

# TAKING EXERCISE CONDITIONING PAST CONVENTIONAL BOUNDARIES

Extension of Physical Performance Beyond the Potential of Traditional  
Approaches

Robert P. Garner, Ph.D.

Odyssey II Solutions

Information provided concerning a non-Department of Defense (DoD) website, product or services does not imply or constitute DoD endorsement of any websites, products or services. Any opinions, findings, conclusions, or recommendations expressed in this non-DoD material are those of the author(s) and do not necessarily reflect the opinions of the United States DoD.

**DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.**

# GENERAL OVERVIEW

- Focus herein might be considered analogous to a case study on performance
  - The mechanisms of molecular and systemic adaptations would deserve presentations specific to context
- Specific approach herein referenced as Altitude Hypoxia Training (AHT)
  - Distinguish from Intermittent Hypoxia Training (IHT) that has often been used and is more generic

# BRIEF BACKGROUND INFORMATION

- Garner, RP, Powers, SK, & Church, G. **Effects of hypoxia and hyperoxia on ventilatory kinetics during recovery from exercise.** *Aviat. Space Environ. Med.* 57: 1165-9, 1986.
- Hudgins, CB, Garner, RP, Mandella, JG & Murphy, RE. **Cognitive performance changes as a result of exposure to various levels of low altitude hypoxia.** *Aviat. Space Environ Med.* 69:238, 1998.
  - Impact of cycle ergometry and altitude exposures of 8-15kft on a cognitive performance test battery.
- **Certification for portable oxygen delivery system using alternative gas delivery technologies.**
  - Proprietary study for certification basis of 787 system (circa 2008) at 13kft and subsequently updated to 14kft in 2018 and 2019. Leveraged exercise responses to altitude as a basis for equivalence.

# TRAINING ROUTINES OVERVIEW

- General characterization of workouts or training
  - Physiological adaptation
  - Specificity of training
  - Endurance
  - Strength
- Concept that altitude (hypoxia) exposures can facilitate adaptations

# THE EXERCISE AND OXYGEN INDUSTRIES

- Cyclic Variations in Adaptive Conditioning (CVAC)
- Exercise with Oxygen Therapy (EWOT)
- Live O2, Maxx O2
- Oxygen Multi-Step Therapy (von Ardenne)
- Various physicians, health/exercise professionals

**Common Characteristic: Long on theory and correlational data but short on truly quantitative results**

# WHAT IS IN THE EVIDENCE

- IHT has become very popular
- Belief that IHT would potentiate greater performance improvements than sea level equivalent training
- “...*functional translation in terms of whole-body performance enhancement is minimal.*”
- Extensive body of research and associated publications

Advancing hypoxic training in team sports: from intermittent hypoxic training to repeated sprint training in hypoxia Faiss R, et al. *Br J Sports Med* 2013;47:i45–i50

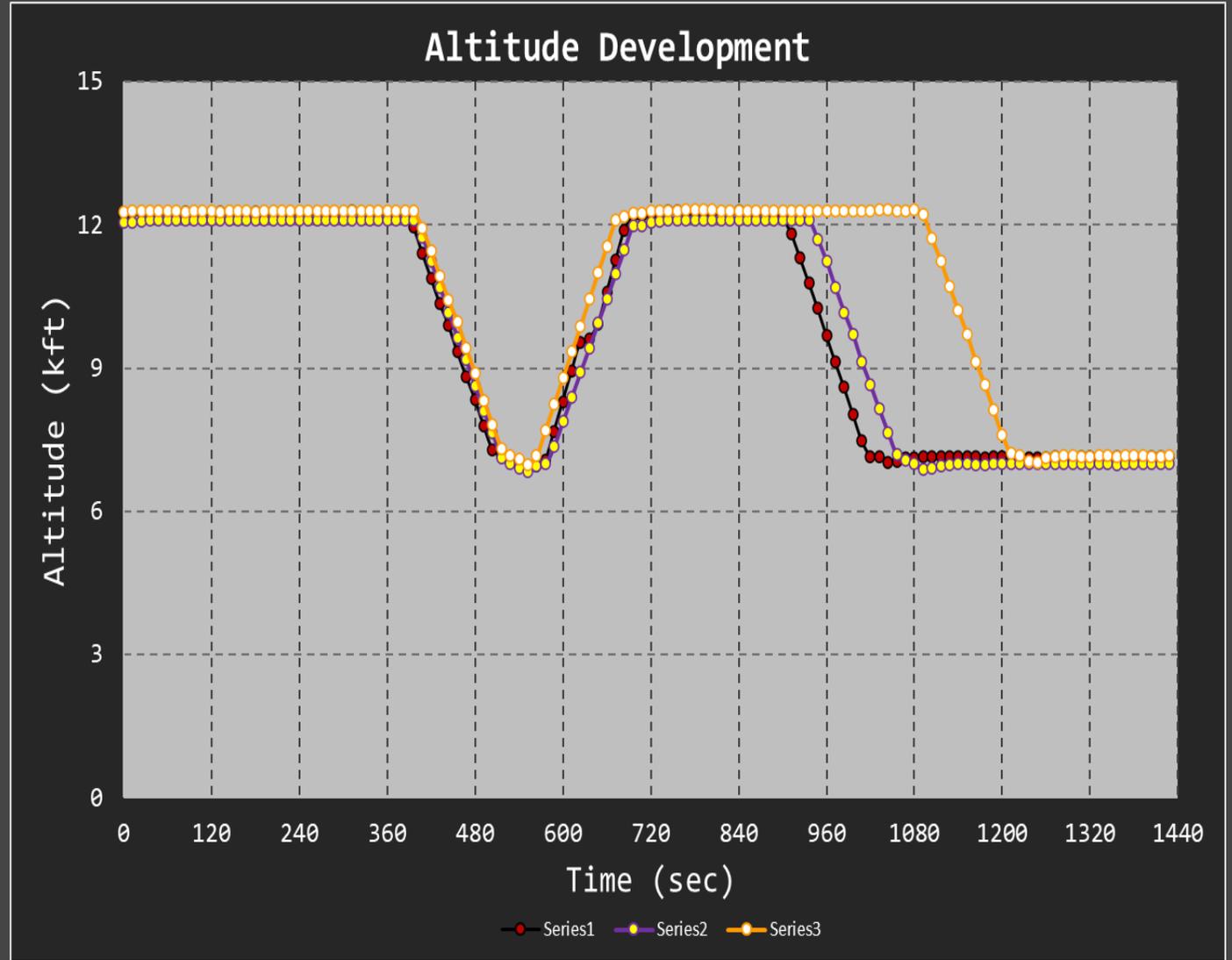
# BASIS OF DEVELOPMENT

- “...*the characteristics of optimal training stimulus in hypoxia are still unclear*”
- The modality is important
  - “*specificity of training*”
- AHT approach built on experience in exercise sciences and human exposure over a range of altitudes (5k-45k feet)
- Leverages variations in workload at altitude as a function of aerobic capacity ( $V_{O_2}$  max) and anaerobic threshold (AT)

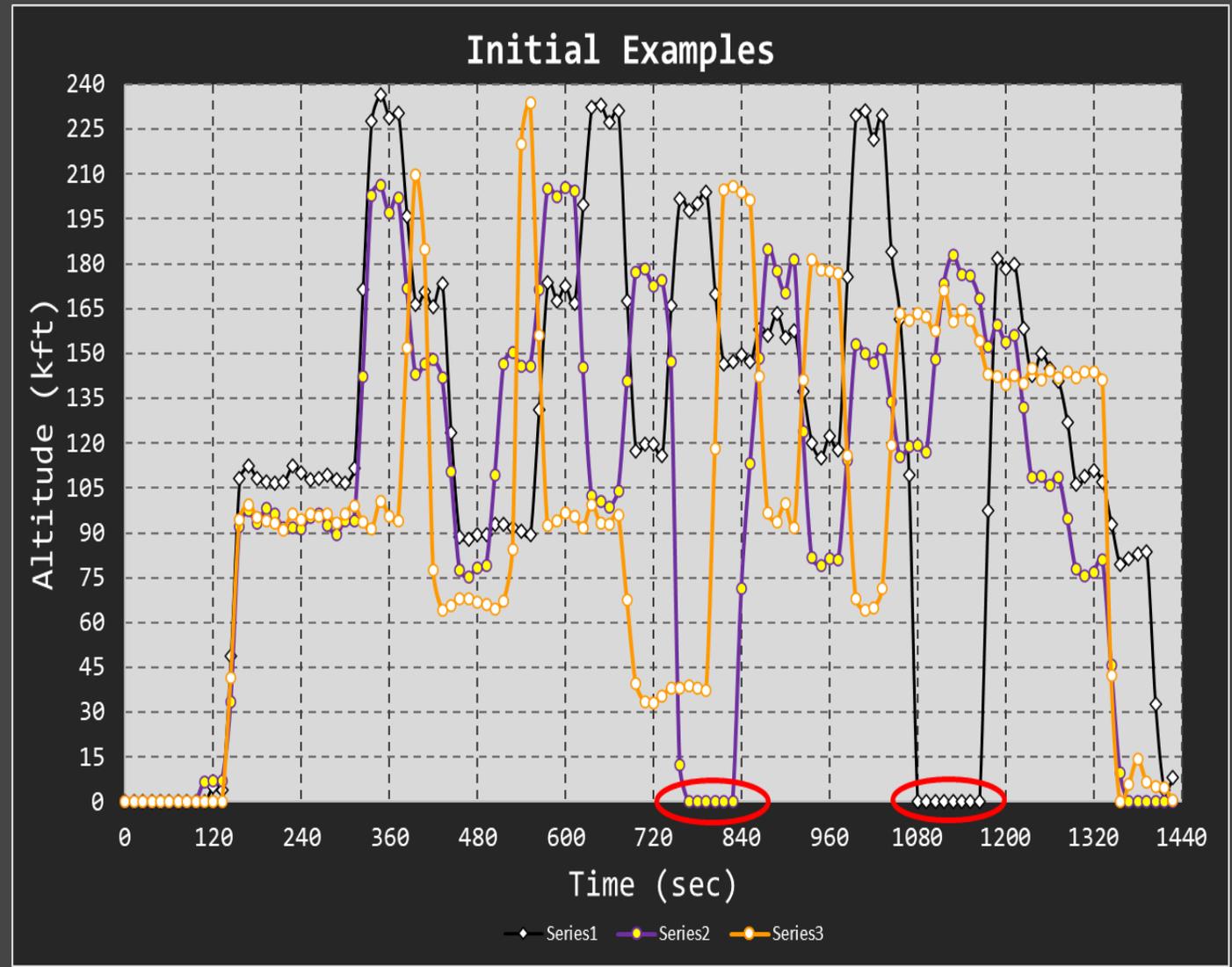
# KEY POINTS OF ALTITUDE EXPOSURE

- Minimize known risk factors
  - Barotrauma
  - Decompression Sickness
  - Other Pressure Issues
- Inherently challenging
- Not incapacitating
- Variation presents a complex challenge to elicit stronger adaptive responses
  - Timeframe consistent with allowing feedback and associated responses

# THE ALTITUDE EXPOSURE



# INITIAL WORK RATE DEVELOPMENT



# INITIAL WORK RATE DEVELOPMENT T



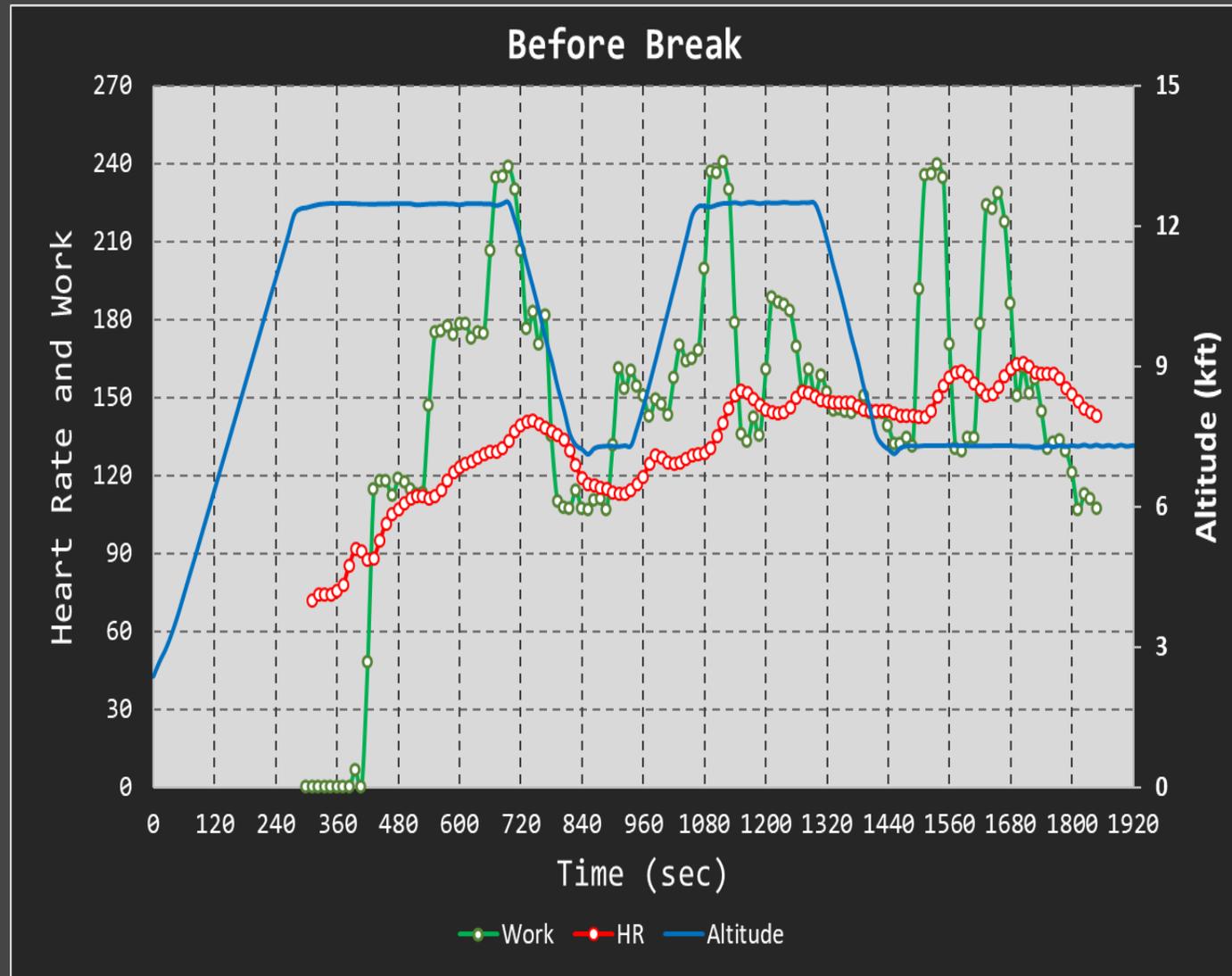
# HOW TO DEMONSTRATE EFFECTIVENESS

- Limited resources
  - Number of people
  - Control groups
- Fitness Levels
  - Sedentary: anything elicits improvement
  - Active: interaction of activities
    - Potential synergistic effects
- Highly Trained / Conditioned
  - Harder to elicit changes

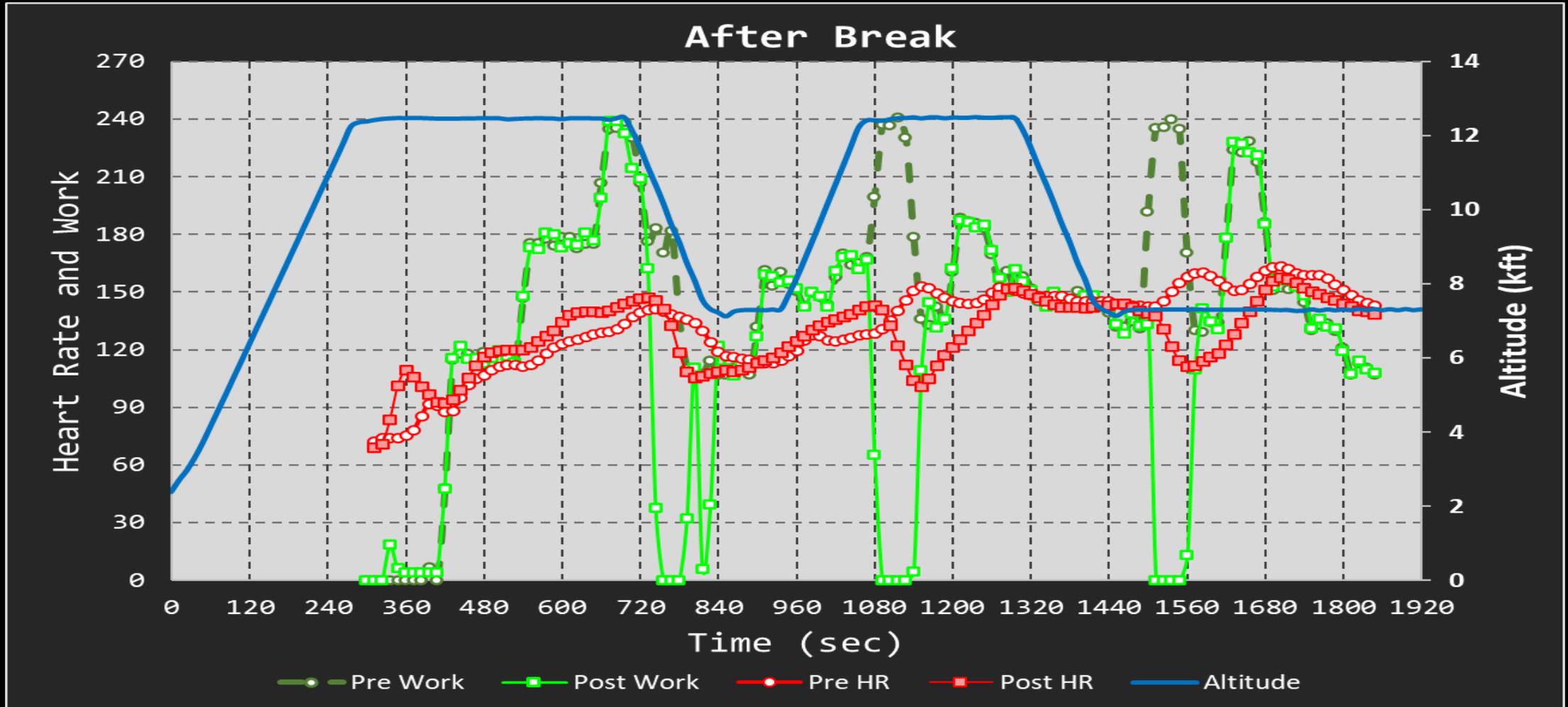
# INVESTIGATE OPPORTUNITIES AVAILABLE

- Professional Athlete interested in Altitude Training
  - Competitive heavyweight fighter (8-1)
  - Age 29, 6'2" at 265lb
  - $V_{O_2}$  max 43.2 mlO<sub>2</sub>/kg/min
  - AT 27.2 mlO<sub>2</sub>/kg/min
- Work rate based on preliminary evaluations
- AHT done in addition to normal training
- Original comparison was going to be magnitude of changes in  $V_{O_2}$  and AT before and after training that included AHT<sup>2</sup>
- Fortuitous
  - AHT break after a few weeks training

# INITIAL ALTITUDE TRAINING



# RETURN TO AHT



# RETURN TO AHT

- Unable to maintain work that was previously able to perform while training under AHT protocol
- Normal training routines associated with professional athletic endeavor continued in interim
- Heart rate response was elevated at identical workloads and altitudes

Suggests that AHT was facilitating performance capabilities beyond what normal training methodologies were eliciting

# NEXT STEPS

- Additional people
  - Highly trained
  - Various Fitness Levels
- Specific training regime
  - 2x / week
  - Minimum 2 days between sessions
- Integration or comparison with ongoing training routines
- More precisely characterize performance parameters

# PARAMETERS TO MONITOR

- Chamber time and support
  - Sessions take ~1 hour, entry to exit
  - Monitoring, supplies, adjustment over time
- Higher resolution resources for evaluation
  - $V_{O_2}$  max and AT, pulmonary function
- Monitoring during training
  - Respiration
  - Lactate (sporadic)
  - Gas exchange (sporadic)
- Monitoring across training sessions
  - Basic blood markers



**QUESTIONS**  
**?**