

1 *Introduction*

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Human ecology is the study of the interrelations that exist between individuals, populations, and the ecosystems of which they are a part, while seasonality has been defined as regular recurring intra-annual fluctuation of environments, and of the individuals and populations living in them. The appreciation of seasonality as a significant source of human variability has a considerable history, anthropologists in particular long having recognised the importance of season in the structuring of people's lives and of their work and ritual activities. However, it is only more recently that the effects of seasonality on a range of human functions and activities have been widely investigated.

The Society for the Study of Human Biology Symposium on Seasonality and Human Ecology, held on April 9–10, 1992 at the University of Cambridge, allowed the different ways in which seasonality influences human biology and behaviour to be examined in a systematic manner by human biologists, anthropologists, physiologists and nutritionists. The papers discussed at that meeting are published in this volume.

In the first contribution (Chapter 2), F.E. Johnston discusses the range of biological phenomena associated with seasonality and concludes that, as a species, humans are enormously responsive to the seasonal changes and environmental cycles that characterise their ecosystems. He argues that environmental seasonality is not so much a stress to which contemporary human populations must adapt, but rather a basic component of the ecosystems within which our ancestors evolved, one that has left its mark indelibly upon the makeup of our biology and behaviour. By using three examples of seasonal effects upon human biology: 1. growth and development; 2. conception and birth; and 3. food intake and nutrition, he is able to make three generalisations. The first is that a wide range of human biological processes show periodicities that seem to exist apart from exogenous influences; the second is that periodic processes in humans are biobehavioural in nature; and the third is that human groups are enormously sensitive to their ecosystems. These generalisations are examined and developed in subsequent chapters.

R.A. Foley (Chapter 3) develops the theme that seasonality is a major

evolutionary pressure, using variation in East African seasonality as a basis for considering the diverse adaptive trends of early African hominids. This analysis is extended by examining some of the problems faced by tropical species adapting to temperate seasonality, including thermoregulation. He concludes that one of the principal proximate ecological factors influencing the success of hominids in their radiation is likely to have been the time available for foraging during mid- to high-latitude winters.

The importance of thermoregulation in adaptation to seasonal environments is made clear by M.A. Stroud (Chapter 4), who reviews current knowledge about physiological responses to hot and cold environments in modern humans. He highlights areas of contention in our understanding of human responses to cold stress, including the importance of shivering, and of non-shivering thermogenesis. On the basis of recent evidence, he raises the possibility that non-shivering thermogenesis may be an important adaptation in adults to severe cold.

Another way in which seasonal environments may operate directly on human physiology is through variation in daylength. In humans, there is every reason to believe that light signals received by the eye have effects on the pineal gland similar to those in animals showing obvious seasonal rhythms. Reviewing this topic, D.L. Ingram and M.J. Dauncey (Chapter 5) conclude that the intensity of light needed to reduce the secretion of melatonin or reset a circadian rhythm is much greater in humans than in other animals, and that such signals have little if any effect on the control of human reproductive function. They show that the seasonality of birth-rates and conception reported for populations in many parts of the world have nothing to do with hormonal changes associated with changing daylength.

L. Rosetta (Chapter 6) continues the theme of seasonality and fertility by examining the effects of photoperiod, temperature and humidity on human sperm quality, hormonal rhythm, menstrual pattern and birth seasonality. Although many of the mechanisms and mediators involved in the seasonal regulation of fertility are not known, seasonal variation in sperm quality and the duration of the menstrual cycle are some of the most important factors influencing birth-rate in all populations. However, in Third World communities seasonality of rainfall and temperature are additional factors influencing fertility, through the physiological effects of changing energy expenditure and nutritional status on the release of hormones involved in the control of ovulation in women.

Seasonality in fertility is placed in an ecological context by S.J. Ulijaszek (Chapter 7), who examines the relationships between birth-rate, pregnancy outcome, lactational performance and child mortality in a rural community in The Gambia, where seasonality of food intake, energy expenditure and infectious disease are experienced. He shows that seasonal troughs in

birth-rate are more closely related to seasonally low intakes of dietary energy, and that childhood mortality is lowest in children conceived at the time of year when fertility is lowest.

From reproductive performance, the focus shifts to seasonal effects on physical growth and development. T. J. Cole (Chapter 8) carries out an analysis of infant growth data from two contrasting populations, one in rural Gambia, the other in Cambridge, England. There is seasonality of growth in both groups, the effect being greater in the Gambian than the Cambridge infants. In The Gambia, birth during certain times of the year is better for subsequent growth and development than birth at other times.

In the next chapter, A.H. Bittles and L. Sanz (Chapter 9) consider the possibility that polygenic multifactorial disorders show seasonal variation. Analysis of British data on neural tube defects and schizophrenia at birth reveals seasonality in both. They suggest that seasonality in children born with neural tube defects is environmentally mediated through the folate nutritional status of their mothers during pregnancy.

A. Tomkins (Chapter 10) reviews the evidence for the influence of a range of factors on seasonality of a number of infectious diseases, including dysentery, malaria, measles, respiratory infections and diarrhoea. He highlights the complexity of disease ecology in the tropics, upon which seasonality is superimposed.

By contrast, K.J. Collins (Chapter 11) examines seasonal morbidity and mortality in temperate regions, focussing on the elderly in Britain. He shows that the characteristic cold weather pattern of increased winter morbidity and mortality in cold and temperate regions is more pronounced in Britain than in many comparable countries, hypothermia contributing only a tiny proportion of excess winter deaths. Respiratory mortality in winter is most closely associated with influenza epidemics and levels of home heating, while outdoor cold is an important factor in the aetiology of winter cardiac deaths.

The next chapter is the first of several to consider seasonal aspects of food and nutrition. A. Ferro-Luzzi and F. Branca (Chapter 12) attempt to determine the proportion of the world's population exposed to seasonal undernutrition. They use an index of seasonality in association with body mass index to identify the parts of the world that are at high risk of seasonal nutritional stress. They conclude that: 1. populations in parts of sub-Saharan and Southern Africa and in India are at greatest risk; 2. populations in China are at considerably lower risk; and 3. Latin American populations are at very low risk. Although the model developed by them is somewhat speculative, and despite the acknowledgement that its utility is restricted by inadequate data for many parts of the world, it is a method that may be of considerable use to nutritionists and planners in the future.

In contrast to the global approach in the previous chapter, K.B. Simondon, E. Bénéfice, F. Simondon, V. Delaunay and A. Chahnazarian (Chapter 13) illustrate the effects of climatic seasonality on the nutritional status of adults and children in two populations in Senegal, West Africa, one having access to modern irrigation technology, the other not. They show how modern irrigation agriculture has served to reduce seasonality in nutritional status in women, but not in children.

I. de Garine (Chapter 14) considers the perception of seasonality in two other African communities, the Massa and Mussey, and how this relates to climate and the human biological effects of seasonality. He shows how complex the biobehavioural relations between humans and their seasonal environment can be. It is important to note that seasonally high biological stress does not necessarily coincide with seasonally high psychological stress in these societies.

R.A. Huss-Ashmore (Chapter 15) addresses the impact of economic change in developing countries on the ability of traditional farmers to cope with seasonality, concluding that agricultural development may increase incomes and food consumption, but does not do away with their seasonality. This chapter illustrates the fact that agricultural development is one of an array of strategies for procuring food and other resources, its adaptive success estimated by its ability to provide adequate resources during the lean season while not jeopardising health or long-term productivity.

In the final chapter (Chapter 16), C. Panter-Brick examines the ways in which communities living in seasonal environments organise themselves to accomplish their subsistence tasks, and the underlying logic governing their choice of work patterns. She shows that in Nepal and elsewhere, households combine to work in labour groups at times of peak work-load, thus enabling them to complete urgent tasks and to maximise labour efficiency for tasks that require cooperation and pooled resources. At other times, cooperative strategies may be less important, and so are less likely to be practised.