Veterinary Letters
ISSN 2581-2416
DOI: https://dx.doi.org/10.29244/avl.10.2.31-32
https://journal.ipb.ac.id/index.php/arshivetlett

Ultrasonographic gestational dating in small ruminants with unknown mating dates: A breed-aware and phase-specific review†

Mokhamad Fakhrul Ulum[1], Nur Afiqah Mohamad Letfee[2,3], Adelaide José Pereira Cristovao[4]

[1] Division of Reproduction and Obstetrics, School of Veterinary Medicine and Biomedical Sciences, IPB University, Bogor, Indonesia
[2] Department of Animal Science and Fishery, Faculty of Agricultural and Forestry Science, Universiti Putra Malaysia Sarawak, Malaysia
[3] Aliyah Rizq Farm, Desaru Integrated Cattle Farm, Johor, Malaysia
[4] Animal Health Department, Faculty of Agriculture, Universidade Nacional Timor Lorosa'e, Timor-Leste

ABSTRACT: Unknown mating dates weaken nutritional planning, vaccination scheduling, pregnancy grouping, and parturition surveillance in small-ruminant herds. This mini review synthesizes traceable ultrasonographic equations from multiple sheep and goat breeds into a phase-specific clinical framework. Crown-rump length is most useful early, whereas head, thoracic, orbital, and long-bone measurements dominate mid and late gestation. In Baluchi sheep, occipito-snout diameter and thoracic diameter at the last-rib junction showed R^2 values of 0.981 and 0.975. In Saanen goats, humerus length, heart area, and neck-to-snout distance reached R^2 values of 0.962, 0.956, and 0.953. A biparietal diameter of 20 mm predicts 56.4-58.7 days in sheep but 64.8 days in Pygmy goats; this 8.4-day discrepancy can misalign prepartum nutrition and vaccination. Therefore, a universal small-ruminant equation is clinically indefensible. Gestational age should use species- and breed-matched equations, two or three measurements, litter-size documentation, and a reported range rather than one precise day.

Keywords:
biparietal diameter, fetal biometry, gestational dating, reproductive ultrasonography, small ruminants

■ INTRODUCTION

Accurate gestational dating converts a positive pregnancy diagnosis into an actionable herd-management decision. In domestic sheep (*Ovis aries*) and goats (*Capra hircus*) with unknown mating dates, the estimate determines feeding intensity, grouping, vaccination timing, dry-off, referral, and the level of surveillance near parturition (Jones & Reed 2017). Real-time B-mode ultrasonography is suitable for field use (Kahn 2004), but its numerical output is often misused. A caliper value is not a species-neutral biological clock. Fetal size depends on species, breed, litter size, placental capacity, plane selection, probe frequency, and operator technique. This review argues for a disciplined alternative: select the measurement by gestational phase, apply an equation validated in the closest population, and triangulate the result with additional independent parameters.

■ EVIDENCE SYNTHESIS

A targeted narrative review was completed using a reproductive ultrasonography textbook and primary peer-reviewed studies available through PubMed and journal databases. Studies were retained when the species or breed,

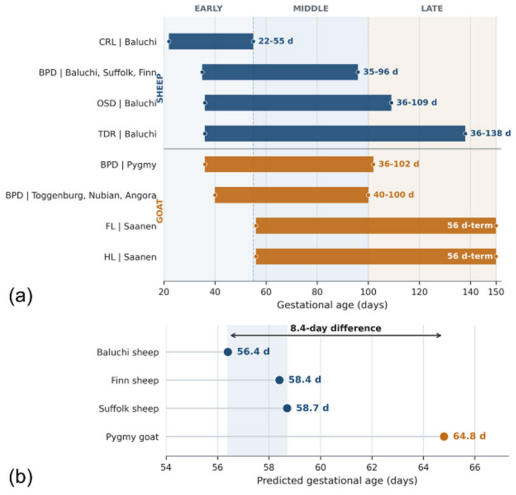

Figure 1. Breed- and phase-specific ultrasonographic dating. (A) Reported measurement windows. (B) At BPD 20 mm, estimates differ by 8.4 days between Baluchi sheep (Ardakani et al., 2022) and Pygmy goats (Reichle and Haibel, 1991), refuting a universal equation.

Received: 02-02-2026 | **Revised:** 06-03-2026 | **Accepted:** 11-03-2026

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measurement definition, unit, gestational window, and regression model or diagnostic performance were traceable.

Tabel S1 shows the ovine synthesis included Baluchi sheep (Ardakani *et al.* 2022), Suffolk and Finn sheep (Haibel & Perkins, 1989), Manchega sheep (de Bulnes *et al.* 1998), and Suffolk-Hampshire or mixed-ewe data (Doize *et al.* 1997). The caprine synthesis included Toggenburg, Nubian, and Angora goats (Haibel *et al.* 1989), Pygmy goats (Reichle & Haibel, 1991), Egyptian native goats (Karen *et al.* 2009), and Saanen goats evaluated using long-bone biometry (Rihab *et al.* 2012) or multiparametric ecobiometry (Del'Aguila-Silva *et al.* 2021).

Equations were interpreted only within their reported measurement windows. Prediction-error metrics were transcribed exactly as reported; mean residual, mean absolute error, root mean squared error, and validation accuracy were not treated as interchangeable. One cross-study calculation compared predicted age at a BPD of 20 mm; it was used to expose model disagreement, not to create a pooled equation.

■ MEASUREMENT HIERARCHY BY GESTATIONAL PHASE

Early pregnancy: Gestational-sac measurements confirm pregnancy but are weak dating tools. CRL is preferred once the embryo is visible longitudinally, remaining reliable at 22–55 days in Baluchi sheep (Ardakani *et al.* 2022) and until fetal flexion limits measurement in goats (Karen *et al.* 2009).

Middle gestation: BPD is practical but requires breed-specific equations for Suffolk and Finn sheep (Haibel and Perkins, 1989), larger goat breeds (Haibel *et al.* 1989), and Pygmy goats (Reichle & Haibel 1991). When head access is poor, OSD and TDR are strong alternatives, with R^2 >0.97 in Baluchi sheep (Ardakani *et al.* 2022).

Late gestation: Long-bone, thoracic, renal, and cardiac measurements should supplement head biometry. Femur and humerus lengths each explained 95% of age variation (Rihab *et al.* 2012), while humerus length, heart area, and neck-to-snout distance outperformed placentome and fetal-heart measurements (Del'Aguila-Silva *et al.* 2021).

■ WHY UNIVERSAL POOLING FAILS

The same BPD cannot be assigned the same age across small ruminants. At 20 mm, the Baluchi equation predicts 56.4 days (Ardakani *et al.* 2022), whereas the Suffolk and Finn equations predict 58.7 and 58.4 days (Haibel & Perkins, 1989). The Pygmy-goat equation predicts 64.8 days (Reichle & Haibel 1991). Within goats, breed-specific BPD equations diverged progressively and differed by approximately 6 days by the end of the studied interval (Haibel *et al.* 1989). These are management-relevant errors, particularly when vaccination, nutritional escalation, or kidding surveillance is scheduled against an estimated due date. Pooling raw equations across species would conceal this structure and generate narrow-looking but biologically false confidence. A general framework is valid; a universal regression is not.

■ CONCLUSION

Gestational dating should combine two or three breed-matched measurements: CRL early, BPD or cranio-thoracic biometry mid gestation, and thoracic or long-bone measurements later. A universal equation is indefensible.

■ ASSOCIATED CONTENT

Supporting Information

†The high-value ultrasonographic models for dating sheep and goat pregnancies was submitted in PDF form as supporting information.

Abbreviation

GA, gestational age; BPD, biparietal diameter; CRL, crown-rump length; FL, femur length; HL, humerus length; OSD, occipito-snout diameter; TDR, thoracic diameter at the last-rib junction

■ AUTHOR INFORMATION

Corresponding Author

*MFU: ulum@apps.ipb.ac.id

Division of Reproduction and Obstetrics, School of Veterinary Medicine and Biomedical Sciences, IPB University, Bogor, INDONESIA.

■ AI DECLARATIONS

The author used OpenAI ChatGPT (GPT-5) for initial drafting, language editing, document formatting, and arithmetic verification.

■ REFERENCES

Ardakani MS, Toosi BK, Azizzadeh M, Rajabioun M. 2022. Estimation of gestational age using ultrasonography in Baluchi sheep. Veterinary Research Forum. 13(2):257-263.

De Bulnes AG, Moreno JS, Sebastián AL. 1998. Estimation of fetal development in Manchega dairy ewes by transrectal ultrasonographic measurements. Small Ruminant Research. 27(3):243-250.

Del'Aguila-Silva P, Dos Santos FC, Santos VJ, Simões AP, Uscategui RA, Padilha-Nakaghi LC, Amoroso L, Vicente WR, Feliciano MA. 2021. B-mode ultrasound and ecobiometric parameters to assess embryonic and fetal development and estimate gestational age in goats. Theriogenology. 175:123-133.

Doize F, Vaillancourt D, Carabin H, Belanger D. 1997. Determination of gestational age in sheep and goats using transrectal ultrasonographic measurement of placentomes. Theriogenology. 48(3):449-460.

Haibel GK, Perkins NR, Lidl GM. 1989. Breed differences in biparietal diameters of second trimester Toggenburg, Nubian and Angora goat fetuses. Theriogenology. 32(5):827-834.

Haibel GK, Perkins NR. 1989. Real-time ultrasonic biparietal diameter of second trimester Suffolk and Finn sheep fetuses and prediction of gestational age. Theriogenology. 32(5):863-869.

Jones AK, Reed SA. 2017. Benefits of ultrasound scanning during gestation in the small ruminant. Small Ruminant Research. 149:163-171.

Kahn W. 2004. Veterinary Reproductive Ultrasonography. Hannover: Schlutersche.

Karen AM, Fattouh ESM, Abu-Zeid SS. 2009. Estimation of gestational age in Egyptian native goats by ultrasonographic fetometry. Animal Reproduction Science. 114(1-3):167-174.

Reichle JK, Haibel GK. 1991. Ultrasonic biparietal diameter of second trimester Pygmy goat fetuses. Theriogenology. 35(4):689-694.

Rihab MA, Bushra HA, Salah MA, Mohamed TI. 2012. The accuracy of gestational age predicted from femur and humerus length in Saanen goats using ultrasonography. Acta Veterinaria Brno. 81:295-299.