INTERNATIONAL STANDARD

ISO 10990-5

First edition
1999-11-01

Animal (mammal) traps —

Part 5:
Methods for testing restraining traps

Pièges pour animaux (mammifères) —

Partie 5: Méthodes d'essai pour pièges de capture

Reference number
ISO 10990-5:1999(E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10990-5 was prepared by Technical Committee ISO/TC 191, *Animal (mammal) traps*.

ISO 10990 consists of the following parts, under the general title *Animal (mammal) traps*:

— *Part 1: Mechanically powered, trigger activated killing traps*

— *Part 2: Restraining traps*

— *Part 3: Submersion killing traps*

— *Part 4: Methods for testing killing-trap systems used on land or underwater*

— *Part 5: Methods for testing restraining traps*

Annex B forms a normative part of this part of ISO 10990. Annexes A and C are for information only.

Introduction

The purpose of this part of ISO 10990 is to provide test methods for performance evaluation of traps in the areas of animal welfare, capture efficiency, selectivity and user safety. Jurisdictional regulations and guidelines related to conducting tests with animals should be followed.

Animal (mammal) traps —

Part 5:
Methods for testing restraining traps

1 Scope

1.1 This part of ISO 10990 specifies methods for use in performance testing of traps used on land to restrain mammals. The performance testing includes methods for evaluation of trauma, selectivity, capture efficiency and user safety.

1.2 It is recognized that injury is only one component of animal welfare. However, there are insufficient data collected in a scientific manner on the additional components to allow for the complete assessment of animal welfare. Several areas of investigation are presented for evaluation in annex A. Selection of the data collection methodology is left to the investigator. However, it is assumed that such collection methods will follow accepted practices.

It should also be understood that data collected in any, or all, of the suggested areas will probably not provide an absolute measure of welfare. Rather, the compilation of such data over time should provide a mechanism for comparing the relative animal welfare impacts of different restraint methods.

2 Terms and definitions

For the purposes of this part of ISO 10990, the following terms and definitions apply:

2.1
capture efficiency
capability of the trap, as part of a trapping system, to capture target animals within a specified time period

NOTE This is expressed as a percentage of the total number of traps set.

2.2
capture rate of target animals
capability of a trap, as part of a trapping system, to capture target animals

NOTE This is expressed as a percentage of the total number of potential captures of target animals.

2.3
capture rate of non-target animals
capability of a trap, as part of a killing-trap system, to capture non-target animals

NOTE This is expressed as a percentage of the total number of potential captures of non-target animals.

2.4
control trap
most commonly used restraining trap for the target animal which is used in accordance with the restraining trap system established through most commonly used practice

NOTE This will be determined by the authority using this part of ISO 10990, such as a nationally recognized certification body.

2.5
instructions
instructions available to the user at the point of sale of the trap(s)

2.6
restraining trap
device used to capture and restrain a mammal

2.7
restraining-trap performance
capability of a restraining trap, as part of the restraining-trap system, to meet the requirements related to trauma, selectivity, capture efficiency and user safety as specified by the authority implementing the standard

2.8
restraining-trap system
system set with the intent to capture and restrain a mammal comprising a combination of

— equipment (the trap and the trigger configuration);

— set (including site modifications, lures, baits, location and other relevant requirements specified in the instructions)

2.9
manufacturer
producer including inventor or a national distributor

2.10
non-target animal
animal of any species other than the one for which the trap is set

2.11
potential captures
number of animals caught plus the number of animals having identifiably escaped

2.12
selectivity
number of captured target animals divided by the total number of captured animals

2.13
target animal
an individual of the species for which the restraining trap system has been set with the intent to capture

2.14
trap layout
pattern in which the test traps and control traps are positioned for field testing

3 Sampling

3.1 Sampling of traps

Select the number of traps specified in each test procedure, from the total number of traps submitted, using random sampling procedures.

3.2 Number of replicates in tests

The number of replicates in the tests shall be sufficient to determine if the differences are statistically significant at the level to be determined by the authority implementing this part of ISO 10990. However, in deciding on the number of replicates required, it should be noted that the greater the sample size, the more reliable are the test results. This decision needs to be considered against welfare aspects related to reducing the number of animals used in the testing.

4 Field testing for effects of restraint on animals

4.1 Principle

The effects of the restraint on the animals by the trap is evaluated in the field. Pathological evaluation of captured animals is part of the test. This test is also used to collect data on capture efficiency, selectivity and user safety (see 1.2, clauses 5, 6 and 7 as well as annex B).

4.2 Test personnel

The test personnel shall be experienced and capable of trapping the target animals. They shall also be familiar with the equipment and the testing procedures.

The pathological evaluation of animals trapped during testing shall be determined by a veterinary pathologist (preferably experienced in the examination of wildlife species).

4.3 Apparatus

4.3.1 Camera, to take photographs of the sets and entrapped animals.

4.4 Traps

The experimental restraining traps shall be assigned with identification numbers. The number of test traps shall be sufficient to determine if the differences are statistically significant at the level to be determined by the authority implementing this part of ISO 10990 (see 3.2). Prior to testing, the restraining traps shall be prepared in a manner recommended by the manufacturer. The preparation may include boiling, waxing, dyeing or painting. An equal number of control traps shall be used, if comparison of the trap performance is desired (see clauses 5 and 6).

4.5 Test procedure in the field

Establish the trap layout, record the longitude, latitude, total area of the site, type(s) of habitat and the animal species (target and non-target) known to be present. Set the traps within the trap layout in accordance with the manufacturer's instructions. Take pictures of each trap and its set and of the general environment. Make the trap identification number a part of the photographic record. (If control traps are used, place the experimental and control traps in the same substrate and/or vegetation type in pairs, with appropriate separation for the target animals, or alternatively within the trap layout using random assignment and the bait or lure recommended by the manufacturer.)

Check the traps daily (once within each 24 h period; at the same time of the day if at all possible) during the test period.

Euthanize all captured target animals immediately using a method of euthanasia that will not obscure any traumas caused by the trap (see note below). Take photographs of each entrapped animal with a label that shows the file number of the animal. Remove the animals from the traps.

Examine externally the captured non-target animals to evaluate whether they are likely to survive upon release without any treatment. Euthanize any captured non-target animals that are too severely injured for release, using a method of euthanasia that will not obscure any traumas caused by the trap (see annex C), and record the method of euthanasia. Provide adequate veterinary care for other injured non-target animals.

NOTE When necessary, for example for conservation reasons, remove the target animals alive from the trap and replace the pathological evaluation by clinical examination of live, captured target animals.

Record the following information regarding each visit to the traps:

— the date and time;

— the weather conditions;

— the ground conditions (e.g. frozen, snow-covered, etc.);

— the trap type;

— the site location of the trap;

— the trap-site substrate and/or vegetation type;

— the status of the trap (i.e. fired, not fired);

— the species captured (if any);

— the number of identifiable escapes;

— the file number for each animal;

— the location of the restraining trap on each animal (if applicable);

— the position of each animal in the trap;

— the condition of each animal (dead, alive, unconscious);

— the observations related to the operation and user safety of the restraining trap.

Make sure that the number of target animals captured by the test traps is sufficient for the differences to be statistically significant at the level to be determined by the authority implementing the standard and include all captured target animals in the test and the report. If necessary, extend the test over time until the required number of target animals have been captured.

Label all the carcasses of target and euthanized or dead non-target animals captured in the test traps (whole carcasses) with the following information:

— the date of capture;

— the file number of each animal;

— the method of killing/euthanasia.

Place the labelled carcasses in plastic bags and freeze them promptly. Make sure that the carcasses are not damaged during handling and transport. Keep the carcasses frozen until pathological and/or radiological examination is performed (see 4.6).

4.6 Pathological evaluation of trapped animals

4.6.1 Principle

The trap-related injuries on a sufficient number of animals trapped during testing (see 3.2) are determined by a veterinary pathologist using accepted post-mortem veterinary examination practices.

4.6.2 Procedure

Subject a sufficient number of the carcasses of trapped animals (see 3.2) to pathological, radiological and, when necessary, histological examination by a qualified veterinary pathologist using accepted post-mortem veterinary examination practices as specified below. The pathologist shall determine and record the trap-related injuries (see 4.6.2.4).

4.6.2.1 Post-mortem examination

Perform the post-mortem examination as specified below and complete the pathology protocol (annex B) for each animal either by reporting the observations made or by NK (not known), NA (not applicable), NI (not inspected) or NS (not submitted).

When performing a post-mortem examination, describe the nature and extent of all tissue damage related to the area of the body examined. Start at the head and proceed anterior-posterior describing all lesions. For the internal examination, dissect all organs noting haemorrhage and damage to soft tissue, bone, organs, etc.

Record the following information regarding each animal:

— the scientific name;

— the sex as M (male) or F (female);

— the age as young/yearling, sub-adult or adult (or more precisely, if known);

— the mass in kilograms;

— the state of nutrition as emaciated, poor, normal or fat;

— a description of lesions/injuries.

4.6.2.2 Radiological examination

Perform the radiological examination when traps based on striking/clamping forces are used. (For other types of traps this is optional.) X-ray the target area of the striking/clamping force and all other organs where fractures/lesions might occur.

4.6.2.3 Histological examination

When necessary, collect specimens for histological examination from the following organs: heart, lung, liver, kidney, brain, adrenal, muscle (preferably longissimus dorsi) and from the area where the trap strikes/restrains. Fix the specimens in 10 % neutral buffered formalin. Collect and examine other organs, if histology is relevant to the evaluation of the type, severity and age of the lesions/injuries.

4.6.2.4 Trap-related injuries

Complete the last part of the pathology protocol (annex B) and describe all the injuries that can be related to the trap/trapping system. For comparison of the performance of restraining traps the injury scales specified in annex C may be used.

4.7 Test report

Report the following information for both test and control traps (see also clause 8):

a) the date and time;

b) the longitude and latitude of the site;

c) the total area of the trap layout;

d) the type(s) of habitat;

e) the weather conditions;

f) the ground conditions;

g) the species (target and non-target) known to be present;

h) the number of traps tested;

i) the total number of trap-nights (number of traps × number of nights set);

j) the number of traps fired and not fired;

k) the species captured (if any, common and scientific name);

l) the total number of identifiable escapes;

m) the total number of captured target animals;

n) the total number of captured non-target animals;

o) the capture rates of target and non-target animals;

p) the file number for each animal;

q) the location of the restraining trap on the animal (if applicable);

r) the position of each animal in the trap;

s) the condition of each animal (dead, alive, unconscious, injured);

t) any observations related to the operation and user safety of the restraining trap;

u) (if control traps are used, record the above information related to them);

v) the pathology protocol prepared by the veterinary pathologist for each evaluated animal (i.e. the information detailed in annex B).

5 Selectivity test

5.1 Principle

The capability of the restraining trap system to capture target animals rather than non-target animals is evaluated in the field by recording the number of the target and non-target animals captured by the trap and by a control trap.

5.2 Procedure

Perform the test at the same time as the field test for the effects of restraint (clause 4). Use control traps and set them as specified in 4.5.

5.3 Test report

Report the following information for test and control traps (see also clause 8):

a) the number of captured target animals;

b) the number of captured non-target animals;

c) the selectivity (see 2.12).

6 Capture efficiency test

6.1 Principle

The capability of the restraining trap system to capture target animals is evaluated in the field by recording the number of target animals caught by the trap and by a control trap.

6.2 Procedure

Perform the test at the same time as the field test for the effects of restraint (clause 4). Use control traps and set them as specified in 4.5.

6.3 Test report

Report the following information for test and control traps (see also clause 8):

a) the number of captured target animals;

b) the number of traps set;

c) the capture efficiency (see 2.1).

7 Inspection and testing for user safety of traps

7.1 Principle

The ability of the trap design, and/or recommended safety devices, to provide safety to the users while handling and setting the trap is inspected and tested. Further information on user safety is recorded during the field tests (clause 4).

7.2 Test personnel

The test personnel shall be experienced in setting the traps for the target animals under normal trapping conditions and shall use reasonable precautions to ensure safety.

7.3 Inspection and testing procedure (when relevant)

Inspect five traps of the same design to:

a) assess whether the user could reasonably extricate him/herself from the trap unaided;

b) assess whether, with safety devices in place, a human limb is restricted from access to striking and clamping components of the trap;

c) inspect whether the striking and clamping forces are set before or after the trap is in the final set position;

d) apply any integral or accessory safety devices provided with the trap or specified by the manufacturer and fire the trap;

e) note whether the safety devices can be easily set and unset with one hand;

f) note also whether the striking components remain in cocked position regardless of the trap position; alternatively, if the striking components move out of the cocked position, note whether they exert any clamping force;

g) assess the potential for and likely extent of human injury resulting from accidental discharge of the trap.

7.4 Test report

Report the following information (see also clause 8):

a) whether the user could reasonably extricate him/herself from the trap unaided;

b) whether, with safety devices in place, the trap restricts a human limb from access to striking and clamping components;

c) whether the striking and clamping forces are set before or after the trap is in the final set position;

d) whether the safety devices (if any) can be easily set and unset with one hand;

e) whether the striking components remained in the cocked position regardless of the trap position; alternatively, if the striking components moved out of the cocked position, note whether they exerted any clamping force;

f) whether there is the potential for and the likely extent of a human injury resulting from accidental discharge of the trap;

g) any additional information on safety noted during the field tests (clause 4) (when performed).

8 Reporting

All test reports in accordance with this part of ISO 10990 shall include the information given under each test method. In addition the report shall be accompanied by the information requested in Table 1 regarding the tests performed and, if applicable, reasons why some tests were not performed.

Table 1 — Declaration of performed tests

No.	Test method	Performed	Not performed	Reasons/ comments
4	Field testing for effects of restraint on animals			
5	Selectivity test			
6	Capture efficiency test			
7	User safety			

Annex A
(informative)

Suggested areas of research for evaluating welfare of animals held in restraining traps

The suggested areas of research include, but are not limited to, the following examples:

EXAMPLE 1 Behaviour:

— Aversion testing, capture-recapture models.

— Observations (direct & remote).

— Vocalization (audible or inaudible).

EXAMPLE 2 Physiology:

Serum chemistries, urine analysis, faecal analysis, endocrinology, acute phase reactants, haematology, cardiac function (rate, arrhythmia), cerebral function, respiratory function, muscle pH, pheromones.

EXAMPLE 3 Immunology:

Lymphocyte stimulation.

EXAMPLE 4 Molecular biology

Recommendations:

ISO/TC 191 recommends that interested member countries develop a coordinated approach to the above suggested areas of research and to development of test protocols. Sharing of relevant data and information and commitment to periodic review of progress is also recommended by the committee.

Annex B
(normative)

Pathology protocol

(A separate report form must be completed for each animal examined.)

Name of examining veterinarian:_____

Institution: _____

Address: _____

_____ Country: _____

ID of animal: ID-number in lab:

Animal species: Scientific name:

Sex: Age:

Mass (kg): State of nutrition:

Material submitted: whole body / part of body .....
(specify)

Type of trap: .....
(specify)

Manufacturer:

Description of trap enclosed Y / N Trap enclosed with animal Y / N

Date of catch: Date of examination:

Restraining trap/ killing trap Animal dead / euthanized

Animal from: experimental test / field test

Method of euthanasia: Radiographic examination Y / N

Carcass frozen / not frozen:

Other information:

.....

.....

.....

.....

.....

Examination of head	Macroscopic	Histological
Skin		
Subcutaneous tissues		
Muscle		
Nose		
Lips		
Teeth		
Gingiva		
Tongue		
Jaw		
Eyes		
Ears		
Cranium		
Brain		
Other parts of head		

Examination of body (including neck)	Macroscopic	Histological
Skin		
Subcutaneous tissues		
Mammary glands		
Muscles		
Ligaments		
Ribs-sternum		
Vertebral column		
Tail		
Thoracic cavity		
Heart		
Trachea		
Lungs		
Oesophagus		
Abdominal cavity		
Liver		
Spleen		
Stomach		
Intestines		
Kidneys		
Adrenals		
Bladder, uterus, external genitalia		
Vessels		
Other organs		

Examination of limbs	Macroscopic	Histological
Skin		
Subcutaneous tissues		
Tendons		
Ligaments		
Muscles		
Long bones		
Hip joint		
Scapular / humeral joint		
Elbow / knee joint		
Carpal / tarsal joint		
Metacarpal / metatarsal joint		
Feet		
Foot pads		
Toes		
Claws		
Other		
Other observations		

Trap-related Injuries: Based on the post-mortem examination it is my opinion that the following lesions/injuries can be related directly to the trap/trapping method:

.....

.....

.....

.....

.....

Signature_____ Date _____

Instructions

This pathology protocol shall be completed by a qualified veterinary pathologist and shall be enclosed with the trapping test report.

Post-mortem examination

Perform the post-mortem examination as specified below and complete the aforementioned pathology protocol for each animal either by reporting the observations made or by NK (not known), NA (not applicable), NI (not inspected) or NS (not submitted).

When performing a post-mortem examination, describe the nature and extent of all tissue damage related to the area of the body examined. Start at the head and proceed anterior-posterior describing all lesions. For the internal examination, dissect all organs noting haemorrhage and damage to soft tissue, bone, organs, etc.

Record the following information regarding each animal:

— the scientific name;

— the sex as M (male) or F (female);

— the age as young/yearling, sub-adult or adult (or more precisely, if known);

— the mass in kilograms;

— the state of nutrition as emaciated, poor, normal or fat;

— a description of lesions/injuries.

Radiological examination

Perform the radiological examination when traps based on striking/clamping forces are used. (For other types of traps this is optional.) X-ray the target area of the striking/clamping force and all other organs where fractures/lesions might occur.

Histological examination

When necessary, collect specimens for histological examination from the following organs: heart, lung, liver, kidney, brain, adrenal, muscle (preferably longissimus dorsi) and from the area where the trap strikes/restrains. Fix the specimens in 10 % neutral buffered formalin. Collect and examine other organs, if histology is relevant to the evaluation of the type, severity and age of the lesions/injuries.

Trap-related Injuries

Complete the last part of the pathology protocol and describe all the injuries that, in your opinion, can be related to the trap/trapping system (for comparison of the performance of restraining traps the injury scales specified in annex C may be used).

Annex C
(informative)

Trauma

C.1 Trauma scale — Example 1

Pathological observations	Score (points)	
1) Claw loss	2 points	
2) Oedematous swelling or haemorrhage	5 points	(max. 15)
3) Minor cutaneous laceration	5 points	
4) Minor subcutaneous soft tissue maceration or erosion (contusion)	10 points	
5) Major cutaneous laceration, except on foot pads or tongue	10 points	
6) Minor periosteal abrasion	10 points	
7) Severance of minor tendon or ligament (each)	25 points	
8) Amputation of one digit	25 points	
9) Permanent tooth fracture exposing pulp cavity	30 points	
10) Major subcutaneous soft-tissue maceration or erosion	30 points	
11) Major laceration on foot pads or tongue	30 points	
12) Severe joint haemorrhage	30 points	
13) Joint luxation at or below the carpus or tarsus	30 points	
14) Major periosteal abrasion	30 points	
15) Simple rib fracture	30 points	
16) Eye lacerations	30 points	
17) Minor skeletal muscle degeneration	30 points	
18) Simple fracture at or below the carpus or tarsus	50 points	
19) Compression fracture	50 points	
20) Comminuted rib fracture	50 points	
21) Amputation of two digits	50 points	
22) Major skeletal muscle degeneration	55 points	
23) Limb ischemia	55 points	
24) Amputation of three or more digits	100 points	
25) Any fracture or joint luxation on limb above the carpus or tarsus	100 points	
26) Any amputation above the digits	100 points	
27) Spinal cord	100 points	
28) Severe internal organ damage (internal bleeding)	100 points	
29) Compound or comminuted fracture at or below the carpus or tarsus	100 points	
30) Severance of major tendon or ligament	100 points	
31) Compound rib fractures	100 points	
32) Ocular injury resulting in blindness of an eye	100 points	
33) Myocardial degeneration	100 points	
34) Death	100 points	

NOTE This point system does not represent a statement by ISO/TC 191 related to welfare aspects of individual traumas. Such judgements are left to the parties using this part of ISO 10990.

C.2 Trauma scale — Example 2

Mild trauma

1) Claw loss

2) Oedematous swelling or haemorrhage

3) Minor cutaneous laceration

4) Minor subcutaneous soft tissue maceration or erosion (contusion)

5) Major cutaneous laceration, except on foot pads or tongue

6) Minor periosteal abrasion

Moderate trauma

7) Severance of minor tendon or ligament (each)

8) Amputation of one digit

9) Permanent tooth fracture exposing pulp cavity

10) Major subcutaneous soft tissue maceration or erosion

11) Major laceration on foot pads or tongue

12) Severe joint haemorrhage

13) Joint luxation at or below the carpus or tarsus

14) Major periosteal abrasion

15) Simple rib fracture

16) Eye lacerations

17) Minor skeletal muscle degeneration

Moderately severe trauma

18) Simple fracture at or below the carpus or tarsus

19) Compression fracture

20) Comminuted rib fracture

21) Amputation of two digits

22) Major skeletal muscle degeneration

23) Limb ischemia

Severe trauma

24) Amputation of three or more digits

25) Any fracture or joint luxation on limb above the carpus or tarsus

26) Any amputation above the digits

27) Spinal cord injury

28) Severe internal organ damage (internal bleeding)

29) Compound or comminuted fracture at or below the carpus or tarsus

30) Severance of major tendon or ligament

31) Compound rib fractures

32) Ocular injury resulting in blindness of an eye

33) Myocardial degeneration

34) Death

NOTE This system does not represent a statement by ISO/TC 191 related to welfare aspects of individual traumas. Such judgements are left to the parties using this part of ISO 10990.

C.3 Determination of trauma classes when an animal receives more than one trauma

Trauma class

Mild:	= 1 mild trauma
Moderate:	= 1 moderate trauma
	or 3 mild traumas
Moderately severe:	= 1 moderately severe trauma
	or 2 moderate traumas
	or 1 moderate + 2 mild traumas
	or 5 mild traumas
Severe:	= 1 severe trauma
	or 2 moderately severe traumas
	or 1 moderately severe + 1 moderate + 2 mild traumas
	or 1 moderately severe + 2 moderate traumas
	or 1 moderately severe + 5 mild traumas
	or 3 moderate traumas
	or 2 moderate + 4 mild traumas
	or 1 moderate + 7 mild traumas
	or 10 mild traumas

Bibliography

[1] BRANNON R.D. Serum Chemistry and Northern Alaska Grizzly Bears. *J. Wildl. Manage.*, **49** (4), 1985, pp. 893-900.

[2] BRELURUT A. Effects of capture and transportation on some blood parameters in red deer (*Cervus elaphus*) fawns. *Gibier Faune Sauvage*, **8** (September), 1991, pp. 271-282.

[3] BROOM D.M. and JOHNSON K.G. *Stress and animal welfare.* Chapman & Hall, London; New York, 1st ed., 1993, p. 211.

[4] BUDDLE B.M. *et al.* Influence of stress of capture on haematological values and cellular immune responses in the Australian brushtail possum (*Trichosurus vulpecula*). *N.Z. Vet. J.*, **40** (4), 1992, pp. 155-159.

[5] CHAPPLE R.S *et al.* Haematology and serum biochemistry of captive unsedated chital deer *(Axis axis)* in Australia. *J. Wildl. Dis.*, **27** (3), 1991, pp. 396-406.

[6] CLARK R.K. and JESSUP D.A. Field evaluation and treatment of medical problems resulting from wildlife capture. Alaska. *University, Agricultural and Forestry Experiment Station, Fairbanks. Miscellaneous Publications*, **6**, 1991, pp. 381-386. The issue has separate title: Wildlife production: conservation and sustainable development. (RENECKER L.A. HUDSON R.J., eds.). 1991.

[7] CROCKETT C.M. *et al.* Urinary cortisol responses of longtailed macaques to five cage sizes, tethering, sedation, and room change. *Am. J. Primatol.*, **30** (1), 1993, pp. 55-74.

[8] DE MENEGHI D. *et al.* Blood serum analysis in chemically captured alpine ibex *(Capra ibex). Trans. Congr. Int. Union Game Biol.*, **18** (2), 1992, pp. 39-43.

[9] EISERMANN K. Long-term heart rate responses to social stress in wild European rabbits: predominant effect of rank position. *Physiol. Behav.*, **52** (1), 1992, pp. 33-36.

[10] GANHAO M.F. *et al.* Physiological responses of blesbok, eland and red hartebeest to different capture methods. *S. Afr. J. Wildl. Res.*, **18** (4), 1988, pp. 134-136.

[11] GERICKE M.D., HOFMEYR J.M. and LOUW G.N. The effect of capture stress and haloperidol therapy on the physiology and blood chemistry of springbok (*Antidorcas marsupialis). Madoqua*, **11** (1), 1978, pp. 5-18.

[12] GUTHRIE D.R., OSBORNE J.C. and MOSBY H.S. Physiological changes associated with shock in confined gray squirrels. *Journal of Wildlife Management*, **31** (1), 1967, pp. 102-108.

[13] HAJDUK P., COPLAND M.D. and SCHULTZ DA. Effects of capture on haematological values and plasma cortisol levels of free-range koalas (*Phascolarctos cinereus*). *J. Wildl. Dis.*, **28** (3), 1992, pp. 502-506.

[14] HANSEN S.W. and DAMGAARD B.M. Behavioural and adrenocortical coping strategies and the effect on eosinophil leucocyte level and heterophil/lymphocyte-ratio in beech marten (*Martes foina*). *Appl. Anim. Behav. Sci.*, **35** (4), 1993, pp. 369-388.

[15] HANSON J.C. *Some physiological characteristics of wild, cage-stressed, and shock-comatose gray squirrels.* Unpublished M.S. thesis, Virginia Polytechnic Institute, Blacksburg, Virginia, 1966.

[16] HAMILTON G.D. and WEEKS H.P. JR. Cortisol and aldosterone comparisons of cottontail rabbits (*Sylvilagus-floridanus*) collected by shooting trapping and falconry. *J. Wildl. Dis.*, **21** (1), 1985, pp. 40-42.

[17] HARLOW H.J. *et al.* Stress response of cougars to non-lethal pursuit by hunters. *Can. J. Zool.*, **70** (1), 1992, pp. 136-139.

[18] HATTINGH J., PITTS N.I. and GANHAO M.F. Immediate response to repeated capture and handling of wild impala. *Journal of Experimental Zoology*, **248** (1), 1988, pp. 109-112.

[19] KARNS P.D. and CRICHTON V.F.J. Effects of handling and physical restraint on blood parameters in woodland caribou. *J. Wildl. Manage.*, **42** (4) (October), 1978, pp. 904-908.

[20] KIRKWOOD J.K., SAINSBURY A.W. and BENNETT P.M. The welfare of free-living wild animals: Methods of assessment. *Animal Welfare*, **3** (4), 1994, pp. 257-273.

[21] KOCK N. Ultrasound production and stress in rodents. *Vet. Rec.*, **118** (21), 1986, p. 588.

[22] KOCK M.D *et al.* Effects of capture of biological parameters in free-ranging bighorn sheep *(Ovis canadensis)*: evaluation of normal, stressed and mortality outcomes and documentation of postcapture survival. *J. Wildl. Dis.*, **23** (4), 1987, pp. 652-662.

[23] KOCK M.D *et al.* Effects of capture on biological parameters in free-ranging bighorn sheep *(Ovis canadensis)*: evaluation of drop-net, drive-net, chemical immobilization and the net-gun. *J. Wildl. Dis.*, **23** (4), 1987, pp. 641-651.

[24] KOCK M.D *et al.* Capture methods in five subspecies of free-ranging bighorn sheep: an evaluation of drop-net, drive-net, chemical immobilization and the net-gun. *J. Wildl. Dis.*, **23** (4), 1987, pp. 634-640.

[25] KREEGER T.J. The physiological, biochemical, and pathological responses of wild canids to stress. Ph.D. dissertation, Univ. Minn., 1988, 200 p., *Diss. Abstr. Int. B Sci. Eng.*, **49** (12:5174) 1989, Order no. DA8905834.

[26] KREEGER T.J. *et al.* Pathological responses of red foxes to foothold traps. *J. Wildl. Manage.*, **54**, 1990, pp. 147-160.

[27] KRONBERG S.L., WALKER J.W. and FITZGERALD J.A. Feeding behavior of grazing ruminants experiencing stress. *Physiol. Behav.*, **54** (6), 1993, pp. 1191-1194.

[28] MACARTHUR R.A., GEIST V. and JOHNSTON R.H. Cardiac responses of bighorn sheep (*Ovis-canadensis-canadensis*) to trapping and radio instrumentation. *Can. J. Zool.*, **64** (5), 1986, pp. 1197-1200.

[29] MARTUCCI R.W. *et al.* Blood gas and catecholamine levels in capture stressed desert bighorn sheep. *J. Wildl. Dis.*, **28**(2), 1992, pp. 250-254.

[30] MAUTZ W.W., Siea U.S. and Boardman C.B. Blood serum analyses of chemically and physically restrained white-tailed deer. *J. Wildl. Manage.*, **44** (2) (April), 1980, pp. 343-351.

[31] MCALLUM H.J.F. Stress and postcapture myopathy in red deer. *R. Soc. N. Z. Bull.*, **22**, 1985, pp. 65-72.

[32] MOBERG G.P. *Animal stress*. American Physiological Society, Baltimore, Md., Distributed by Williams & Wilkins, 1985, 324 p.

[33] MORTON D.B. and GRIFFITHS P.H.M. Guidelines on the recognition of pain, distress and discomfort in experimental animals and an hypothesis for assessment. *Vet. Rec.*, **116**, 1985, pp. 431-436.

[34] MORTON D.J. *et al.* Plasma cortisol as an indicator of stress due to capture and translocation in wildlife species. *Veterinary Record*, **136** (3),1995, pp. 60-63.

[35] ORLOV MM., MUKHLYA AM.; KUZ'MIN AA. Characterization of hormonal and electrolyte changes in the blood of cetaceans after trapping and during experimental stress. *Zhurnal Evolyutsionnoi Biokhimii i Fiziologii*, **27** (2), 1991, pp. 197-205.

[36] PEDERSEN V. Long-term effects of different handling procedures on behavioural, physiological, and production-related parameters in silver foxes. *Applied Animal Behaviour Science*, **40** (3-4), 1994, pp. 285-296.

[37] PRICE S., SIBLY R. Heart-rate of red deer during routine handling procedures taking account of motor activity and basal metabolic rate. *Appl. Anim. Behav. Sci.* **35** (3), 1993, p. 297.

[38] PROULX G. *et.al.* Injuries and Behaviour of raccoons *(Procyon lotor)* captured in the Soft Catch and Egg traps in simulated natural conditions. *J. Wildl. Dis.*, **29**, 1993, pp. 447-452.

[39] SANFORD J. *et al.* Guidelines for the recognition and assessment of pain in animals. *Vet. Rec.*, **118**, 1986, pp. 334-338.

[40] SEAL U.S. *et al.* Metabolic and endocrine responses of white-tailed deer to increasing population density. *J. Wildl. Manage.*, **47** (2) (April), 1983, pp. 451-462.

[41] ST. AUBIN D.J., AUSTIN T.P. and GERACI J.R. Effects of handling stress on plasma enzymes in harp seals (*Phoca groenlandica*). *J. Wildl. Dis.*, **15** (4) (October), 1979, pp. 569-572.

[42] Stereotypic Animal Behaviour: Fundamentals and Applications to Welfare. *Journal of Veterinary Medical Education*, **21** (2), 1994, p. 64.

[43] VAN JAARSVELD A.S. and SKINNER J.D. Plasma androgen concentrations in initial samples from spotted hyaenas immobilized with zoletil (CI-744) reflect hormonal status estimated by GnRH challenge and immobilization stress response. *S. Afr. J. Zool.*, **26** (1), 1991, pp. 1-5.

[44] VAN MOURIK S., BEILHARZ R.G. and STELMASIAK T. Plasma cortisol levels in rusa deer handling. *R. Soc. N. Z. Bull.*, **22**, 1985, p. 390.

[45] VESTERGAARD K.S., BROOM D.B. and JOHNSON KG. Stress and Animal Welfare. *Animal Behaviour*, **48** (6), 1994, p. 1494.

[46] VOGT J.L., COE C.L. and LEVINE S. Behavioral and adrenocorticoid responsiveness of squirrel monkeys to a live snake: is flight necessarily stressful? *Behav. Neural Biol.*, **32** (4) (August), 1981, pp. 391-405.

[47] WALLACE M.C. *et al.* Problems associated with heart rate telemetry implants. *Desert Bighorn Council Trans.*, **36**, 1992, pp. 51-53.

[48] WESSELS T.C. and BLUMENTHAL C.L. Some blood physiological values of *Oryx gazella* captured alive with dog teams. / Enkele bloedfisiologiese waardes van gemsbokke (*Oryx gazella*) wat lewend met honde gevang is. *S. Afr. J. Wildl. Res.*, **8** (3), 1978, pp. 113-115.

[49] WESSON J.A. III *et al.* Influence of chemical immobilization and physical restraint on packed cell volume, total protein, glucose, and blood urea nitrogen in blood of white-tailed deer. *Can. J. Zool.*, **57** (4) (April), 1979, pp. 756-767.

[50] WHITE P.J. *et al.* Pathological responses of red foxes to capture in box traps. *J. Wildl. Manage.*, **55** (1), 1991, pp. 75-80.

[51] WILLIAMS T.D. *et al.* Influence of age, sex, capture technique, and restraint on hematologic measurements and serum chemistries of wild California sea otters. *Vet. Clinical Pathol.*, **21** (4), 1992, pp. 106-110.

ICS 65.145

Price based on 20 pages