Something in the Air

If you are considering whether altitude training might be for you, *TMSM* contributing editor Rod Cedaro has compiled the following report that will help you make an informed decision.

Words: Rod Cedaro | Images: Courtesy of Suunto

As an exercise physiologist who's played in this space for the best part of 20 years, I've experienced first-hand the benefits associated with altitude exposure. While these are not huge, they are certainly significant – particularly at the top end. Altitude training won't turn a donkey into a world-beating thoroughbred, but, if you're training and recovering well, got your nutrition down pat, have optimised your equipment and are at your optimal race weight, then altitude training could provide the edge over your competitors.

It is no coincidence that not so long ago in the athletic world, every world record in the 800 metres to the marathon was held by an athlete who either lived, or at least trained, at altitude or used some form of altitude simulation routinely as part of their training regimen. Locations such as Boulder, St Moritz and Flagstaff have become synonymous with endurance sport training.

So what happens to the body at altitude?

The physiological adaptation to altitude exposure goes through two distinct phases:

1. Upon initial altitude exposure (days one-to-10), there is an increase in rate and depth or respiration and increased cardiac output (both heart rate and stroke volume). During this period, training loads should be kept low and aerobic as the athlete is experiencing significant physiological loading. The only quality work should be short (10-15-second) efforts rather than longer sustained lactic sessions.

2. In the second phase of altitude adaptation (days seven-to-30), the athlete's body starts to acclimate to altitude stress. Heart rate and respiration decrease back to normal/pre-exposure levels as other bio-physiological changes kick in (e.g. increases in red cell mass, increases in aerobic enzymes, increased mitochondria concentrations, capillary density, myoglobin concentrations, etc.). In humans this is often shown initially as an increase in red cell concentration, which may then return to normal levels as plasma volume increases – as is the case with heat exposure.

It is during this second adaptation phase that training loads can be progressively increased back towards normal training loads.

The above is typical of a reasonably well-trained athlete going from sea level to train at altitude but there is considerable variation for person to person.

Living for sustained periods of time at altitude has in some circumstances actually proven to be detrimental to performance as athletes have been unable to train hard and fast enough to maintain top-end speed, and with sustained altitude exposure the body can become 'catabolic' and actually eat into its own muscle mass. This causes a decrease in power-to-weight ratio.

It was for these reasons that over a decade ago, American Professor Benjamin Levine proposed the 'live high, train low model' of altitude training. This involves athletes living at altitude but training at sea level. His landmark study produced significant performance improvements in five-kilometre performance times for a group of well-trained, sub-elite runners.

The problem is not everyone has access to a mountain, the time to drive up and down it or the money to relocate in order to train in this manner.

Thus, simulated altitude training was born.

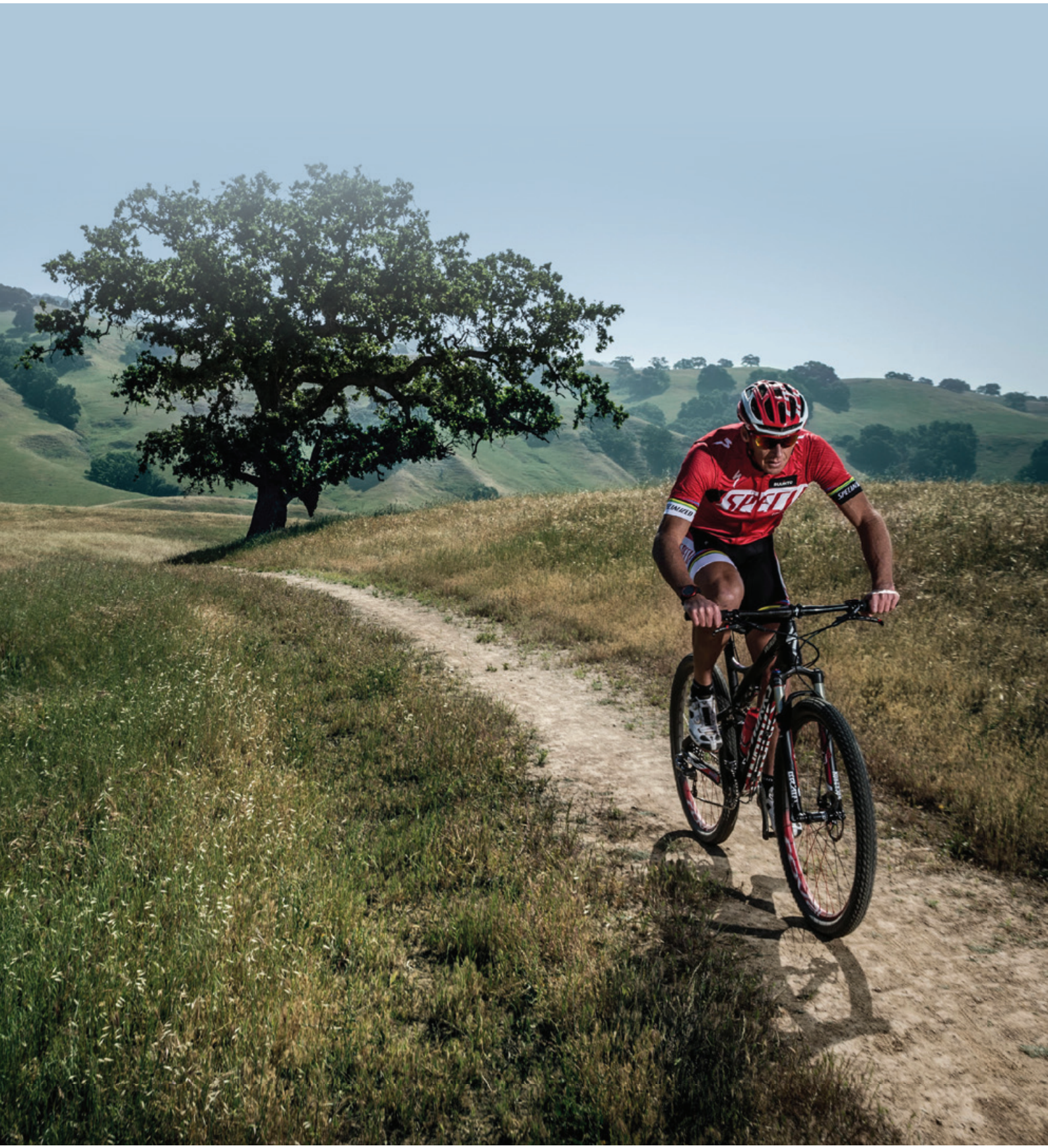
From the early days of the CAT Hatch – a Perspex vessel into which an athlete slid and from which air was literally sucked out to simulate a specified altitude. While effective from a training perspective, these chambers proved to be impractical. For example, if you wanted to go to the loo during the night, you either had to wee into a bottle in the chamber or exit the chamber and go to the toilet before bringing the vacuum system in the chamber back to the levels you wanted it at.

Soon after the CAT Hatch system we saw the evolution of altitude tents. These employ a small generator to pump hypoxic gas into a tent at a rate of about 120 litres per minute while the athlete sleeps. These systems allow you to vary the O2 concentration of the air at normal air pressures – lowering the risk of altitude-related illnesses due to hypobaria – to simulate the effects of going up a mountain. These systems and technology have proven popular and persist to this day. Indeed this type of technology is what we use here at *Altitude Services Pty Ltd.*

Hypoxic generators can also be removed from the sleeping tent, married directly to a facemask and the athlete can train in their preferred exercise modality (e.g. rowing, swimming – and yes, we have even placed domes over lanes to trap the hypoxic air – cycling and running).

Where are we today and what does the future hold in this regard?

Currently the price of altitude simulators is decreasing, (in fact here at *Altitude Services Pty. Ltd.* our costs are some of the cheapest in the world) – although with some suppliers you wouldn't know it. In some locations around the world, hotels are getting into the athletic market by providing altitude rooms for athletes to live in while they are holidaying on training camps. *Altitude Services Pty. Ltd.* is currently negotiating such an arrangement with a leading Australian training facility. *Altitude Services Pty. Ltd.* is one of the first in the world to successfully infiltrate the thoroughbred horse racing market with altitude stalls and training facilities.



One of the major controlling factors is the ability to control the 'dosage' of hypoxia via pulse oximetry, which measures the oxygen concentration in the blood during the hypoxic exposure. Two athletes – be they human, equine, camel, or whatever – exposed to precisely the same hypoxic conditions (i.e. oxygen levels and duration of exposure) can respond in completely different manners. One can be quickly overwhelmed by the hypoxia, while for the second the hypoxia may have little to no impact. By measuring blood oxygen saturation (SAO2) the trainer, athlete, coach or sports scientist can better refine the hypoxic training regimen on an athlete-by-athlete basis.

Some key points to remember:

- Altitude training is not a one-size-fits-all approach. Altitude training (in humans at least) is beneficial in about 85 per cent of cases. Some athletes simply don't cope and go backwards. Pulse oximetry helps with personalising altitude exposure.
- Extended periods of altitude exposure can result in muscle wastage – hence the importance of regularly weighing yourself if you're at altitude for an extended period of time.
- Altitude training is dehydrating. You breathe deeper and harder, drying out your airways. If you're in a simulated altitude, the environment is also air-conditioned, which exacerbates this problem.
- Altitude-training effects persist post-exposure for three-to-four weeks but decrease progressively.
- From the experiences we've seen – certainly in the equine model – the ideal scenario is to do your base work at lower intensities and higher altitudes for two-to-four weeks, then commence the more intense, specific training. The base phase work should be done at higher altitudes (e.g. up to 4000 metres – similar to Flagstaff, Arizona) whereas the more specific training should be done at lower altitudes (e.g. 1800-to-2000m – similar to Boulder, Colorado/St Moritz, Switzerland).
- Aside from the aerobic benefits, it is thought that altitude also has a beneficial impact on lactic acid buffering (i.e. human athletes seen to have the greatest benefit have been rowers – six-to-eight minute maximal efforts – significant contributions from both aerobic/anaerobic systems).
- Counterintuitively, athletes sometimes struggle more at altitude than non-athletes. Athletes are used (due to training) to often being 'hypoxic' whereas non-athletes when exposed to hypoxia see the benefits immediately. Therefore, some athletes suffer more readily with altitude exposure from a blunted response to the need to breathe more than do non-athletes. Again, regularly monitoring your oxygen saturation levels can be valuable here.
- Males seem to adapt more quickly to altitude than females.
- When adapting to altitude, increase your intake of carbohydrate.
- Many athletes complain of an altitude hangover during the acclimation period. Literally feeling like they have a hangover, which leads to the following point.
- Typically, athletes exposed to altitude have intensive flat spots of fatigue through weeks two, three or four depending on the individual athlete, training load, maturity or prior altitude exposure. Normally, two-to-three days down from altitude coupled with lighter training loads are enough to turn this around.
- When using the sleep high/train low model, ensure the athlete has at least two hours back at sea level before commencing a training session – particularly an intense training session and at least one hour at sea level (for adequate recovery) before going back to altitude to rest or sleep.

Altitude training is still a work in progress. The AIS has built its own 'nitrogen room', recognising there is a modest (but valuable) ROI for elite athletes. The message for Jack and Jill Average – get everything else sorted and then if you're looking for that little bit extra, explore altitude training as a viable option to improve your endurance and competitive edge.

If you'd like more information about altitude training contact Rod Cedaro direct at *www.altitudeservices.com.au* alternatively order yourself a copy of: Altitude Training and Athletic Performance by Randall L. Wilber which is an excellent reference for athletes, coaches and sports scientists interested in this evolving field of athletic conditioning.

Rod Cedaro is the contributing editor of TMSM.