



# Weight Variation Trends in Juvenile and Adult Male Pair Housed New Zealand White Rabbits (*Oryctolagus cuniculus*)



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## Background

- New Zealand White (NZW) rabbits (*Oryctolagus cuniculus*) are a social species, and per regulatory and welfare standards<sup>1</sup>, should be housed in groups or pairs whenever possible.
- There is little information regarding pair housing male rabbits.
- In addition to aggression concerns with socially housing male rabbits, there is also the possibility of food hoarding by the dominant rabbit, preventing the subordinate rabbit(s) adequate access to necessary resources thus confounding longitudinal age-weight matched studies.
- To ensure that the socially housed rabbits in our large transgenic colony are receiving sufficient nourishment, we performed a preliminary evaluation of weight trends in addition to Body Condition Scores (BCS) of pair housed juvenile and adult male rabbits.
- It was hypothesized that stable pairs would have weights comparable to age matched single housed rabbits and the BCS would not vary more than 1 on a 1-5 BCS scale.

## Materials & Methods

We compared the body weight and BCS of male, single and pair housed, age matched, NZW transgenic rabbits. Body weight(kg) was collected using a portable scale (Ultrababy Scale, My Weight, Phoenix AZ). BCS was assessed following the characteristics of the Rabbit Size-O-Meter (Pet Food Manufacturers' Association, London, UK.)(Fig.1). A ration of ¼ cup LabDiet 5326 (LabDiet, St. Louis MO) chow and a handful of Western Timothy hay (Oxbow Animal Health, Omaha, NE) was provided daily per rabbit. All rabbits were monitored daily for inappetence and other health concerns. Pair housed rabbits were also assessed for behaviors indicating pair incompatibility. If pair housed rabbits varied by more than 1 BCS, were consistently losing weight, or varied more than 20% in body weight, this would qualify them for separation. All rabbits were housed in Allentown cages, and pair housed rabbits were provided double cages with the dividers removed (Allentown Inc., Allentown, NJ) Nontoxic Ketchum markers (Ketchum Manufacturing Inc., Brockville, ON) were used to create distinguishing marks on pair housed rabbits to assist with individual identification. Data was analyzed using an unpaired, nonparametric, Mann-Whitney test with GraphPad Prism (GraphPad Software, San Diego, CA).

The study was divided into three groups:

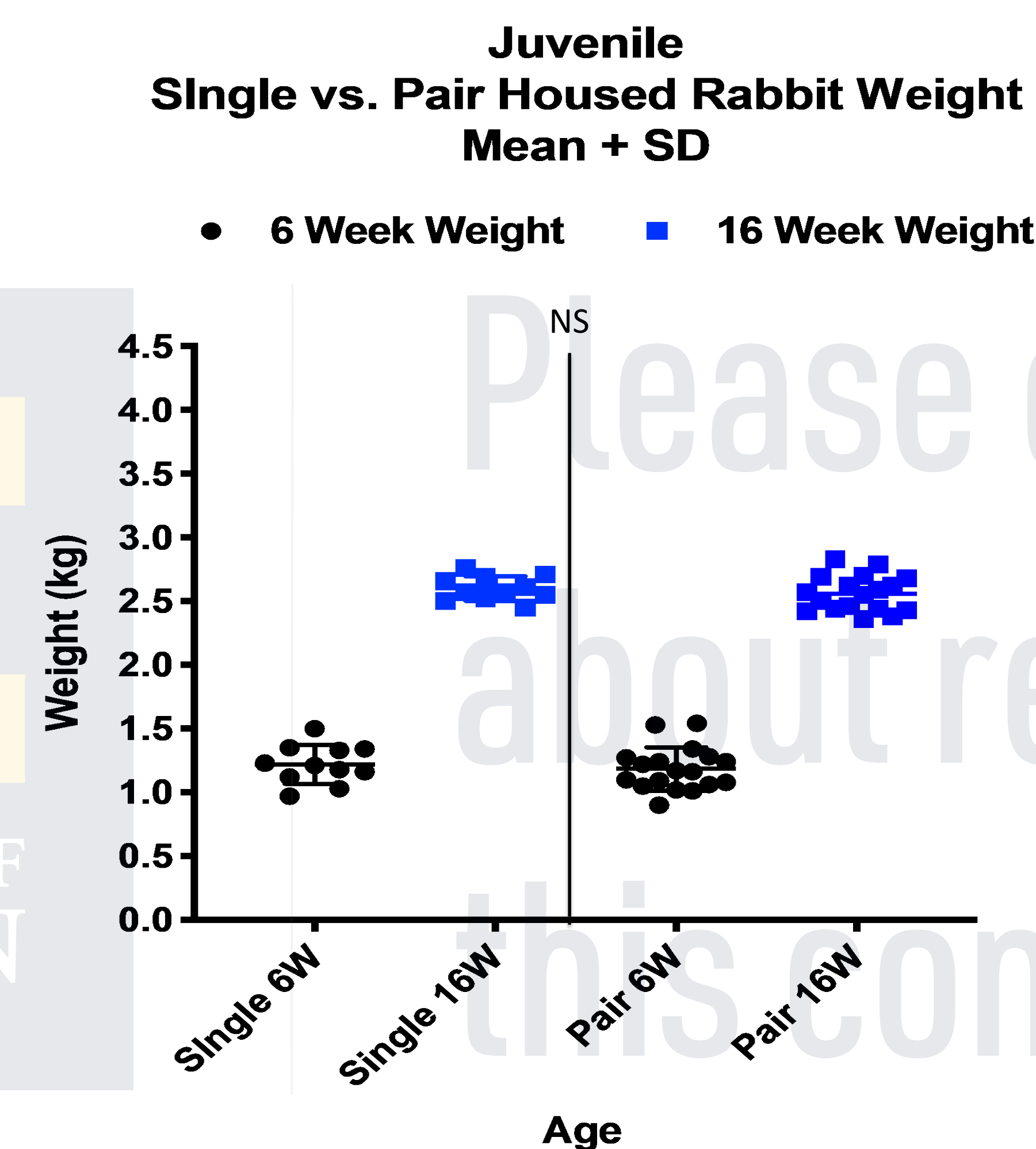
- **Juvenile males** - 12 single and 18 pair housed rabbits assessed at 6 weeks of age (weaning), and 16 weeks of age (sexual maturity).
- **10 month old males** - 4 single and 4 pair housed rabbits were assessed and compared at 6 weeks and 10 months of age.
- **12 month old males** - 2 single and 4 pair housed rabbits assessed every three months over a 9 month period.



Figure 1: Rabbit-Size-O-Meter (<https://www.pfma.org.uk/pet-size-o-meter>)

## Study Results

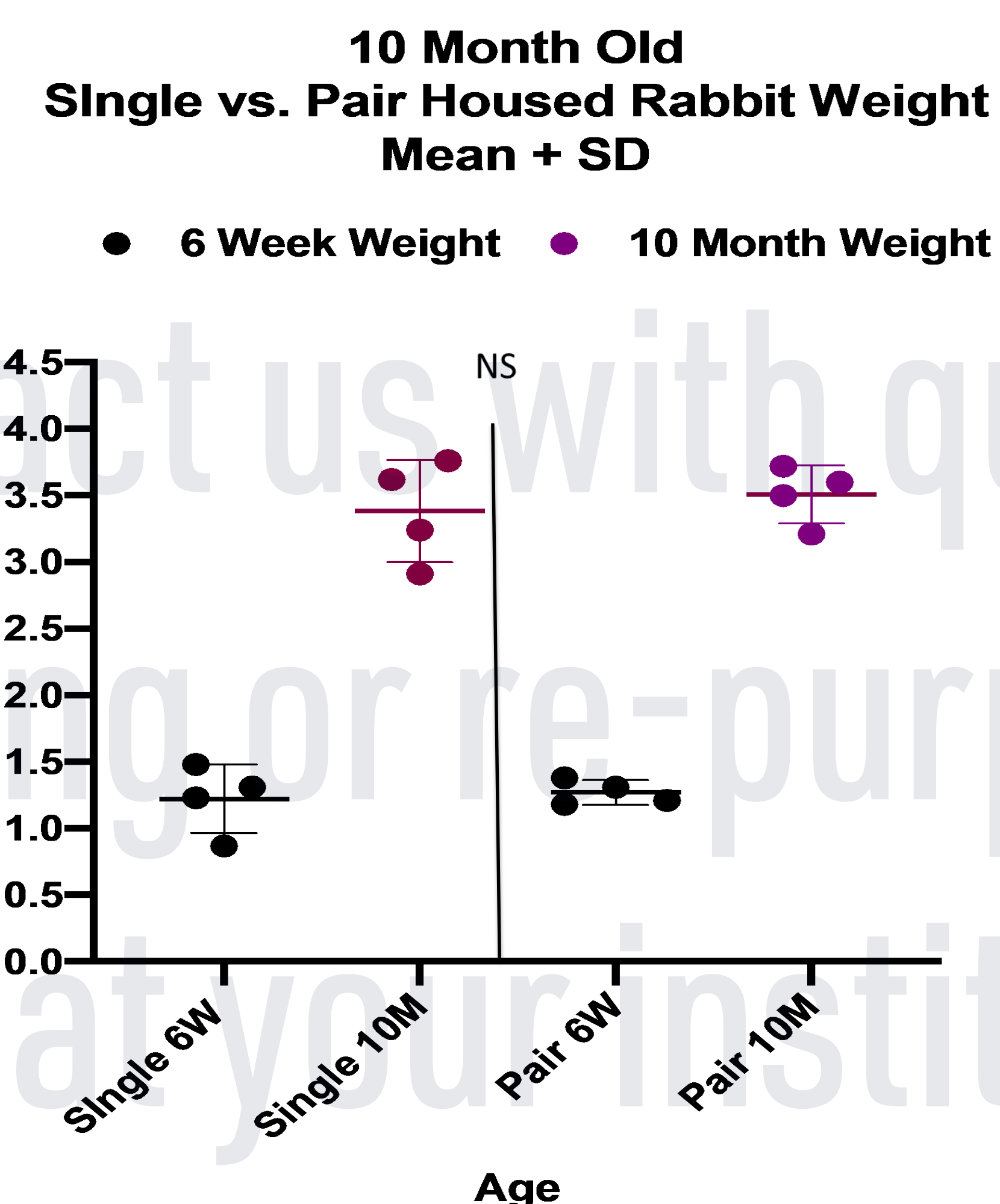
### Weight Results:



**Figure 2:** Single versus pair housed juvenile rabbits at 6 and 16 weeks of age. There was no significant weight difference between single (n= 11) and pair housed (n= 18) rabbits at weaning age (6 weeks) ( $P > 0.2$ ) or sexual maturity (16 weeks) ( $P > 0.3$ ). Single housed male rabbits experience an average of 113% gain in weight compared to an average of 117% weight gain in pair housed male rabbits between 6 and 16 weeks of age.

### 12 month old single verses paired housed rabbit weight data:

- There were no significant differences ( $P > 0.9$ ) in weight between adult and pair housed rabbits (n=4) or single housed (n=2) male rabbits over a 9-month period



**Figure 3:** Single versus pair housed rabbit weights at 10 months of age. There were no significant weight differences between adult single (n=4) and pair housed (n=4) rabbits at weaning age (6 weeks) ( $P > 0.5$ ) or 10 months ( $P > 0.3$ ) of age.

### BCS Results: The BCS for all animals was 3 +/- 1 score

16 week old rabbits	<ul style="list-style-type: none"><li>1 single and 1 pair housed rabbit had a score of 4</li><li>1 pair housed rabbit had a score of 2 (paired with a rabbit that had a BCS of 3)</li><li>The remaining 10 single and 16 pair housed rabbits had a BCS of 3</li></ul>
10 month old rabbits	<ul style="list-style-type: none"><li>1 pair housed rabbit had a BCS of 4</li><li>4 single housed and 3 pair housed rabbits had a BCS of 3</li></ul>
12 month old rabbits	<ul style="list-style-type: none"><li>1 single and 2 pair housed rabbits had a BCS of 2</li><li>1 single and 2 pair housed rabbits had a BCS of 3</li></ul> <p>The BCS remained consistent in these rabbits over the 9 month period</p>

## Study Conclusions

### Pair housing male rabbits does not lead to significant weight or body condition variation.

- No significant differences in weight were noted between single and pair housed rabbits at 6 weeks, 16 weeks, 10 months or over 12-18 months of age.
- The BCS of single and pair housed rabbits ranged from 2-4. The majority of all rabbits were a BCS of 3.
- The body condition of the older rabbits had the most variation regardless of pair housing status. 3/6 of the 12-month old rabbits had a BCS of 2 (one single housed rabbit and two rabbits from the same pair).
- During the physical evaluations of the rabbits, 2 single housed males and 3 pair housed males were noted to have stereotypies and/or minor signs of aggressive behavior including urine staining and minor superficial lesions. These rabbits were place on an increased enrichment program<sup>2</sup> and the pair housed rabbits remained together. The conditions improved or resolved for all of the noted single housed rabbits and pair housed rabbits.

## Discussion

Social housing male NZW laboratory rabbits is a highly debated topic due to concern that social hierarchy may confound research results. Aggressive behaviors, including food hoarding by the dominant rabbit, may lead to improper weight distribution and poor body conditions. A previous study using pair housed female NZW rabbits concluded feeding behavior, weight, and growth rates of dominant and subordinate rabbits were similar<sup>3</sup>, indicating social hierarchy did not interfere with the health status. In this study we have shown that stable male pairs gain and maintain body weight and composition similarly to single housed male rabbits. To ensure healthy animals and prevent compromising research, it is important to set up a routine process to assess the behavior, weight and body condition of all NZW rabbits.

## References

- National Research Council. *Guide for the Care and Use of Laboratory Animals: Eighth Edition*. Washington, DC: The National Academies Press, 2011.
- Thurston, Sarah, et al. "Methods of Pairing and Pair Maintenance of New Zealand White Rabbits (*Oryctolagus Cuniculus*) Via Behavioral Ethogram, Monitoring, and Interventions." *JoVE (Journal of Visualized Experiments)* 133 (2018): e57267.
- Chu, L., Garner, J., Mench, J. "A behavioral comparison of New Zealand White rabbits (*Oryctolagus cuniculus*) housed individually or in pairs in conventional laboratory cages." *Applied Animal Behaviour Science* Volume 85. Issues 1-2 (2004): Pages 121-139.

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