

# Individual identification of brown bears from their footprints



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## Introduction

Protection and management of threatened animal species require accurate methods of population size estimation that include individual identification of animals.

## Objectives

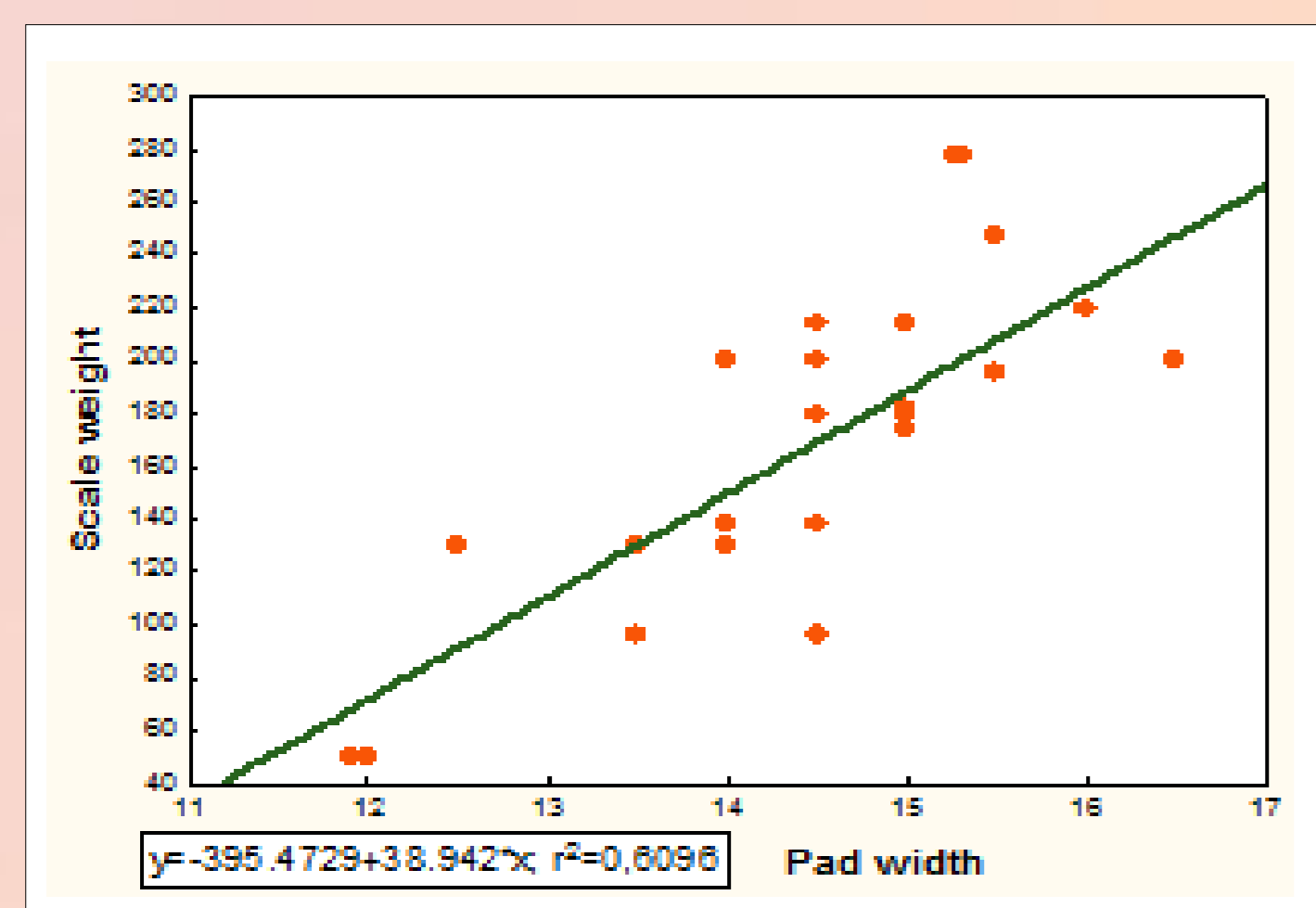
- Development of an objective non-invasive method for the identification of individual brown bears from their footprints.
- Association of biometric features of footprints with specific body measurements.

## Materials and Methods

- 23 bears were captured, measured and radio-collared by "Callisto" field team during 2007-2008 in Central Pindos Mts.
- 7 radio-collared bears and 4 unknown bears were tracked.
- 16 forefoot print and 8 stride linear dimensions were measured.
- Footprints were measured using the Minimum Outline Method (Halfpenny 2000, Mattson 2003).
- Multiple regression analyses and decision trees were applied to reduce the sample of effective measurements and effective sample of footprints.

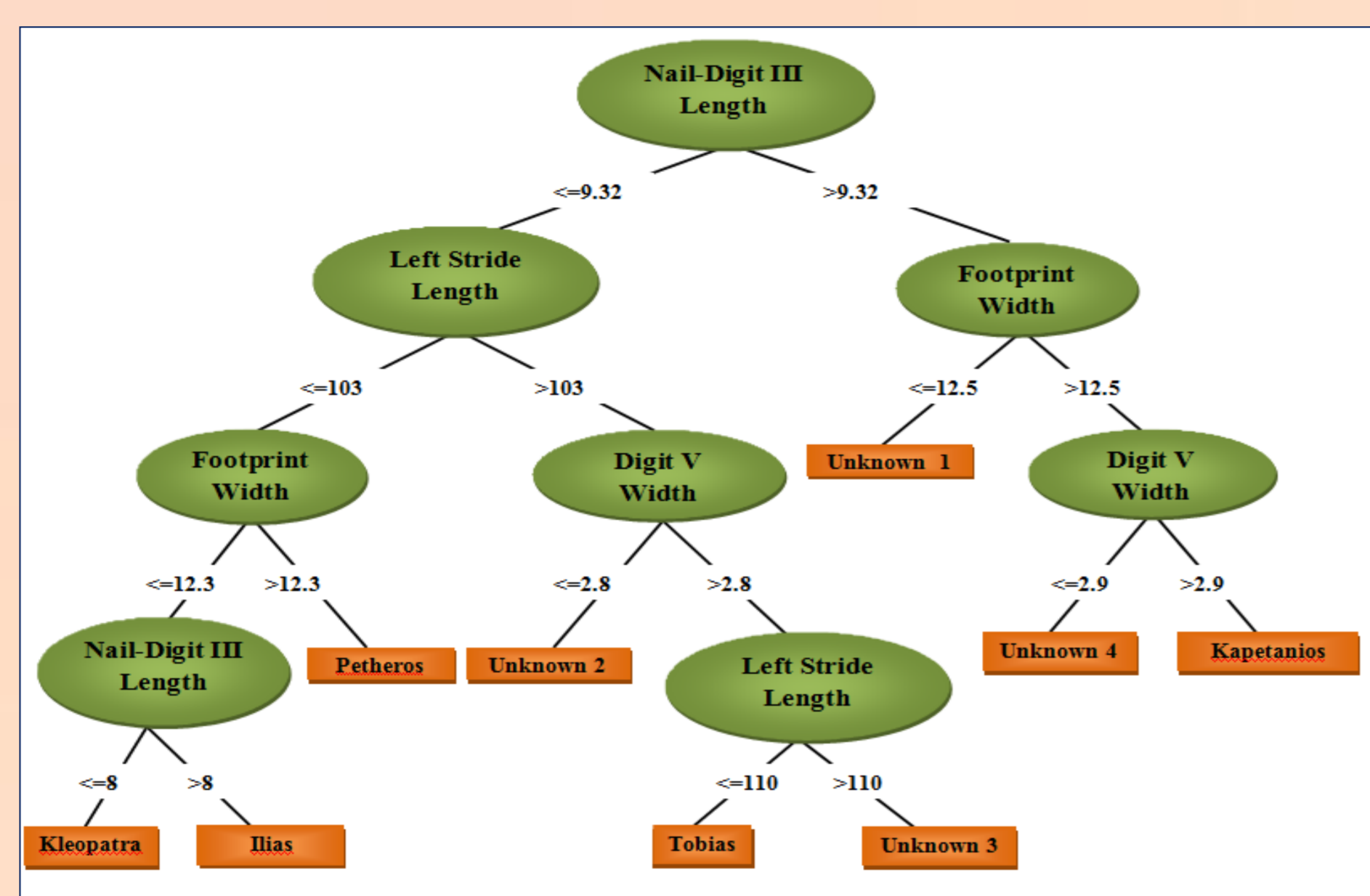
## Results

- **Multiple regression analyses:** measurements with high level of linear correlation with others were excluded from the data set.



**Picture 1:** Relationship between the front pad width and the front pad length. Due to their high correlation ( $r^2=0.8999$ ) the pad length was excluded.

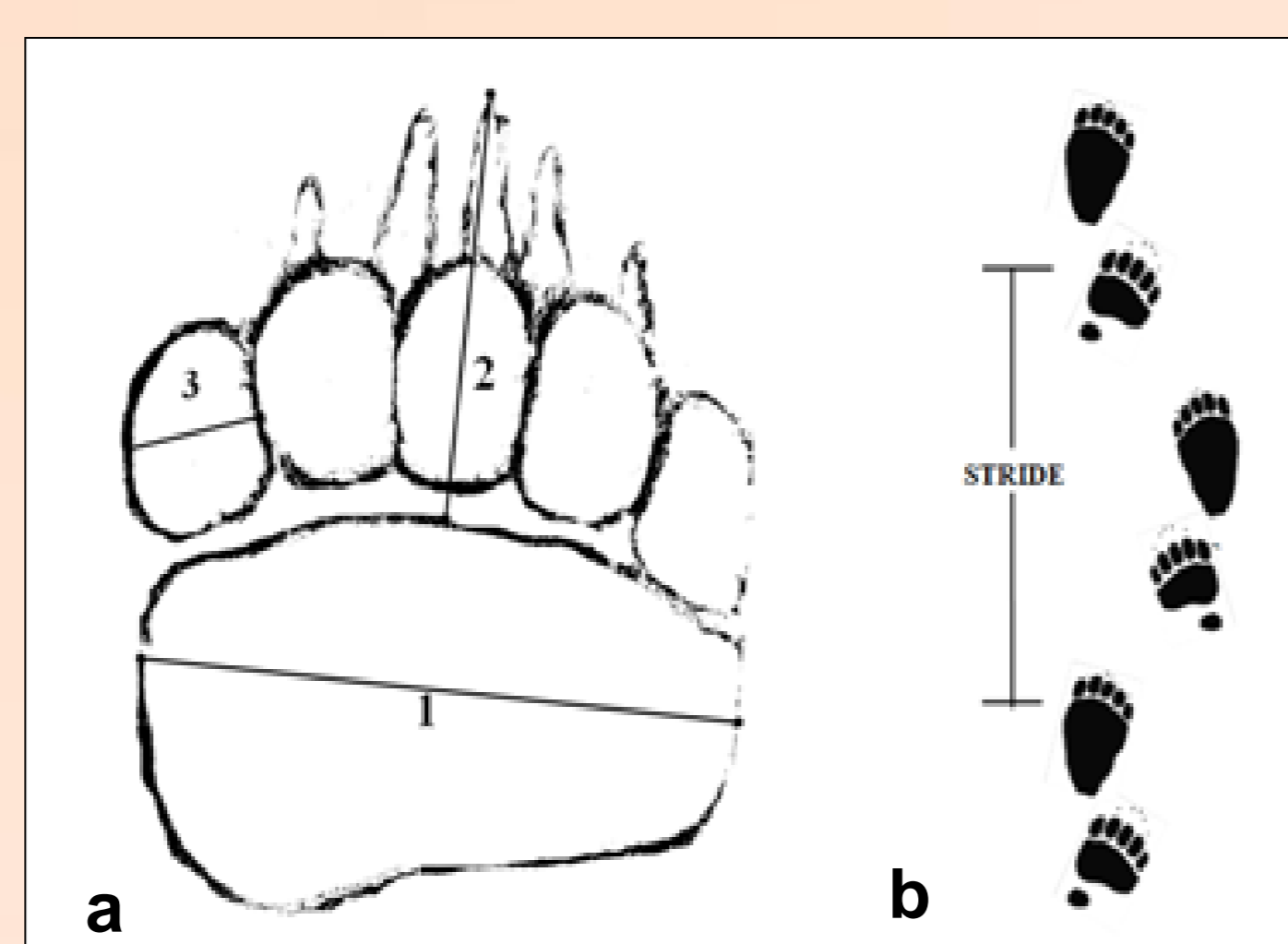
- **Decision trees:** footprint width, length from nail to base of digit III, width of digit V, and left stride length were selected as the most significant measurements for the identification of brown bear individuals with up to 94% classification accuracy.



**Picture 2:** Decision tree representing the most significant parameters of the footprint for the identification of individual bears.

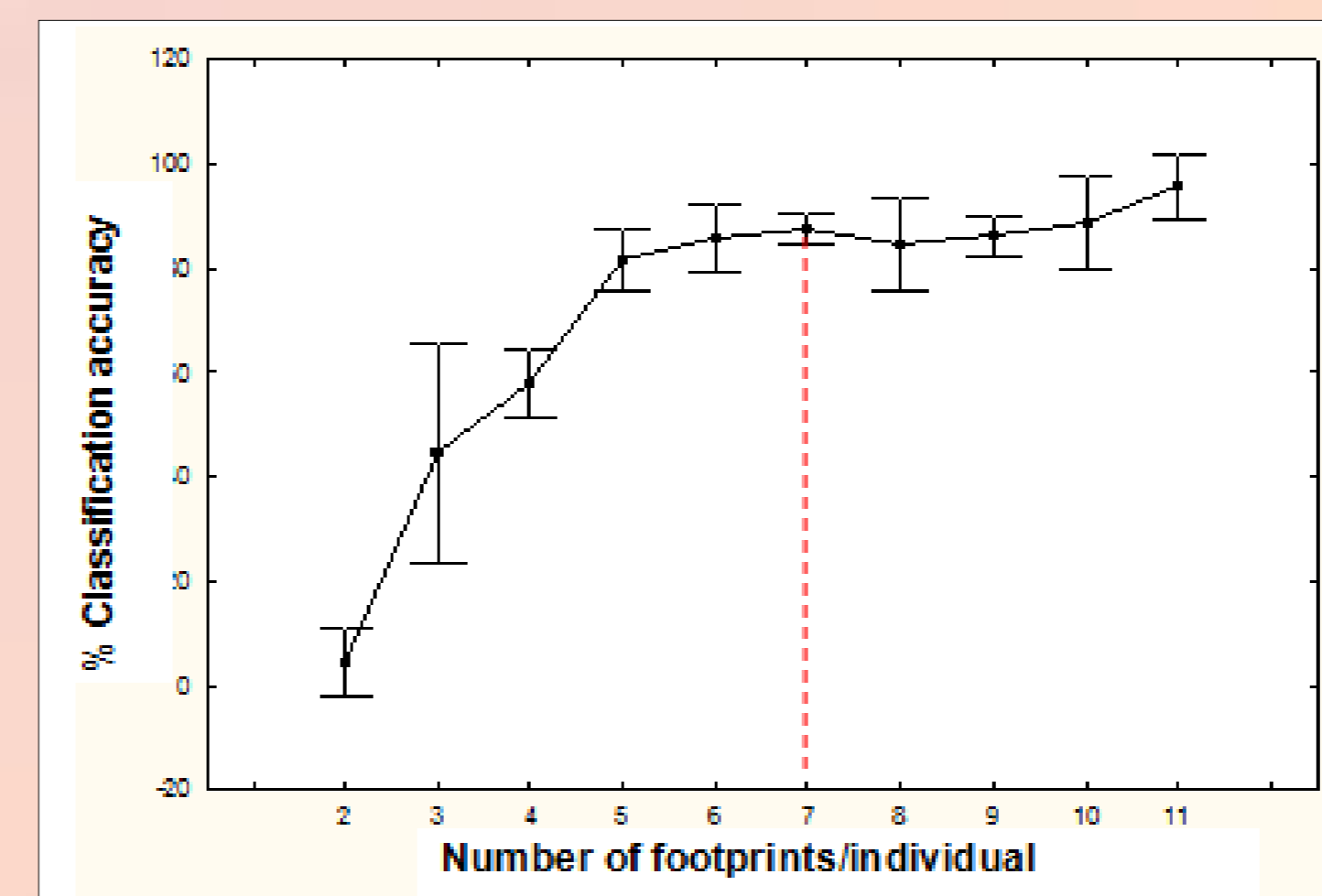


**Picture 3:** The forefoot (bottom) and the hind foot (top) of the bear and their prints.



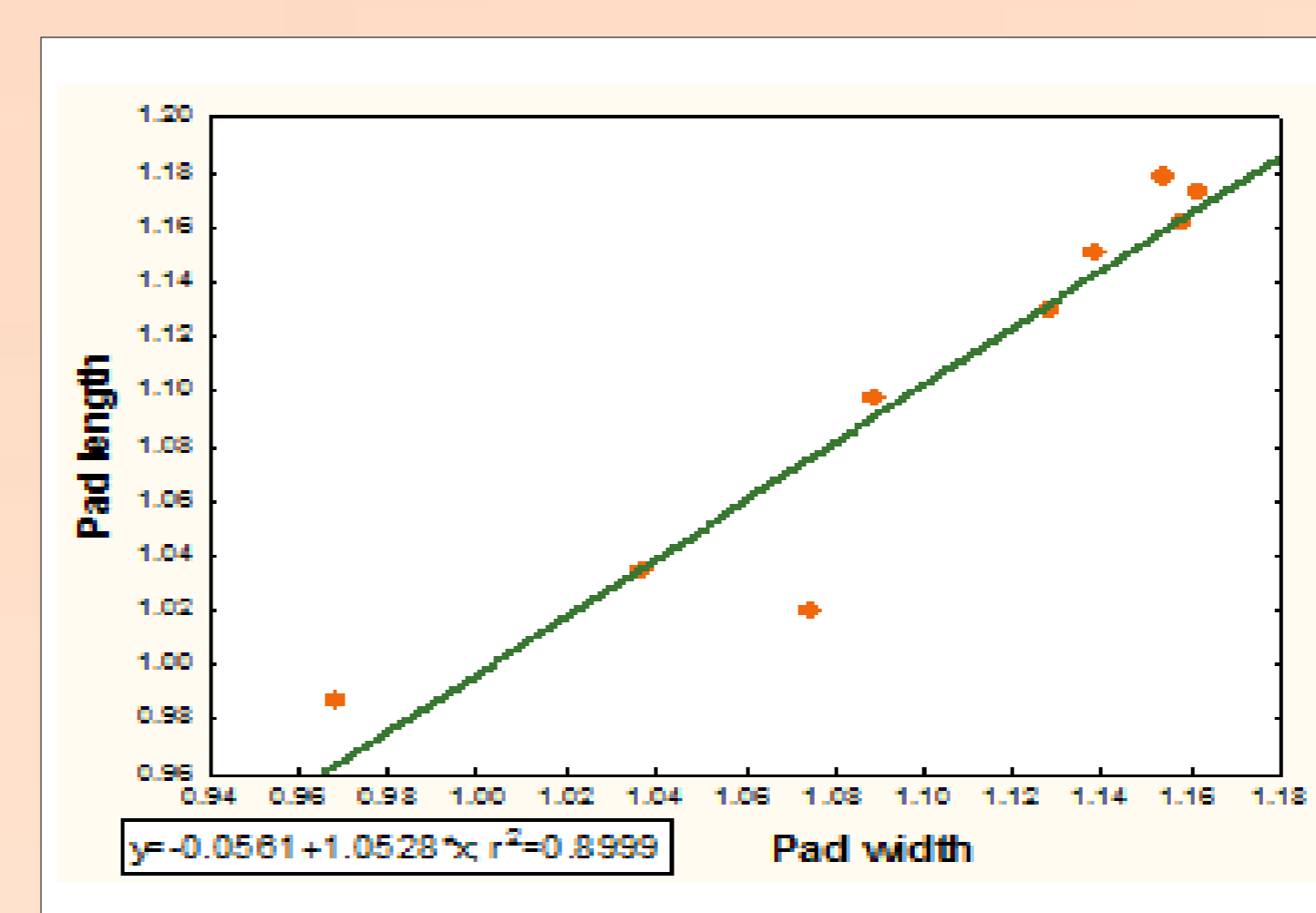
**Picture 4:** a) the most significant measurements of the footprint: 1. footprint width, 2. nail to base of digit III length and 3. digit V width and b) the stride of the animal.

- For the application of the method, the adequate number of footprints per individual was estimated to be 7.



**Picture 5:** Relationship between the number of the footprints that was measured per individual and resulting footprints correctly classified using decision trees.

- Significant correlations between footprint width and specific body dimensions that individually characterized distinct animals were found.



**Picture 6:** Relationship between the front pad width and the scale weight of the bears.

## Conclusion

Brown bears can be individually identified from their footprints with a high level of accuracy and the method can be used for population estimation of the species.

## Acknowledgments

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## References

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 Halfpenny J., 2000. Tracking the great bear: my track's bigger than yours. *Bears* 1: 11-13.