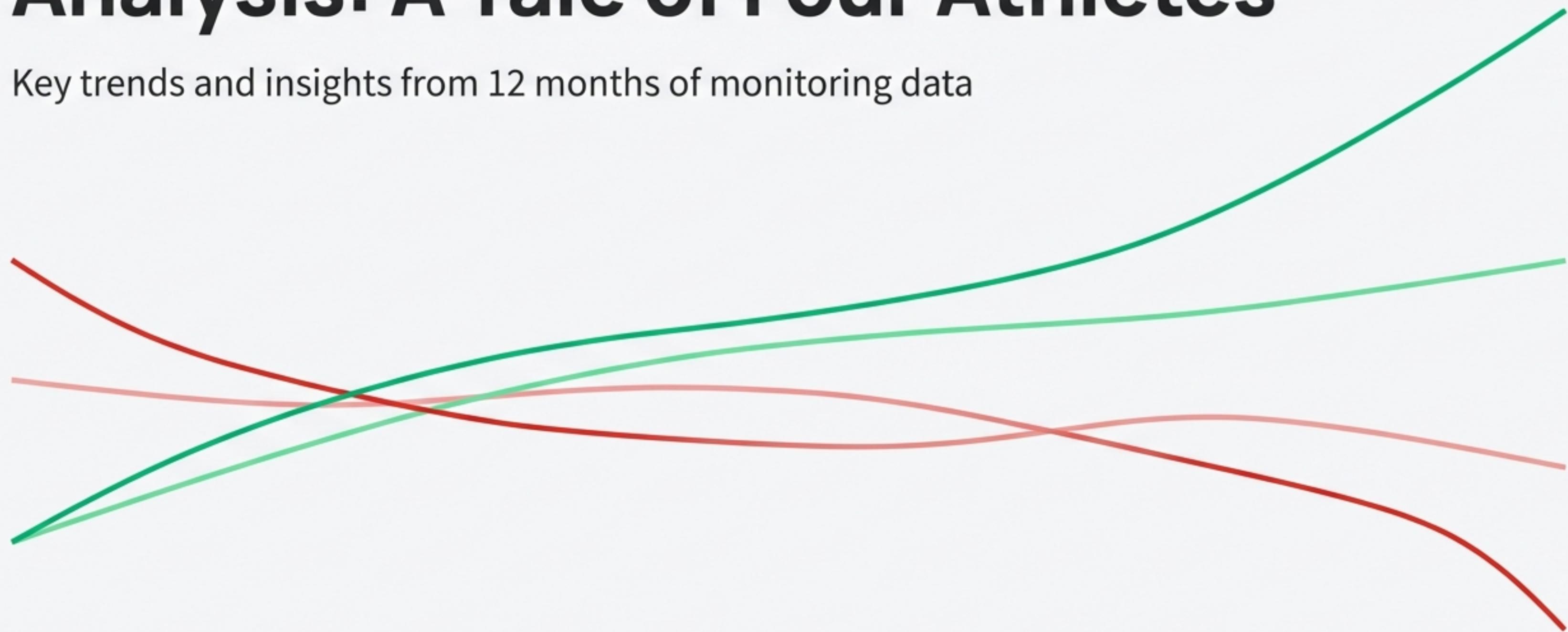


Longitudinal Performance Analysis: A Tale of Four Athletes

Key trends and insights from 12 months of monitoring data



The Analytical Framework: How We Define Performance Changes



Jump Height (m)

Flagging Logic: A drop of $>10\%$ from baseline.

Interpretation: Indicates neuromuscular fatigue or reduced explosive capacity.



Peak Propulsive Power (W)

Flagging Logic: A drop of $>5\%$ across consecutive sessions.

Interpretation: Suggests cumulative fatigue or insufficient recovery.



Peak Velocity (m/s)

Flagging Logic: A drop of $>5\%$ from baseline.

Interpretation: May indicate fatigue; asymmetry can flag injury risk.



Speed Max (m/s)

Flagging Logic: Falling below 90% of personal best.

Interpretation: Suggests suboptimal readiness; taper or recovery is needed.



Distance Total (m)

Flagging Logic: A rise of $>20\%$ above 7-day average.

Interpretation: Exceeding safe load progression increases injury risk.

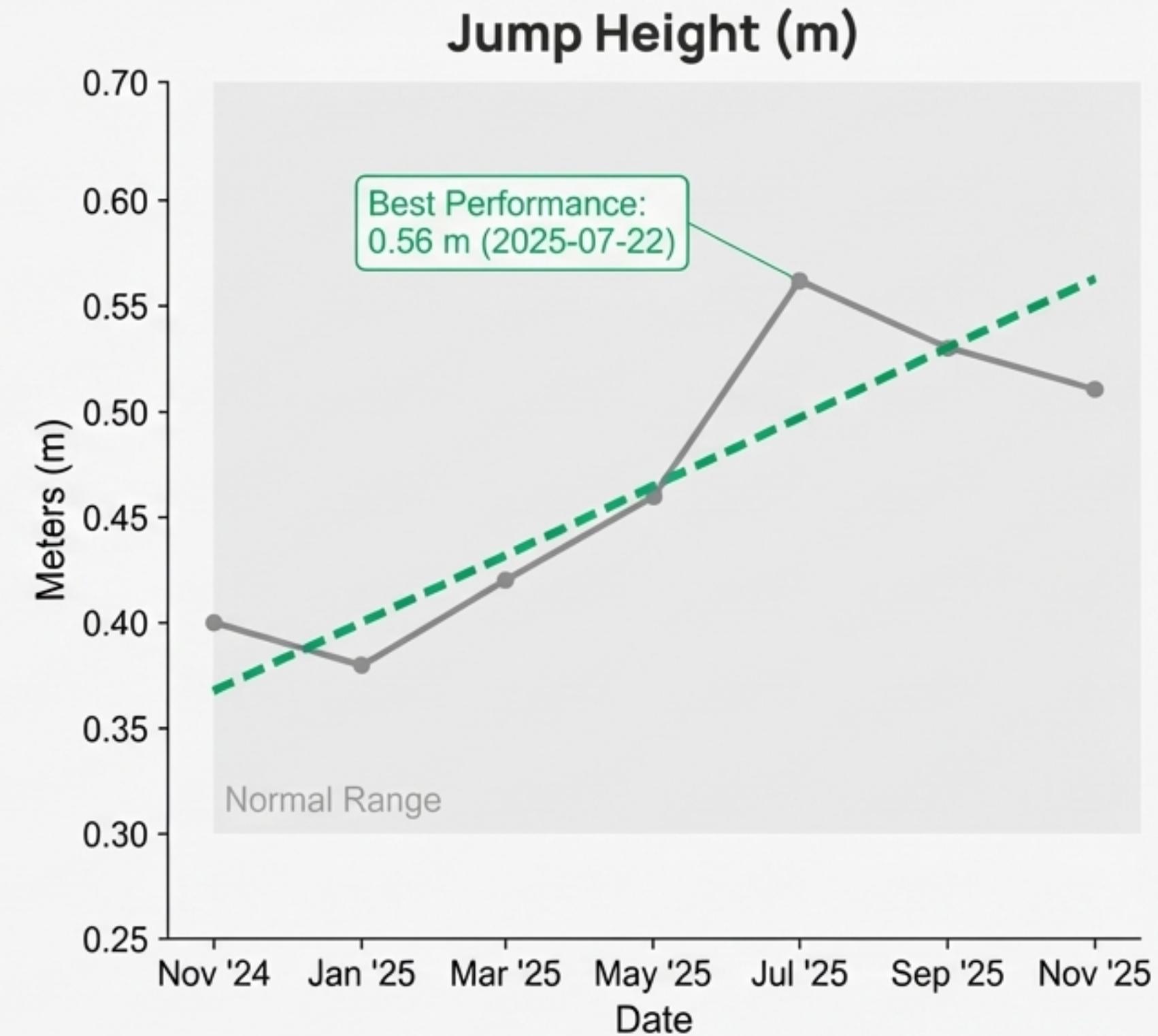
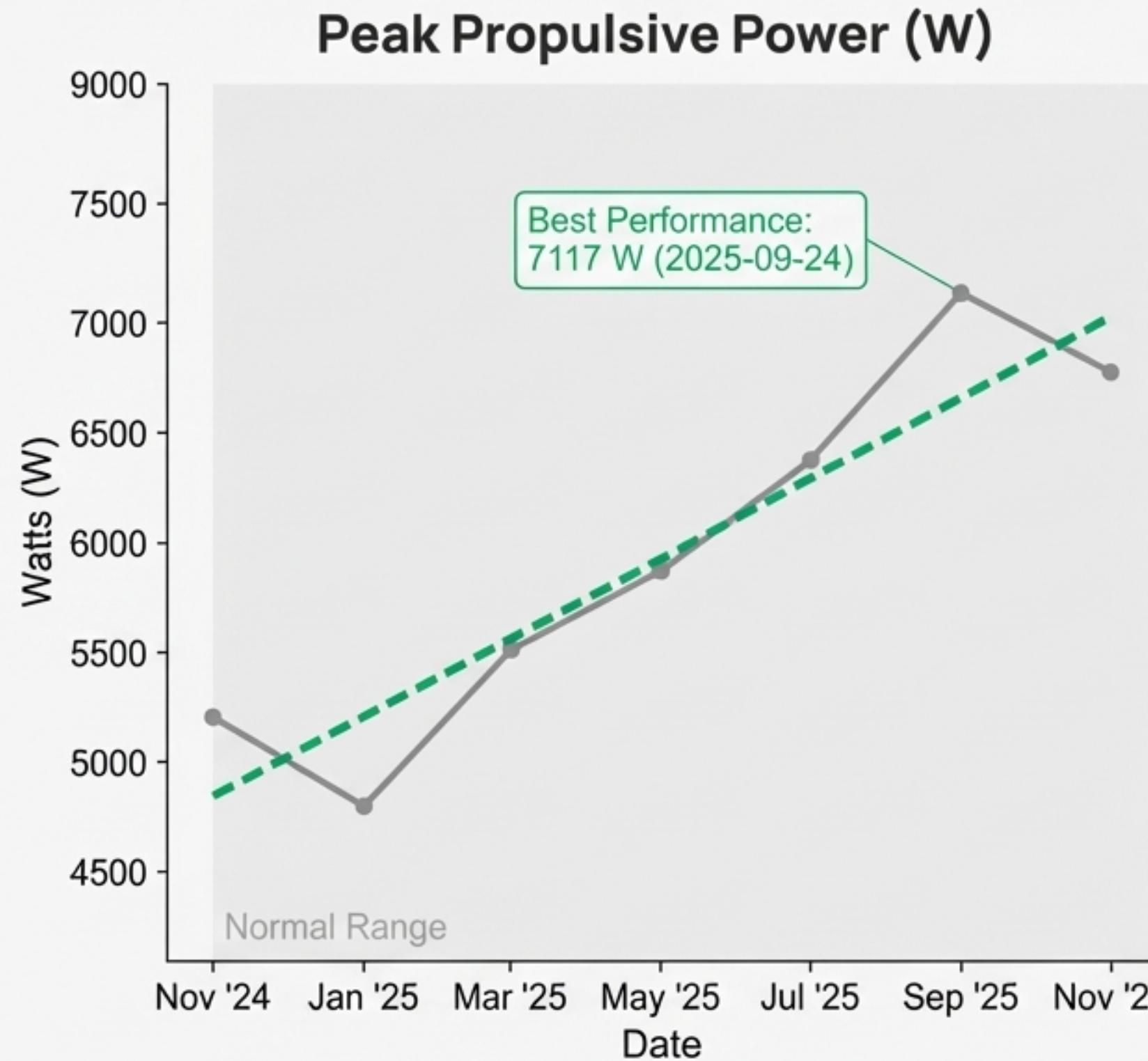
Thresholds and ranges are sport-specific (Men's/Women's Basketball) as per established literature (Markovic et al. 2004; Gathercole et al. 2015; Bourdon et al. 2017).

Case Study 1: Player 995 (Men's Basketball) – Consistent and Statistically Significant Improvement

Key Insight: This athlete shows strong, statistically significant gains in key power and velocity metrics over the last 12 months, serving as a model of positive adaptation.

| Metric | 12-Month Trend | Statistical Significance (p-value) |
|-----------------------|----------------|------------------------------------|
| Peak Propulsive Power | ↑ Improving | 2.139e-07 |
| Jump Height | ↑ Improving | 0.006 |
| Mrsi | ↑ Improving | 0.021 |
| Peak Velocity | ↑ Improving | 0.011 |
| Speed Max | Improving | 0.386 |
| Distance Total | Declining | 0.755 |

Visualizing Success: Player 995's Power and Height Trajectory



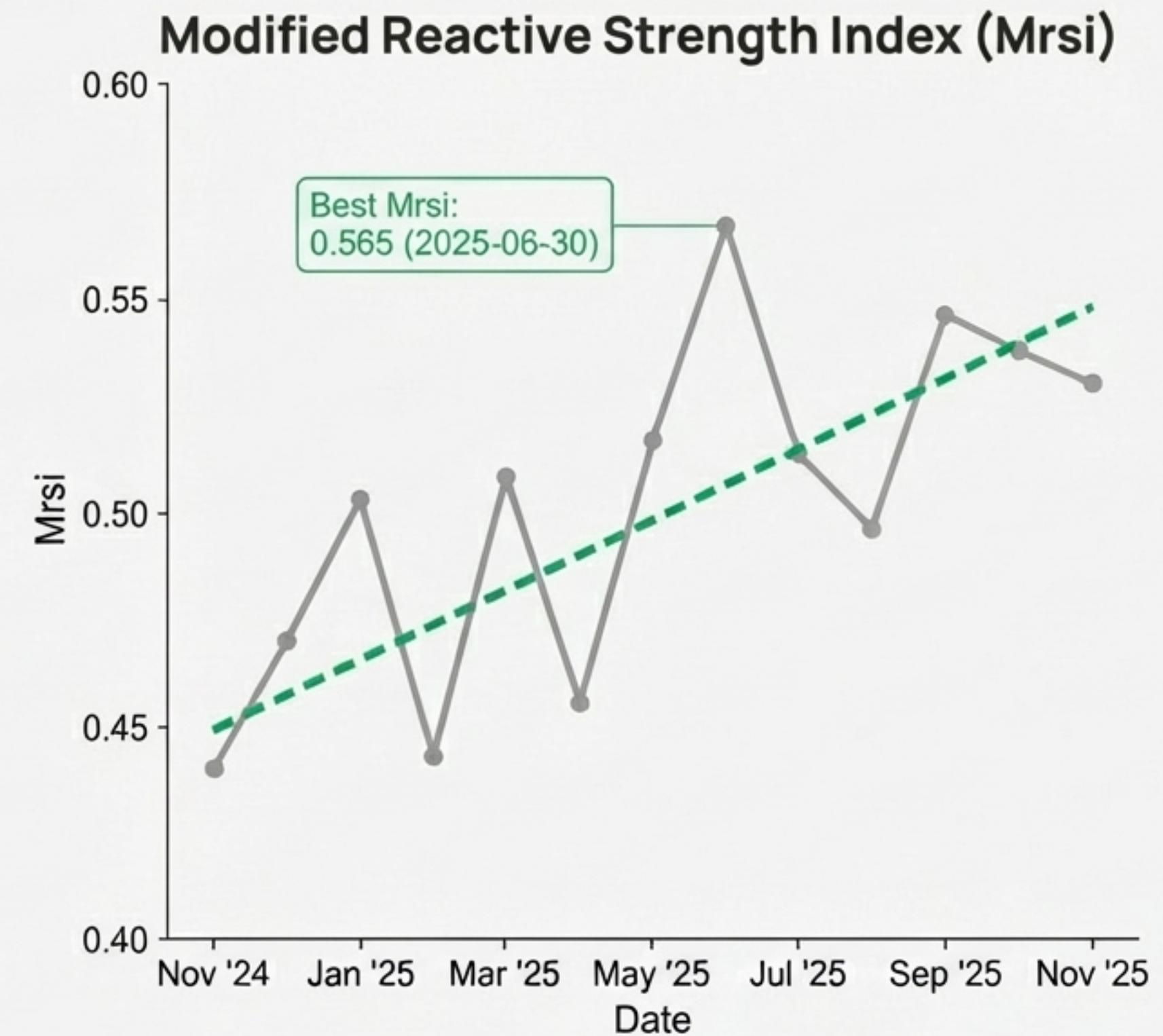
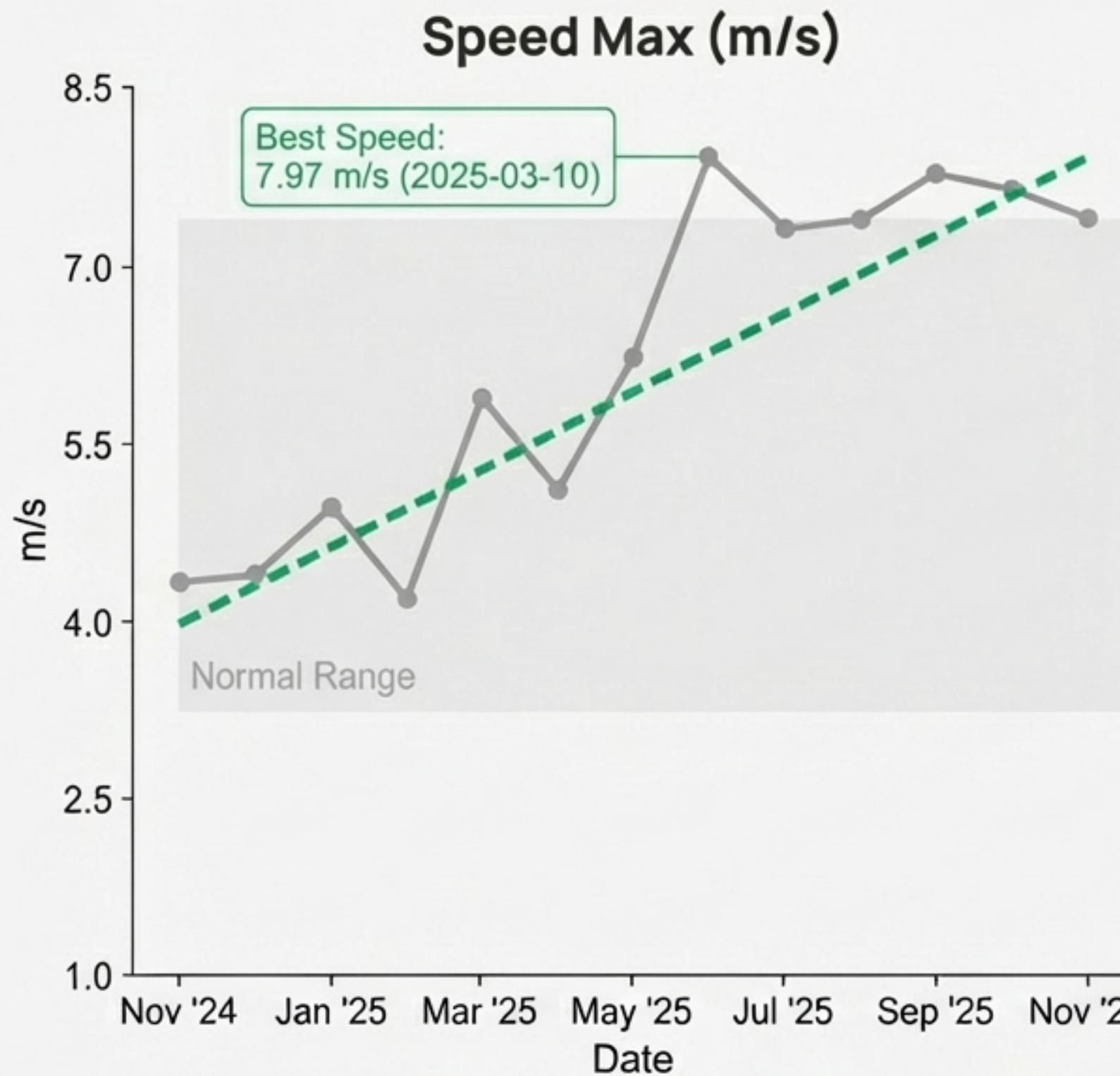
Case Study 2: Player 555 (Women's Basketball) – Broad-Based Gains in Performance Metrics

This athlete demonstrates statistically significant improvements in maximum speed and modified reactive strength, indicating enhanced athletic readiness and explosive capabilities.

| Metric | 12-Month Trend | Statistical Significance (p-value) |
|-----------------------|----------------|------------------------------------|
| Speed Max | ↑ Improving | 0.0017 |
| Mrsi | ↑ Improving | 0.0052 |
| Distance Total | ↓ Declining | 0.0285 |
| Jump Height | Improving | 0.322 |
| Peak Propulsive Power | Improving | 0.899 |
| Peak Velocity | Improving | 0.351 |

**Note: A statistically significant decline in total distance can indicate improved training efficiency or a strategic reduction in volume.*

Player 555's Progress in Speed and Reactive Strength

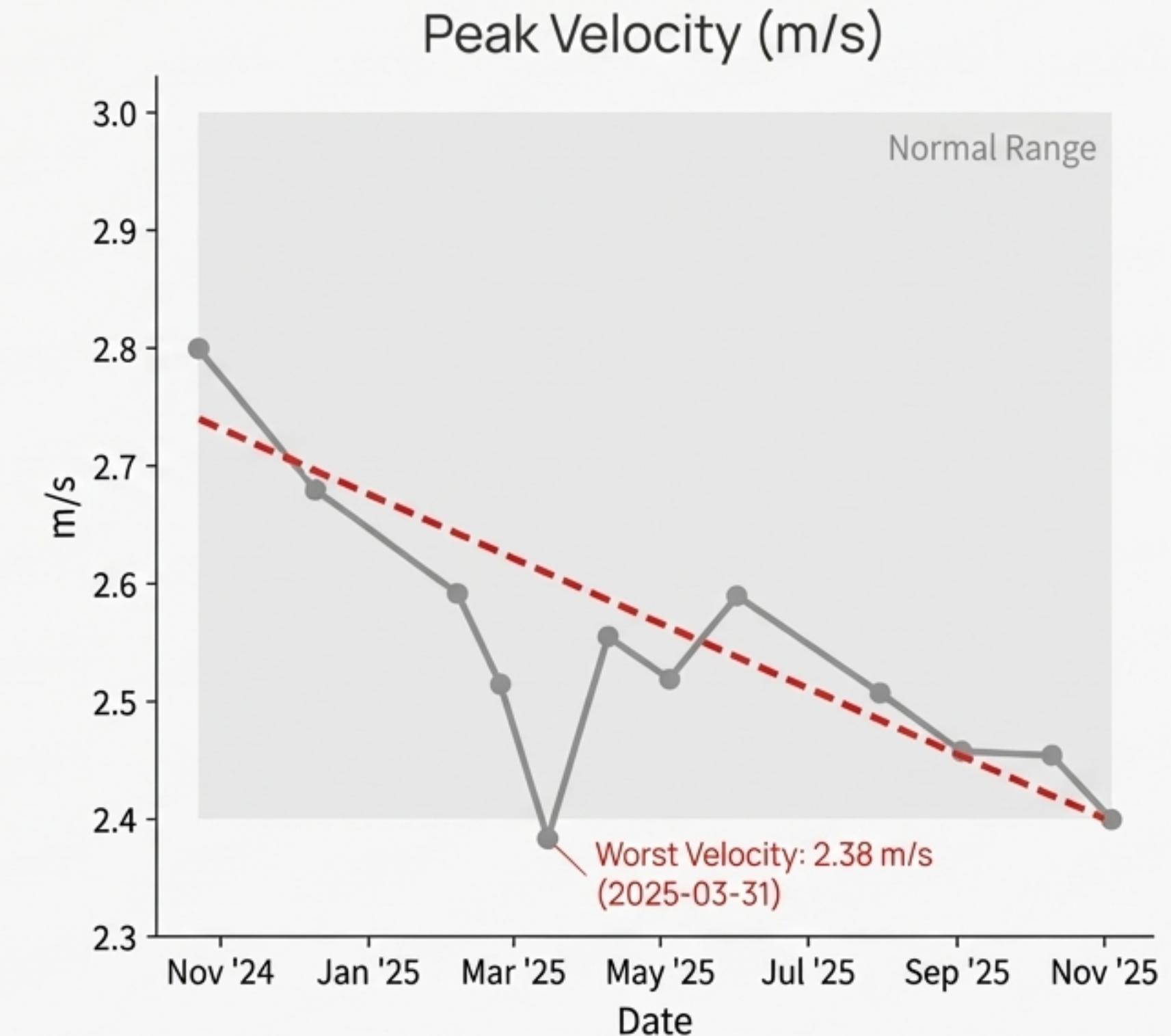
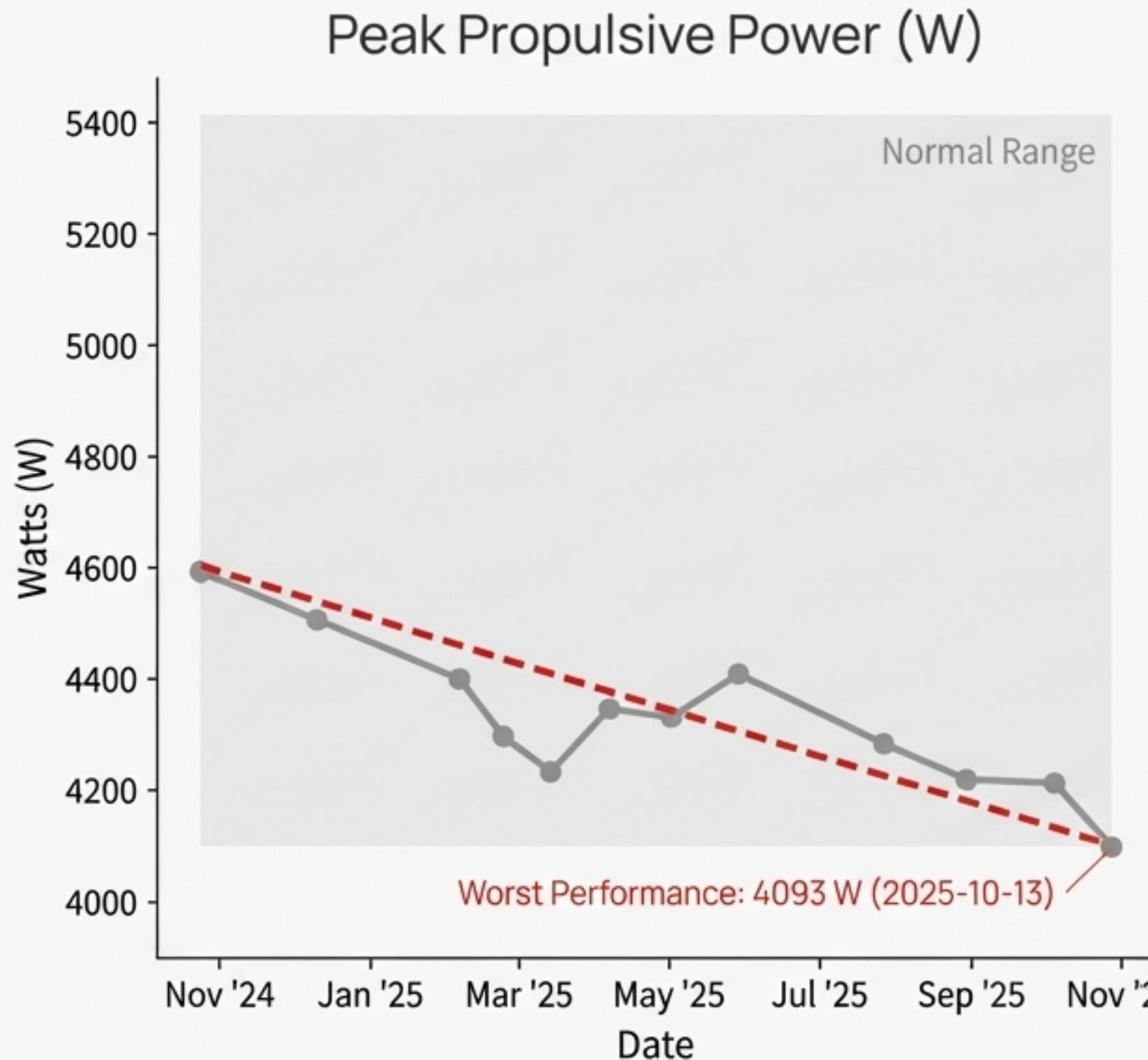


Case Study 3: Player 755 (Men's Basketball) – Declining Power and Velocity Raise Concerns

Significant negative trends in power and velocity, core components of explosive performance, suggest a need for review of this athlete's training load and recovery protocols.

| Metric | 12-Month Trend | Statistical Significance (p-value) |
|-----------------------|----------------|------------------------------------|
| Peak Propulsive Power | ↓ Declining | 0.000047 |
| Peak Velocity | ↓ Declining | 0.0295 |
| Jump Height | Declining | 0.134 |
| Mrsi | Declining | 0.663 |
| Distance Total | Declining | 0.286 |

A Downward Trend: Charting Player 755's Power and Velocity

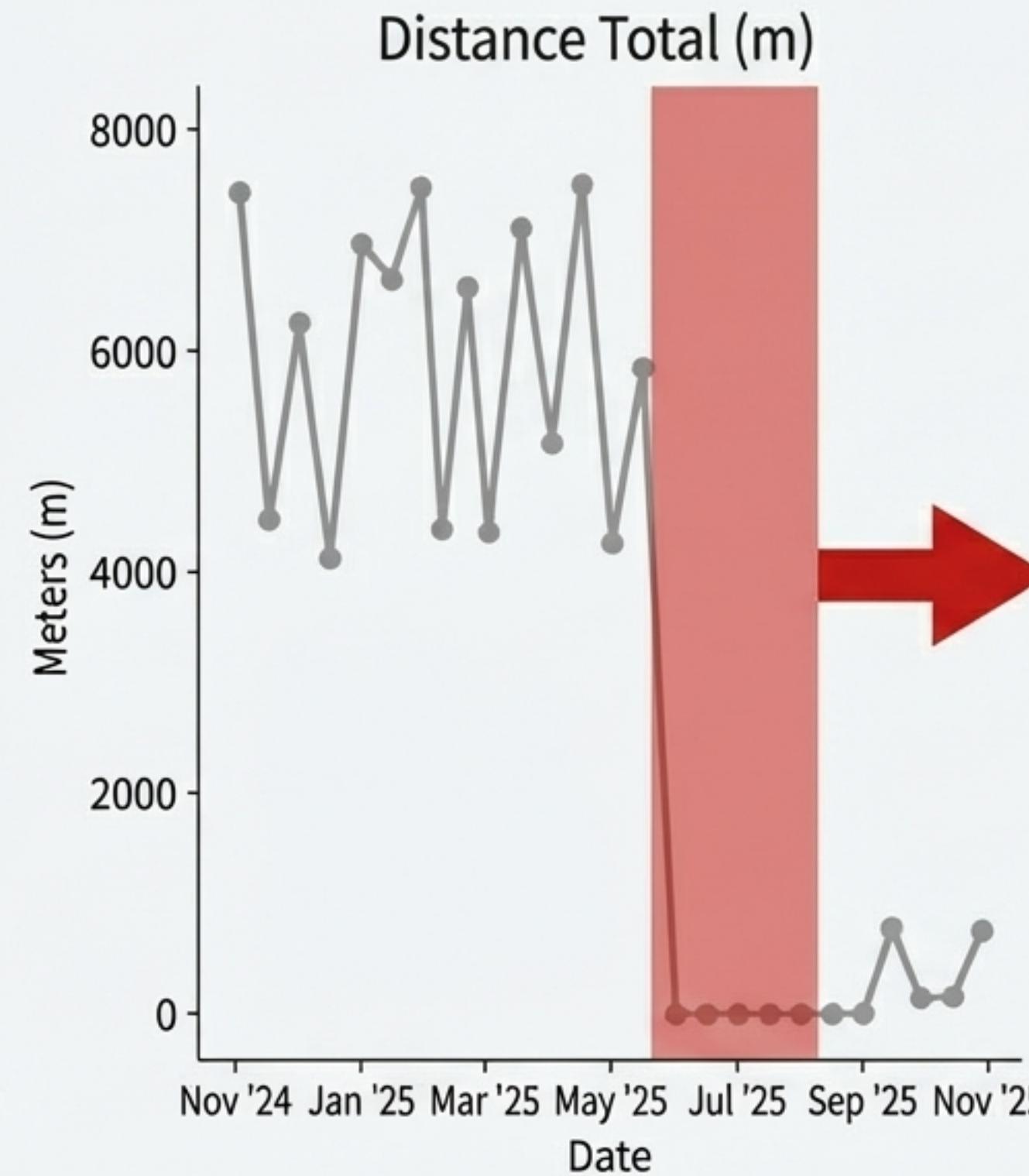
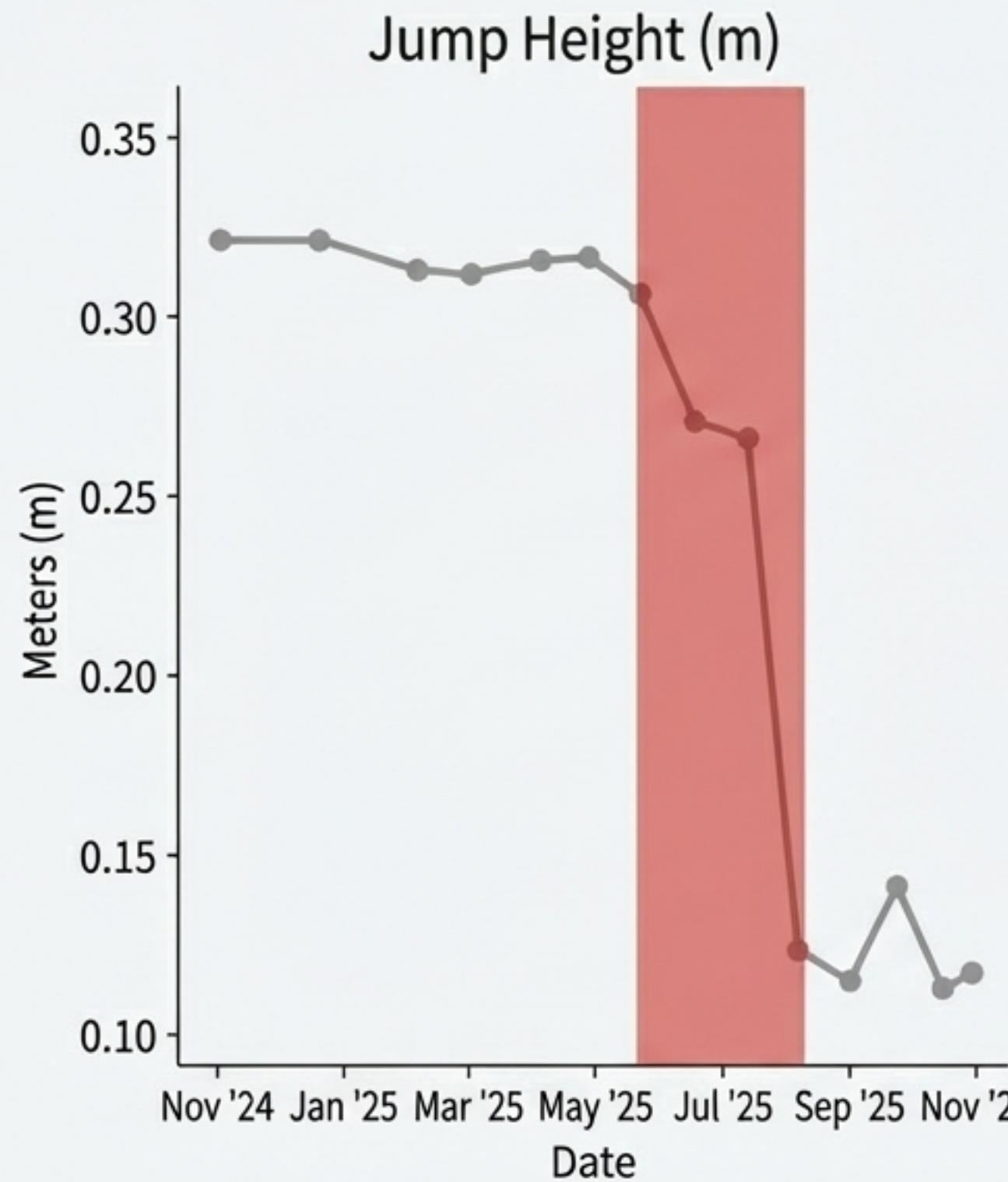


Case Study 4: Player 741 (Women's Basketball) – A Statistically Significant Decline Across All Metrics

This athlete presents a **critical** case, with a **universal, statistically significant performance decline across all monitored metrics**, indicating a **high risk of overtraining, illness, or potential injury**.

| Metric | 12-Month Trend | Statistical Significance (p-value) |
|-----------------------|----------------|------------------------------------|
| Speed Max | ↓ Declining | 1.36e-08 |
| Jump Height | ↓ Declining | 1.08e-04 |
| Peak Propulsive Power | ↓ Declining | 1.37e-03 |
| Peak Velocity | ↓ Declining | 4.60e-04 |
| Mrsi | ↓ Declining | 2.18e-03 |
| Distance Total | ↓ Declining | 3.99e-04 |

The Red Flag: Visualizing Player 741's Performance Collapse



CRITICAL EVENT:
Multiple 'worst performance' dates for power, velocity, and jump metrics cluster on **August 21, 2025**, preceded by a significant data gap. This pattern strongly suggests a major event such as an injury or extended illness requiring immediate investigation.

Four Athletes, Four Trajectories: A Comparative View



Player 995 (Improving)



Player 741 (Critical Decline)

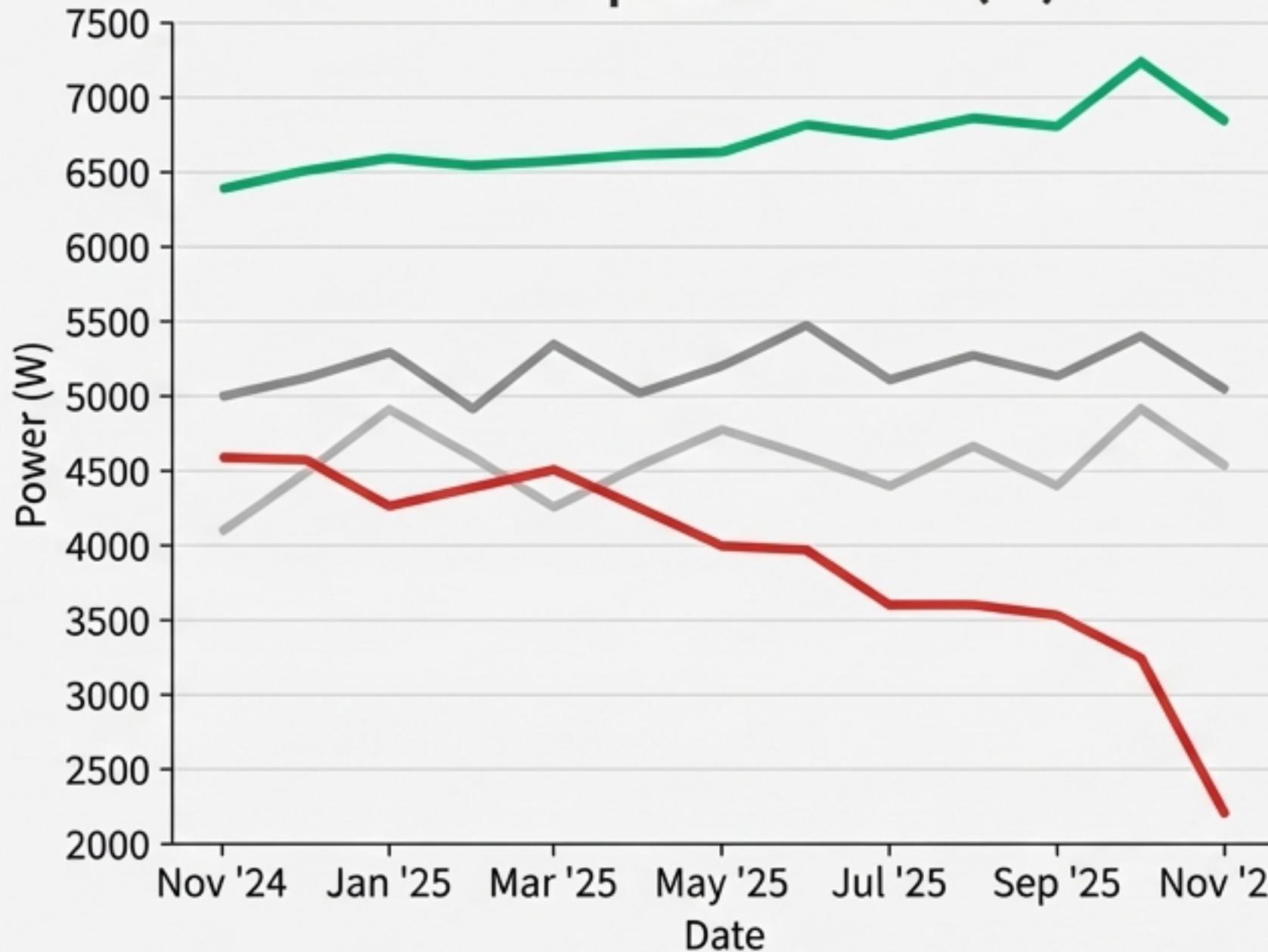


Player 555

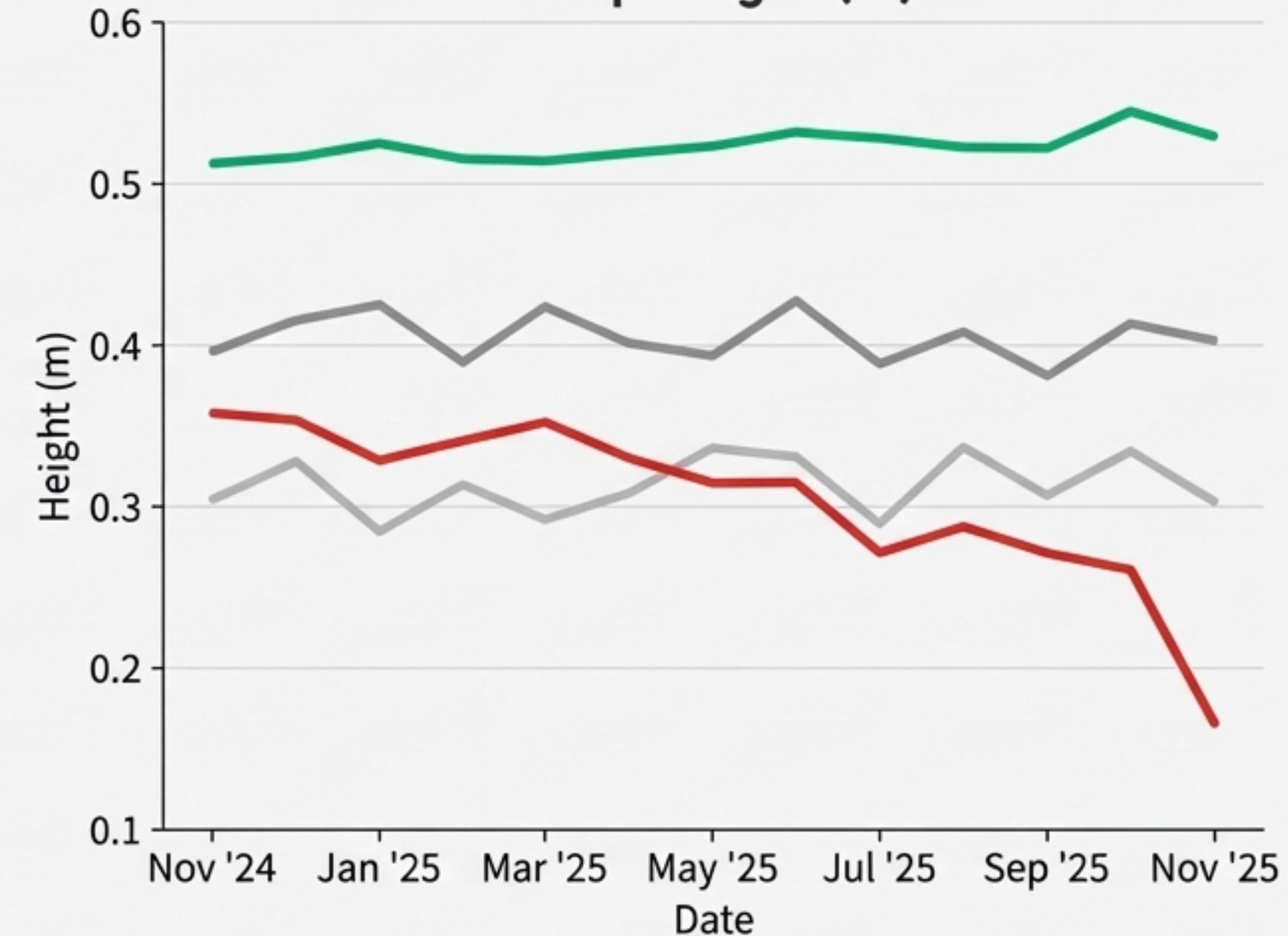


Player 755

Peak Propulsive Power (W)



Jump Height (m)



The visual separation in performance is stark. Player 995 consistently operates at a higher level, while Player 741's output collapses over the same period.

Key Findings from the Longitudinal Analysis

1. Positive Adaptation

Player 995 exemplifies a successful training response, showing statistically significant improvement in explosive power and velocity. This profile can serve as an internal benchmark for effective program design.

2. Early Warning Signs

Player 755's significant declines in power and velocity are clear warning signs. While not yet critical, these trends warrant an immediate review of training load and recovery to prevent further negative adaptation.

3. Critical Urgency

Player 741 presents a critical case. The universal and statistically significant decline across all metrics requires immediate intervention to mitigate injury risk and address potential root causes like overtraining or illness.

From Insight to Action: Recommended Next Steps



Immediate Intervention (Player 741)

- Conduct a full multidisciplinary review (medical, coaching, psychological).
- Develop a revised, recovery-focused program with adjusted load and intensity.



Proactive Adjustment (Player 755)

- Analyze recent changes in training load, sleep, and nutrition data.
- Implement a strategic deloading period and monitor key key metrics for positive response.



Program Replication (Player 995)

- Identify the key training protocols and recovery modalities contributing to Player 995's success.
- Assess the feasibility of applying these principles to other athletes' programs.

Analytical Methodology

Data Sources: Hawkins Dynamics Force Plates (Jump Height, Power, Velocity, Mrsi), Kinexon GPS (Speed, Distance).

Time Period: Analysis covers 12 months of athlete data from November 2024 to November 2025.

Trend Analysis: Simple linear regression was used to determine the slope and direction of performance trends over time for each athlete-metric pair.

Statistical Significance: A p-value of < 0.05 was used as the threshold to determine if an observed trend was statistically significant.

Project Context: This analysis fulfills the requirements of the “Part 3: Longitudinal Analysis & Visualization” assignment.

Questions & Discussion