have small endolymphatic sacs, and do not develop a skin deposit on preservation.

It is likely that the ingestion of calcareous material is intentional and normal in reproductively active females to replace the large amounts of calcium lost in the production of shelled eggs. Captive geckos are regularly fed cuttlefish and dietary supplements to replace their calcium, without which uncalcified, inviable eggs are produced or bone degeneration may occur (Demeter, 1976; Bloxam and Vokins, 1978; Howard, 1980). Deliberate ingestion of calcareous material by female geckos in the wild has not been previously reported, though Vinson (1975) did note the presence of coral fragments in the stomachs of two specimens of *Phelsuma guentheri* on Round Island, Mauritius. One of these was a female, but the sex of the other specimen was not given.

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SHORT NOTE:

GETTING INTO A PICKLE WITH PRESERVED SPECIMENS: FORMALIN AND DISTORTION IN THE SMOOTH NEWT, *TRITURUS VULGARIS*

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INTRODUCTION

In an interesting and highly relevant paper to herpetologists, Lee (1982) cautioned against the unguarded use of morphometric data collected from preserved specimens. In an analysis of 20 characters in the toad *Bufo marinus*, Lee found a number of significant effects of preservation when data from the 'fresh' and 'preserved' states of the same toads were compared using univariate statistics. One important point raised by Lee at the end of his paper concerned the species- and tissue- specificity of responses to a preserving fluid.

In an ongoing study of the reproductive biology of the smooth newt (*Triturus vulgaris*), I have collected and preserved several hundred specimens; but, can I be sure that the 10 per cent unbuffered formalin solution that I use for preservation does not distort the characters in which I am interested? In this report, I present data on the effects of preservation on several morphological characters which suggest little distortion when compared with the "fresh" state.

METHODS

The data presented below were derived from the analysis of 20 male and 20 female smooth newts obtained from ponds in the Oxford and Milton Keynes areas of southern England, between April 1982 and February 1984. Within one or two days of capture, the newts were sacrificed in m-aminobenzoate and scored

for the following characters to the nearest 0.5 mm:

1. Snout-vent length — from the tip of the snout to the posterior angle of the vent.
2. Tail length — from the posterior angle of the vent to the tip of the extended tail.
3. Tail height — measured 10 mm posterior to the posterior angle of the vent.

The newts were then each given an incision in the ventral body wall and placed individually in labelled bottles containing 10 per cent unbuffered formalin solution.

On 1st October 1984, these 40 newts were again scored for the three characters defined above. The mean number of days spent in formalin was 393 for the males and 408 for the females.

In addition, 25 male newts were dissected fresh, one or two days after capture, and the combined weight of the two testes recorded for each individual. After a maximum period of 240 days in formalin, the testes were weighed once again. In all comparisons between "fresh" and "preserved" measures, Student's t-test was used.

RESULTS

Means, standard deviations, per cent differences between means and the results of t-tests are shown in Table 1 for the three morphological scores recorded for both sexes. For all scores, there was shrinkage after preservation; however, differences between means were not statistically significant for any score. Individual newts showed much variability in their scores' responses to formalin; 50 per cent showed a reduction in tail height, 70 per cent a reduction in snout-vent length and 72.5 per cent a reduction in tail length. No individual scores were increased by preservation.

In fresh specimens, male newts had significantly longer ($t = 4.2, P < 0.001$) and higher ($t = 4.3, P < 0.001$) tails than females. There was no significant sexual dimorphism in snout-vent length ($t = 1.2$, $P > 0.05$). However, after preservation, snout-vent length was just significantly greater in males ($t = 2.03, P = 0.05$). It thus seems that preservation in formalin "created" a novel sexual dimorphism in this sample of newts.

Before preservation, the mean (+ standard deviation) weight of the males' testes was 0.055 ± 0.03 g. Weight after preservation was 0.053 ± 0.029 g, a decrease of 3.6 per cent which was not significant ($t = 0.24$, $P > 0.05$).

DISCUSSION

In all, the data presented above suggest that 10 per cent unbuffered formalin solution is a preservative that causes little distortion in smooth newts; nevertheless, there is a general shrinkage of the tissues. In the case of snout-vent length, this shrinkage was sufficient to result in the appearance of a novel sexual dimorphism. With regard to the testis, formalin probably has little influence on histological appearance due to general shrinkage, although it may have more subtle effects in terms of the microdistortion of various cell types.

For my purposes, formalin is an effective preserving fluid. However, the distortion it causes may have serious consequences in other areas of herpetology, such as the study of sexual dimorphism in amphibians. Several workers have used the extent of sexual dimorphism to predict the occurrence of intermale combat in a species (e.g. Shine, 1979). Whilst such data may result in questionable interpretations (as in Woolbright, 1983 and Sullivan, 1984), I suggest that a more basic flaw may be present. If data are collected from preserved specimens, then spurious cases of sexual dimorphism may appear, as found in the present study and by Lee (1982). I can only agree with Lee (1982, p.280) that "uncritical use of morphological data . . . from preserved specimens could lead to spurious conclusions".

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	Fresh	Preserved	%	t
Male (N = 20)				
Snout-vent length/mm	45.25 ± 2.50	44.57 ± 2.43	-1.5	0.88
Tail length/mm	43.20 ± 3.24	41.75 ± 3.22	-2.9	1.42
Tail height/mm	9.05 ± 2.36	8.55 ± 1.84	-5.5	0.75
Female (N = 20)				
Snout-vent length/mm	44.25 ± 2.75	43.00 ± 2.46	-2.9	0.75
Tail length/mm	38.00 ± 4.50	36.80 ± 4.60	-3.2	0.83
Tail height/mm	6.50 ± 1.22	6.12 ± 1.45	-5.9	1.70

TABLE 1. Results of t-tests and descriptive statistics for 40 specimens of *Triturus vulgaris* measured fresh and after preservation.