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TEST OF AN ELECTRONIC INDIVIDUAL TAG FOR NEWTS

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No satisfactory technique for the individual marking of urodeles has been discovered, and this methodological problem limits ethological and behavioural studies. Joly & Miaud (1989) report that rings and jaw tags may cause necrosis and may entangle the newt in aquatic vegetation; the regenerative capability of newts limits the use of toe-clipping (toes are regenerated within months), and of freeze- or heat-branding (scars last only a few weeks) to short-term studies. Hagström (1973) identified individual newts by comparing their belly patterns with a photographic archive of the patterns of the local newt population; however it is impractical to distinguish more than 100 individuals, and some species lack recognizable belly patterns. Autotransplantation of skin patches from the belly to the back (Andreone, 1986) can be used only for large species, is laborious, and cannot be accomplished in the field.

Joly & Miaud (1989) described a skin staining technique, and stated that spots tattooed on the belly remain readable for 2-3 years. We tested skin staining with unsatisfactory results. Seven alpine newts *Triturus alpestris*, and three Italian crested newts *Triturus carnifex* were anaesthetized, and spots were drawn on their bellies with hypodermic injections of alcian blue using an odontological anaesthetic injector. All the newts, kept in aquaria, were unharmed and survived, but the spots disappeared completely within 2-5 months in three of the newts, and after eight months the spots drawn on all the other seven newts had considerably faded and were hardly recognizable.

Camper & Dixon (1988) proposed the use of microchips for marking amphibians and reptiles. We have tested a permanent electronic tag that is being widely used for the individual tagging of animals in veterinary and farming practice on a sample of newts, kept in aquaria. The tag is a passive "transponder" chip encapsulated in glass, (external size 1.8 x 12 mm, weight 100 mg). The tag's unique, 8 digit alphanumeric code is read by a hand-held scanner (1.1 kg with batteries) which emits a low frequency magnetic field that activates the passive transponder, which has no power source of its own and hence has an unlimited lifespan. The tag codes may be read directly on the scanner, or may be sent to a computer port. The scanner can read the tag from a distance of 20 cm, through water and through organic tissues.

In order to test the tolerance of these tags by urodeles, on 16 December 1991 we inserted tags intraperitoneally in 11 metamorphosed Italian warty newts (*Triturus carnifex*), seven metamorphosed alpine newts (*T. alpestris*), and six branchiate alpine newts (non-metamorphosed individuals still retaining external gills, and presumably born either in the same or in a previous year). The tags were implanted using a special syringe, and each operation lasted a few seconds; the newts were under anaesthetic (chloretone in water). These newts were kept together in the same aquaria with control, non-tagged metamorphosed Italian warty newts ($n=9$), metamorphosed alpine newts ($n=7$), and branchiate alpine newts ($n=4$) until 15 April 1992. The newts had been divided into three size classes, and within each class individuals were assigned at random to the tagging or the control group. The newts were fed twice a week with earthworms and fly larvae. From 15 April to 28 May 1992 all the newts were kept in a controlled outside pond. During all these periods the newts were checked and weighed weekly.

Only one of the marked newts, the smallest branchiate alpine newt weighing only 1.3 g, died within one day due to tagging. All the other newts survived, and their wounds from the tag insertion had healed completely in two weeks, without infection. Later in the study period, 1 marked and 2 control newts died of unknown causes.

The intraperitoneal tags apparently did not impair movement by the tagged newts. In order to check the effect of the

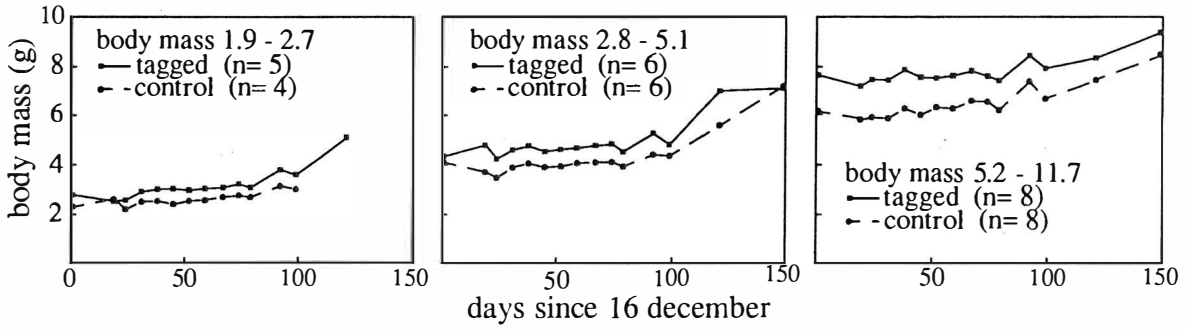

FIG. 1. Average body mass of marked and control newts, divided into three size classes. The class with body mass < 2.7 g included metamorphosed male or female alpine newts and branchiate alpine newts; class 2.8-5.1 g metamorphosed male or female alpine newts and Italian warty newts; class > 5.1 g metamorphosed male or female Italian warty newts.

tags, we compared the body mass changes of the marked and the control newts during their residency in the aquaria and in the outside pond (Fig. 1). The tagged and the control groups in the three size classes did not differ significantly in their initial, or final body mass (Mann-Whitney tests: $P > 0.05$). Body mass changes were tested by the Wilcoxon sign test on the body mass increments respective to the first day, in each of the three size classes of Fig. 1, and again no significant difference was found between marked and control newts (all tests: $P > 0.05$). In May all the newts had acquired their full reproductive characters and they were engaged in courtship.

We conclude that these electronic tags may be used for individual marking of newts above 2 g in body mass, with the advantages of a permanent marking and of an easy insertion in the field. Recently, Sinsch (1992*a*, 1992*b*) marked toads using electronic tags: microchips similar to those used by us were suitable for toads of snout-vent lenght exceeding 30 mm, and coded wires for newly metamorphosed toadlets.

The tags and the scanners we used are marketed by Euro I.D. (Grossbullesheimer Str. 56, 5350 Euskirchen 16, Germany). Similar tags (slightly smaller, 2.1 x 10 mm and 63 mg) and scanners (less suitable for our purposes) are marketed by FishEagle Co. (Lechlade, Gloucestershire, GL7 3QQ, England). The prices are approximately 10 US$ per tag and 2,000 US$ per scanner.

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