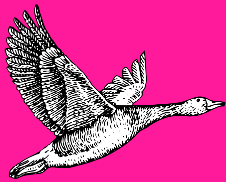
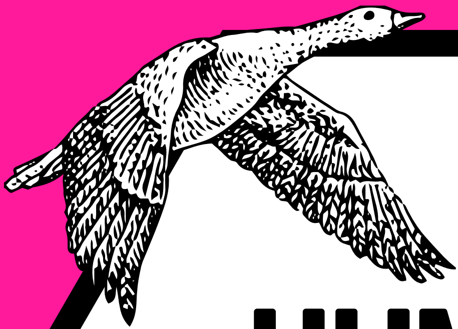
PROGRAMME AND ABSTRACT BOOK

HUMANATURE
11 – 12 NOVEMBER 2017
NATURAL HISTORY MUSEUM
LONDON, UK





HUMAN NATURE

SOCIETY FOR EXPERIMENTAL BIOLOGY

HUMANATURE

ORGANISED BY:
CRAIG FRANKLIN
THE UNIVERSITY OF QUEENSLAND, AUSTRALIA
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IN COLLABORATION WITH:

WORLD EXTREME MEDICINE

NATURAL HISTORY MUSEUM

DELEGATE INFORMATION

BADGES

Participants are required to wear name badges at all times for proof of registration, security purposes and catering identification.

CATERING

Lunch and refreshments during the symposium are included in your registration fee and will be served in the breakout area.

CERTIFICATE OF ATTENDANCE

Delegates requiring a certificate of attendance should visit the SEB registration desk on their departure.

VENUE

Natural History Museum
Cromwell Rd
Kensington
London
SW7 5BD

The scientific sessions will be taking place in the Flett Events Theatre, which is located next to Earth Hall.

LIABILITY

Neither the Society for Experimental Biology nor the Natural History Museum will accept responsibility for damage or injury to persons or property during the symposium. Participants are advised to arrange their own personal health and travel insurance.

PHOTOGRAPHY

No photographs are to be taken of the speakers and their slides during the symposium.

**Please note: The SEB will be taking photos during the event for promotional purposes. If you have any concerns, please visit the SEB registration desk.*

REGISTRATION

The registration desk will be open during the hours of the conference and a SEB staff member will be on hand during the refreshment and lunch breaks should you require any assistance.

TWITTER

We're looking to increase the conversation at the meeting using Twitter so please get tweeting!
Follow the conversation **#HUMNAT17**
SEB – **@SEBiology**

WI-FI INTERNET ACCESS

Internet access is available during the symposium and free of charge. No log in details are required.

PROGRAMME

SATURDAY 11 NOVEMBER

09:45 REGISTRATION

10:30
Welcome
Prof Craig Franklin
Vice President, Society for Experimental Biology
Dr Mark Hannaford
Founder, World Extreme Medicine

SESSION 1 ALTITUDE

CHAIR: LUCY HAWKES

10.45
Dr Lucy Hawkes
University of Exeter, United Kingdom
Free flight physiology
A17.1

11:15
Dr Denny Levett
University Hospital Southampton NHS trust, United Kingdom
Xtreme Everest: Human adaptation to hypoxia
A17.2

11:45
Dr Charles Bishop
Bangor University, United Kingdom
How animals cope with low oxygen availability: some favourite examples
A17.3

12:15
Dr Christina Eichstaedt
University Hospital Heidelberg, Germany
Human adaptation to high altitude in the Andes
A17.4

12:45
Panel discussion

13:00 LUNCH

SESSION 2 COLD

CHAIR: MATTHEW EDWARDS

14:00
Prof Stuart Egginton
University of Leeds, United Kingdom
The effects of cold environments on cardiovascular physiology in animals
A17.5

14:30
Dr Beth Healey
European Space Agency at Concordia station, Antarctica
White Mars
A17.6

15:00
Panel discussion

15:15 REFRESHMENT BREAK

15:45
Discussion and conclusions from Day 1
Prof Craig Franklin
Vice President, Society for Experimental Biology
Dr Mark Hannaford
Founder, World Extreme Medicine

16:00
PLENARY LECTURE
Dr Matthew Edwards
Collaboration and adaptation from the medical frontline
A17.7

17:00
Plenary speaker interview and question time

17:30 END OF DAY 1

PROGRAMME

SUNDAY 12 NOVEMBER

08:00 REGISTRATION

08:30
Welcome
Prof Craig Franklin
Vice President, Society for Experimental Biology
Dr Mark Hannaford
Founder, World Extreme Medicine

SESSION 3 DEPTH

CHAIR: CRAIG FRANKLIN

08:40
Dr Andreas Fahlman
Oceanografic Foundation, Spain
Comparative diving eco-physiology; a tool to assess environmental health
A17.8

09:10
Prof Zeljko Dujic
University of Split School of Medicine, Croatia
Cardiovascular effects of depth
A17.9

09:40
Prof Craig Franklin
University of Queensland, Australia
Diving reptiles: Masters of submergence
A17.10

10:10
Dr Andreas Møllerløkken
Norwegian University of Science and Technology, Norway
Decompression stress - using barophysiology as a model
A17.11

10:40
Panel discussion

10:55 REFRESHMENT BREAK

SESSION 4 AGEING

CHAIR: LEWIS HALSEY

11:20
Dr Carl Soulsbury
University of Lincoln, United Kingdom
Exercising to the limit (and more) in birds
A17.12

11:50
Dr Leigh Breen
University of Birmingham, United Kingdom
The role of inactivity in age-related musculoskeletal deterioration: Move it or lose it!
A17.13

12:20
Panel discussion

12:35 LUNCH

PROGRAMME

SESSION 5 ENDURANCE

CHAIR: LEWIS HALSEY

13:20
Prof Anders Hedenström
Lund University, Sweden
What are the limits to animal flight performance?
A17.14

13:50
Prof Andrew M Jones
University of Exeter, United Kingdom
Breaking 2: A physiological perspective on the <2 hour marathon
A17.15

14:20
Dr David Oxborough
Liverpool John Moores University, United Kingdom
Endurance exercise and the human heart: Can you get too much of a good thing?
A17.16

14:50
Panel discussion

15:05 REFRESHMENT BREAK

SESSION 6 HEAT

CHAIR: MARK HANNAFORD

15:30
Dr Jo Corbett
University of Portsmouth, United Kingdom
Preparing elite human athletes to perform in the heat
A17.17

16:00
Dr Steven Trangmar
University of Roehampton, United Kingdom
Circulatory limitations to exercise: heat, hydration and the human brain
A17.18

16:30
Dr Michael Scantlebury
Queen's University Belfast, United Kingdom
Walking the energetic tightrope: seasonal energetics of Arabian oryx
A17.19

17:00
Panel discussion

17:15
Discussion and conclusions from Day 2

17:30 END OF SYMPOSIUM

HUMANATURE

A17.1 FREE FLIGHT PHYSIOLOGY

SATURDAY 11 NOVEMBER 2017 10:45

LUCY HAWKES (UNIVERSITY OF EXETER, UNITED KINGDOM)

@ L.HAWKES@EXETER.AC.UK

High altitude skies in mountainous areas are home not only to high-flying bird species but also to daring humans taking part in adventure sports like paragliding. One of the most famous species to fly at high altitude is the bar-headed goose, which has been tracked to 7,290 metres and whose physiology has been studied across much of the oxygen transport cascade. This talk will detail some of the work that has been done on this species to reveal the adaptations that enable it to fly to altitudes that are known to cause adverse symptoms in non-acclimatised humans. At the same, a nascent project to record similar variables in high altitude paragliders will be discussed, detailing flights above 7,000 metres by some exceptional paraglider athletes.

A17.2 XTREME EVEREST: HUMAN ADAPTATION TO HYPOXIA

SATURDAY 11 NOVEMBER 2017 11:15

DENNY LEVETT (UNIVERSITY HOSPITAL SOUTHAMPTON NHS TRUST, UNITED KINGDOM)

@ D.LEVETT@SOTON.AC.UK

A fall in cellular oxygen use occurs in diverse disease states: oxygen uptake may be reduced (pulmonary disease), its mass transport diminished (cardiac contractile failure or anaemia), or its local delivery (microvascular disease) or cellular use (cellular dysoxia) impaired. In the critically ill patient many or all of these factors may exist simultaneously. The physiological responses to hypoxaemia and cellular hypoxia are far from understood, and inter-individual differences in performance at altitude and outcome in critical illness remain unexplained. This lack of understanding stems partly from difficulties in dissecting the pathways of hypoxic adaptation in pathophysiological states. In critical illness, patient demographics, presenting conditions, co-morbidities and therapies vary greatly, and multiple biological characteristics are disturbed. Defining the specific effects of hypoxia, a single component in a multi-factorial disease state, is therefore difficult. Clarifying whether a change in a measured variable is the cause of the hypoxia, or a response to it, is harder still.

The Xtreme Everest Hypoxia consortium proposed an alternative model for exploring hypoxia in the critically ill: the study of healthy humans, progressively exposed to environmental hypobaric hypoxia in a controlled manner. In our first major field project Caudwell Xtreme Everest, we prospectively studied a large cohort of healthy humans exposed to progressive, sustained hypoxia during an ascent of Mount Everest to explore inter-individual variability in hypoxia tolerance in lowlanders. In XE2 we returned to explore features of the Sherpa population that allow them to adapt to a hypoxic environment. I will summarise some of our findings.

A17.3 HOW ANIMALS COPE WITH LOW OXYGEN AVAILABILITY: SOME FAVOURITE EXAMPLES

SATURDAY 11 NOVEMBER 2017 11:45

CHARLES M BISHOP (BANGOR UNIVERSITY, UNITED KINGDOM)

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Oxygen availability can vary with altitude due to low atmospheric pressure and density but also due to changes in environmental circumstance resulting in changes in gas composition and concentration. Some animals, particularly in the aquatic environment, may also engage in apnoea and effectively self-regulated gas exchange. Locomotion in different media will impose various restrictions on locomotor performance, for example that of flapping flight compared to human and terrestrial movement, although both are affected by a balance between generating thrust and overcoming drag forces. Many species of birds may be quite well adapted to high altitude flight, even if exposure only occurs relatively rarely in a season. An example being the Frigatebird which can spend many weeks at a time continuously on the wing, day and night, while potentially enduring sleep deprivation. Oxygen supply limitations can lead to anaerobic respiration via a number of different routes, while intrinsically low metabolic rates may enhance resilience to low oxygen environments.

A17.4 HUMAN ADAPTATION TO HIGH ALTITUDE IN THE ANDES

SATURDAY 11 NOVEMBER 2017 12:15

CHRISTINA A EICHSTAEDT (UNIVERSITY HOSPITAL HEIDELBERG, GERMANY)

@ CHRISTINA.EICHSTAEDT@MED.UNI-HEIDELBERG.DE

High altitude represents an extreme environment characterised by low concentrations of atmospheric oxygen (hypoxia), arid climate, high solar radiation and other environmental stressors. Populations have resided at high elevations in Ethiopia, the Himalayas and the Andes for several millennia. Each of these populations, faced with the same on-going environmental pressures, has developed their unique array of physiological adaptations. These adaptations are distinct from the acclimatisation observed in short term visitors of the highlands. In Andeans, these changes include an enlarged chest, increased lung capacities, only slightly increased ventilation rate and an elevated haematocrit. In comparison, the haematocrit is only mildly elevated in Tibetans and Ethiopians most likely due to distinct changes in their genome. The time the Tibetan genome could adapt to hypobaric hypoxia has been more extensive than in the other high altitude populations. Thus, different adaptations may arise with more generations having lived at high altitude acting on the specific gene pool of the population. This presentation will place an emphasis on the genetic changes identified in the Andean genome that aided their specific phenotypic adaptations. Permanent high altitude populations thus offer a great chance to investigate on-going human evolution as no cultural adaptations may fully buffer the impact of hypobaric hypoxia on human physiology.

A17.5 THE EFFECTS OF COLD ENVIRONMENTS ON CARDIOVASCULAR PHYSIOLOGY IN ANIMALS

SATURDAY 11 NOVEMBER 2017 14:00

STUART EGGINTON (UNIVERSITY OF LEEDS, UNITED KINGDOM)

@ S.EGGINTON@LEEDS.AC.UK

People who inhabit cold regions have an increased incidence of hypertension and related cardiovascular diseases, but the mechanisms involved are unclear; animals from cold environments may offer some clues (hypertension and cardiac hypertrophy occur on exposure to cold). On acute cold exposure most animals show a reduction in cardiac output and increased blood viscosity that may impair oxygen supply to peripheral tissue, and hence reduce motor activity. In Golden hamsters, acute cold exposure decreased ex vivo heart rate, while euthermic hearts decreased systolic pressure. Cold acclimation led to cardiac hypertrophy, without affecting intrinsic heart rate or coronary flow, and preservation of systolic pressure development. Here, peak cardiac performance tracked ventricle volume, although poor contractile performance associated with β-receptor down-regulation may impact arousal. Fishes are particularly sensitive to environmental temperature, and acute cold exposure impairs aerobic locomotion in most species, but in contrast to mammals often maintain activity on acclimation. We examined the thermal tolerance of Antarctic notothenioid fishes that inhabit probably the most stenothermal environment on earth, where some species lack expression of haemoglobin and myoglobin. Cardiovascular adaptations to reduced O_2 delivery include low heart rate and MO_2, but also low peripheral resistance and cardiomegaly required to increase stroke volume. The dominance of vagal tonus over cardiac sympathetic tone is accentuated on acute cold exposure of mammals, leading to a bradycardia appropriate for reduced metabolic rate, and Antarctic fishes likewise show an unusually high (sustained) vagal tone. Thus, changes in sympathovagal balance and cardiac hypertrophy appear to be conserved traits.

A17.6 WHITE MARS

SATURDAY 11 NOVEMBER 2017 **14:30**

BETH HEALEY (EUROPEAN SPACE AGENCY AT CONCORDIA STATION, ANTARCTICA)

@ BETHAHEALEY@GMAIL.COM

Concordia Station, Antarctica, is an ESA spaceflight analogue, often referred to as “White Mars”, in view of its isolation, inaccessibility, altitude, low light levels and skeleton crew. In 2015, Beth completed a year-long mission there implementing research protocols to investigate the effects of this extreme environment on the physiology and psychology of the overwinter crew. They were also testing systems for sustainable extra-terrestrial habitats - for example, water recycling. At this symposium, Beth will discuss her experience, the science as well as the use of the platform for research.

A17.7 COLLABORATION AND ADAPTATION FROM THE MEDICAL FRONTLINE

SATURDAY 11 NOVEMBER 2017 **16:00**

MATTHEW EDWARDS
(KENT AIR AMBULANCE, UNITED KINGDOM)

@ MATTDOC1979@GMAIL.COM

It is my intention to ground the theme of the day in practical medical applications, from the everyday to the extreme. Emergency doctors must move quickly from case to case - reassuring the parents of snotty toddlers to the critical minutes for the severely injured motorcyclist. The ability to adapt is vital, as emergencies ebb and flow through the doors and change our practice with every gradual advance of medical science. I believe the key to adaptation in our dynamic knowledge economy is collaboration.
Our profession is increasingly complex. The tendency to cope with this complexity is for us to further sub-specialize. We need to drill down deeper to discover the detail but, more than ever, we also need people with their heads looking up and taking note of emergent tides. We create silos where we cannot easily learn from each other and where we may even be working on the same line of inquiry. History is littered with polymaths and they are just as important now. We need people who can see the potential in the ideas of others and the scepticism to exclude the irrelevant.

The World Extreme Medicine faculty are privileged to work alongside professionals in multiple disciplines, including colleagues from the world of comparative physiology. On their behalf I hope to give examples and food for thought to give more grounding to the day’s discussion.

A17.8 COMPARATIVE DIVING ECO-PHYSIOLOGY; A TOOL TO ASSESS ENVIRONMENTAL HEALTH

SUNDAY 12 NOVEMBER 2017 **08:40**

ANDREAS FAHLMAN
(OCEANOGRAFIC FOUNDATION, SPAIN)

@ AFAHLMAN@OCEANOGRAFIC.ORG

August Krogh, the Nobel laureate and grandfather of comparative physiology, first coined the term, “For every defined physiological problem, there is an optimally suited animal that would most efficiently yield an answer.” Marine mammals are a supreme example of that principle when trying to understand extreme physiology. Marine mammals live a life in an extreme environment and cope daily with atelectasis, hyperoxia, hypoxia, ischemia/reperfusion, hyper- and hypotension, acid-base balance disturbances, intravascular gas bubbles, and inert gas narcosis. Recent data suggest that some species live with elevated blood and tissue N_2 levels throughout most of their lives and could be at risk of gas bubble disease. It is vital to understand the physiological constraints imposed on these animals, and how these limitations may affect physiology and survival in a changing environment. We have investigated the structural and functional properties of the respiratory system in both pinnipeds and cetaceans to allow us to better understand how marine mammals alter gas dynamics during diving, and better predict how physiology may limit diving. The data indicate great variability in the structural properties of the respiratory system between marine mammal species, possibly indicating species differences in diving ability. Our data help to understand how changes to the environment may affect survival. In addition, our measurements enable non-invasive assessment of respiratory health of different wild populations, which provides an index of environmental health.

A17.9 CARDIOVASCULAR EFFECTS OF DEPTH

SUNDAY 12 NOVEMBER 2017 **09:10**

ZELJKO DUJIC (UNIVERSITY OF SPLIT SCHOOL OF MEDICINE, CROATIA)

@ ZELJKO.DUJIC@MEFST.HR

Elite breath-hold divers are unique athletes challenged with compression induced by hydrostatic pressure and extreme hypoxia/hypercapnia during maximal field dives. The current world records for men are 214 meters for depth (Herbert Nitsch, No-Limits Apnea discipline), 11:35 minutes for duration (Stephane Mifsud, Static Apnea discipline), and 300 meters for distance (Mateusz Malina, Dynamic Apnea with Fins discipline). The major physiological adaptations that allow breath-hold divers to achieve such depths and duration are called “diving response” that is comprised of peripheral vasoconstriction and increased blood pressure, bradycardia, decreased cardiac output, increased cerebral and decreased myocardial blood flow, splenic contraction, and preserved O_2 delivery to the brain until the end of long breath holds. This complex of physiological adaptations is not unique to humans, but can be found in all diving mammals. Despite these profound physiological adaptations, divers may frequently show hypoxic loss of consciousness. The breath-hold starts with an easy-going phase in which respiratory muscles are inactive, whereas during the second so-called “struggle” phase, involuntary breathing movements start. These contractions increase cerebral blood flow by facilitating left stroke volume, cardiac output, and arterial pressure. The analysis of the compensatory mechanisms involved in maximal breath-holds can improve brain survival during conditions involving profound brain hypoperfusion and deoxygenation.

A17.10 DIVING REPTILES: MASTERS OF SUBMERGENCE

SUNDAY 12 NOVEMBER 2017 **09:40**

PROF CRAIG FRANKLIN (UNIVERSITY OF QUEENSLAND, AUSTRALIA)

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A17.11 DECOMPRESSION STRESS – USING BAROPHYSIOLOGY AS A MODEL

SUNDAY 12 NOVEMBER 2017 10:10

ANDREAS MØLLERLØKKEN (NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, NORWAY)

@ ANDREAS.MOLLERLOKKEN@NTNU.NO

The human physiology is dynamic in nature, and an intimate understanding of the processes taking place within the organism is essential for preventing serious damage when we alter our natural environments.

The activity of diving is a popular recreational activity, in addition to being an important intervention method for large industries, both in-shore and off-shore. Despite improvements in ROV technology, the human flexibility for inspections and repairs are still superior and needed. In order to safely perform the different tasks, a diver is totally dependent on the knowledge behind the dive table that describes how much time one have on specific depths, and when and how to return to the surface in a controlled manner. Diving involves the risk of developing decompression sickness, which is linked to the formation of vascular gas bubbles during and after decompression. In addition, physiology is stressed by being immersed in water, by the elevated total ambient pressure and by the exposure to potentially toxic partial pressures of oxygen and nitrogen or other inert gases, which all confer risks of adverse effects. Additional risk may arise from other environmental factors; exposure to cold is one example. And even if acute injury can be prevented, long-term effects have to be considered.

Observations in clinical settings is now taking advantage of the knowledge of decompression-induced vascular gas bubbles, and highlights the importance of using extreme environmental physiology as models for understanding physiological mechanisms in medical settings.

A17.12 EXERCISING TO THE LIMIT (AND MORE) IN BIRDS

SUNDAY 12 NOVEMBER 2017 11:20

CARL SOULSBURY (UNIVERSITY OF LINCOLN, UNITED KINGDOM)

@ CSOULSBURY@LINCOLN.AC.UK

Many organisms carry out exercise as part of their daily lives, be it through behaviours such as finding food, reproducing or avoiding predators. In bird, many species carry out impressive physical feats such as long distance migration, flying at high altitudes, through to intense, energetically expensive mating displays. Exercise can be viewed both in terms of its intensity and its duration. It is the combination of these that determines how physiologically stressful exercise is. In this talk, I compare the relative contribution of duration and intensity of exercise as determinants of exercise's costs, and how this in turn impacts individual ageing. Using systems where the amount of intensive exercise pushes individuals to their physiological limits, I demonstrate its negative effect on individual physiology and survival. By using comparisons found in nature, it can provide critical insights into the effects of intense and extreme exercise on the human body.

A17.13 THE ROLE OF INACTIVITY IN AGE-RELATED MUSCULOSKELETAL DETERIORATION: MOVE IT OR LOSE IT!

SUNDAY 12 NOVEMBER 2017 11:50

LEIGH BREEN (UNIVERSITY OF BIRMINGHAM, UNITED KINGDOM)

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Age-related muscle loss (sarcopenia) leads to reduced strength, impaired functional capacity, increased risk of falls/fractures and metabolic disease and is associated with premature mortality. Sarcopenia increases in prevalence with advancing age, affecting more than half of older individuals aged 80 years and over. This is particularly alarming given the rapid expansion in global ageing. Thus, the emerging gap between the number of years lived and the number of years spent in good health places a significant strain on healthcare resources. Age-related impairments in skeletal muscle protein stasis that drive sarcopenia are thought stem from an impaired muscle anabolic response to protein/amino acid provision. The precise contributing causes of age-related muscle anabolic resistance in sarcopenia are multifactorial in nature, but essential to understand in order to develop therapeutic interventions. This presentation will explore the role of chronological ageing and aspects of biological ageing (in this case, inactivity) contribute to the progression of sarcopenia. I will outline that repeated episodes of musculoskeletal disuse (i.e. during hospitalisation or illness) on a background of declining habitual activity levels may result in a state of chronic muscle anabolic impairment in older individuals. Thus, although sarcopenia is, to some degree, an inevitable characteristic of chronological ageing, inactivity plays a key role in the progression of this debilitating condition. Further to this, there is no doubt that physically activity is an extraordinarily potent preventive health behaviour to slow the progression of sarcopenia.

A17.14 WHAT ARE THE LIMITS TO ANIMAL FLIGHT PERFORMANCE?

SUNDAY 12 NOVEMBER 2017 13:20

ANDERS HEDENSTRÖM (LUND UNIVERSITY, SWEDEN)

@ ANDERS.HEDENSTROM@BIOL.LU.SE

Birds, bats, insects and the extinct Pterosaurs all evolved muscle power flight as main mode of locomotion. Since powered flight is energetically demanding, with metabolic rates reaching the order 10xBMR or more, there are physiological and mechanical limits to flight performance. Yet, it is the locomotion mode by which billions of birds change location between continents during their annual migrations. During migration birds face ecological barriers such as mountains, glaciers, seas and deserts, but these are crossed or circumvented, depending on the ecological context. Some birds, such as the bar-tailed godwit, make their entire migration as one big leap across the Pacific when flying non-stop between Alaska (breeding area) and New Zealand (wintering area), a flight that may take up to 8 days of continuous flight. Other birds, like the migratory swifts, have taken flight performance one step further and spend their entire non-breeding period, which can be up to 10 months, in the open airspace. How have they managed to adapt to such an extreme life style? A continuous life flying at high levels of metabolic rate may lead to oxidative damage and a shortened life-span, but swifts seem to overcome such hurdles by being extremely well adapted for cost-efficient flight. During migrations birds climb to altitudes of several kilometres, not only to enable the crossing of mountain ranges but also to seek out favourable wind layers. Large birds may save some energy by flying in flock formation, but flying in flocks may also be costly for some individuals.

A17.15 BREAKING 2: A PHYSIOLOGICAL PERSPECTIVE ON THE <2 HOUR MARATHON

SUNDAY 12 NOVEMBER 2017 13:50

ANDREW M JONES (UNIVERSITY OF EXETER, UNITED KINGDOM)

@ A.M.JONES@EXETER.AC.UK

On 6th May, 2017, exactly 63 years after Sir Roger Bannister ran the first sub-4 min mile, three elite distance runners attempted the (almost) unthinkable: to run a 26.2 mile marathon in less than 2 hours. This event, performed at the Formula 1 race track in Monza, Italy, was the culmination of more than 2 years of scientific development work by Nike and its associates (including the presenter). The existing marathon world record for men stands at 2 hours, 2 minutes and 27 seconds and there has been much speculation amongst sports scientists and the athletic community over whether a sub-2 hour marathon may be humanly possible (and, if so, when and how it might occur). In this presentation, I shall describe the physiological limitations to human endurance exercise performance and outline the strategy employed by the Nike team with regard to athlete selection and creation of the optimal conditions to make the sub-2 attempt viable. This will include information on the battery of laboratory and field-based physiological tests used to identify the athletes most likely to achieve the feat and insight into the consideration given to the environmental, course, pacing, drafting, biomechanical and nutritional factors that can impact marathon performance.

A17.16 ENDURANCE EXERCISE AND THE HUMAN HEART: CAN YOU GET TOO MUCH OF A GOOD THING?

SUNDAY 12 NOVEMBER 2017 14:20

DAVID OXBOROUGH (LIVERPOOL JOHN MOORES UNIVERSITY, UNITED KINGDOM))

@ D.L.OXBOROUGH@LJMU.AC.UK

The human being has evolved over millions of years to become an efficient endurance animal with the primary driver to hunt and to survive. Modern day humans however are less physically active than our ancestors and yet it is well established that regular moderate intensity exercise has numerous health benefits. Likewise, there is evidence of reduced cardiovascular risk and improved structure and function of the heart in physically active individuals. There is however, a growing trend for the human being to push themselves to the limit of endurance with participant numbers at ultra-endurance events increasing annually. Is this type of exercise beyond what the human heart has evolved to do? This lecture highlights how the heart adapts to allow an individual to partake in endurance exercise but raises the question as to whether too much exercise is deleterious. The acute cardiac response to ultra-endurance exercise is explored which poses a further question as to whether this 'event' acts as a stimulus for adaptation or something more sinister. Evidence for chronic remodelling of the heart is presented which builds a platform to allow the discussion on the incidence of myocardial fibrosis, exercise induced cardiomyopathy and coronary artery disease.

A17.17 PREPARING ELITE HUMAN ATHLETES TO PERFORM IN THE HEAT

SUNDAY 12 NOVEMBER 2017 15:30

JO CORBETT (UNIVERSITY OF PORTSMOUTH, UNITED KINGDOM)

@ JO.CORBETT@PORT.AC.UK

Compared to training and nutrition, the influence of environment on athletic performance has, historically, received less attention. However, athletes are often required to exercise in hot and/or humid conditions and future major sporting events are scheduled for such environments, e.g. 2020 Olympic Games (Tokyo) and the 2022 World Cup (Qatar). These environmental conditions present an increased challenge for athletes, who are seeking to perform at a high level under ambient conditions posing a greater physical and physiological challenge to homeostasis when compared to exercise under more temperate conditions. Indeed, the detrimental influence of heat on prolonged exercise is well established and failure to adequately prepare can result in multiple effects ranging from impaired performance to a spectrum of heat illnesses and, in the extreme, death. Consequently, there is increasing interest from athletes as well as those individuals assisting athletes with their preparation, in effective strategies for mitigating the deleterious effects of high heat and/or humidity on prolonged exercise performance. This talk will explore the research underpinning a number of contemporary approaches used by elite athletes before, and during exercise, in order to negate the deleterious effect of heat and optimise their performance in hot environments. The talk will also explore some of the unique challenges posed in the preparation of elite athletes, who are nearer to their ceiling of adaptation than non-elite sportspeople, must balance their heat preparations with multiple practical and logistical constraints, and are highly motivated to perform under conditions posing an increased risk to their health.

A17.18 CIRCULATORY LIMITATIONS TO EXERCISE: HEAT, HYDRATION AND THE HUMAN BRAIN

SUNDAY 12 NOVEMBER 2017 16:00

STEVEN TRANGMAR (UNIVERSITY OF ROEHAMPTON, UNITED KINGDOM)

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Reductions in total body fluid (dehydration) generally occur when individuals perform prolonged strenuous exercise in hot environments. If these fluid losses are not sufficiently replaced, aerobic performance can be impaired in association with numerous alterations in physiological function, including impaired thermoregulation and body hyperthermia, circulatory strain characterised by reductions in tissue and organ blood flow, alterations in neural drive and, in some circumstances, reduced aerobic exercise performance. However, the impact of dehydration on physiological function is largely dependent on 1) the level of dehydration, 2) the extent of the ambient environmental conditions, and 3) the functional demand imposed by exercise. For example, moderate reductions in total body water (< 2% body mass loss), cooler environmental conditions or exercise involving only a small proportion of the total muscle mass can prevent the physiological strain normally associated with dehydration. On the other hand, the combination of higher levels of dehydration, skin and internal body hyperthermia, and strenuous exercise, pose a marked challenge to cardiovascular control and, in particular, the maintenance of active muscle, skin and brain blood flow. This talk will examine the recent advances in knowledge and understanding of how dehydration differentially impacts physiological function during exercise requiring low compared to high functional demand. A specific emphasis will be placed on how the circulation and metabolism of the human brain is affected by the combination of dehydration, hyperthermia and exercise, and whether these changes contribute to early fatigue seen in physiologically stressful environmental conditions.

A17.19 WALKING THE ENERGETIC TIGHTROPE: SEASONAL ENERGETICS OF ARABIAN ORYX

SUNDAY 12 NOVEMBER 2017 **16:30**

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Hot deserts are characterised by limited and unpredictable rainfall, intense solar radiation, highly variable ambient temperatures and low primary productivity. Mammals inhabiting these environments must regulate water and energy balance tightly to avoid dehydration and starvation. Arabian oryx *(Oryx leucoryx)* are medium-sized (80kg) ungulates which survive in extreme deserts without access to water. They previously inhabited extensive areas of the Arabian Peninsula, but became extinct in the wild in 1972. Subsequent releases of captive-bred individuals in the following decades have met with mixed success, with survival apparently related to environmental conditions such as temperature and resource availability, as well as illegal poaching. Understanding their seasonal requirements for water and energy is key to planning successful future reintroductions. We show that energy expenditure and water turnover of Arabian oryx is actually higher in the summer than the winter although they were thinner during the summer. Oryx moved similar distances during both seasons, but were mobile at different times of the day. Seasonal differences in energy and water requirements are likely to be a consequence of energetically costly cooling mechanisms, such as panting, when ambient temperatures are above their upper critical point. Therefore, when the environment is at its most harsh, oryx require the largest amount of resources and are at their most vulnerable. This makes them susceptible to climate change in their former ranges; optimal times for future releases are during cool periods and after rainfall when vegetation growth is maximal.

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