SCIENTIFIC CORRESPONDENCE

Relationships among isolates of HIV

SIR-In their informative analysis of restriction-site diversity among multiple molecular clones of three HIV isolates, M.S. Saag et al. (Nature 334, 440; 1988) do not estimate restriction-map distances between isolates in the most appropriate way. The impact on the conclusions is minimal in this case, but we wish to draw attention to this point, not only because with a different data set it could have a considerable effect, but also because a

of each pair of restriction maps (see table).

The weighting has only a small effect on the mean distances in this data set because of the rather low frequency of each restriction map in the isolates. In studies of smaller regions of the HIV genome, however, the commonest type might be much more abundant, leading to a serious bias.

From the table we note that the weighting of the distances leads to a smaller fractional reduction in inter- than intra-group

Inter- and intra-isolate diversities of HIV isolates				
	Outgroup*	RJS4	WMF1	WMF3
Outgroup	58.7 † 58.7	55.4	54.5	56.5
RJS4	54.5	13.4 12.0	41.9	45.0
WMF1	53.4	40.3	14.1 11.6	24,2
WMF3	56.2	44.1	21.0	12.6 10.7

Above diagonal (bold), means of the pairwise restriction map distances (per cent) as calculated by Saag et al.; below diagonal, weighted restriction map distances (per cent) between and within groups.

Group consisting of isolates HXB2, LAV-MAL, LAV-ELI, ARV2 and WMJ1.

[†]Mean distance of 55 per cent given in error by Saag et al.

comparison between the distances published by Saag et al. and the corrected distances points to an interesting aspect of these data.

Although the computation of a pairwise distance matrix is, indeed, a valid way of presenting data of this type, the simple arithmetic mean of the distances between each map (mean difference) is not a correct expression of restriction-site diversity, which is best obtained by weighting each distance by the product of the frequencies diversity. This arises because the commonest clones in each group are relatively more similar to each other than are the less abundant clones. This may be a first indication of some constraint on the rate of divergence between HIV sequences.

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Calculating just how small a whale can be

SIR—Pearson¹ hypothesized that the lower limit of body size for terrestrial endotherms would be that size at which metabolic heat production, as limited by rates of assimilation, would be balanced by rates of conductive and convective heat loss. We have applied his reasoning to lower limits of body size for aquatic endotherms.

The Cetacea and Sirenia give birth in water^{2,3}, and are the only obligate aquatic endotherms. These mammals did not evolve endothermy in aquatic environments⁴, rather aquatic environments were invaded by terrestial mammals that were already well-developed endotherms.

Erratum

In the letter entitled "Ice-layer dating of eruption at Santorini", by Malcolm K. Hughes (*Nature* **335**, 211–212; 1988), the penultinate paragraph should read "... strongly suggestive circumstantial evidence . . ." rather than ". . . compelling circumstantial evidence . . .", an error which was introduced at the editing stage.

Aquatic and terrestrial environments differ in that rates of convective heat loss do not scale directly with differences in heat capacity but are related to differences in Reynold's numbers⁵. In air, at 20°C, the rate of convective heat loss is $3.93 [V/D]^{0.3}$ where V is velocity, and D is a linear measure of size. In water, convective heat loss is much higher 357 $[V/D]^{0.5}$. The rate of heat loss in water is 90.8 times greater than in air (the ratio of the coefficients of these equations). Because rates of heat loss scale with body weight $(W)^6$: 0.224 $W^{0.57}$ it is possible to calculate the expected minimum size of an aquatic endotherm.

If aquatic endotherms are subject to the same constraints as terrestrial endotherms, the minimum size of an aquatic endotherm would be that size at which the rate of heat loss (RHL) is 90.8 times greater than the heat loss of the smallest (2.5 g)terrestrial endotherm ($RHL_{terrestrial} = 0.224$ [2.5 g]^{0.57} and RHL aquatic = 90.8 (RHL_t)). Solving RHL_a = 0.224 [W_a]^{0.57} for W_a , we find $W_{1} = 6.8$ kg, the expected minimum weight of an aquatic endotherm.

We recognize that neonates of some terrestrial endotherms weigh less than 2.5 g and their thermoregulatory capabilities are limited. Our prediction, however, is the minimum size at which we might realistically expect endothermic competence. The calculated minimum neonate



Lengths and weights of fetal and postnatal river dolphins'. The open circles are fetuses and the filled circles are the smallest postnatal specimens of Lipotes vexillifer (L), Pontoporia blainvillei (P), Inia geoffrensis (I), and Platanista spp. (PL). The relationship between length and weight is shown by the least squares regression (wt (kg) = 21.1 length (m) - 8.66, P < 0.001). The dashed horizontal line is the predicted minimum body mass for an endothermic aquatic neonate.

weight for an aquatic endotherm is 6.8 kg. If an aquatic neonate is smaller than this lower limit, then it cannot generate metabolic heat fast enough to compensate for heat loss, and its body temperature will decline. The predicted value is less than or equal to neonate weights of the smallest aquatic endotherms, the river dolphins (see figure)⁷.

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