Seal disease predictions

SIR—It is now generally accepted that the primary agent responsible for the deaths of more than 17,000 common seals *(Phoca vitulina)* in Europe since April 1988 is a previously undescribed morbillivirus, phocine distemper virus (PDV)[1]. At least 185 grey seals *(Halichoerus grypus)* have been found dead around the United Kingdom during the same period, some with pathological symptoms similar to those of common seals. At present we do not know enough about the virus or the behaviour of seals to model its epidemiology realistically but there is sufficient information to make some broad predictions.

The speed with which the disease has spread across Europe, and the fact that seals periodically form dense aggregations on sandbanks or rocks to pup and to moult, suggest that the prevalence of the virus within a local seal population should reach high levels within months of first exposure. This prediction was confirmed when we tested samples of blood from adult grey seals and their pups collected at three colonies in Scotland in October and November 1988. The presence of serum antibodies against canine distemper virus (CDV), which is closely related to PDV, was tested by a virus neutralization assay and with an ELISA test using CDV proteins as the antigenic target; results from these assays are highly correlated[2]. All but 2 of the 73 sera contained antibodies to CDV but no antibodies were detected in sera taken from grey seals between 1977 and 1987, including at least five animals that were subsequently resampled in 1988. These results confirm previous suggestions that PDV was introduced into the seal populations of the North Sea during 1988, although they provide little insight into the origin of the virus.

Antibodies against CDV in common seals sampled in 1989

Site	Age* (yr)	No. tested	Antibody-positive(%)
The Wash	<2	3	0
	>2	3	100
Dornoch Firth	<2	10	20
	>2	6	67
Orkney	<2	4	25
	>2	12	100
Mull	<2	2	0
	>2	4	50
Strangford Lough	<2	5	70
	>2	7	100
Total	all	56	55
	<2	24	12
	>2	32	88

*Seals were divided into age classes on the basis of length; those less than 110 cm were considered to have been born in 1988 or 1987.

When we tested blood samples from surviving and apparently unaffected common seals collected at a number of UK sites in 1989, as part of a project funded by the British Department of the Environment, we were surprised to find that only half had a significant immune response. As shown in the table, however, most of the older (> 2 yr) animals had serum antibodies whereas few of the younger ones did. This implies that many of the younger seals have yet to be exposed to the virus.

We would expect approximately one third of a seal population with a stable age structure to be in age-classes 0 and 1 eight months after the pupping season, when our samples were taken. Provided there has been no differential mortality among the age-classes (and there is no conclusive evidence of this[3]) we can calculate approximate 95 per cent confidence limits for the proportion of susceptible animals in the surviving population using a normal approximation 0.285 – 0.465.

Thus between about one quarter and one half of the surviving British common seal population has yet to develop an immune response to PDV and could be susceptible to infection with PDV in 1989. These animals are concentrated in the youngest age-classes. Their susceptibility to fatal infection may be increased by the apparently poor immune status of young common seals[2]. They will be particularly vulnerable to infection during the moult in August when large and dense aggregations of all age-classes form, except pups born that year. If there are still infected animals around at this time, we predict that there could be substantial mortality among the youngest age-classes.

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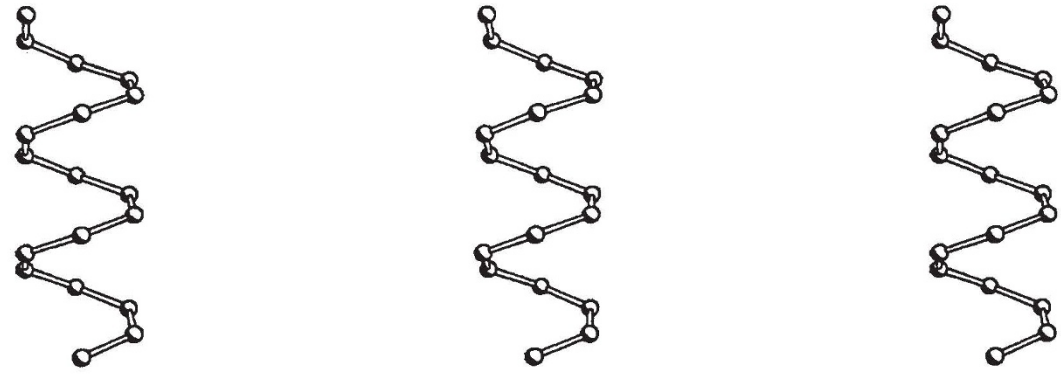
Stereopsis ambiguity in stereo images

SIR—Tucker[1] is right to ask those who publish stereo pairs to mention for which eye each element of the pair is intended. In many cases, however, the potential ambiguity can be removed by various techniques.



The helical structure shown here, for example, can be viewed in only one possible handedness because of the care taken to represent volumes. Thus, the three-dimensional image of the right-hand pair viewed by direct stereopsis exhibits some contradictory details, indicating it is the incorrect orientation.

Many programs are available that are able to remove the stereopsis ambiguity. Perhaps the most popular is ORTEP[2], in which each stereo pair can be unambiguously identified when properly treated.

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