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Population estimates from recapture studies in which no recaptures have been made

THE number of animals in a population can be estimated from the proportion of individuals in a sample which have been captured previously[1–3]. Animals which have been captured previously may be recognised by some method of marking. If the population is very large relative to the size of the samples, no marked individuals might be recaptured, because the probability of capturing any of the few marked animals is very small. Marked animals may, however, fail to be recaptured even if the population is quite small, because of random sampling error. It has not been realised before that a useful estimate of population size can be made even when no animals have been recaptured.

Suppose that a animals from a total population of size N have been marked and released. On a subsequent occasion, n animals are captured, none of which bear marks. If it is assumed that the usual conditions of recapture analysis are met, then the probability that the first animal to be captured will be unmarked is $(N - a)/N$. Similarly, the probability that the second animal to be captured is unmarked is $(N - a - 1)/(N - 1)$. Thus, the probability that all n captures are unmarked is:

$$P = \frac{(N-a)}{N} \cdot \frac{(N-a-1)}{(N-1)} \cdots \frac{N-a-(n-1)}{N-(n-1)}$$

$$= \frac{(N-a)!/(N-a-n)!}{N!/(N-n)!}$$

$$= \frac{(N-a)!\,(N-n)!}{N!\,(N-a-n)!}$$

By inserting trial values of N into this equation, one can obtain the probability P that the population is not larger than this trial value. The distribution of the probability is shown in Fig. 1, for an example in which eight marked animals have been released and several animals have subsequently been captured, none of which bear marks. As expected, the curves become asymptotic with $N = \infty$ at $P = 1$ and with $N < (n + a)$ at $P = 0$. I would suggest that in studies of small populations, an appropriate minimum estimate of population size may be made by solving the equation given above for N, by iteration, with $P = 0.5$. The meaning of this estimate is that the probability that the population is larger than the estimate is equal to the probability that it is smaller. If 95% limits are required, they can be obtained by solving for N with $P = 0.025$ and $P = 0.975$ respectively.

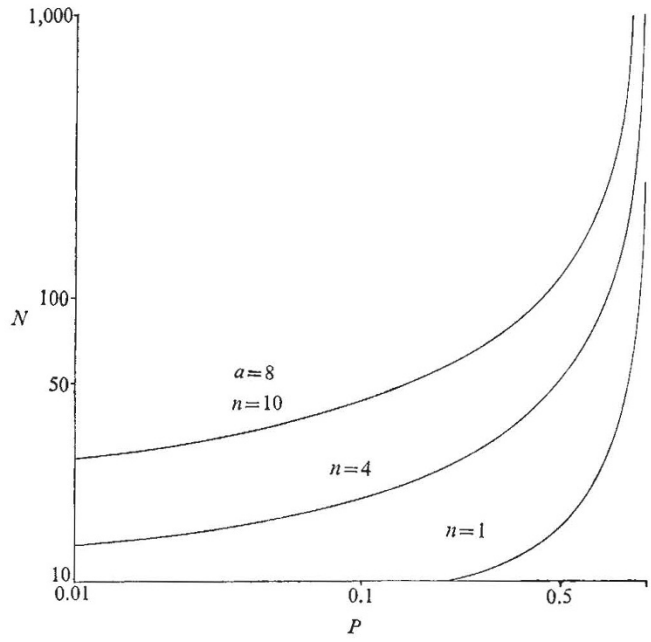

FIG. 1 Probability distribution for an example described in the text.

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Restoration of libido in castrated red deer stag (*Cervus elaphus*) with oestradiol-17β

THE role of oestrogens in male reproduction remains an enigma. It is known that the stallion[1,2] and the boar[3] excrete enormous amounts of oestrogen in their urine, and that this is of testicular origin[4,5]; more modest amounts of oestrogen are secreted by the testis of the bull[6], rat[7], and man[8–10]. Interest in male oestrogen was recently reawakened by the discovery that the hypothalami of rats, rabbits, monkeys and men are capable of aromatising testosterone to oestradiol-17β (ref. 11). This indicated that oestradiol-17β might be the central mediator of androgenic effects, an idea that is beginning to receive support from a number of different experiments. For example, it has been established that newborn female rats can be sterilised equally effectively by small doses of either androgen or oestrogen[12]. In addition, the anti-oestrogen MER-25 will effectively inhibit this neonatal sterilisation even when it has been induced by testosterone[13]. It also seems significant that androgens which cannot be metab-