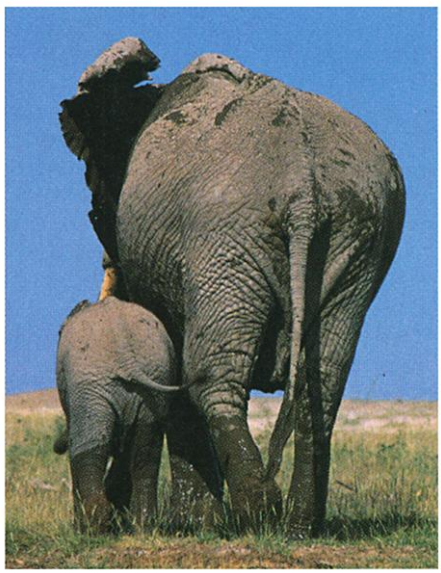
Elephant Hunting and Conservation

A STUDY OF AFRICAN ELEPHANTS BY Karen McComb and colleagues revealed that matriarchs are repositories of social knowledge for family groups (Reports, "Matriarchs as repositories of social knowledge in African elephants," 20 Apr., p. 491). Therefore, the authors suggest that the removal of older elephants by hunters could have serious consequences for the conservation of the species. McComb *et al.* did not elaborate on conservation issues, so we wish to discuss two key considerations that are important to take into account in elephant conservation efforts: namely, the different consequences of legal versus illegal hunting, and the importance of habitat loss in reducing elephant numbers.

Evidence on illegal hunting indicates that poachers target individuals with the largest tusks, including many matriarchs (*1*). In contrast, trophy hunting, besides being regulated and limited by quota to relatively few animals per year, primarily targets large bulls (*2, 3*). Bulls are far more solitary than females (*4*), so their role as repositories of social knowledge, although untested, is likely to be less important than that of matriarchs. Although the removal of significant numbers of older bulls from a population may have other detrimental results (*2*), the effect of regulated, low off-take trophy hunting on group social knowledge is likely to be minimal when compared with poaching.

More importantly, a well-regulated trophy hunting system can help maintain elephant numbers while raising revenues to fund elephant conservation programs and benefit local communities, who share 80% of the species' range. Given that habitat loss contributes significantly to elephant decline (*5*), it is essential to encourage coexistence between elephants and local communities outside protected areas. Without intervention, however, elephants are generally unpopular because they may damage crops or threaten the lives of people (*3*). Furthermore, compensation schemes for those adversely affected have largely failed (*6*), and tourism benefit-sharing schemes are limited to more accessible areas with relatively developed infrastructure and do not provide a focussed benefit from elephants. Consequently, many communities and wildlife authorities have resorted to the destruction of problem animals. Indeed, in Kenya, where there is no trophy hunting, figures from 1992 to 1999 show that similar numbers of elephants were killed by poachers as were shot by Problem Animal Control units (412 compared with 428, respectively) (*7*).



Mother knows best.

In other countries, however, trophy hunting provides a means of turning a problem into assets worth more than $10,000 per elephant trophy to the community, resulting in greater tolerance of elephants and fewer animals killed overall (*4*). In Zimbabwe, implementing trophy hunting has doubled the area of the country under wildlife management relative to the 13% in state protected areas (*3*). As a result, the area of suitable land available to elephants and other wildlife has increased, reversing the problem of habitat loss and helping to maintain a sustained population increase in Zimbabwe's already large elephant population (*8*).

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Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Response

IN OUR STUDY, WE USED PLAYBACK experiments on female African elephants to demonstrate that the possession of enhanced abilities for social discrimination by the oldest female in a group can influence the social knowledge of the group as a whole (*1*). These superior abilities for social discrimination may result in higher per capita reproductive success for female groups led by older individuals, and thus removal of matriarchs from elephant family units could have serious consequences for the conservation of this endangered species. While our experiments provide evidence that older group members act as repositories of social knowledge, other forms of accumulated knowledge held by such individuals, including knowledge of the location of food resources, may also have important effects on reproductive success.

Older female elephants clearly face

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their major threat from illegal hunters, who kill them for their tusks and for food. Leader-Williams and co-authors argue the case for legal hunting of male elephants maintaining elephant numbers. Although serious concerns are raised elsewhere over the implications of losing older males from endangered elephant populations because of their particular importance in breeding (*2*), male elephants were not the subjects of our paper. However, we emphasize in general terms the danger of removing older, more experienced individuals from social groups in endangered populations of advanced social mammals, because the situation for female elephants has obvious parallels elsewhere (*1, 3*). In many whale species, for example, large-brained, long-lived females also form closely bonded social groups (*3, 4*), and examination of the size of individuals in commercial catches suggests that the largest may have been selectively taken (*5*). Given that our results indicate that groups may rely on older members for their store of social knowledge, in the absence of information on specific cases we would urge caution over any activity that results in their removal from endangered populations.

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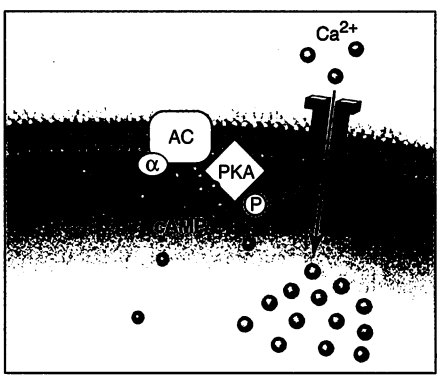
The Fourth Dimension in Cellular Signaling

A KEY QUESTION IN CELL BIOLOGY IS HOW signaling specificity is achieved. The authors of two Perspectives (*1, 2*) reflected on the difficulties of relaying information from a staggering number of extracellular receptors through a small number of intracellular signaling molecules. A classic example is the cAMP (cyclic adenosine 3′,5′-monophosphate) pathway, in which the binding of hormones, neurotransmitters, and odorants to receptors triggers the production of cAMP. This soluble messenger activates downstream effectors such as cAMP-dependent protein kinase (PKA), which differentially phosphorylates hundreds of cellular targets. In the past few years, the primary focus of research into specificity has been on macromolecular signaling complexes that effectively organize proteins (from receptors to targets) into two-dimensional arrays at the surface membrane. In their report, M. A. Davare and colleagues provide an elegant example, demonstrating that β_2 adrenergic receptors assemble in complexes with L-type Ca^{2+} channels, and that signals from the receptor to the channels (transmitted through the cAMP pathway) are localized (Reports, "A β_2 adrenergic receptor signaling complex assembled with the Ca^{2+} channel $Ca_v1.2$," 6 Jul., p. 98).

Although this sort of organization is essential for signaling specificity, a pressing question remains, what happens to cAMP?



Keeping cAMP close by. Perhaps cAMP is "channeled" between adenylyl cyclase (AC) and protein kinase (PKA) in certain macromolecular signaling complexes (see the response by Hall and Hell). (α, a G protein; P, phosphate)

Laporte *et al.* (*2*) touch on the problem: "[I]t is commonly assumed that activation of ion channels through second messenger–dependent kinases such as PKA can be sensed anywhere within the cell because of the rapid diffusion of small second messenger molecules. The findings from Devare *et al.* certainly challenge the generality of this assumption." We would like to point out that this vital issue, diffusional spread of small molecules, has received some attention. In two cell types studied by Devare and colleagues, rat hippocampal neurons and human embryonic kidney cells, there are multiple lines of evidence for diffusional restrictions under the surface membranes, giving rise to chemical compartmentalization (*3, 4*). The latter study dealt specifically with cAMP. Diffusional restrictions have also been observed in cardiac myocytes (*5*). It is worth noting that without these restrictions, cAMP concentrations right next to adenylyl cyclase (the enzyme that produces cAMP) would not be high enough to activate PKA, unless the entire cell filled with cAMP (*4*). This, of course, would acti-

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Old expectations.

Probes

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