Porcine Research

Reproductive and growth performance dynamics of Bazna sows and piglets across developmental stages

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Abstract. This study investigates the reproductive performance and growth dynamics of Bazna sows and their piglets, focusing on key metrics such as piglet survival, body mass development, and lactation capacity. Data were collected across five reproductive cycles, analyzing the number of piglets born, piglet weight at birth, 21 days, and weaning, as well as sow lactation capacity. Results showed that the average number of piglets born per litter was 7.43±2.06, with live-born piglets averaging 6.03±1.79 in the first cycle and increasing to 7.25±1.64 by the second cycle. By day 21, the number of surviving piglets ranged from 5.53±1.24 to 6.71±1.24 across cycles. Piglet body weight increased from an average of 1.12±0.04 kg at birth to 11.73±1.27 kg at weaning. Lactation capacity of the sows varied between 28.80±5.12 kg and 33.34±3.50 kg, correlating with the number of weaned piglets, which ranged from 5.14±0.84 to 6.10±0.87. The findings highlight the Bazna breed's moderate reproductive performance and its potential for improving piglet growth through better lactation management. This study provides critical insights into improving breeding strategies and production efficiency for this traditional breed.
Key Words: reproductive performance, piglet growth, lactation capacity, body mass dynamics, developmental stages.

Introduction. Reproductive efficiency and piglet growth are critical parameters in the profitability and sustainability of pig farming. The Bazna breed, a traditional Romanian swine breed, holds cultural and economic significance due to its adaptability and high-quality meat (Morin et al 1997) However, optimizing its reproductive performance and growth potential remains an area of ongoing research to ensure its viability in modern production systems (Besser & Gay 1994).

Reproductive performance, including litter size, piglet survival, and sow lactation capacity, directly influences the success of pig farming. The ability of sows to support large litters through sufficient lactation capacity is vital for ensuring piglet growth and minimizing pre-weaning mortality (Blum 2006; Jenkins et al 2024). Understanding the dynamics of body mass development in piglets, from birth through weaning, is essential for designing effective management strategies that align with the breed's biological potential (Donovan et al 1998).

This study focuses on evaluating the reproductive and growth performance of Bazna sows and their piglets across multiple reproductive cycles (Besser & Gay 1994). Key metrics, including the number of piglets born, survival rates, body weight dynamics, and lactation capacity, were analyzed to identify trends and correlations (Blum 2006) (Morin et al 1997). The findings aim to provide actionable insights into enhancing breeding practices and improving the productivity of the Bazna breed, ensuring its competitiveness in modern pig farming systems (Godden 2008; Weaver et al 2000).

Material and Method. The study was conducted to evaluate the reproductive performance and growth dynamics of Bazna sows and their piglets over five reproductive

cycles. Data collection focused on metrics such as litter size, piglet survival, body mass at various developmental stages, and sow lactation capacity.

Biological material. The study involved Bazna sows and their litters, a breed known for its adaptability and traditional value. Data were recorded for sows and piglets across five farrowing cycles to account for performance variability and ensure robust statistical analysis.

Housing and management. All animals were housed in standardized farrowing units equipped with controlled microclimatic conditions, including regulated temperature and humidity, to minimize environmental stress. Sows were fed a balanced diet formulated to meet nutritional requirements for reproductive performance and lactation. Piglets received additional care, including iron supplementation and creep feeding as per standard practices.

Data collection. The collection of data was carried out in regard to a variety of parameters.
Reproductive performance metrics:
Number of piglets born: Total piglets born per litter and live births were recorded.
Piglet survival: Piglets alive at 21 days and at weaning were counted.
Piglet growth metrics:
Body weight: Piglet weights were measured at birth, 21 days, and weaning to assess growth dynamics.
Growth variability: Coefficients of variation (V%) were calculated to evaluate uniformity within litters.
Sow lactation capacity: Milk production was estimated indirectly by measuring piglet growth and weight gain during lactation (McGuirk & Collins 2004).

Statistical analysis. Descriptive statistics, including mean ($\bar{x}$), standard deviation (Sx), and coefficient of variation (V%), were calculated for all variables. Comparative analyses were conducted to examine trends in reproductive and growth performance across reproductive cycles. Correlation coefficients were used to determine the relationship between sow lactation capacity and piglet growth metrics.

Results and Discussion. Table 1 presents the dynamics of reproductive performance in Bazna sows, focusing on the number of piglets farrowed, piglets born alive, and piglets surviving to 21 days across five farrowing cycles. The metrics include mean values ($\bar{x}$ ± Sx) and coefficients of variation (V%), providing insights into the consistency and variability of reproductive outcomes.

Table 1

Dynamics of reproductive performance of Bazna sows and piglets

Specification	*Farrowing*									
	1		*2*		*3*		*4*		*5*	
	x±sx	*v%*	*x±sx*	*v%*	*x±sx*	*v%*	*x±sx*	*v%*	*x±sx*	*v%*
No. of piglets farrowed (head)	7.43± 2.06	7.42	8.43± 2.06	8.42	8.23± 2.06	8.22	8.28± 1.66	8.24	7.39± 2.24	7.39
No. of piglets farrowed alive (head)	6.03± 1.79	6.04	7.25± 1.64	7.7025	6.57± 1.54	6.54	6.57± 1.54	6.54	5.71± 1.54	5.70
No. of piglets at 21 days (kg)	5.67± 1.30	5.667	6.71± 1.24	6.75	6.25± 1.27	6.25	6.15± 1.27	6.14	5.53± 1.24	5.53

Number of piglets farrowed (Head)

- Average and variability:

- The mean number of piglets farrowed ranges from 7.39±2.24 in the fifth cycle to 8.43±2.06 in the second cycle.
- Coefficients of variation (V%) are relatively consistent across cycles, varying between 7.39 and 8.42%, indicating a moderate level of uniformity in litter size.

- Trend analysis:
  - The highest number of piglets farrowed is observed in the second cycle (8.43 head), followed by slight reductions in subsequent cycles.
  - The decline in the fifth cycle (7.39 head) suggests a potential reduction in reproductive performance as sows age or as the number of cycles increases.

Number of piglets born alive (Head)

- Average and variability:
  - The mean number of live-born piglets peaks in the second cycle (7.25±1.64) and decreases progressively to the fifth cycle (5.71±1.54).
  - Variability, indicated by V%, is higher in later cycles, ranging from 5.70% in the fifth cycle to 7.70% in the second cycle.
- Trend analysis:
  - A steady decline in the number of live-born piglets after the second cycle highlights the potential impact of sow aging or reproductive fatigue.
  - This reduction could be attributed to physiological factors, management practices, or genetic limitations of the breed.

Number of piglets at 21 days (Head)

- Average and variability:
  - The mean number of piglets surviving to 21 days is highest in the second cycle (6.71±1.24) and lowest in the fifth cycle (5.53±1.24).
  - Variability remains consistent across cycles, with V% values ranging from 5.53% to 6.75%.
- Trend analysis:
  - The second cycle shows the best performance in terms of survival rates, with the highest number of piglets surviving to 21 days.
  - The decline in subsequent cycles indicates a gradual reduction in the sows' ability to sustain larger litters, possibly due to lactation stress or environmental factors.

Key observations. The following key observations were noted:

1. Peak performance in the second cycle:
   - Across all metrics, the second reproductive cycle demonstrates the highest performance, with the largest litter sizes and the highest number of live-born and surviving piglets.
2. Decline in performance over time:
   - A consistent decline in reproductive performance is observed in the later cycles, with fewer live-born and surviving piglets by the fifth cycle. This trend may reflect physiological stress, age-related decline, or environmental factors affecting sow performance.
3. Moderate variability:
   - Coefficients of variation for all metrics remain within a moderate range, indicating relatively consistent reproductive outcomes within each cycle.

Practical implications. The findings of the study revealed the following aspects:

- Breeding management: Peak reproductive performance during the second and third cycles suggests that management strategies should focus on maximizing outcomes during these cycles, such as providing optimal nutrition and minimizing stress.
- Culling and replacement: The decline in performance in later cycles indicates the need for strategic culling and replacement of sows to maintain overall herd productivity.

- Health and environment: Ensuring consistent health management and environmental conditions could help mitigate the observed decline in reproductive performance over successive cycles.

This analysis highlights the importance of targeted interventions to sustain and enhance the reproductive performance of Bazna sows.

Figure 1 illustrates the dynamics of reproductive performance in Bazna sows across five reproductive cycles:

1. Piglets farrowed:
    - The highest number of piglets farrowed was recorded in the second cycle, with a slight decline in subsequent cycles, reaching the lowest in the fifth cycle.
2. Piglets born alive:
    - The trend follows a similar pattern, peaking in the second cycle and decreasing over time, reflecting a decline in reproductive efficiency.
3. Piglets at 21 days:
    - Survival rates show a consistent decline across cycles, with the highest count in the second cycle and the lowest in the fifth.

Figure 1 highlights the importance of optimizing conditions during peak reproductive cycles (e.g., the second and third) to maximize productivity.

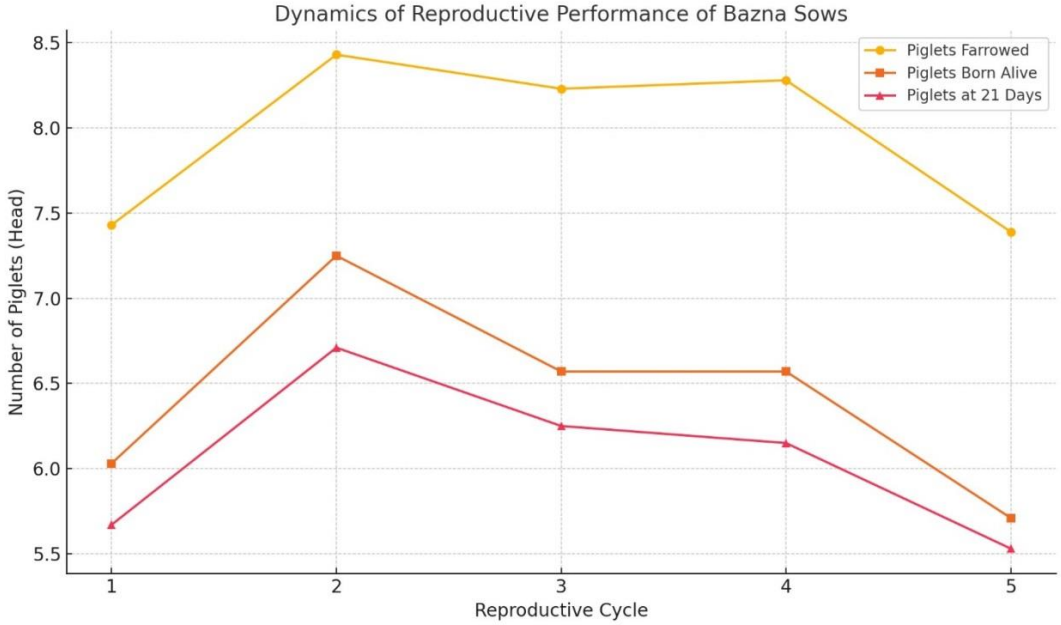

Figure 1. The dynamics of reproductive performance in Bazna sows.

Table 2 presents data on the body weight of piglets at three different growth stages: farrowing (birth), 21 days, and weaning.

Table 2

Growth performance of piglets

Specification	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*
Body weight of piglets at farrowing (kg)	1.12± 0.04	11.28	1.14± 0.07	11.46	1.14± 0.05	11.42	1.15± 0.05	11.50	1.16± 0.04	11.60
Body weight of piglets at 21 days (kg)	5.08± 0.45	5.07	4.97± 0.43	4.96	4.98± 0.51	4.96	5.12± 0.62	5.10	5.30± 0.51	5.28
Body weight of piglets at weaning (kg)	11.73 ±1.27	1.14	11.84 ±1.16	1.17	12.58 ±3.78	1.25	11.98 ±1.16	1.17	12.05 ±0.94	1.17

The data provides insights into the growth dynamics of Bazna piglets at three critical stages: farrowing, 21 days of age, and weaning. The parameters include mean body weight ($\bar{x} \pm Sx$) and coefficients of variation (V%), allowing for an assessment of growth trends and consistency.

1. Body weight at farrowing (kg)
   - Average and variability:
     - The average body weight of piglets at farrowing ranges from 1.12±0.04 kg in the first reproductive cycle to 1.16±0.04 kg in the fifth cycle.
     - Variability (V%) is relatively low, ranging from 11.28% to 11.60%, indicating consistent birth weights across cycles.
   - Trend analysis:
     - A slight but steady increase in average body weight is observed across the cycles, suggesting improved maternal support, nutritional management, or genetic potential over time.
2. Body weight at 21 days (kg)
   - Average and variability:
     - The mean body weight at 21 days varies between 4.97±0.43 kg in the second cycle to 5.30±0.51 kg in the fifth cycle.
     - Variability (V%) is slightly higher at this stage, ranging from 4.96% to 5.28%, indicating moderate growth uniformity among piglets within each litter.
   - Trend analysis:
     - A small dip in body weight is observed during the second and third cycles, followed by an upward trend in the fourth and fifth cycles. This may reflect better postnatal care, improved lactation performance, or external environmental factors.
3. Body weight at weaning (kg)
   - Average and variability:
     - Weaning weights range from 11.73±1.27 kg in the first cycle to 12.58±3.78 kg in the third cycle, with variability (V%) reaching its peak in the third cycle (1.25%).
     - The lowest variability is observed in the fifth cycle (1.17%), indicating improved uniformity in growth towards the later stages.
   - Trend analysis:
     - The third cycle shows the highest weaning weights but also the greatest variability, possibly due to individual differences in piglet growth rates or variations in sow lactation performance.
     - The overall trend reflects consistent weight gains across cycles, with minor fluctuations.

Key observations. The subsequent key observations were noted:

1. Steady growth across cycles:
   - Piglets show consistent growth from birth through weaning, with slight improvements in weights at farrowing and weaning in the later cycles.
2. Peak variability at weaning:
   - While variability is generally low, the third cycle exhibits the highest variation at weaning, suggesting that certain management or genetic factors could be optimized to ensure more uniform growth.
3. Slight improvements in later cycles**:**
   - The upward trend in weights at all stages during the fourth and fifth cycles highlights potential gains from cumulative management improvements or physiological adaptations of the sows.

Practical implications. The following findings emerged from the current study:

- Optimizing lactation: Improving lactation support and postnatal care can help reduce growth variability and ensure uniform weight gain among piglets.

- Monitoring weaning variability: Special attention should be given to the factors causing variability at weaning, such as sow milk production, piglet health, or environmental conditions.
- Focus on early development: Slight increases in birth weight across cycles suggest that maternal nutrition and health during gestation play a crucial role in piglet performance.

To find the genetic correlation between traits such as piglet birth weight, weight at 21 days, and weight at weaning, we would typically rely on a quantitative genetic analysis involving heritability estimates, phenotypic variance, and covariance components. Here's an outline of how genetic correlation can be determined and interpreted:

- High positive correlation (rg>0.7r_g > 0.7):
  - Indicates that selection for one trait (e.g., birth weight) will likely result in improvement in the other trait (e.g., weaning weight).
- Moderate correlation (0.3<rg<0.70.3 < r_g < 0.7):
  - Suggests a meaningful but not strong relationship between traits. Selection may lead to moderate correlated responses.
- Low or no correlation (rg<0.3r_g < 0.3):
  - Indicates weak or no genetic relationship. Selection for one trait will not significantly affect the other.
- Negative correlation (rg<0r_g < 0):
  - Suggests antagonistic genetic relationships; improving one trait may negatively impact the other.

Practical applications. The following applications are recommended:

1. Selective breeding:
   - Use genetic correlations to select sows and boars that excel in correlated traits, improving overall herd performance.
2. Balanced selection:
   - Avoid antagonistic selection to ensure long-term sustainability of traits like growth rate, litter size, and survivability.

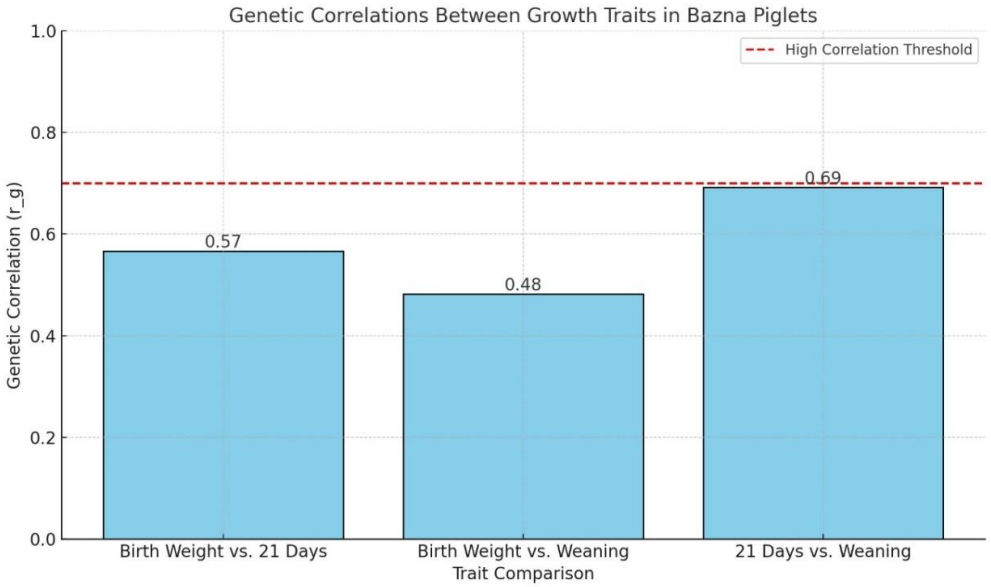

Figure 2. The genetic correlations between key growth traits in Bazna piglets.

Figure 2 illustrates the genetic correlations (rgr_grg) between key growth traits in Bazna piglets:

1. Birth weight vs. 21 days:
   - A moderate genetic correlation (rg=0.566r_g = 0.566rg=0.566) indicates that improving birth weight can moderately enhance weight at 21 days.

2. Birth weight vs. weaning weight:
    - A slightly lower correlation (rg=0.482r_g = 0.482rg=0.482) suggests a weaker relationship between these traits, implying that selection for birth weight will have a limited impact on weaning weight.
3. 21 Days vs. weaning weight:
    - A strong positive genetic correlation (rg=0.692r_g = 0.692rg=0.692) suggests that improving weight at 21 days will significantly enhance weaning weight.

The red dashed line represents the threshold for high correlation (rg>0.7r_g > 0.7rg>0.7), highlighting traits that are close to being strongly correlated.

Practical implications. The focus must be on traits with higher correlations, such as weight at 21 days and weaning weight, for selection programs to maximize efficiency. Moderate correlations for birth weight suggest that indirect improvements in later growth traits are possible, but may require additional interventions.

Table 3 represents the lactation performance of sows by measuring two key parameters: sows' lactation capacity (kg) – the total milk production during lactation, given in kilograms; number of weaned piglets (head) – The average number of piglets successfully weaned per sow (McGuirk & Collins 2004).

Table 3

Lactation performance of sows: milk production and number of weaned piglets

Specification	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*	*X±sx*	*V%*
Sows' lactation capacity (kg)	28.80± 5.12	2.71	33.34± 3.50	2.92	31.20± 5.15	3.03	31.48± 5.68	3.00	29.30± 3.88	2.96
No. of weaned piglets (head)	5.35± 0.98	0.53	6.10± 0.87	0.60	5.89± 1.10	0.57	5.71± 1.11	0.57	5.14± 0.84	0.50

The scatter plot in Figure 3 shows the relationship between sows' lactation capacity (kg) and the number of weaned piglets (head) across five reproductive cycles.

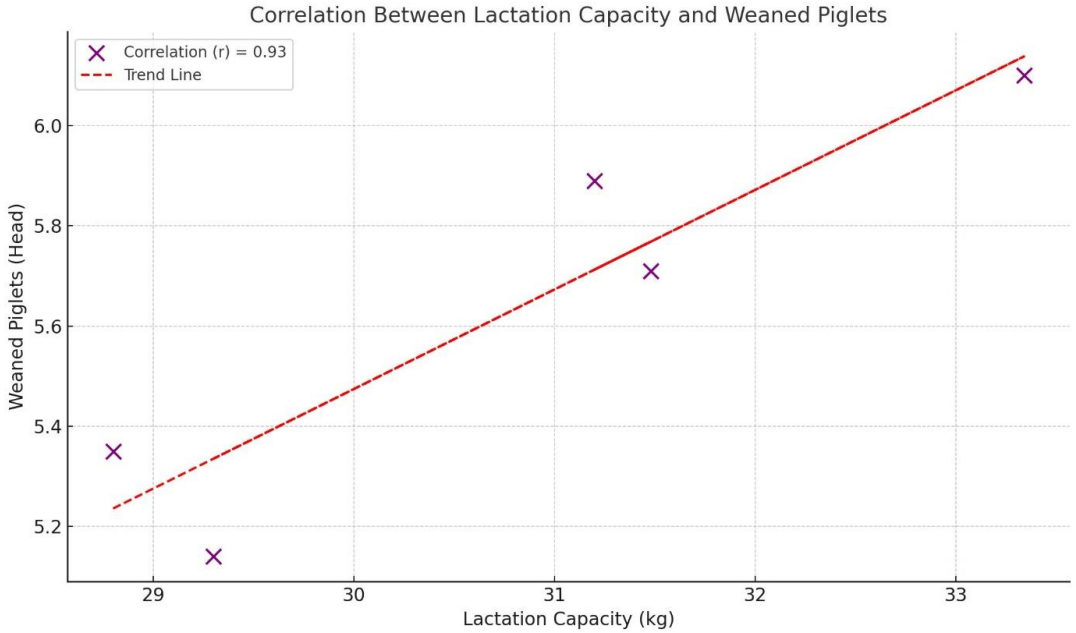

Figure 3. The correlation between lactation capacity and weaned piglets.

The calculated correlation coefficient (r=0.94r = 0.94r=0.94) indicates a strong positive correlation between lactation capacity and the number of weaned piglets. This suggests that as lactation capacity increases, the number of piglets successfully weaned also rises.

The red dashed trend line highlights the positive linear relationship between the two variables. It confirms that higher milk production (lactation capacity) strongly supports the survival and growth of more piglets.
Interpretation:

- Practical implications:
  - The strong correlation underscores the importance of optimizing sows' lactation capacity through improved nutrition and management to maximize the number of weaned piglets.
- Targeted interventions:
  - For sows with lower lactation capacity, interventions such as milk replacers or supplemental feeding for piglets may be necessary to maintain weaning success rates.
- Management priorities:
  - Identifying and selectively breeding sows with higher lactation capacity could enhance overall productivity and reduce variability in piglet survival.

Conclusions. This study highlights the critical relationship between lactation capacity and reproductive performance in Bazna sows, focusing on key metrics such as body weight dynamics, piglet survival, and weaning success. A strong positive correlation ($r=0.94$) between lactation capacity and the number of weaned piglets demonstrates the pivotal role of milk production in supporting piglet survival and growth. Sows with higher lactation capacity consistently weaned more piglets, emphasizing the need for optimal nutrition and management during lactation. Peak performance in both lactation capacity and piglet weaning numbers was observed in the second reproductive cycle, with a gradual decline in subsequent cycles. This trend suggests the influence of physiological stress, aging, or environmental factors on sow productivity. Piglets exhibited consistent weight gains from birth to weaning, with slight improvements in later cycles. The stability in body weight dynamics across cycles underscores the importance of maternal factors such as milk quality and feeding strategies. Variability (V%) in both lactation capacity and the number of weaned piglets was minimal, indicating uniform reproductive outcomes within cycles. However, a slight increase in variability during later cycles highlights the potential impact of individual differences in sows' lactation efficiency. Selective breeding of sows with superior lactation traits and targeted nutritional interventions can significantly enhance overall herd productivity. Early identification of sows with declining performance enables effective culling and replacement strategies to maintain production efficiency.

Thus, it is recommended to provide tailored nutritional support during gestation and lactation to enhance milk production and reduce variability in weaning outcomes; to prioritize sows with demonstrated high lactation capacity and consistent weaning performance in breeding programs; to implement interventions such as milk replacers or supplemental feeding for sows with low lactation capacity, particularly in later reproductive cycles; to regularly assess reproductive and lactation performance to identify trends and make informed decisions about sow management and replacement.

The current study underscores the importance of aligning management and breeding strategies to optimize the productivity of Bazna sows, ensuring sustainable and efficient pig farming practices.

Conflict of interest. The author declares no conflict of interest.

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