

# A Review of Friction Hitch Research



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**SAR<sup>3</sup>**

**[HTTP://SARRR.WEEBLY.COM/](http://sarr.wweebly.com/)**

# Impetus...



- Conversation with Bruce Parker
- Need synopsis of data
- Not more testing (for prusiks)
- He had a point...
  
- I started collecting data...



# Need...



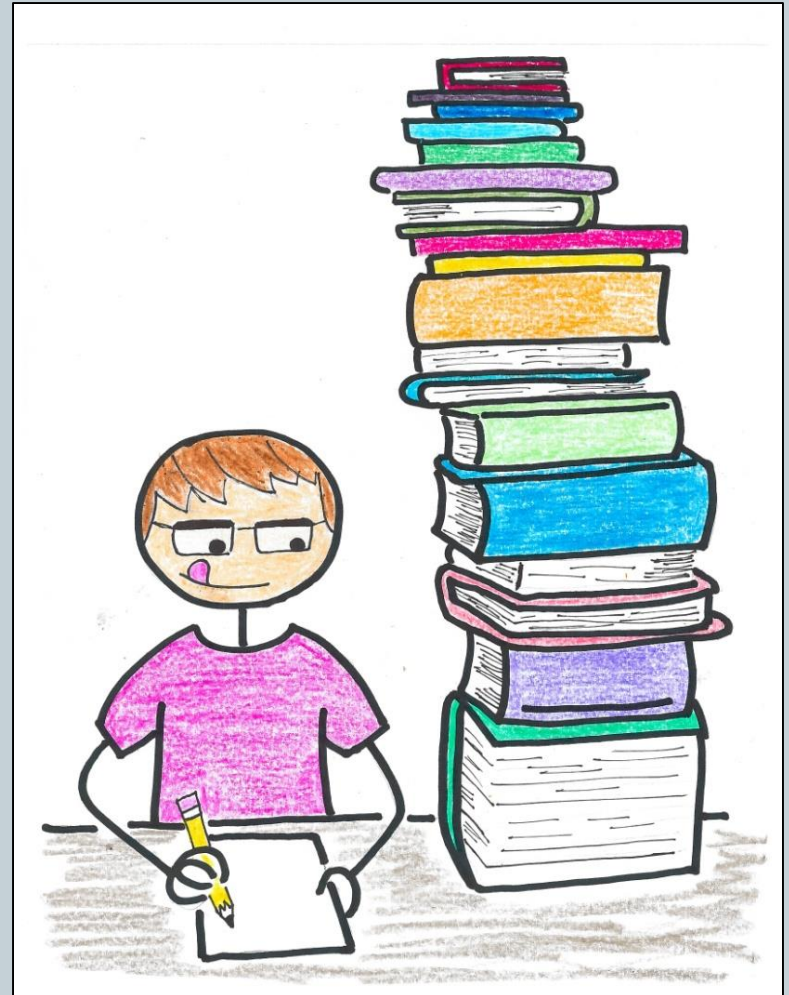
- Many uses of friction hitches
  - Ascending
  - Belays
  - Personal tethers
  - Etc.
- Need a meta analysis
  - Learn what we know
  - Learn what we do not know...



# Methods



- Performed a literature review
  - Found sources on hitch behavior
  - Read/watched them
  - Synthesized data
  - Drew wider conclusions



# Methods: What Was Included



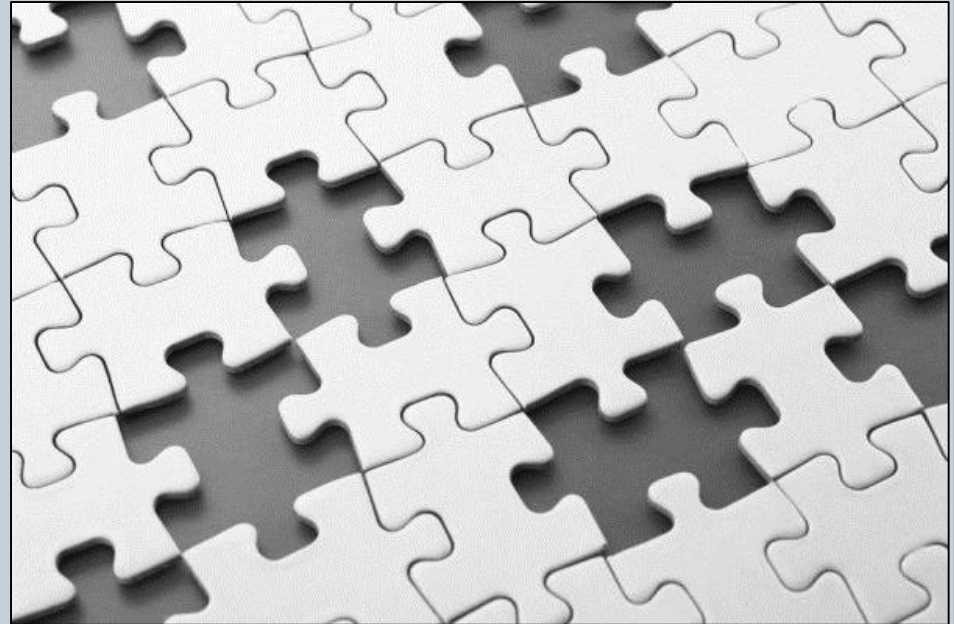
- Identify hitch(es)
- Identify methods
- Slip or failure data
  - Measurements
  - Synopsis statistics
  - Both/Either
- Relevant materials



# Methods: What Was Included



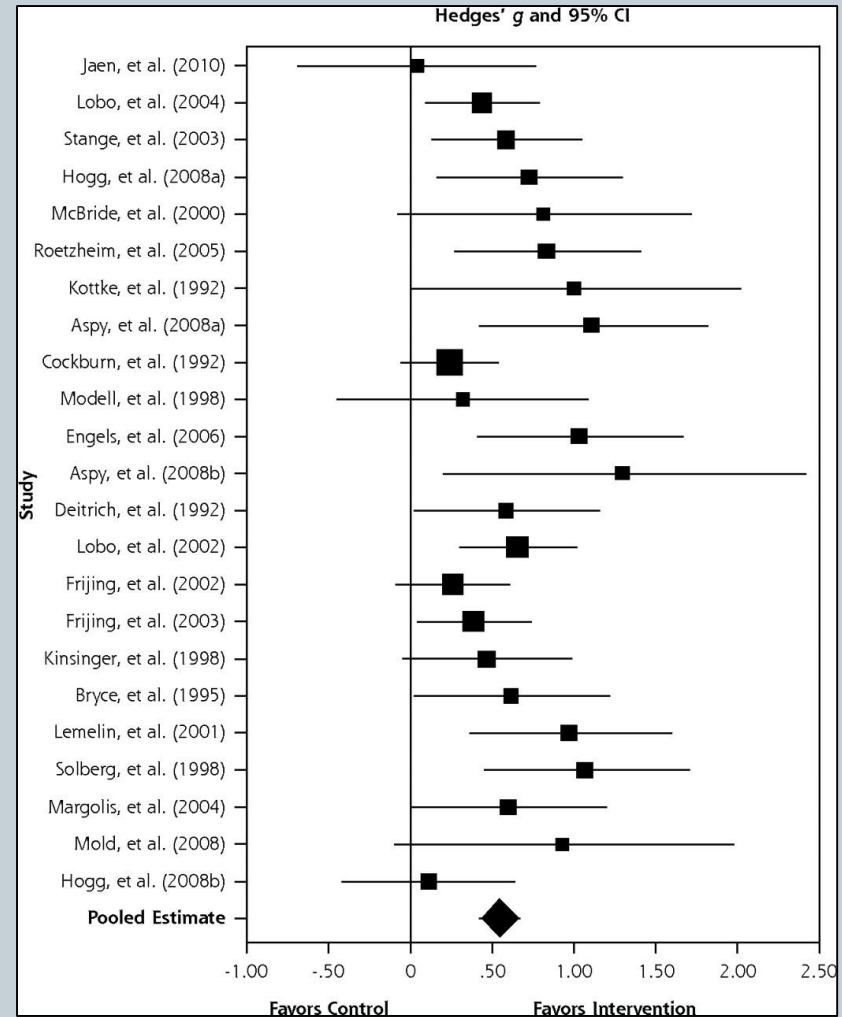
- Included what I found...
- Undoubtedly data missing!
- This is a minimum data set
  
- If you know of more data...



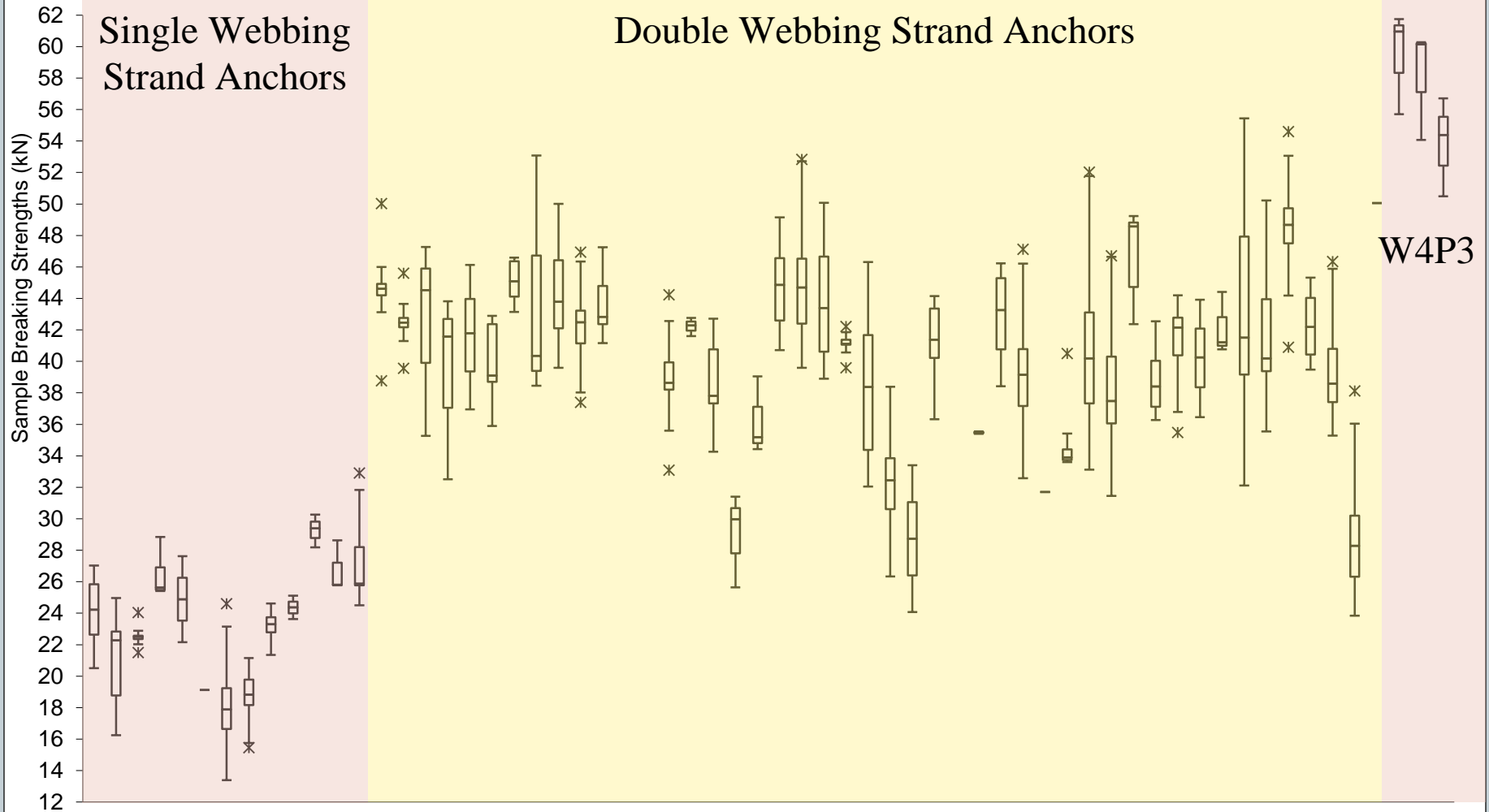
# Disclaimer



- Comparing studies
  - Different methods
  - Different sample histories
  - Different measurement capabilities
- I acknowledge the problems
- Larger trends become visible
  - Called a meta-analysis



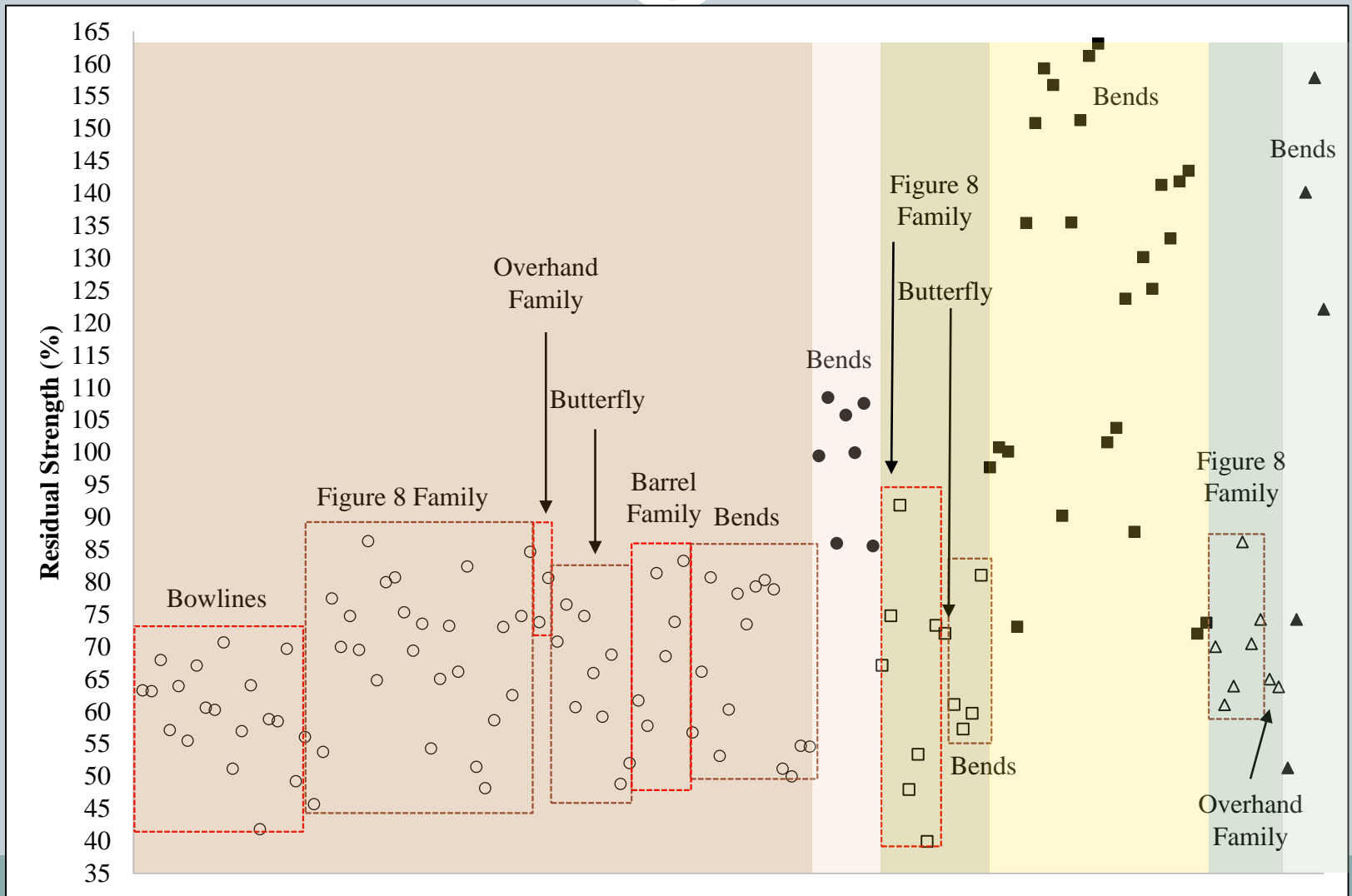
# Meta-Analysis Example: ITRS 2015





# Meta-Analysis Example: ITRS 2016

## Residual Knot Strengths (R.K.S.)



# Methods: Deliverables

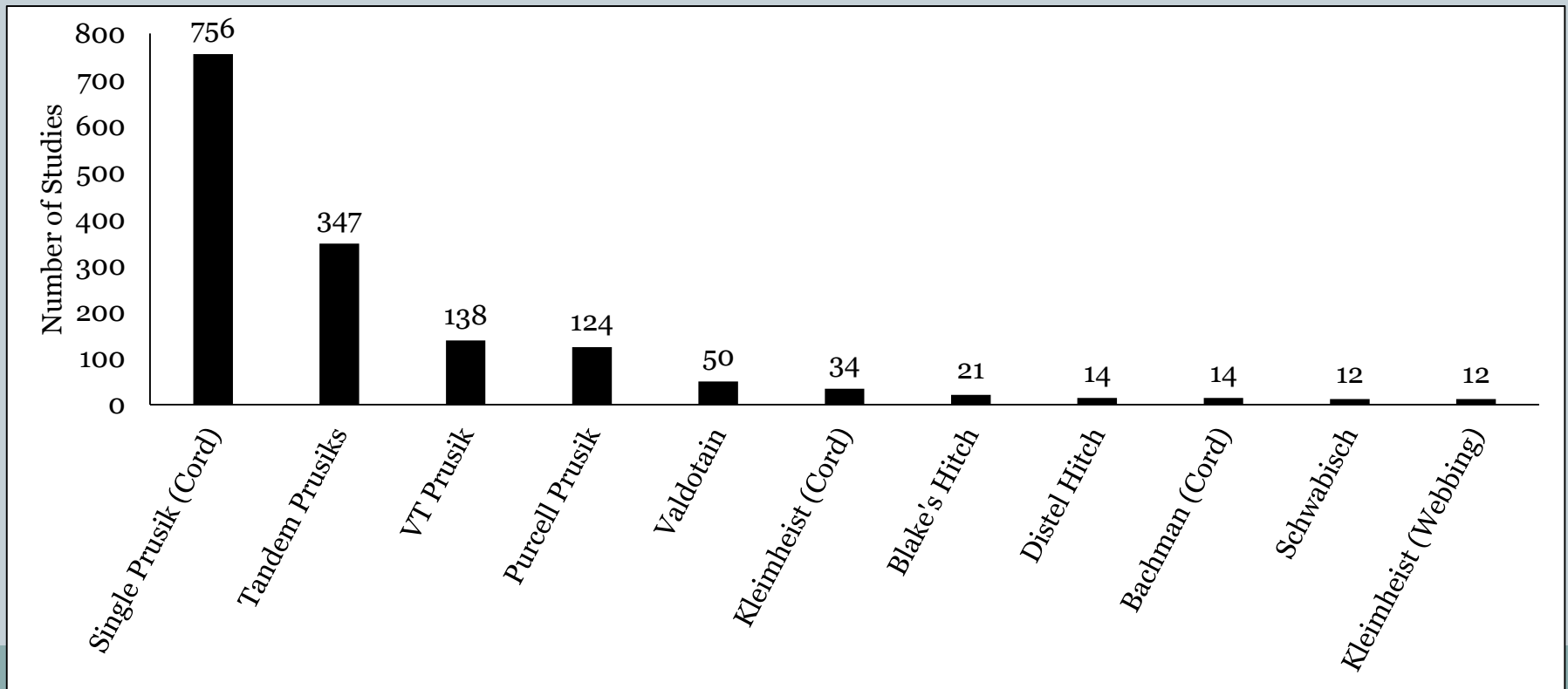


- Synopsis figures in the paper
- Spreadsheet
  - Too big to print
  - Posted on SAR<sup>3</sup> page
  - <http://sarr.weebly.com/>

# Results: General



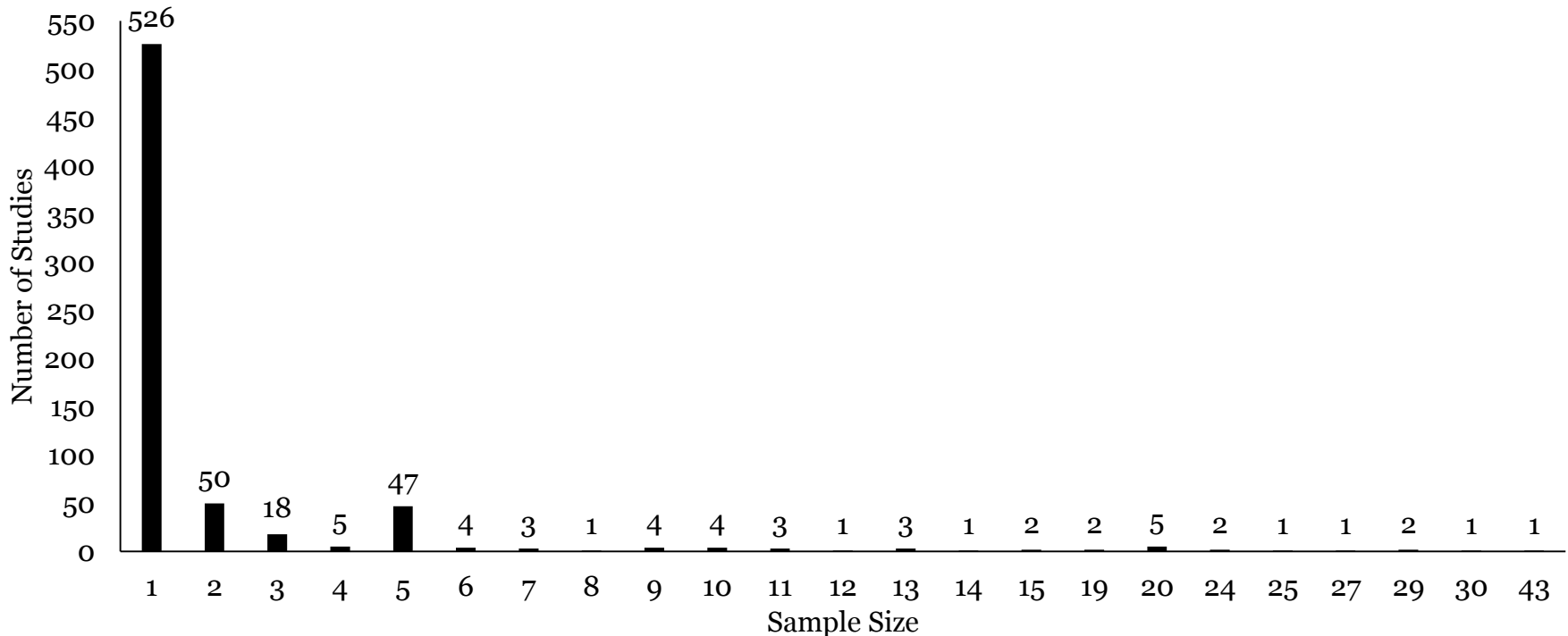
- 139 sources
  - See paper for details
- >1651 test results
- Expected hitches tested
  - Those most used
  - Just like knots...



# Results: General

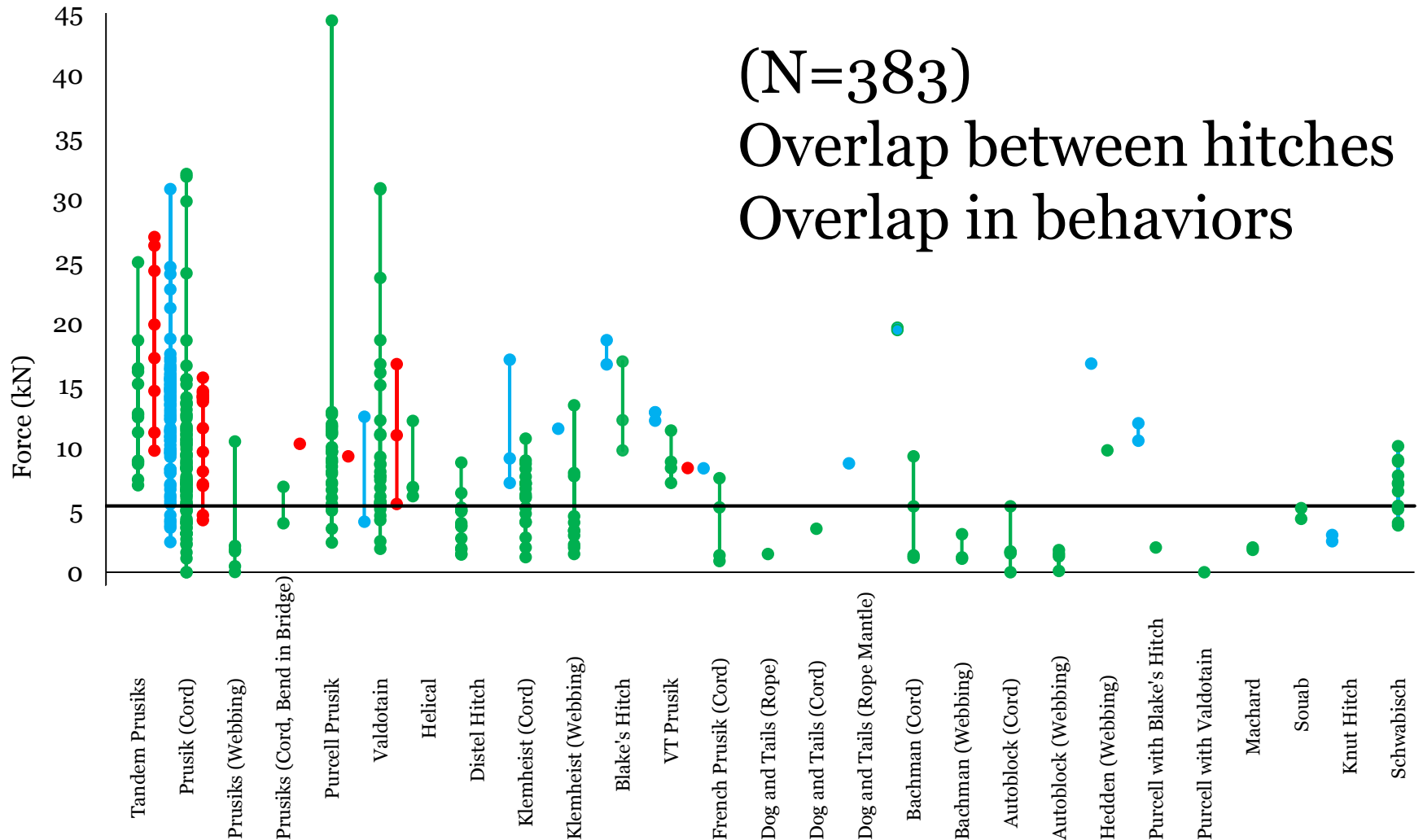


- Sample sizes (N=687)
- Most 1 (N=526)
- 5 or less most common
- Probably convenience sampling
- Just like knots...

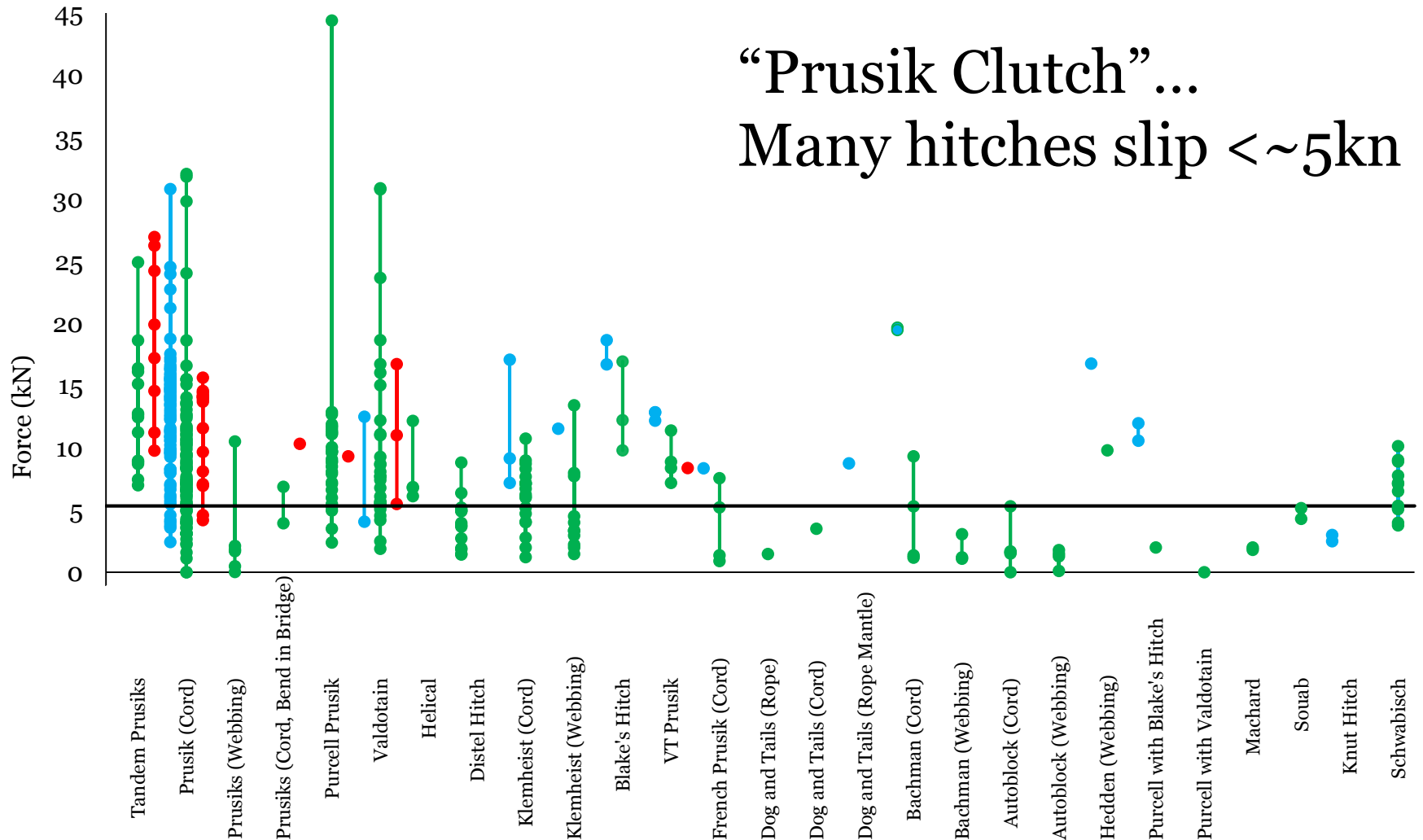




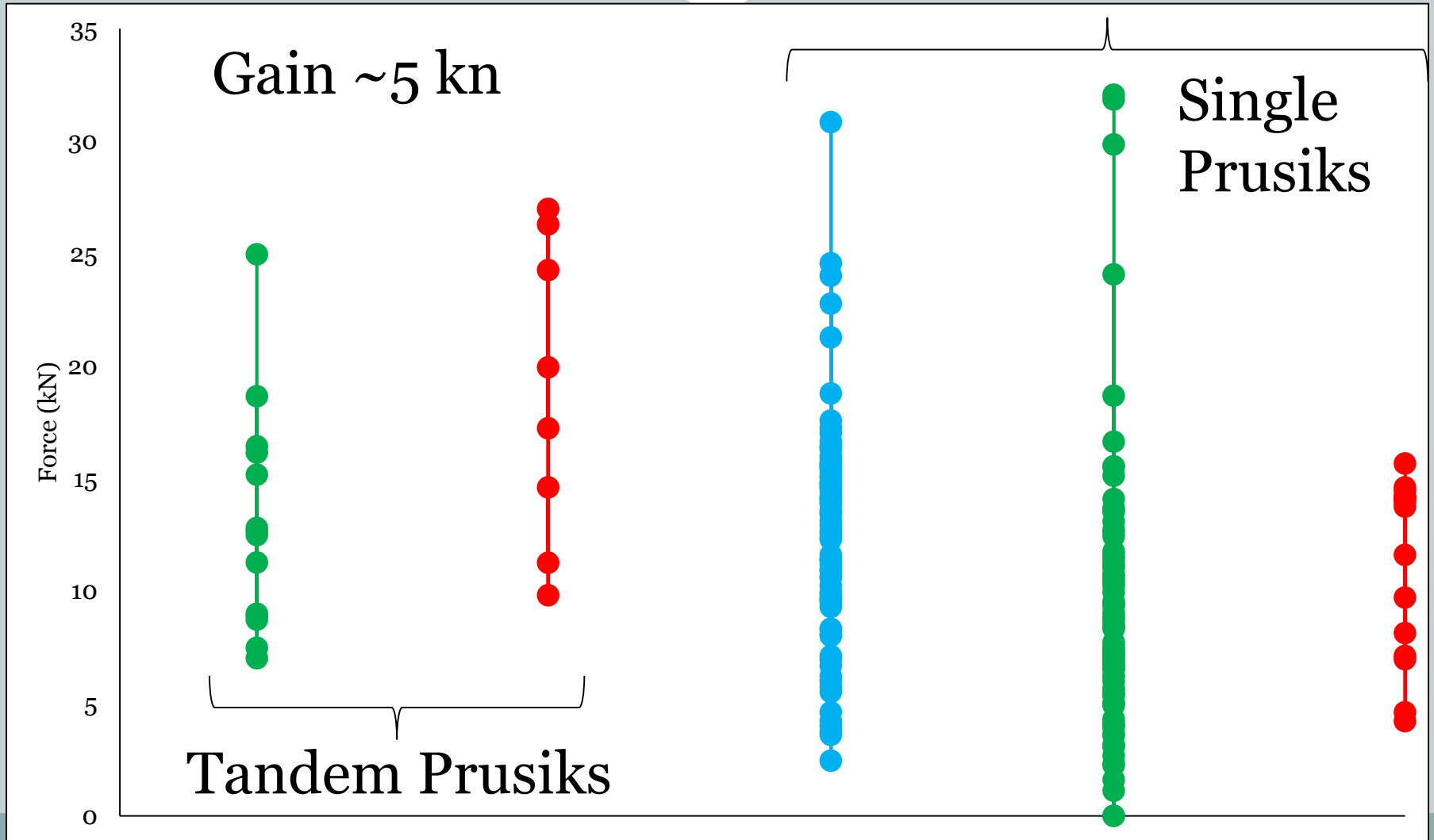
# Results: Hitch Failure, Slip, Rope Damage



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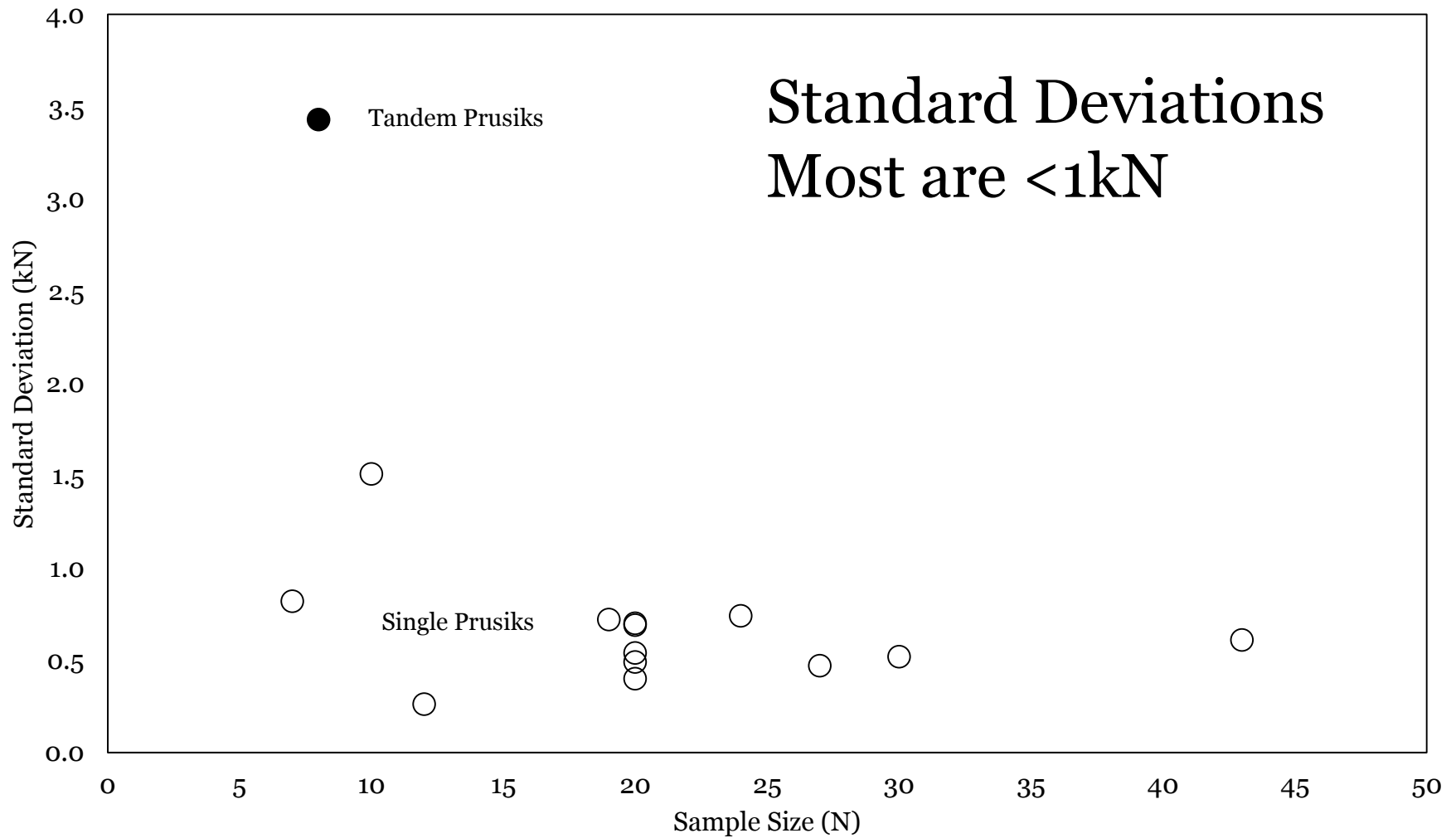


# Results: Hitch Failure, Slip, Rope Damage

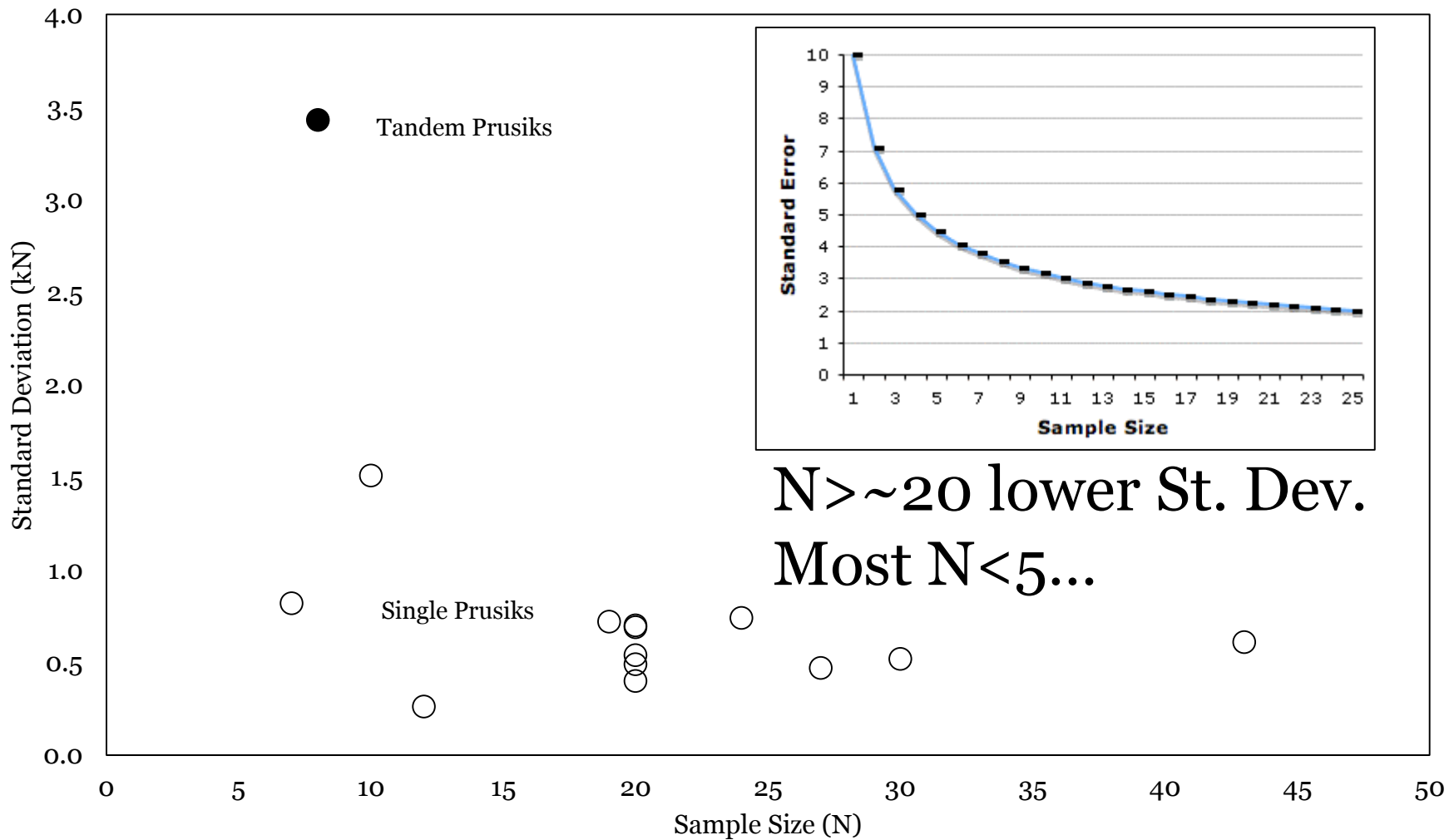




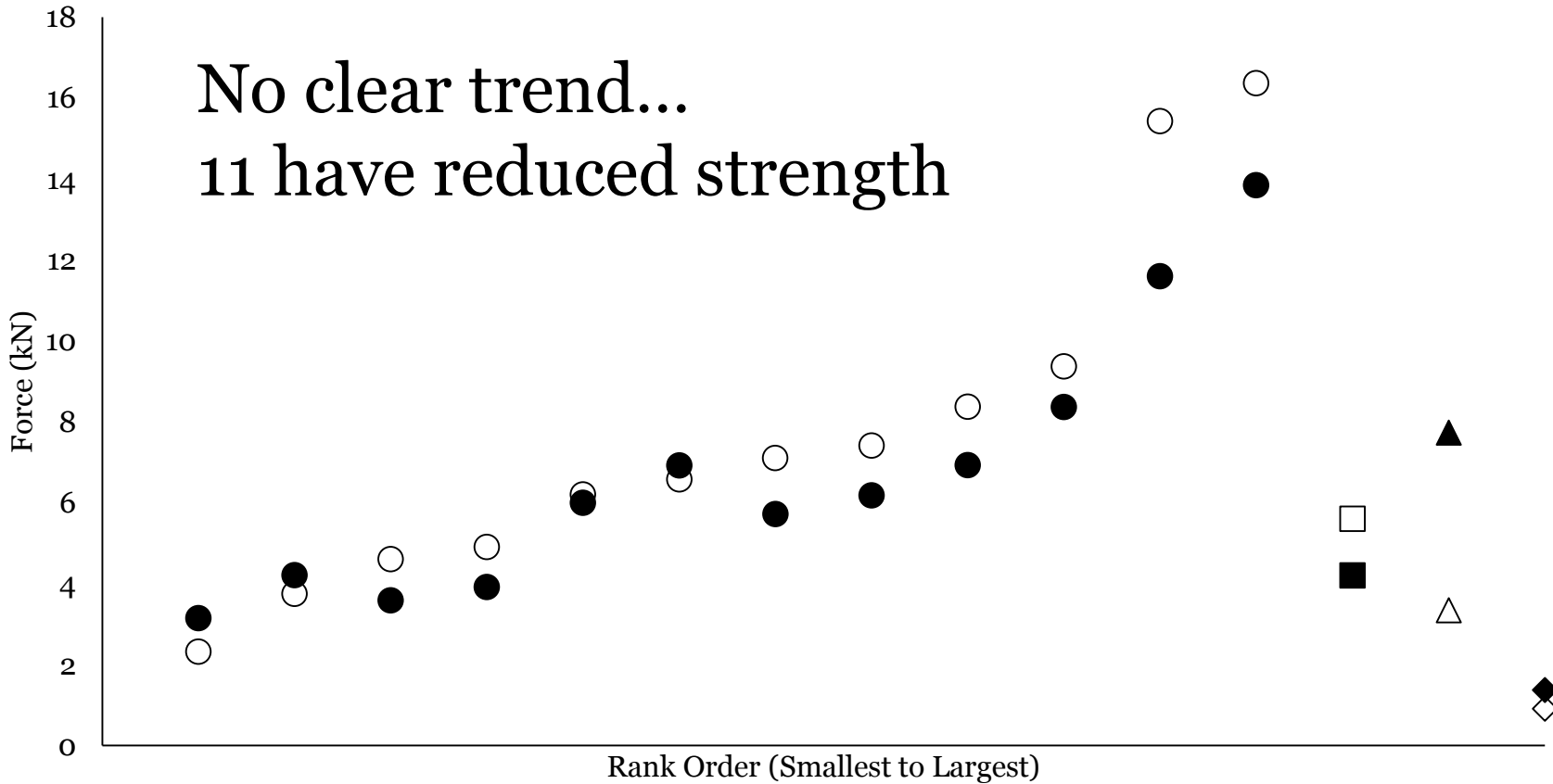
# Results: Prusik Variability (N=14)



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# Results: Effects of Hydration (N=15)



○ Dry Prusiks

● Wet Prusiks

□ Dry Valdotaïn

■ Wet Valdotaïn

△ Dry Klemheist

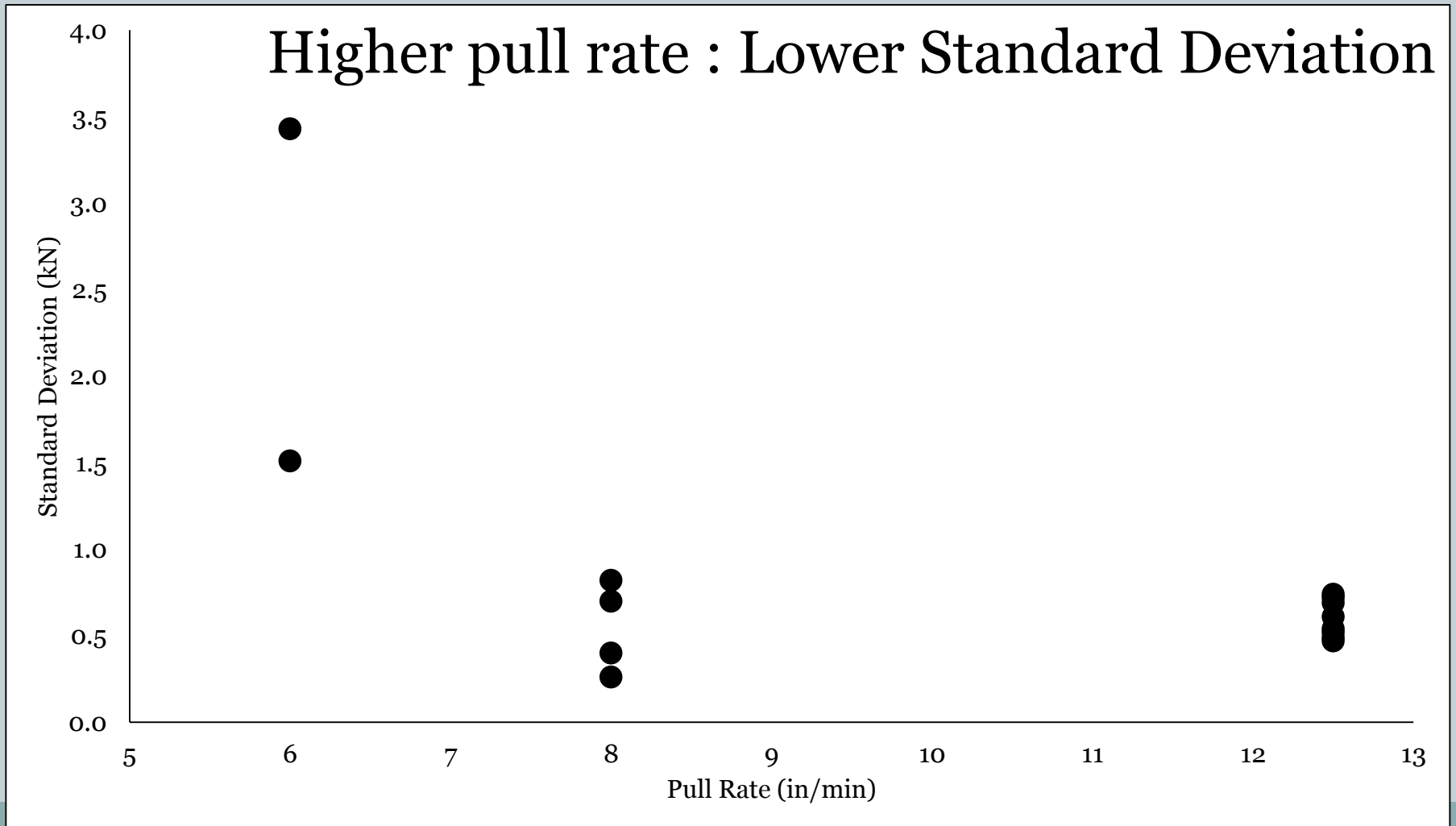
▲ Wet Klemheist

◇ Dry French Prusik

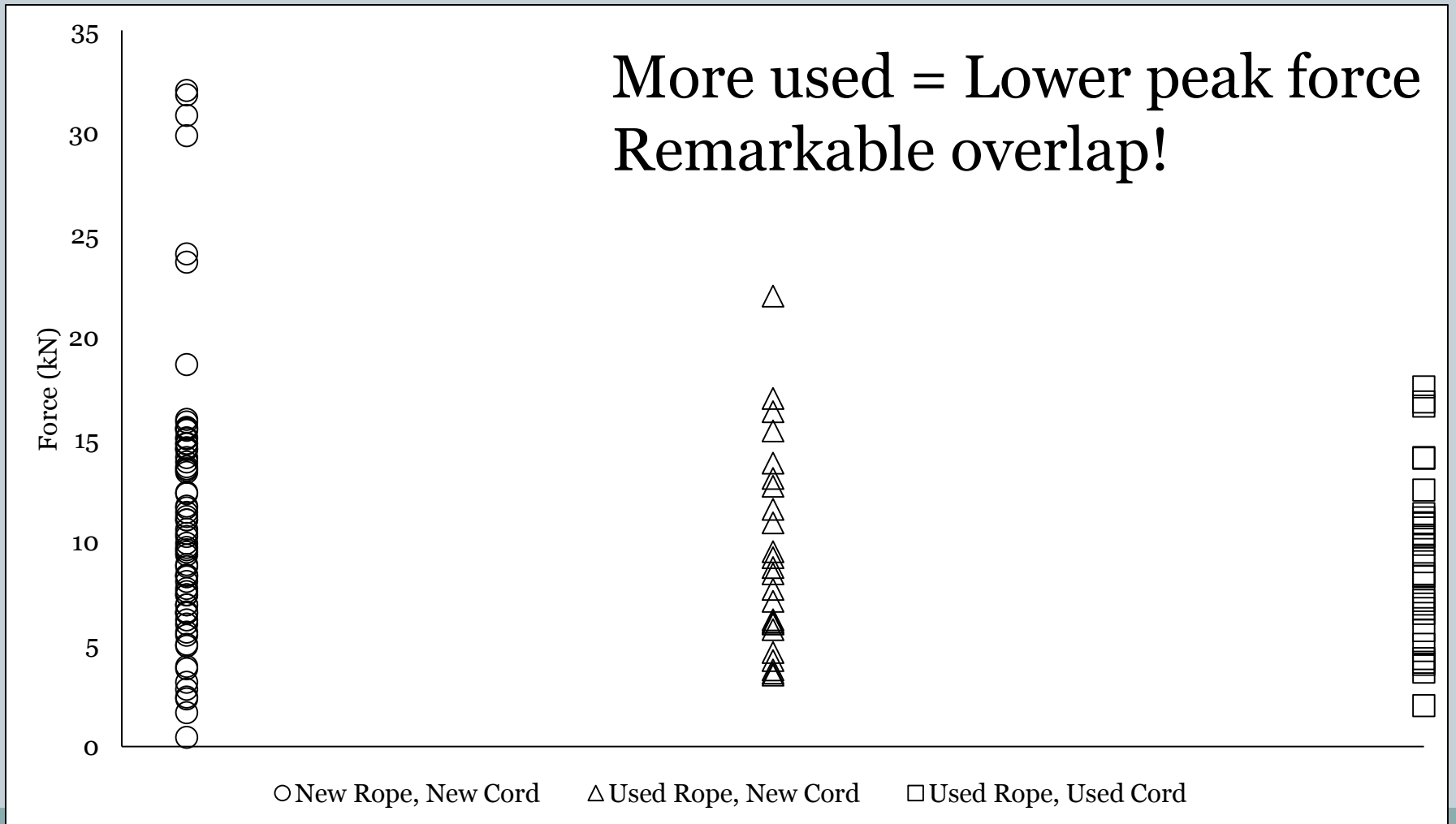
◆ Wet French Prusik



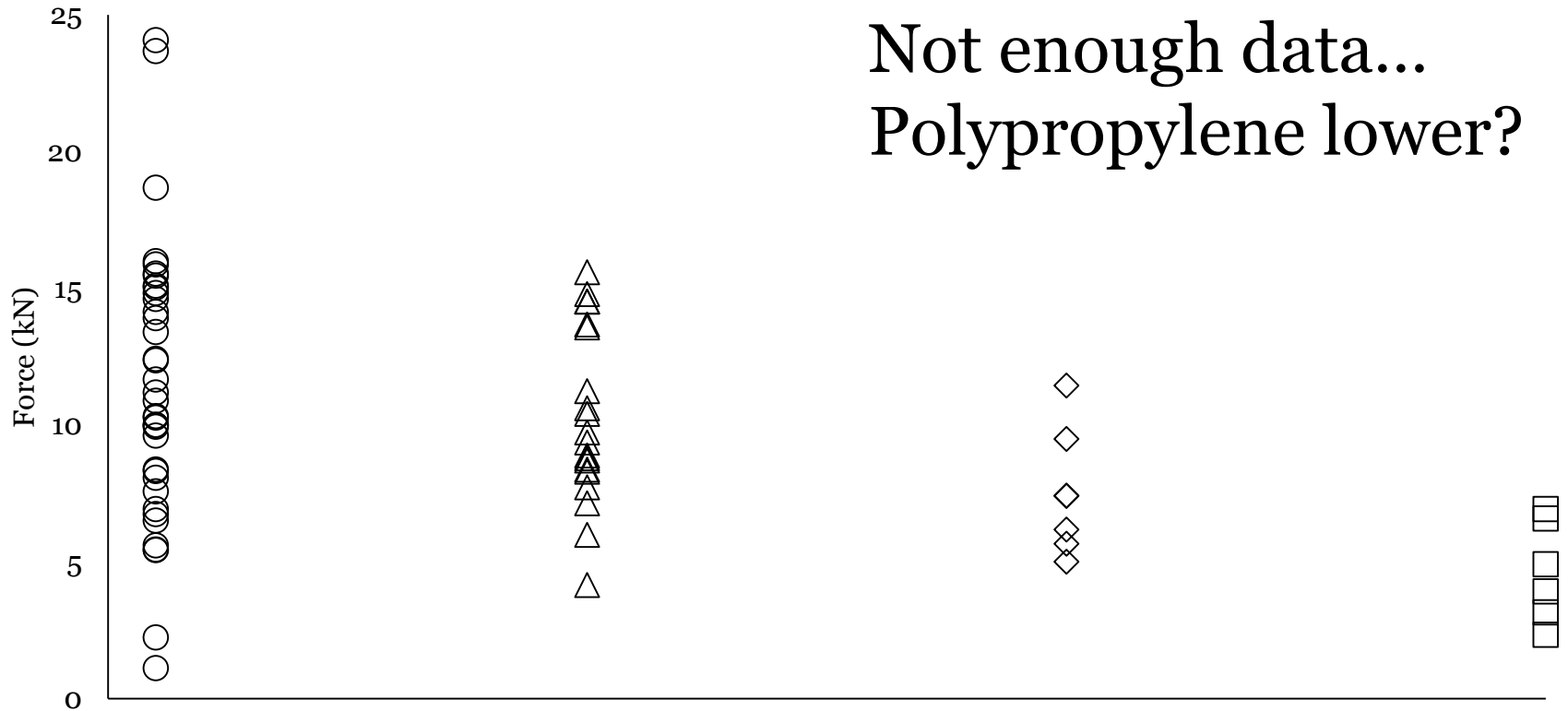
# Results: Prusik Pull Rate vs St. Dev. (N=14)



# Results: Prusik New VS Used (N=71, 25, 31)



# Results: Prusik Composition (N=37, 20, 7, 5)



Not enough data...  
Polypropylene lower?

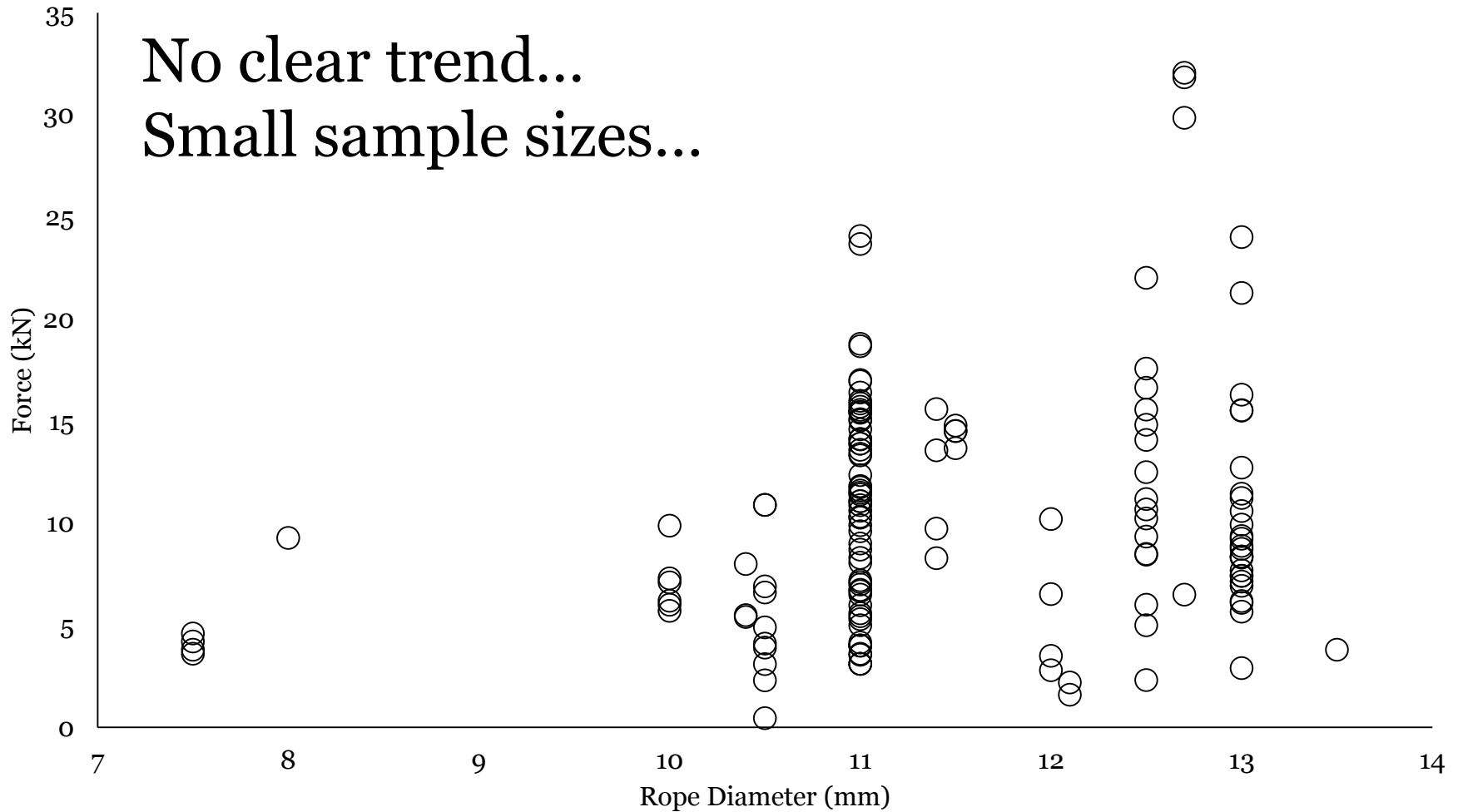
○ Nylon Rope, Nylon Prusik

△ Polyester Rope, Nylon Prusik

◇ Polyester Sheath/Nylon Core Rope, Nylon Prusik

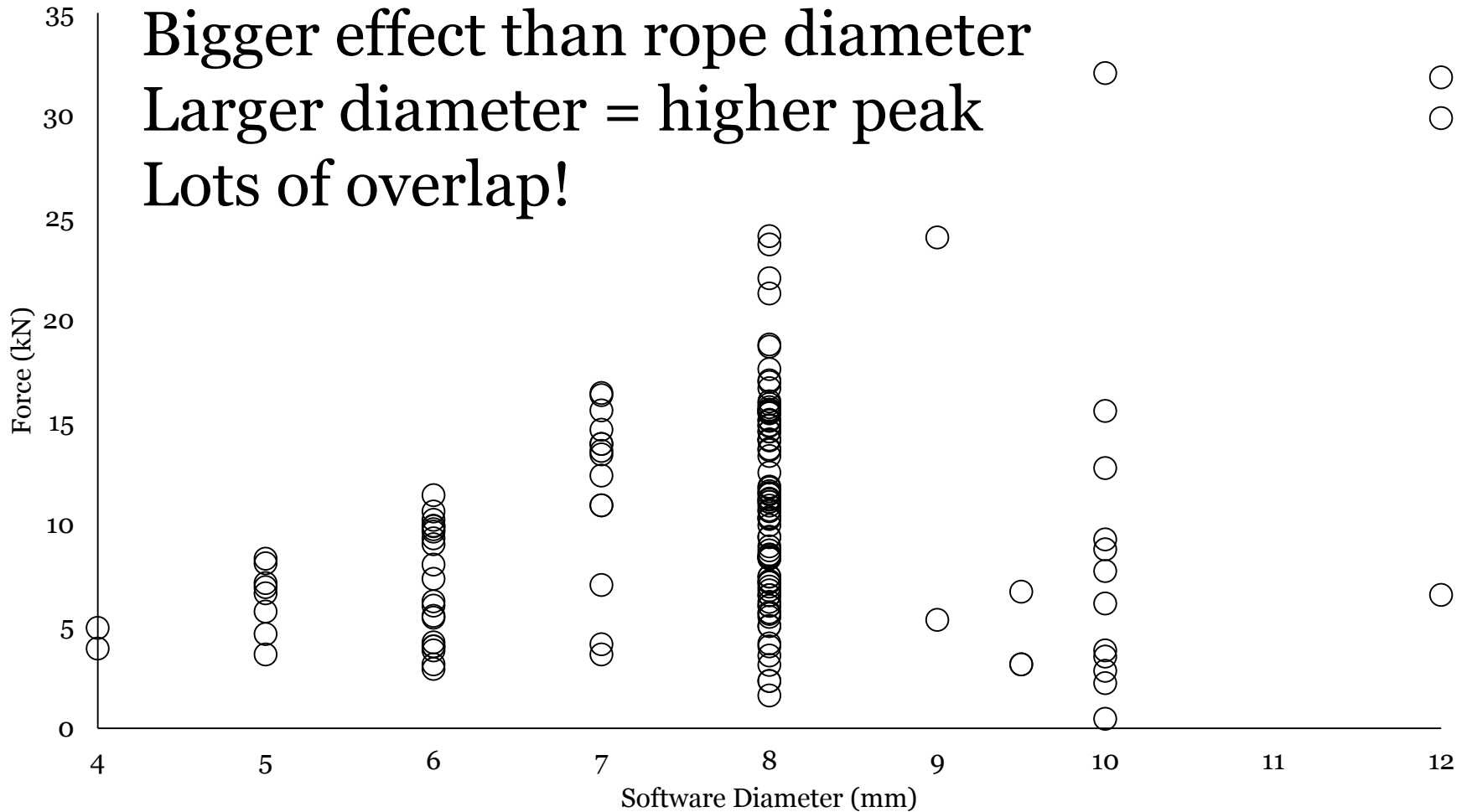
□ Polypropylene Rope, Nylon Prusik

# Results: Rope Diameter and Prusiks (N=147)





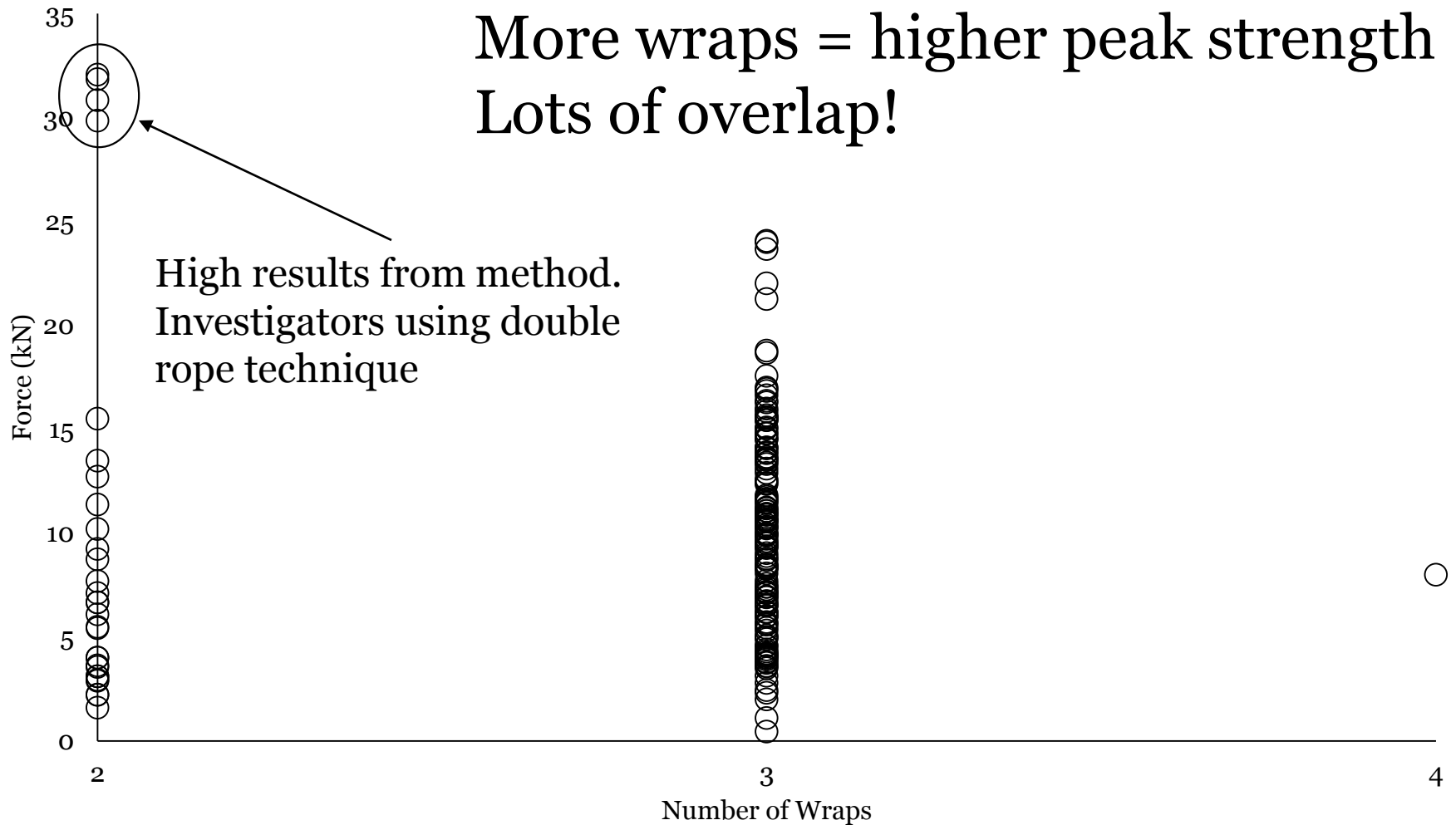
# Results: Prusik Cord Diameter (N=147)



# Results: Number of Wraps in a Prusik (N=184)



More wraps = higher peak strength  
Lots of overlap!



# Rigging Consequences



- If you need more strength or grip...
  - Add a second friction hitch
  - Use a larger diameter cord for the hitch
  - Add more wraps to the hitch
- These results are unsatisfying...

# Future Research



- Less tested hitches
- Larger sample sizes ( $N \approx 20$ )
- Wet vs Dry
- Pull rates over  $\sim 8$  in/min
- Use faster pull rates for lower standard deviations
- Focus on hitch materials, not the rope
- Still a little unsatisfying...



# Rigging Philosophy?

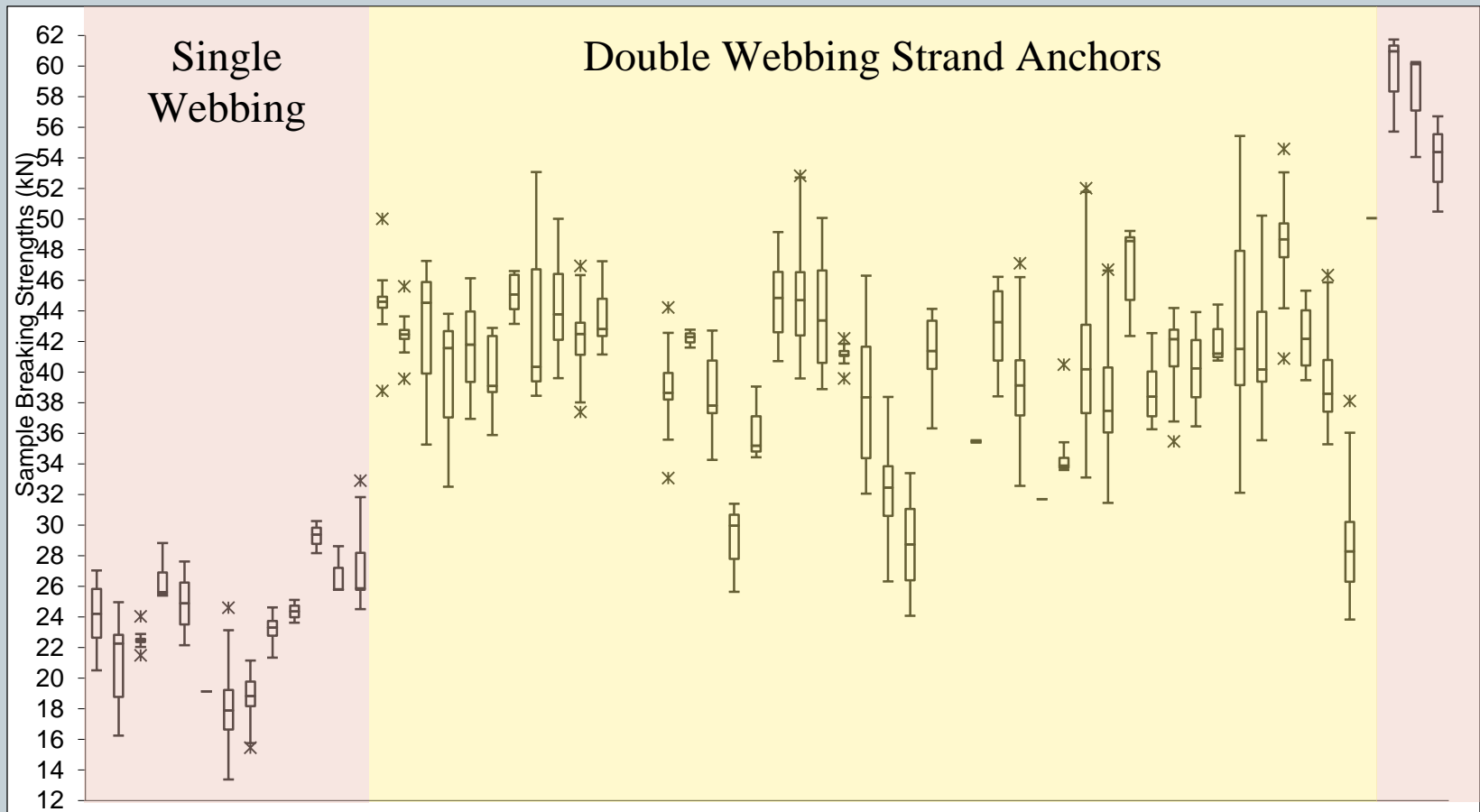


- Numbers are not enough
- I do not care about the numbers...
- Once we have numbers...
- We can move on to something interesting
  - Elevate the discussion...

# Rigging Philosophy?



- Something more interesting:



# Rigging Philosophy?- Something More Interesting



**Basket  
Hitch**



**Basket Hitch  
+ One Wrap**



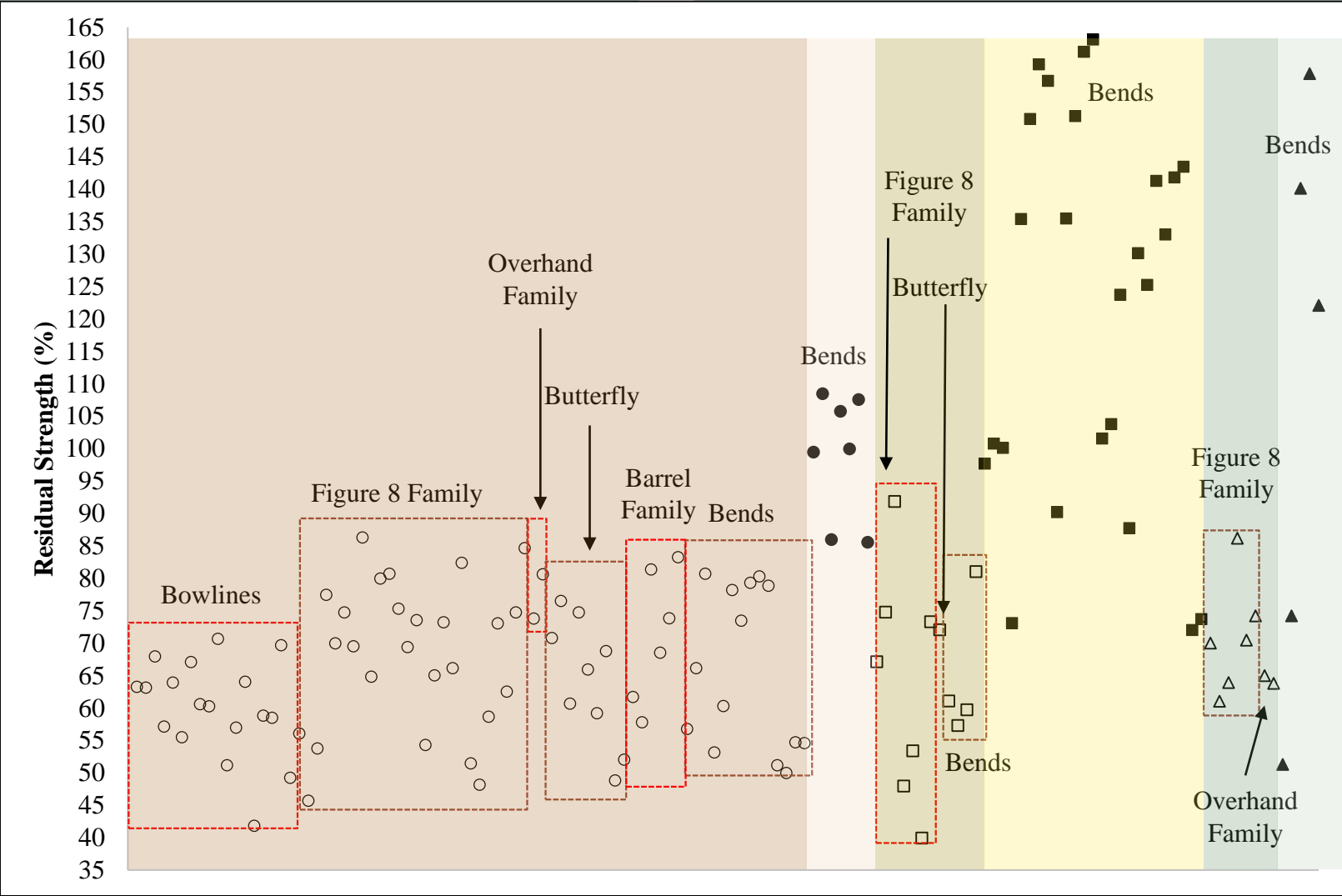
**Basket Hitch +  
Overhand Focal Knot**



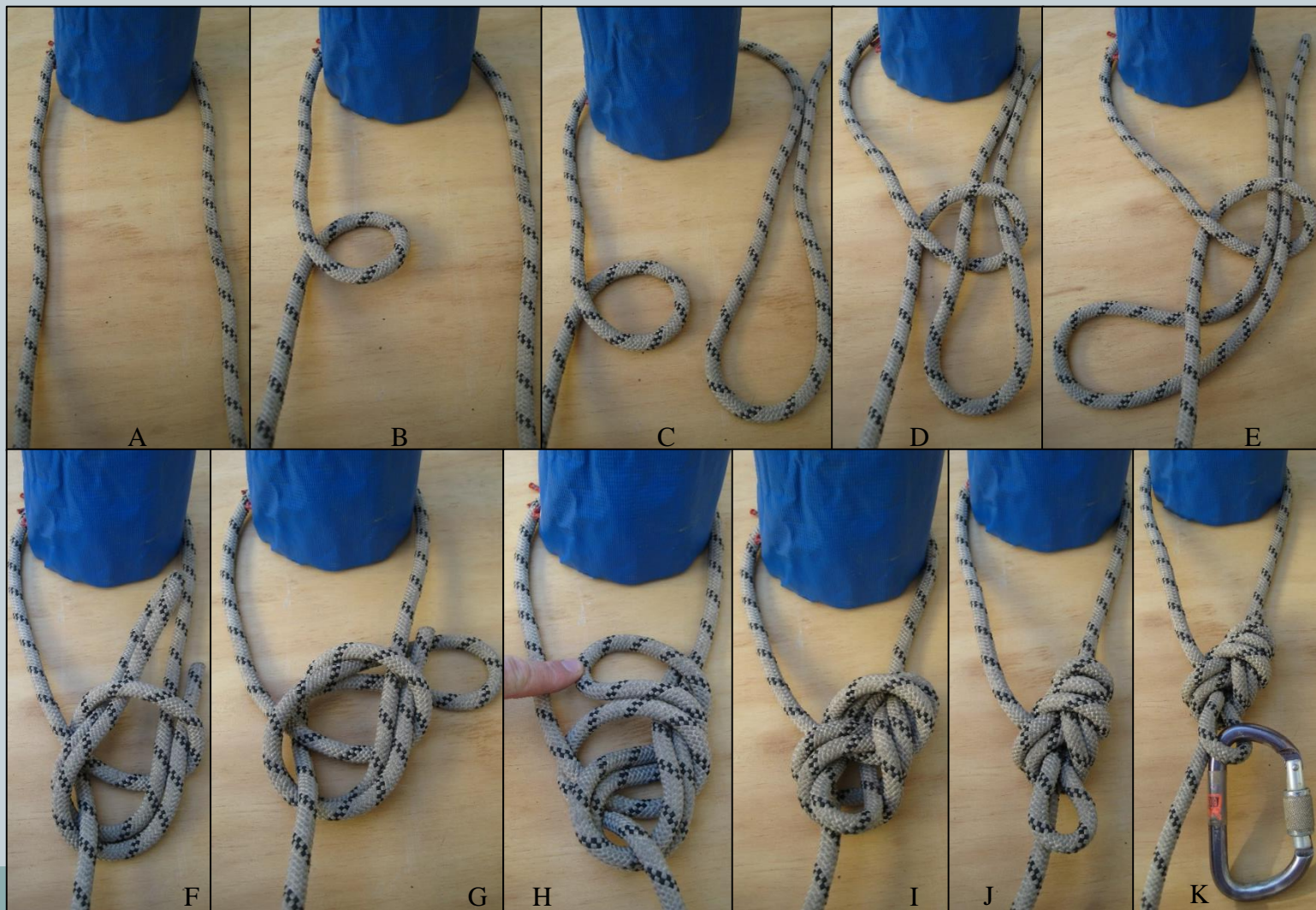
**Basket Hitch  
+ Connector**



# Rigging Philosophy?- Something More Interesting



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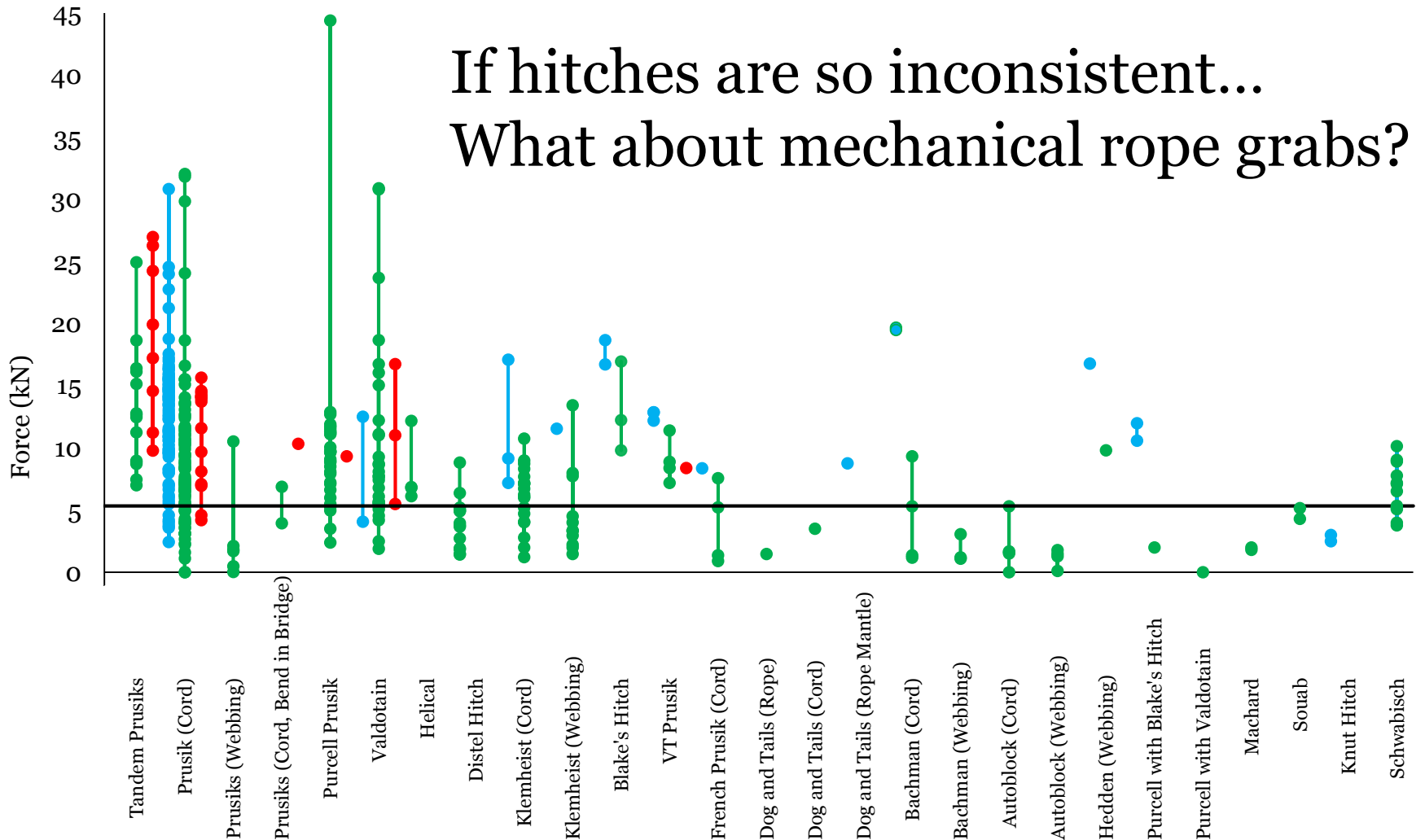
# Rigging Philosophy?- Something More Interesting



# Rigging Philosophy?- Something More Interesting



If hitches are so inconsistent...  
What about mechanical rope grabs?



# What's The Point?



- We need to move past the numbers
- A necessary first step
- Once we have them, move on...
- We are stalling on basic understanding

# How To Move On



- Personal revolution
  - Active study
  - Engage in the conversation
  - Actively humble ourselves to learn



# How To Move On



- Cultural revolution
  - Teach these ideas to others
  - Leaders attend ITRS
  - We are the thought leaders



# Let's End Rigging Groundhog Day!

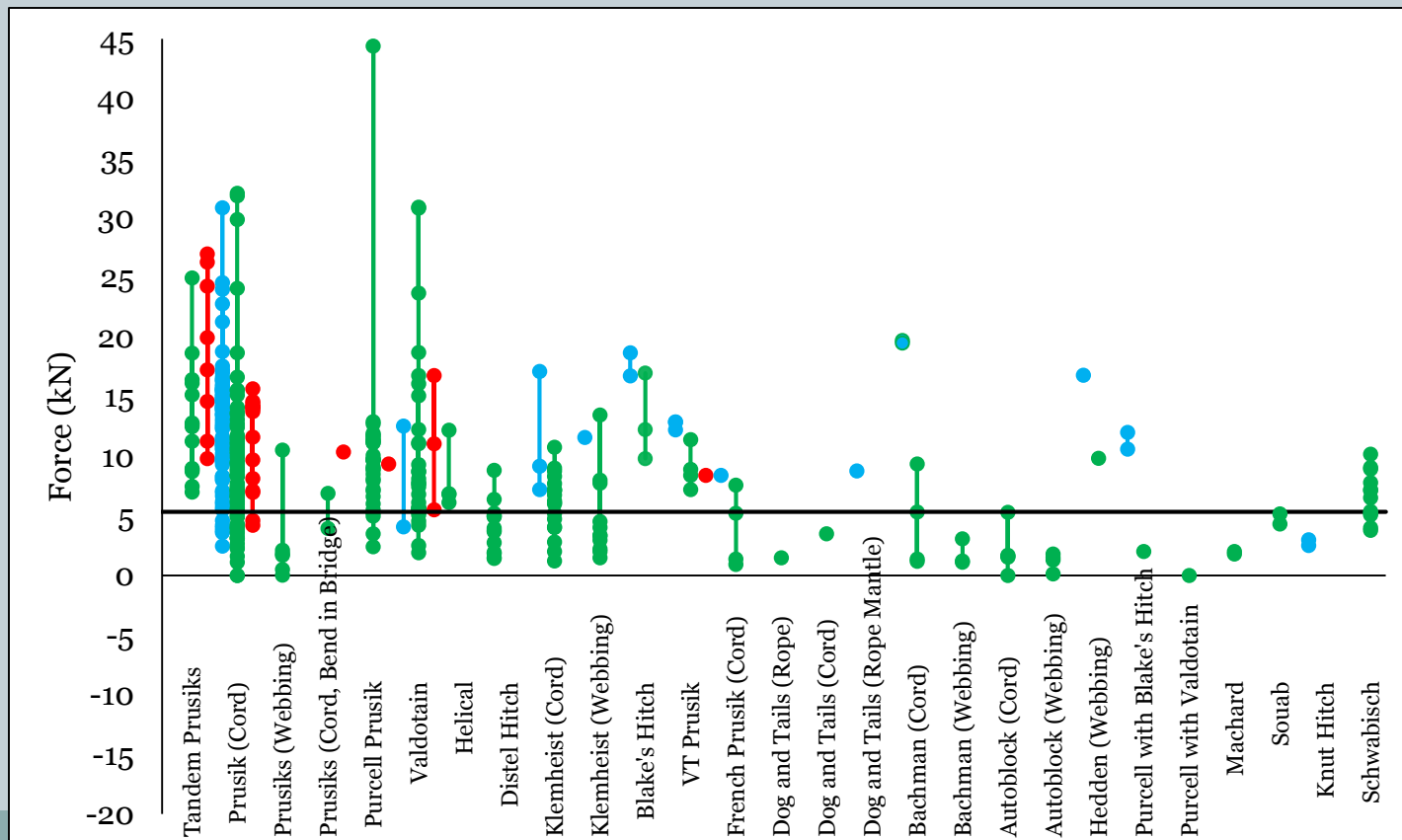




# Final Thoughts...



- Back yard testing is science
- It is invaluable



# Final Thoughts...



- Decisions can be data driven!
- Please read the citations!
- Please contribute to the research!



# Acknowledgements



- Everyone who has done research!!
- Manufacturers
  - Donations of equipment!
- Bruce Parker
  - For the idea...



# Questions?



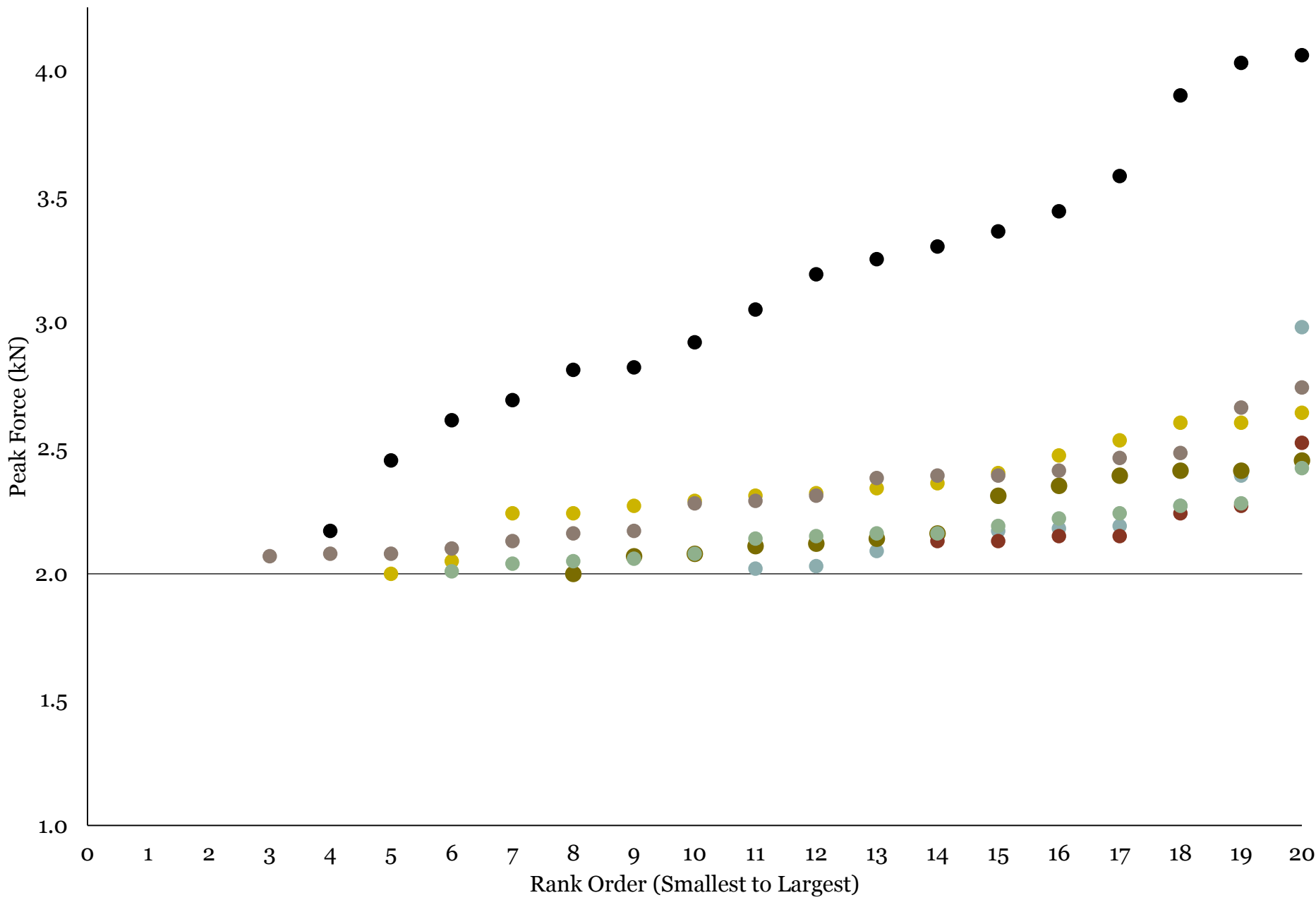
Thomas Evans

SAR<sup>3</sup>

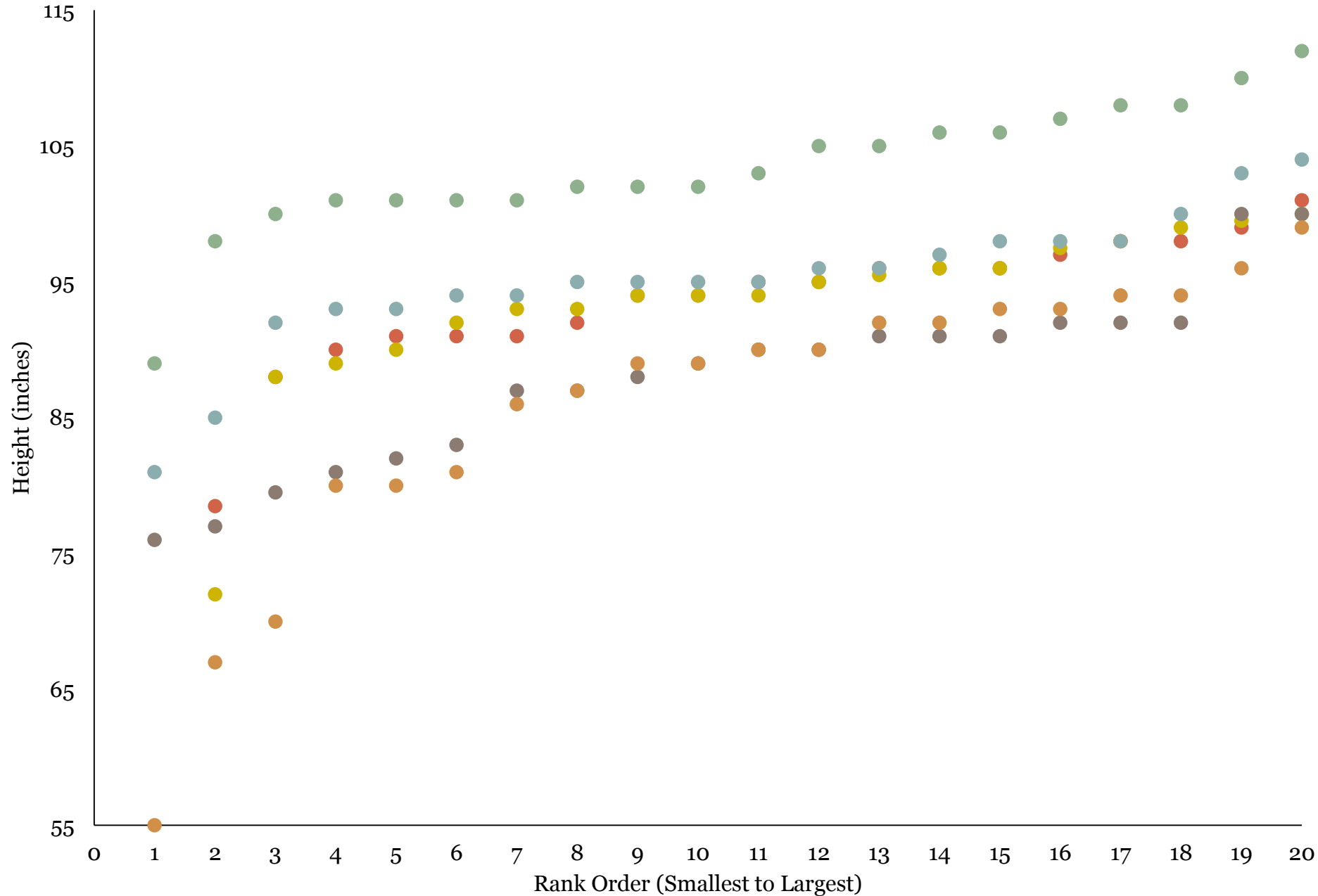
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- MPDs
- Munter Hitches
- Racks-Correctly Used
- Racks-Incorrectly Used
- Scarabs-Correctly Used
- Scarabs-Incorrectly Used
- Figure 8s
- 2 kN



- Munter HIches
- Racks-Correctly Operated
- Scarabs-Incorrectly Operated
- Figure 8's
- Scarabs-Correctly Used
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