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STUDIES ON MORBIDITY AND MORTALITY IN SMOOTH SNAKES (*CORONELLA* SPP.)

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Data on morbidity and mortality in European smooth snakes, *Coronella austriaca* and *C. girondica*, were collated and a limited amount of clinical and pathological material was examined. There proved to be a paucity of published information and much of that available related to captive reptiles. *Coronella* spp. appeared to be susceptible to diseases that are well recognised in other reptiles in captivity - for example, pneumonia, ophthalmitis, nephritis, salpingitis and hepatitis. Mites were commonly associated with anaemia. Data from captivity are of some relevance to free-living populations, particularly when *Coronella* spp. are translocated or captured and studied in confinement. Information on health and disease needs to be collated and made available to those who are working on these species. There is also an urgent need to collect field data, not only in order to ascertain the prevalence of diseases and infections in free-living populations but also to establish databases on "normal" snakes. Protocols are presented to assist in the compilation and standardization of findings in live and dead specimens.

INTRODUCTION

There are two European species of *Coronella* both of which can reach a length of 50-60 cm. *C. austriaca* (the smooth snake) occurs in Europe as far east as Russia and southern Scandinavia and south to Italy and Greece. In Britain it is at the northern limit of its range and is found in a few small areas of heathland: eastern Dorset; the New Forest district of Hampshire, and adjacent south-eastern corner of Wiltshire; Hampshire-Surrey border between Farnham and Haslemere, and north-western Sussex. *C. girondica* (the southern smooth snake) is present in the south of France, Italy, the Iberian peninsula and NW Africa (Arnold & Burton, 1978; Street, 1979).

In Britain smooth snakes are sometimes rescued from doomed habitats and translocated to protected areas as a conservation measure. However, there is no information available on the diseases of free-living snakes or on the implications of disease transmission by such translocations. Here we present some preliminary data on health and disease in *Coronella*, and propose a protocol for health monitoring.

MATERIALS AND METHODS

Thirty-eight letters were sent to individuals and herpetological journals in Europe and North America. These requested information on disease in captive or free-living *Coronella* spp. There were nine responses to the letters, of which only four respondents were able to supply any data.

Two dead specimens of *C. girondica* were received from Spain. These were radiographed and examined *post mortem*: a selection of tissues was taken and processed for histopathological investigation. Three faecal samples from free-living specimens of *C. austriaca* were obtained from A .H. Gent's PhD study on this species in the New Forest area of Britain (Gent, 1988). These were examined microscopically as wet mounts in normal saline. Records from a subsequent study in the same locality were supplied by M. Gaywood (pers. comm.). Data from post mortem examinations of captive *C. austriaca* (18 specimens) and *C. girondica* (three specimens) over 40 years were provided by the Zoological Society of London (ZSL).

A literature search was carried out for references to disease in *Coronella* spp.

RESULTS

The findings in 18 *C. austriaca* examined *post mortem* at the ZSL are summarized in Table 1. Some conditions occurred in combination. Six specimens were known to be males, and one was a female. Findings included pneumonia, pulmonary congestion and oedema, inanition, and nephritis. In two out of the three specimens of *C. girondica* examined by ZSL the main finding was inanition. Anaemia was reported in both species and was associated with mites and, in one specimen of *C. girondica*, with haemogregarine blood parasites.

The two dead specimens of *C. girondica* received from Spain showed no abnormalities radiographically, grossly, or on histopathological examination.

TABLE 1. *Post mortem* findings in eighteen specimens of *C. austriaca* (ZSL data).

Finding	Number of snakes	%
Pneumonia	7	38.8
Inanition	3	16.6
Nephritis	1	5.5
Peritonitis	1	5.5
Salpingitis	1	5.5
Gastric dilatation	1	5.5
Anaemia/mites	1	5.5
Hepatitis	1	5.5
Respiratory ascariasis	1	5.5
Unknown	1	5.5

The faecal samples of *C. austriaca* contained vegetable matter, presumed to have been ingested accidentally or within the digestive tract of prey, but no evidence of endoparasites or abnormalities.

Gaywood observed 28 *C. austriaca* in the wild and recorded an ocular lesion in one snake. Gent observed 129 snakes and recorded abnormalities in 16 of them. Gaywood and Gent's findings are summarized in Table 2. The majority of the affected animals had lesions attributable to trauma.

The literature search yielded a few specific references to disease in *Coronella* spp. These were mycotic abscessation of the liver (Reichenbach-Klinke & Elkan, 1965), experimental infection of *C. austriaca* with the cestode *Ophiotaenia europaea* (Biserkov & Genov, 1963) and a report from what was then Czechoslovakia of a young *C. austriaca* with duplication of its head (Zidek & Zidek, 1985).

DISCUSSION

There appears to be a paucity of information on the diseases and pathology of *Coronella* spp. and very little relevant stored material. This may have led to bias in interpretation of findings in this paper as most of the data were from *post-mortem* specimens at the ZSL together with some observations of findings in free-living snakes. It is clear, however, that *Coronella* spp., in common with most other reptiles, are susceptible to physical injuries; this, as studies on other species of snake have shown (Greene & Hardy, 1989; Willis *et al.*, 1982), can reduce survival *per se*, and probably predispose to infection (Cooper & Jackson, 1981).

TABLE 2. Observations on free-living *C. austriaca* (Gaywood and Gent data)

Finding	Number of snakes
Truncated tail	5
Scarring	5
Trauma	4
Eye lesions	2
Predation	1
Abrasion/bruising	1
"Bulge" in body	1
Tick	1

It is possible that infectious and/or non-infectious diseases can have an adverse effect on free-living snakes. When a species such as *C. austriaca* is at the edge of its range, and also occurs in fragmented habitats, it could be particularly sensitive to changes in climate and/or habitat (Frazer, 1983). There is increasing evidence that disease can be significant in threatened vertebrate populations, especially when it is coupled with other factors such as habitat destruction, inbreeding depression, malnutrition or toxic chemicals (Cooper, 1989). However, most of the current work on this subject has been on mammals and birds: there is a need for comparable research on reptiles. An important prerequisite is the establishment of a database on normal values and some preliminary work has been performed - for example, on the cloacal flora of British reptiles (Cooper *et al.*, 1985).

More data on morbidity and mortality of *Coronella* spp. would be valuable, especially relating to free-living populations. Information from captive animals may also be relevant.

A multi-disciplinary approach is desirable in studies on the biology of *C. austriaca* and *C. girondica*; a veterinary input can help in elucidating the significance of disease. Studies in the field should as a routine include clinical examination for health and disease; where feasible, simple laboratory tests should be performed. Examination of faeces for parasites can be combined with analysis of samples for food items (Rugiero *et al.*, 1995). A suggested protocol for examination of live snakes is shown in Appendix 1 and of dead snakes in Appendix 2. Standardisation of records could do much to improve our knowledge and understanding of the part played by disease in these species.

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APPENDIX 1. Protocol for health monitoring of live *Coronella* spp.

BASIC

Observation and examination

(1) Presence or absence of:
- a. clinical signs of disease
- b. injuries or external lesions
- c. ectoparasites

(2) Standard data on sex, age and reproductive status coupled with the following:
- a. bodyweight
- b. measurements
- c. condition score

(3) Gross appearance of:
- a. faeces/urates
- b. sloughed skin

Laboratory tests

(1) Presence or absence of protozoan and metazoan parasites in faeces.

(2) PCV (haematocrit) and total blood protein.

(3) Differential blood counts plus presence or absence of parasites or cellular abnormalities in blood smears.

ADDITIONAL INVESTIGATIONS, IF PERSONNEL AND FACILITIES PERMIT

(1) Bacteriological examination of swabs from:
- a. trachea
- b. rectum/cloaca

(2) Blood tests - complete haematology and biochemistry, DNA studies.

(3) Examination of serum for antibodies (serology).

Whenever possible - and always if an animal appears to be in ill-health - a full clinical examination should be carried out and supporting laboratory tests performed. In this case a standard clinical sheet should be completed.

APPENDIX 2. Protocol for health monitoring of dead *Coronella* spp.

BASIC:

(1) *Gross examination*:
The following data should be coupled with standard data on sex, age and reproductive status
a. bodyweight
b. measurements
c. condition score
d. appearance of internal organs
e. presence or absence of fat
f. presence or absence of ectoparasites
g. presence or absence of endoparasites in alimentary or respiratory tract

(2) *Toxicology:*
Submission or retention (frozen) of carcass or tissues for analysis (e.g. for chlorinated hydrocarbon pesticides, heavy metals).

ADDITIONAL INVESTIGATIONS, IF PERSONNEL AND FACILITIES PERMIT

(1) *Bacteriology:*
a. heart blood
b. intestinal contents
c. any significant lesions

(2) *Histopathology:*
a. lung
b. liver
c. kidney
d. any significant lesions

(3) *Other tests*:
Submission or retention (frozen/fixed) of tissues for virology, mycoplasmology, electronmicroscopy, DNA studies, etc.

Whenever possible a full *post-mortem* examination should be carried out and supporting laboratory tests performed. In this case a standard *post-mortem* sheet should be completed.