

BOOK REVIEWS

Whitehead, H. 2003: *Sperm Whales: Social Evolution in the Oceans*. University of Chicago Press, Chicago and London. 431 pp. \$30. ISBN 0-226-89518-1.

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This is a story about sperm whales, written by the scientist who understands these animals better than anyone else, Hal Whitehead. The volume comprises a summary of the field research that has been done with sperm whales, much of which has been carried out by Whitehead, his students and colleagues during the last 20 years. The story that Whitehead tells draws from first-hand scientific discoveries and observations made since he and his associate Jonathan Gordon first developed a suite of methods for studying the behavior of living sperm whales from sailing boats. In this long-term research effort, groups of females and immatures, as well as bachelor schools of males, are tracked both visually and acoustically and photoidentifications of individual whales are repeatedly collected by Whitehead's team.

With few reservations, I think Whitehead's book is an exceptional treatise on the behavioral ecology and social evolution of these deep-diving leviathans. The text is comprehensive but not tedious, because Whitehead weaves the relevant available data on sperm whales, along with his own observations and research findings into an appealing text with a unifying point of view. Throughout the description of sperm whale natural history and ecology – while covering material from distribution and abundance to behavior and conservation – Whitehead builds a case that the sperm whales' deep-diving behavior and extensive oceanic travel patterns are the critical driving forces behind the evolution and adaptation of their vocal and social behavior.

As Whitehead reminds us in his first chapter, sperm whales are animals of extremes. Not only do they have the largest brain on earth, but also they are the largest odontocete cetacean and the most sexually dimorphic, with a gigantic head containing a massive nasal complex surrounded by spermaceti oil. Despite some debate among marine mammalogists, the spermaceti organ, which comprises about 30% of the sperm whale's body, is likely to have evolved in relation to the production of extremely loud underwater clicks that are used in several ways. First and foremost, the nose functions in emitting a powerful sonar in which the role of the spermaceti organ is similar to the melon of dolphins and beluga whales. It is used to transmit and focus sound energy in the form of clicks, producing what is the loudest biological sound ever recorded. Sperm whales echolocate in deep dark water by emitting a train of regularly spaced clicks, bouncing the sounds off large squid and fish and listening for the returning echoes. Sperm whales probably modulate the production of these clicks to find, close in on, and consume their diverse mesopelagic and benthic prey.

Click production as a secondary adaptation is significantly tied in with conspecific communication. Groups of females observed and heard in social situations, emit a stereotyped pattern of three to 20 clicks called 'codas'. Originally it had been proposed that coda types identified individuals in a manner analogous to the stereotyped calls, or signature whistles, of bottlenosed dolphins. However, the author and his collaborator Linda Weilgart strongly suggest that this is not so. Instead, they and others have found that different individuals may produce the same coda, and that in any population, there are many fewer coda types than there are individuals. Their initial impression when listening to sperm whales codas, containing a set number of clicks, was that they could be subdivided into quite well-defined and distinct categories and types depending on their relative inter-click intervals. This idea was later substantiated statistically by representing coda repertoires in multi-variate space. Whitehead sees all of this as analogous to individuals within a clan of killer whales having similar vocal dialects, and so he has adopted the term 'clans' to label the female and immature social units with similar coda repertoires or dialects.

In contrast to codas, which are emitted primarily by socializing females, another type of click, the 'slow click' or 'clang' is largely or entirely emitted by large males. These very distinctive ringing clicks are repeated every 6–8 s. Indeed, such clicks may be an important signal in the context of sexual

selection. The spermaceti organ may be proportionately larger in adult males when compared with adult females, because the spectral frequency, signal amplitude, and inter-click interval may be size related and therefore provide a benefit to huge males that can acoustically advertise their size, age and health to potential mates while at the same time repelling other smaller males.

In the chapters dealing with life history parameters, social behavior, and culture, Whitehead points out that, like other odontocete cetaceans, sperm whales live long lives, have a long delay of sexual maturity (particularly in males), and the young have prolonged periods of dependency. Female caretaking of the young lasts many years and there is a relatively low infant mortality rate. In their oceanic habitat, females and immatures are usually found in cohesive groups of 20–30 individuals; they swim and behave together in a coordinated way. Birth, rearing, foraging, and mating all occur within this self-contained social unit. Individual members of the group show a variety of epimelatic behavior, including ‘babysitting’ and perhaps allonursing while mothers deep-dive to forage as well as several complex behavior patterns related to communal protection of the group. Until recently, these ‘altruistic’ behaviors were interpreted simply as kin aiding kin in stable matrilineal groups; however, recent photoidentifications, genetic analyses, and behavioral observations show that these groups consist of adult female and immature sperm whales of both sexes that seem to live in a fission–fusion society. The observed group, for example, may be a temporary association between two or more stable social units. The genetic analyses of these groups show the presence of multiple matrilines. Groups contain clusters of closely related individuals, but some individuals within the unit have no close relatives, and it appears that these groups consist of both kin and unrelated friends. Whether strong aiding behaviors, such as high-risk cooperative defensive behavior and allonursing, occur among or outside of matrilines is currently unknown.

In the context of these sperm whale societies, Whitehead defines culture broadly, as any action acquired through social learning. He does not discuss the psychological principles that underlie social learning in these animals, i.e. local enhancement, observational learning, and/or imitation; instead, he takes an ethnographic approach. Whitehead argues that because all sperm whales share similar oceanic environments, and because there are genetic dissimilarities as well as genetic similarities within social groupings, the idiosyncratic codas and behavioral patterns shared by group members can only be ascribed to cultural factors. This ethnographic approach, while functional, does not consider the role of social cognition. Further study of individuals, as well as groups, might differentiate individual learning and ecological influences from behaviors attributed to culture. For example, Whitehead notes the apparent homogeneity of social relationships among group members, indicating that individuals treat group members as equivalents. Taken at the group level only, Whitehead sees members of the social unit as lacking obvious hierarchical relationships, but perhaps, if it were possible to look more closely at the behavior of individuals, such observations would lead to a somewhat different conclusion. It is possible that the behavior of the sperm whales in a group may resemble that of chimpanzees, in that internal relationships within the group may be less uniform than they appear. Differences in relationships may exist between individual sperm whales but these differences may be overshadowed by shared community identity reflected in common codas and movement patterns.

As a whole, Whitehead’s story of sperm whales is a remarkable synthesis drawing from the fields of ethology, bioacoustics, anthropology, sociobiology, population biology, and a multitude of other disciplines. With new advances in technology and better resolution of group dynamics, Whitehead’s next 20 years are likely to reveal even more about the social evolution of these unusual creatures.

Vaarst, M., Roderick, S., Lund, W. & Lockeretz, W. 2003: Animal Health and Welfare in Organic Agriculture. CABI Publishing, CAB International, Wallingford, Oxon, UK. 448 pp., US\$ 120.00 (hardback). ISBN 0 85199 668 X.
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The growth of organic farms represents the most remarkable transformation in European agriculture practice over the last decades. Contrary to conventional, intensive, specialized agriculture, which is still the most widely spread throughout European countries, organic agriculture is based on the concept of an integrated agricultural system, in which all living organisms interact to their mutual benefit, and where land, animals and humans harmonically coexist. So, the main goal of organic