by a species that would prevent total adaptation. This is illustrated by the development of ever more elaborate and precise displays by many species living in relatively stable tropical environments, and the conservation of variation in unvarying environments, particularly for mimetics. Individual differences may also arise as a result of the advantages associated with kin recognition and the communication of individual characteristics (phenotypic mimicry).

The importance of individual differences in animal management, conservation and welfare is increasingly recognized as increased awareness is focused on the importance of the individual’s welfare and its value as a genetic resource. Different individuals may respond to a similar disease challenge or load of stressor differently as a result of individual differences (personal risk factors), and so the physical and psychological health of an individual cannot be understood fully without an appreciation of the individual that is affected.

Recognition and appreciation of this is one of the essential skills of a good clinician. One of the challenges of medicine and the development of good husbandry practices is the identification of significant risk factors of clinical relevance relating to individual differences, i.e. those factors that are of real importance and which vary with the condition under consideration. For example, in the case of a potentially fatal disease, small risk factors relevant to small individual differences may be important but, in the case of less serious conditions, such variation may be of less relevance.

In a recent study, most work has focused on physical differences, e.g. skin coloration in mammals, fur patterns in carnivores and cats, with less attention generally paid to behavioral and psychological differences, despite their potential importance in predicting survival. The notable exception to this is the study of individual differences in behavior as a risk of behavioral problems, e.g. aggression and the risk of cannibalism in chickens, attachment behavior and the risk of separation anxiety in dogs, etc.

An appreciation of the importance of individual differences in behavior is also important to many aspects of applied animal behavior and welfare.

References and further reading

Individual fitness
Evolution by natural selection is a potent force of adaptive change. Simply put, those individuals whose genes spread through the population have greater fitness than those whose genes do not. An individual's genes can spread directly or indirectly, and this is important. Charles Darwin recognized possible ways that this phenomenon might exist. Individuals that are selected to breed at some cost to themselves, for example, we often see in helping feed or care for other or emitting potentially costly alarm calls. How could these potentially costly behaviors be adaptive to individuals? A solution is that individuals that share more genes with close relatives and fewer with distant relatives (see: Kinship) and, by helping relatives to survive and reproduce, are helping their own genes to survive and reproduce.

The British geneticist J.B.S. Haldane once said that he would be willing to sacrifice his life for two brothers or eight cousins. Working though the maths, we see that such a large family would generate a large fitness effect. For example, if the coefficient of relationship between an individual and his two brothers is 0.5 (full siblings), as will saving eight first cousins (8 × 0.125) is correct. Thus, Haldane's back of the envelope calculation was correct.

There are a number of common confusions about the term fitness. Darwinian fitness is often mistakenly confused with physical fitness. Evolution by natural selection does not inexorably select those in the best condition to reproduce. Rather, those that are fitter have the highest Darwinian fitness. Envision an elephant seal. The elephant seal population has 2% of large-bodied males that are better able to defend harems and therefore have more reproductive success. In most years, the elephant seal harem is seen when the puppopulations and sire the most young in a colony. However, what happens when insufficient food is available? We know that, in such conditions, females of some species may have energy by not breeding. Because large-bodied individuals require absolutely more energy than smaller-bodied ones, large males may be the most vulnerable individuals when food is drastically restricted. In this case, small-bodied individuals are able to survive and are able to reproduce the following year. Thus, the largest individuals, in apparently the best physical condition, might not have the highest fitness.

Fitness is another aspect that is frequently misunderstood. Large males exert a lot of energy defending their territories as well as their harems. Because they have no chance of winning a fight with a large male, often on occasion, smaller males will try to mate with a female in a large male's territory. The fitness of those small males is not high. These males are referred to as "steakers", and this illustrates a condition-dependent strategy whereby large males fight for reproductive success and smaller males try to steal it. Such condition-dependent strategies are common and illustrate another way that being in a species, including the human, can be different from most other species.

Fitness is a relative concept. Fitness will not lead to the best conceivable individuals. Rather, heritable traits will evolve so that populations conform to a particular physiological or ecological niche. When conditions change, what determines the best trait might change, and thus we will have selection for another trait. Moreover, traits do not evolve to some 'optimal' function, rather, traits evolve such that individuals with them perform better than those without them.

Fitness is constrained in many ways. The fluctuating environment in which they live leads to the variation in intellectual and physical development. Undernutrition in years of plenty and smaller animals might develop better. In years of major limitation, their pineal glands may not be destroyed due to stress. In years of plenty, smaller animals might be more likely to develop better due to stress. In years of major limitation, their pineal glands may be destroyed due to stress.

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