox disease in India. *Vet Res Commun*. 2025;49(2):90.
 18. Pariat AO, Bora DP, Panda SP, Ingtipi S, Dutta LJ, Barman NN. Seroprevalence of goatpox in Assam. *Int J Curr Microbiol Appl Sci*. 2020;9(5):2726-2733.
 19. Reddy GB, Shivasharanappa N, Mishra AK, Paul S, Sharma DK. Pathology of naturally occurring paratuberculosis in caprine. *Indian J Vet Pathol*. 2012;36(2):221-223.
 20. Sajid AC, Sadique U, Maqbol A, Anjum AA, Qureshi MS, Hassan ZU, *et al.* Prevalence of goatpox disease in Punjab province of Pakistan. *J Anim Plant Sci*. 2012;22(Suppl 2):28-32.
 21. Sumana K, Revanaiah Y, Apsana R, Roy P, Reddy GM. Molecular characterization of sheeppox virus from outbreaks in Karnataka, India. *Vet World*. 2020;13(2):386-391.
 22. Sumana K, Yogisharadhya R, Sathish BS, Dipti M, Apsana R, Saminathan M, *et al.* Molecular phylogeny of capripoxviruses based on major immunodominant protein (P32) reveals circulation of host-specific sheeppox and goatpox viruses in small ruminants of India. *Infect Genet Evol*. 2020;85:104472.