

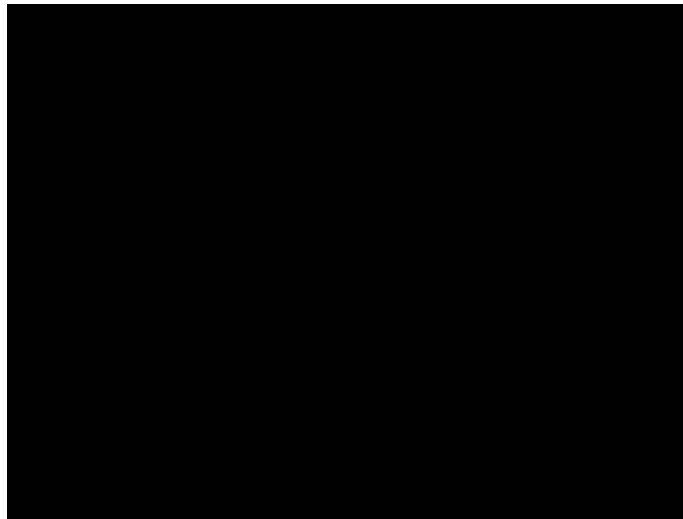
# Mäestikutreening

Harry Lemberg  
Tartu Ülikool

Jõulumäe

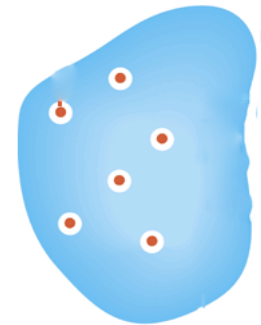
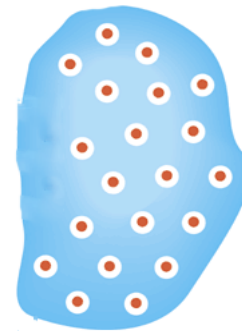
2013

# Siit see algas....



1968 Olympic 1500m Final

Hapniku  
mere ta:



# Ajalugu ...

- \* Early studies reported improved running performance and increased aerobic capacity at sea-level (SL) after training at altitude
  - \* Balke, 1964; Balke et. al 1965; & Faulkner et. al 1967
- \* Effects attributed to significant training adaptations that occurred during the experimentation
  - \* Faulkner et. al 1968
- \* Effects of equivalent sea-level and altitude training on VO<sub>2</sub>max and running performance
  - \* Adams WC, Bernauer EM, Dill DB, & Bomar JB, 1975.

# MEXICO 68



# Aklimatiseerumine

- \* Aklimatiseerumine tähendab harjumuspärastest erinevate kliima – ja keskkonnatingimustega kohanemist.
- \* Temperatuur
- \* Niiskus
- \* Ajavahe
- \* **Kõrgus merepinnast**



# Cameron Highlands

Pahang, Malaysia

1,500m above sea level

26-28 July 2013

Limited to 40 Participants



## ALTITUDE TRAINING AND ATHLETIC PERFORMANCE



RANDALL L. WILBER

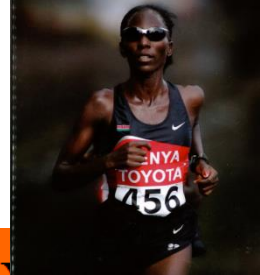
Altitude Running Training  
The A.R.T. Of Running

Altitude Training & Team Sports Conference  
24 & 25 March 2013



### MORE FIRE

How to Run the Kenyan Way  
Toby Tanser



Sky High TRAINING

SKY HIGH TRAINING COLORADO

AltitudeTrainingCamps.com

High Altitude Training  
Falls Creek  
Sat & Sun  
12th & 13th April 2013

High Altitude Training Camps

## RUN TO WIN

© Springer Verlag 1998

ing for sea-level endurance

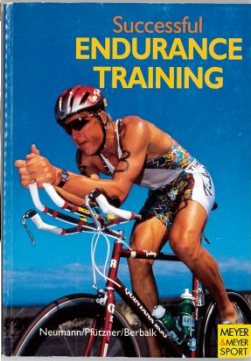
Adharanand Finn

## RUNNING WITH THE KENYANS

Discovering the secrets of the fastest people on earth



Successful ENDURANCE TRAINING



TRAINING SECRETS OF THE KENYAN RUNNERS



It was characterized by a 30% increase in the number of erythrocytes and corresponding hemoglobin during the altitude exposure, and low methemoglobin levels were diagnosed with infectious mononucleosis being their most common diagnosis. In Group mean hemoglobin concentrations at rest decreased by 1.6 or 14.1 g/dl ( $P < 0.001$ ) after 3 weeks of altitude, which may have been influenced by the increased volume of red blood cells.

**2 weeks Hypobaric hypoxia - Infectious mononucleosis.** Plasma glutamine immunoprecipitation

**Conclusion**  
Adaptation to a reduced respiratory partial pressure (hypobaric hypoxia) involves metabolic and endocrinologic adaptations that influence oxygen transport and utilization. Some adaptations may facilitate endurance during hypoxia, but others may be maladaptive. In high altitude, human studies have demonstrated that hypobaric hypoxia or normobaric hypoxia per se is insufficient for increases in blood hemoglobin (Hb) concentration (Shapiro, 1962), except when combined with exogenous erythropoietin (EPO) administration (Knapik et al., 1971; Armstrong et al., 1981; Fry et al., 1981; Fry and Robinson, 1981). In a study by Fry et al. (1981), one of five long and well-trained male triathletes (one of five long and well-trained male triathletes) who had been living at sea level for 1 year, the effects on sea-level performance of 12 weeks of altitude training on sea-level performance have been compared without a hypoxia-matched control group tested in normoxia. In the 11 controlled investigations, only 4 have reported performance-enhancing benefits (Bishop, 1987; Fry et al., 1981; Fry and Robinson, 1981; and Fry et al., 1981).

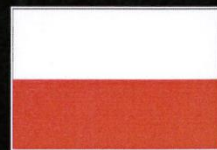
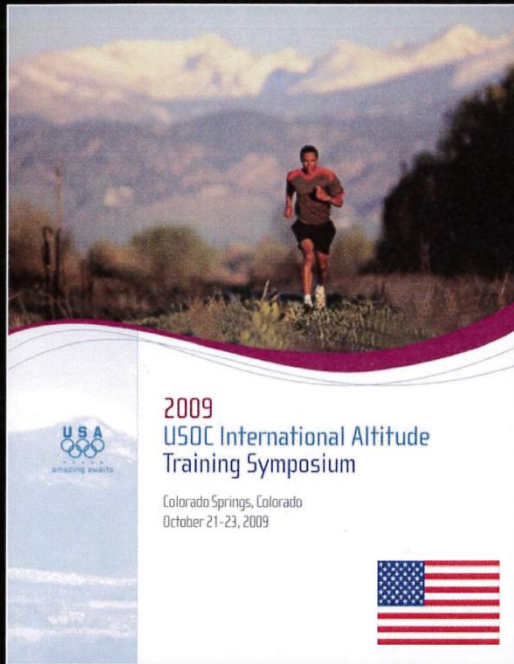




# USOC International Altitude Training Symposium

21-23 October 2009

Colorado Springs



# Hapnik!

Vastupidavuse tähtsaim mõõt hapniku tarbimisvõime, mis on seotud organismi hingamise – ja vereringeelundite seisundiga.

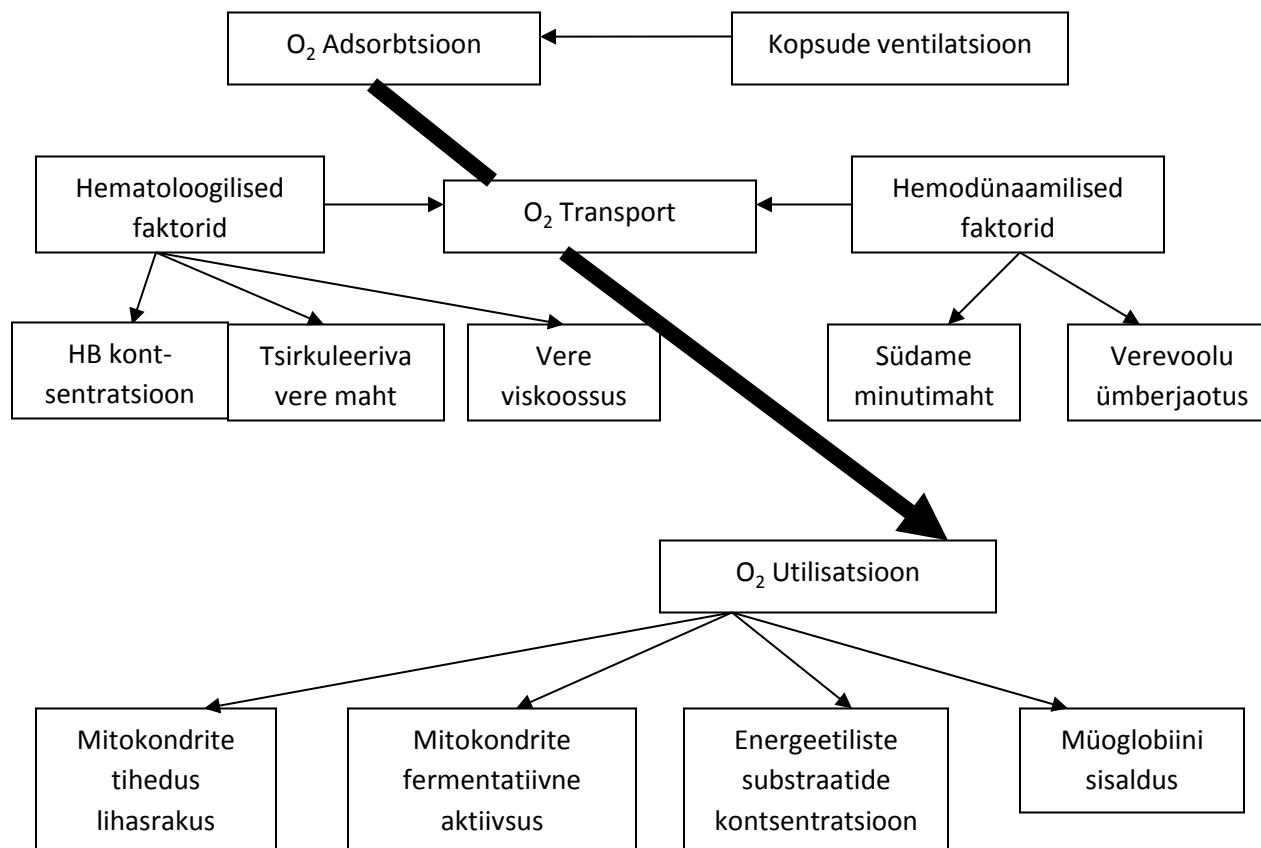
## Hapniku tarbimisvõime koosneb kolmest tegurist:

- \* Südame löögivõimest (löögisagedus X löögimaht)
- \* Kopsumahust
- \* Lihaste võimest kasutada hapnikku
  
- \* *Hapnik liigub kehas, mis on heas vormis.....*



# Hapniku kaskaad

J. Verhošanski 1988



# Mäestik ja hapnik

- \* Hapnikuvaegus - hapniku osarõhu langus

- \* Atmosfääri rõhk merepinnal

- 1) merepinnal keskmiselt 769mm elavhõbedasaamast (mmHG)
- 2) hapnik 20.93%, süsihappegaas 0.03%, lämmastik 79.04

- \* Mäestkus

- 1) 2000m kõrgusel keskmiselt 600mmHG
- 2) 2000m kõrgusel hapnik 16.1%

*Koos üldise atmosfääri rõhu vähenemisega kõrguse suurenedes, väheneb erinevate gaaside, sealhulgas hapniku osarõhk*

*Õhu temperatuur ja niiskus. Temperatuur langeb keskmiselt 1°C võrra iga 150 - 200m kohta Päikesekiirgus.*

# Oluline.....

Aklimatiseerumise üheks tähtsamaks teguriks on vere koostise paranemine

- \* **Erütrotsüüt** ehk **punaverelible** südame -ja veresoondkonna kaudu hapnikku ja süsihappegaasi transportiv vererakk
- \* **Hematokrit** on vererakkude (punavereliblede) osa vere üldmahust.
- \* **Hemoglobiin** ehk globulaarne **kromoproteiin**(lühendatult **Hb**) on punastes verelibledes ringlev valk (hingamispigment), mis sisaldab rauda ning seob ja transpordib hapnikku
- \* **VO<sub>2</sub> max**  
*Suurimat hapniku hulka ajaühikus, mida inimene suudab tarbida intensiivse kehalisel tööl, kui töösse on haaratud suured lihasgrupid*

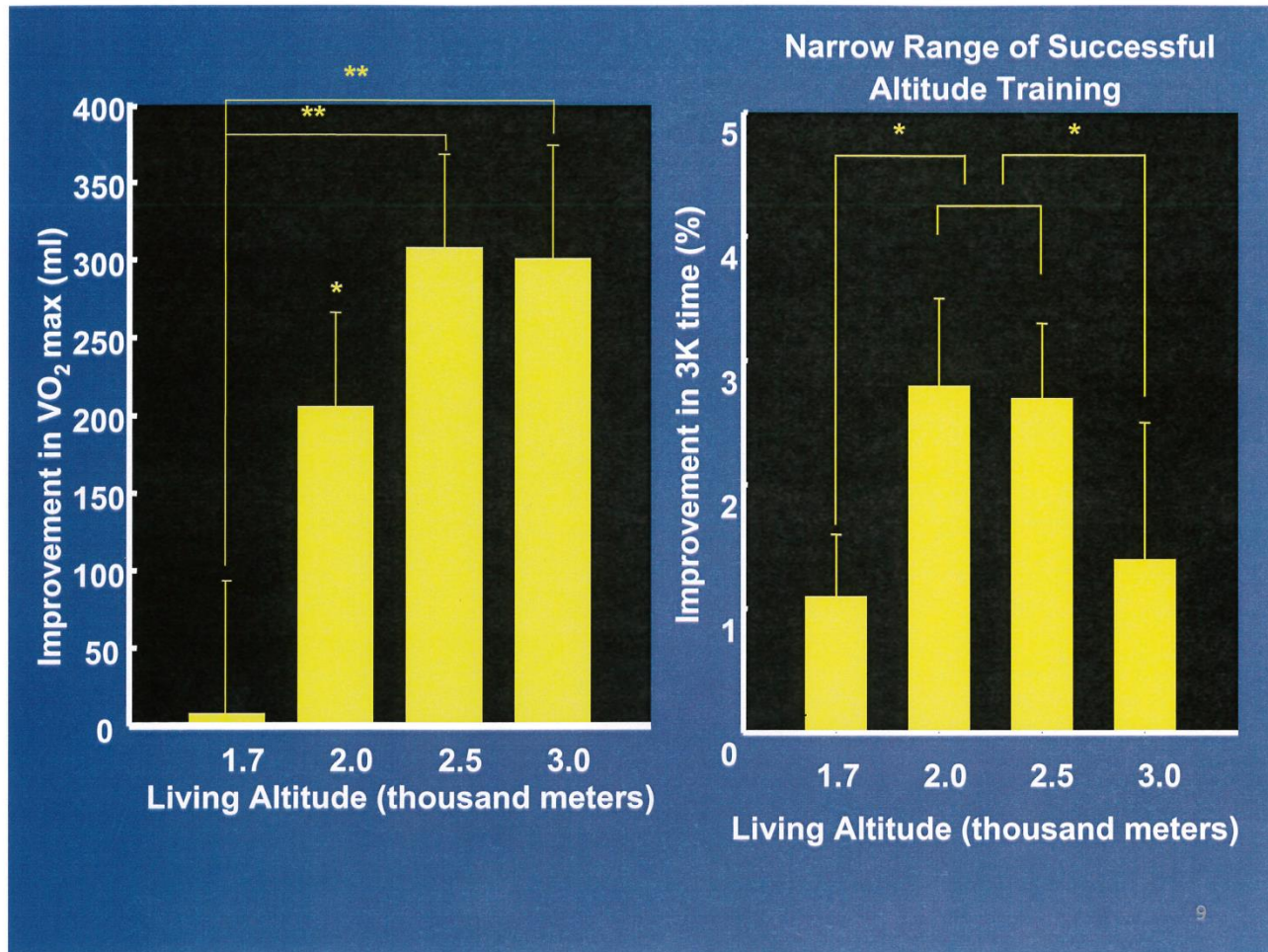
# Organismi reaktsioon mäestikutingimustele

- \* SLS ja LA suhe. Sama LA taseme juures SLS kuni 5 – 7 lööki kõrgem
- \* **LEILA LUIK**
- \* **Puhkeseisund** Ortoproov 3. päev 52/76  
III nädal 42/54
- \* **Kehaline töö** 4. päev SLS 143 ja km aeg 5.11  
III nädal SLS 135 ja km aeg 5.07
- \* Taastumisaeg pikem (pausid pikemad 1.5 – 2 korda)
- \* Tugevate trennide vahe 2 – 3 päeva





# Maksimaalne hapniku tarbimine ja tulemuste juurdekasv



# Treeningkiirused mäestikus

## Distantse

200m

400m

800m

1000m

1600m

2000m

## Muutus

0.5 – 1“ kiirem

sama

2 – 3“ aeglasem

4 – 6“ aeglasem

7 – 9“ aeglasem

25 – 30“ aeglasem

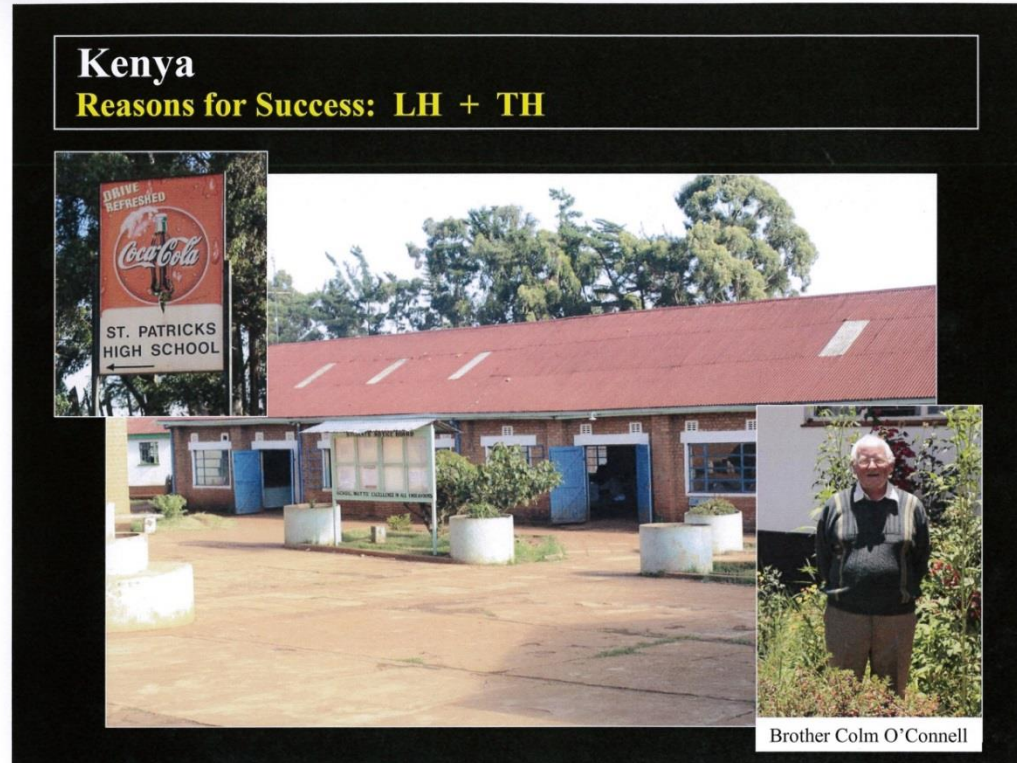
*Treener Joe I. Vigil, Ph.D*

**TAASTUMISAEG PIKEM!**

# ST. Patrick HiGH School Itenis

## 800m edetabel

|                    |         |
|--------------------|---------|
| David Rudisha      | 1:40.91 |
| Wilson Kipketer    | 1:41.83 |
| Benson Koech       | 1:43.17 |
| David Kiptoo       | 1:43.38 |
| Mike Boit          | 1:43.57 |
| Joseph Tengelei    | 1:43.57 |
| Cosmos Sielei      | 1:45.38 |
| Japheth Kimutai    | 1:44.91 |
| Kipkoech Cheruiyot | 1:46.46 |
| Peter Rono         | 1:46.66 |



# Jake and Zane Robertson



# ALTITUDE TRAINING OPPORTUNITIES

UKA and London Marathon are pleased to announce the 2012 altitude training camp programme for UK endurance athletes.



The UKA/London Marathon altitude camps have become an important fixture in the training programmes of the majority of leading UK endurance athletes, providing them with the opportunity to train at altitude three to four times per year.

The established training bases in Font Romeu (France) and Iten (Kenya) have provided the ideal environment for athletes and coaches to work together, supported by a team of UKA staff including coaches, physiotherapists, doctors, soft tissue therapists and exercise physiologists.

Building on the success of 2010, the UKA/London Marathon altitude programme has continued to have a positive impact on endurance performances throughout the 2011 season, with highlights including Mo Farah's World Championships gold at 5,000m and silver at 10,000m, Hannah England's World Championships silver at 1500m, Helen Clitheroe's European Indoor Championships gold at 3,000m, Adam Cotton's European Junior Championships 1500m title and James Shane's 1500m silver at the European Under-23 Championships, with all athletes having spent periods training at the UKA/London Marathon camps in Iten and Font Romeu.

The UKA/London Marathon altitude training camps will continue to play an important role in the training and preparation phase of each of the athletes who attend the camps.

| Description (2012 altitude camp)                              | Departure and return dates  | Location           | Closing date for expression of interest | Altitude  |
|---|---|--------------------|---|-----------|
| Winter Training Camp (Indoor/Cross Country/ Road Race season) | Depart: 10 January 2012<br>Return: 8 February 2012<br>(option for early departure/ later return date for WCPP athletes with a focus on the indoor season) | Iten, Kenya        | 15 November 2011                        | 4 weeks   |
| Marathon Training Camp (Also available to WCPP athletes)      | Depart: 13 March 2012<br>Return: 19 April 2012  | Iten, Kenya        | 15 January 2012                         | 4-5 weeks |
| Spring Training Camp  | Depart: 10 or 16 April 2012<br>Return: 1 or 17 May 2012   | Font Romeu, France | 15 February 2012                        | 3-6 weeks |
| Summer Training Camp (Preparation camp for London Olympic)    | Opens: 26 June 2012<br>Closes: 2 Aug 2012<br>(alternative departure/return dates for Diamond League fixtures and London Olympics)                         | Font Romeu, France | N/A                                     | 3-5 weeks |
| Winter Training Camp  | Late October to early December 2012   | Iten, Kenya        | TBC                                     | 4-6 weeks |

George Gandy (National Event Coach - Endurance), Ian Stewart (Head of Endurance), Spencer Barden (National Endurance Manager) and David Bedford (Race Director London Marathon) will make the final decision on who will be offered the available places on each of the altitude camps.

**If you have any questions on the above please contact:**  
UKA National Endurance Manager - Spencer Barden  
by email [sbarden@uka.org.uk](mailto:sbarden@uka.org.uk)

# ALTITUDE TRAINING OPPORTUNITIES



As part of its funding partnership with London Marathon, UKA Endurance is pleased to announce the altitude training camp programme for UK endurance athletes for the remainder of 2010 and early 2011.

The key objective of the UK Endurance-Altitude Strategy is to provide UK endurance athletes and coaches with the opportunity to train at altitude in a group environment within a managed, supported and sustainable long term altitude programme. Altitude training has been adopted by the majority of the world's best endurance athletes from 800m to the Marathon and is an area that is integral to the endurance strategy.

Following consultation with some of the world's leading endurance athletes and coaches and further discussion with UKA exercise physiologists, UKA Endurance and London Marathon are pleased to confirm that Font Romeu in France and Iten in Kenya, at heights of 1850m and 2100m above sea level respectively, will form the two main UKA/London Marathon altitude bases for UK endurance athletes and coaches.

The main camps will be supported by a team of UKA support staff, including physiotherapists, doctors, soft tissue therapists, coaches and exercise physiologists.

The camps will be open to UK endurance athletes and coach pairings with availability of supported places prioritised as follows:

1. World Class Performance Programme athletes
2. UKA 'Futures' Programme athletes
3. UKA endurance house athletes (Loughborough)
4. Current Aviva GB&NI team athletes (GB&NI representation in the 12 months prior to the start of each camp)
5. London Marathon nominated athletes and coaches (primarily road running/Marathon)
6. UKA Endurance Performance Centre athletes part of the Loughborough endurance training groups
7. Regional endurance training centre athletes
8. Invited developing and aspiring athletes
9. Home Country Federation nominated coaches (National and Area Coach Mentors)

The UKA and London Marathon altitude camp programme is detailed below. Athletes and coaches should express interest before the relevant closing dates by emailing UKA National Endurance Senior Coordinator Spencer Barden on [sbarden@uka.org.uk](mailto:sbarden@uka.org.uk) with details of their main event and current performances and details of the camp they would like to attend.

| Description (2010 and early 2011 altitude camps)                                      | Departure and return dates   | Location           | Closing date for expression of interest | Altitude  |
|---|--|--------------------|---|-----------|
| European track season camp  | 2 August (post European Champs) to 3 September 2010<br>(variable depart/return dates depending on individual race programme) | Font Romeu, France | 15-July-10                              | 3-4 weeks |
| World Half/autumn Marathon/cross country preparation training camp                    | Depart: 3 September or 10 September or 20 September 2010<br>Return: 24 September or 8 October 2010 or 15 October             | Font Romeu, France | 2-Aug-10                                | 3-6 weeks |
| Main endurance winter training camp   | Depart: 28 October or 4 November 2010<br>Return: 25 November or 9 December 2010  | Iten, Kenya        | 30-Aug-10                               | 3-5 weeks |
| Winter training camp - Indoor/cross country/ road running season                      | Depart: 3 January or 31 January 2011<br>Return: 27 January or 17 February 2011 or 24 February 2011                           | Iten, Kenya        | 5-Nov-10                                | 3-6 weeks |
| Main London Marathon preparation training camp (race Sunday 17 April) & Summer season | Depart: 1 March or 15 March 2011<br>Return: 1 April or 15 April 2011   | Iten, Kenya        | 7-Jan-11                                | 4-6 weeks |
| Main endurance spring training camp   | Mid April to Mid/Late May 2011 (Exact dates TBC)   | Font Romeu, France | 18-Feb-11                               | 3-5 weeks |

George Gandy (National Event Coach - Endurance), Ian Stewart (Head of Endurance) and David Bedford (Race Director London Marathon) will make the final decision on who will be offered the available places on each of the altitude camps.

**If you have any questions on the above please contact:**  
UKA National Endurance Senior Coordinator - Spencer Barden  
by email [sbarden@uka.org.uk](mailto:sbarden@uka.org.uk)



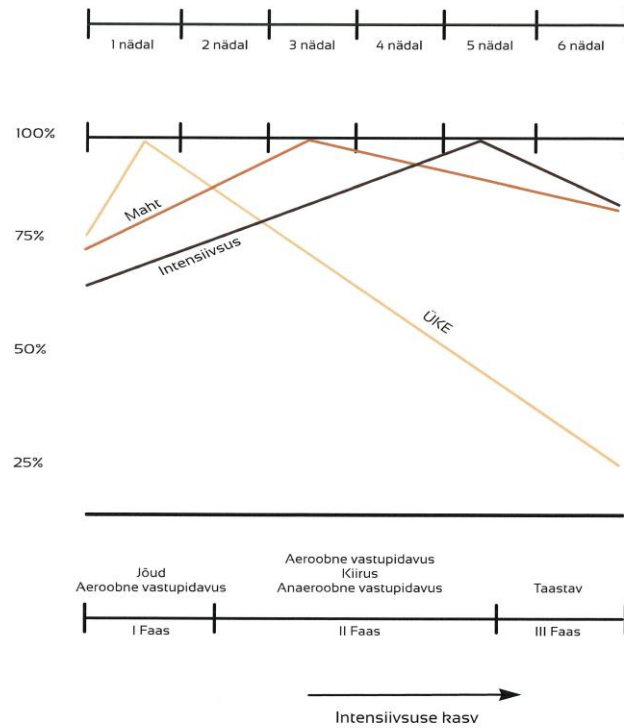
# Iten

**HATC**  
HIGH ALTITUDE TRAINING CENTER

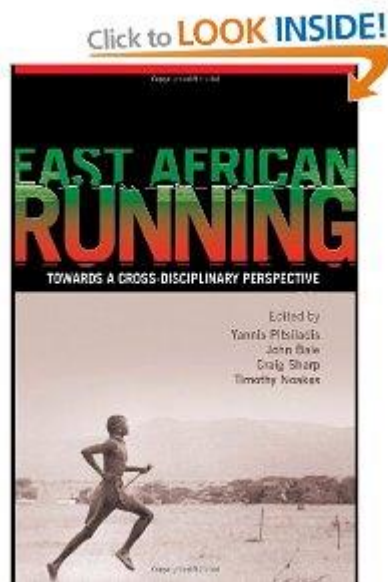


# Mäestikulaager

Treener Joe I. Vigil, Ph.D



# Yannis Pitsiladis



Mis limiteerib treeninglaagri kestvust  
meil Keenias?

....?

....?

....?

**Mida kauem seda parem!**



# MÄESTIK, MÄESTIK, MÄESTIK

*2002 aastal treenis Pavel Loskutov  
152 päeva mäestikutingimustes*



# Eldoretis trennis 2100m







# Taastumine

- \* Uni
- \* Toit peab olema süsivesikute ning rauarikas ja sisaldama vähem rasvu.
- \* Organismi rauavarude eest soovitatakse hoolitseda juba paar nädalat enne mäestikutreeninguid.
- \* Suurem vedeliku tarbimine (4 -5 liitrit päevas), et vereplasma maht ei väheneks, peab rohkesti vedelikku tarbima
- \* Lisaks toidule kasutakse vitamiine E ja C, raua preparaate jt.
- \* massaaž, ujumine

# LIVE HIGH, TRAIN LOW

Elame kõrgel ja treenime madalal

gondatel aastatel on kestvusalade puhul hakatud kasutama skeemi: Live High, Train Low.

**Benjamin Levine ja James Stray-Gundersen**

Uuringud põhinevad järgmisel seisukohal: viibides hüpoksia tingimustes, tagatakse vere hapnikumahtuvuse suuremise.

Treenides suhteliselt madalal kõrgusel, saab koormata vajalikul määral tugi - liikumisaparaati (lihastööd täideviiv organ) ning ei teki vastuolu lihastööd teenindavate (hapniku transpordisüsteem) organitega.

Flagstaff - Phoenix

Sierra Nevada - Granadaga



# LIVE HIGH, TRAIN LOW

Elame kõrgel ja treenime madalal

## *Alpimaja /alpitelk*

Kombineeritud mäestiku efekti kasutamine koos merepinnal treenimisega.

Selle meetodi pioneerideks spordipraktikas on soomlased, eesotsas professor H. Ruskoga.

Alpimaja koosneb lämmastiku generaatorist, õhu kompressorist, segamissüsteemist ja kahest eraldi kontrollsüsteemist. Toodetud lämmastik segunenud välisõhuga suunatakse majja, mis on tehtud nii õhukindel kui võimalik.

Alpimaja tähendab elamist ruumis, kus hapniku protsent (näiteks 16% võrreldes 21%-ga merepinnal) vastab mäestikutingimustele. Sportlased viibivad alpimajas pidevalt välja arvatud, siis kui on treening ja söömine.

Alpimaja kasutatakse palju võistlusperioodil, kus treeningute intensiivsus on suur. Samas ei ole mäestikus võimalik treenida sellise intensiivsusega, mida nõuab põhidistants (näit. keskmaajooks).

Colorado Ülikooli teadlased soovivad viibida kunstlikes hüpoksia tingimustes 8-10 tundi päevas ühe nädala jooksul. See peaks olema nende arvates piisav kohanemise efekti saamiseks. Saavutatud efekt säilib 3 - 4 nädalat.

# Treener Terrence Mahon`i õpilased

## MAMMOTH TRACK CLUB

### - A BRIEF HISTORY -

- Seasonal Training Camps from 2001-2004
  - Team gathers together for 4-8 week camps prior to major events
  - Deena Kastor & Meb Keflezighi were the only full time residents in Mammoth Lakes, CA at the time
  - Athletes came to join up with Deena & Meb from their sea level training sites
  - Deena & Meb both won medals in 2004 Olympics and their success prompted an investment in full time altitude training

# USATF kvalifikatsioonistandardid 2000. aastal

| Distants        | Tulemus<br>Meretaspinnal | Tulemus<br>Mäestik (> 4000ft) + 3% |
|-----------------|--------------------------|------------------------------------|
| Mehed 1500      | 3.40.5                   | 3.46.6                             |
| Naised 1500     | 4.18.5                   | 4.26.2                             |
| Mehed 3000m ST  | 8.42.0                   | 8.57.6                             |
| Naised 3000m ST | 10.38.0                  | 10.57.1                            |
| Mehed 5000m     | 13.47.0                  | 14.11.8                            |
| Naised 5000m    | 16.05.0                  | 16.33.9                            |
| Mehed 10 000m   | 28.50.0                  | 29.41.9                            |
| Naised 10 000m  | 33.20.0                  | 34.20.0                            |

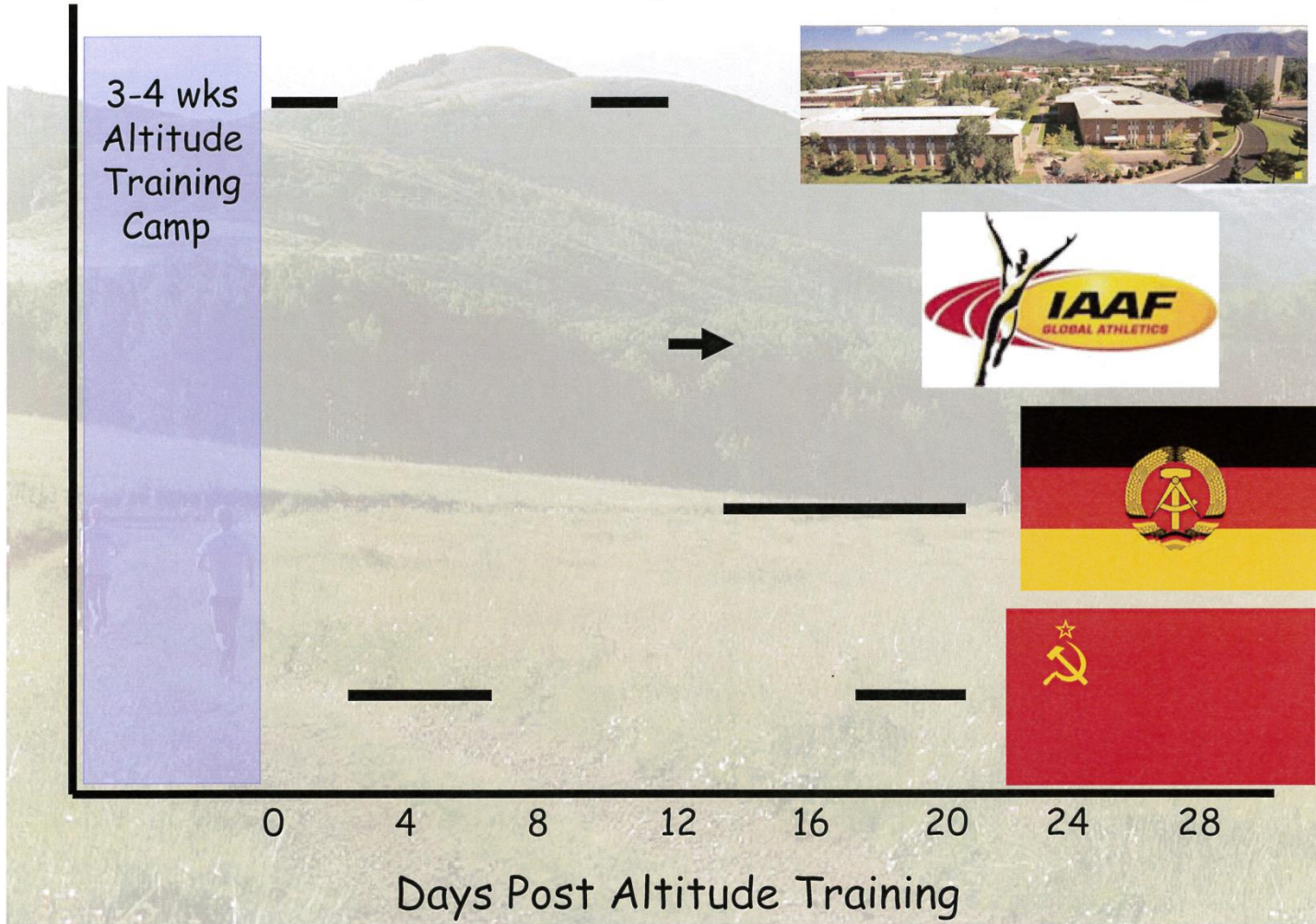
# Võistlemine peale mäestiku

- \* 48 tundi peale mästiku

- \* 18 – 22 päeval suudab sportlane näidata parimaid tulemusi, kuna kogu hingamis-süsteem on normaliseerunud ja keha on kohanenud (re-aklimatiseerunud) meretasapinnaga. *Vaatlusalused treenisid 2150m kõrgusel ja 28 päeva.*  
**Füsioloog Robert Chapman, Indiana University Bloomington.**



# Ideal Competition Days After Altitude Training



# Võistlustegevus peale mäestikutreeningut

## RACING AT SEA LEVEL POST ALTITUDE TRAINING

- ✘ After Initial Altitude Training the return to sea level can get mixed results when racing. Best days we have seen are on the 3<sup>rd</sup>, 7<sup>th</sup>, 10<sup>th</sup>, 17-28days
- ✘ We recommend getting in 1-2 workouts at sea level prior to competition to get used to new breathing patterns
- ✘ For athletes that have either gone through many training cycles or lived at altitude for years then we have seen no change in race performance regardless of what day they race at sea level when coming out of altitude

### Tiidrek Nurme Keenia laagrite järgne talvine hooaeg

|             |                     |             |                              |             |                                     |
|-------------|---------------------|-------------|------------------------------|-------------|-------------------------------------|
| <i>Päev</i> |                     | <i>Päev</i> |                              | <i>Päev</i> |                                     |
| 1           | Euroopas            | 1           | Euroopas                     | 1           | Euroopas                            |
| 2           |                     | 2           |                              | 2           |                                     |
| 3           |                     | 3           |                              | 3           |                                     |
| 4           |                     | 4           |                              | 4           | 4X(1000 + 500)                      |
| 5           | 5X(1000 + 500)      | 5           | 4X(1000 + 500)               | 5           |                                     |
| 6           |                     | 6           |                              | 6           |                                     |
| 7           |                     | 7           |                              | 7           |                                     |
| 8           |                     | 8           |                              | 8           | Eesti klubide karikas 1500m 3.56.56 |
| 9           | 2X2000m ja 3X400    | 9           | 1500m EMV                    | 9           |                                     |
| 10          |                     | 10          |                              | 10          |                                     |
| 11          |                     | 11          |                              | 11          | 3000m 7.55.39 ER                    |
| 12          |                     | 12          |                              | 12          |                                     |
| 13          | 1500m 3.49.75 EMV   | 13          | 3000m 7.59.31 ER             | 13          |                                     |
| 14          | 3000m 8.13.97 EMV   | 14          |                              | 14          |                                     |
| 15          |                     | 15          |                              | 15          |                                     |
| 16          |                     | 16          | Tempojooks 8km (27.13.8)     | 16          | 2000-200-2000-200-2000-200-2000-200 |
| 17          |                     | 17          |                              | 17          |                                     |
| 18          |                     | 18          | 2000/1600/1200/800/400+3X200 | 18          |                                     |
| 19          |                     | 19          |                              | 19          |                                     |
| 20          |                     | 20          |                              | 20          |                                     |
| 21          | 3X600 ja 2X400      | 21          | 4X(800 + 200) 2.06 ja 29     | 21          | 1500m 3.47.40 ER EMV                |
| 22          |                     | 22          |                              |             |                                     |
| 23          |                     | 23          |                              |             |                                     |
| 24          | 2000m 5.18.50 ER    | 24          | 10X200/200m                  |             |                                     |
| 25          |                     | 25          |                              |             |                                     |
| 26          |                     | 26          |                              |             |                                     |
| 27          |                     | 27          |                              |             |                                     |
| 28          | 2X(600 – 400 – 200) | 28          |                              |             |                                     |
| 29          |                     | 29          | 3000m 8.06.69 (EM)           |             |                                     |
| 30          |                     | 30          |                              |             |                                     |
| 31          | 1500m 3.48.42       |             |                              |             |                                     |

|                  |             |        |
|------------------|-------------|--------|
| Font Romeau      | Prantsusmaa | 1895 m |
| St. Moritz       | Šveits      | 1820 m |
| Sestriere        | Itaalia     | 2035 m |
| Addis Abeba      | Etiopia     | 2400 m |
| Nairobi          | Keenia      | 1600 m |
| Ifran            | Maroko      | 1820 m |
| Mexico           | Mehhiko     | 2200 m |
| Toluca           | Mehhiko     | 2700 m |
| Colorado Springs | USA         | 2194 m |
| Keystone         | USA         | 2835 m |
| Flagstaff        | USA         | 2300 m |
| Bogota           | Columbia    | 2500 m |
| Davos            | Šveits      | 1560 m |
| Kislovodsk       | Venemaa     | 1000 m |
| Kaprun           | Austria     | 1800 m |
| Issyk-Kul        | Kirgiisia   | 1600 m |
| Sierra Nevada    | Hispaania   | 2300 m |
| Albuquerque      | USA         | 1600m  |





**KÜSIMUSED?**