A Reference Source for the Recognition & Alleviation of Pain & Distress in Animals

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PREFACE

The Animal Welfare Information Center was established under the 1985 amendments to the Animal Welfare Act (Sect. 13(e)) and is required to provide specific information to the research community. One of these requirements deals with providing information
which would minimize pain and distress to animals used in research.

It is hoped that this publication will be useful to those involved with animal research and that it will provide guidance and information which is useful in further reducing pain and distress in research animals. Science, and humanity, owe a great deal to these animals and they should be provided with conditions as free of pain and distress as possible, both for the welfare and well-being of the animal, and for better scientific results.

**INTRODUCTION**

One of the requirements of the Animal Welfare Act is that procedures are to be taken to ensure that pain and distress in research animals are minimized. This includes adequate veterinary care and the appropriate use of anesthetics, analgesics and tranquilizing drugs or euthanasia (Sect. 13(a)(3)(A)). In order to minimize pain or distress to an animal one must first be able to recognize when an animal is in, or likely to be in, pain or distress. Steps can then be taken to alleviate that pain or distress so far as allowed by the approved research protocol.

This publication provides a list of published reference sources on the recognition and alleviation of pain and distress in animals. It has been developed to provide a source of information and guidance to those using animals in research so that they may better recognize when an animal is suffering pain or distress, or may be likely to suffer pain or distress, and how that pain or distress may be minimized. This publication is not meant to be a complete resource on this subject but to provide a starting point for those concerned about the welfare and humane care of animals used in research. For additional, and more complete, information and resources we suggest you consult the following web site on the compilation of scientific literature on the assessment of animal welfare:

**Literature on the Assessment of Animal Welfare.**

http://www.vetinfo.demon.nl/aw/flist.html

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USDA, NAL, AWIC

**GENERAL**

NAL Call no: Z7994.L3A5
Descriptors: laboratory animals, animal experiments, pain, anesthesia, ethics, diagnosis, treatment, animal welfare.
NAL Call no: HV4708.G85
Descriptors: animal experimentation, animal welfare.

NAL Call no: SF604.R37 no.226
Descriptors: pain in animals.

NAL Call no: 41.8 AU72
Descriptors: pain, pain management, analgesia, guidelines.

Descriptors: Etodolac, pain, rheumatic diseases, therapeutic use.

NAL Call no: 41.8 Au72
Descriptors: animal welfare, pain, assessment, measurement.

NAL Call no: 472 N42
Descriptors: animal experiments, animal welfare.

NAL Call no: 410 B77
Descriptors: animal welfare, pain, assessment.

NAL Call no: QL55.H8
Descriptors: animals, pain, animal welfare, detection, alleviation.

Language: German, Summary in English, French, Italian.
NAL Call no: 41.8 SCH9
Descriptors: pain, analgesics, animals.

NAL Call no: 7P351.B45
Descriptors: neurobiology, opiate, motivational mechanisms.

NAL Call no: SF405.5.C36
Descriptors: animals, euthanasia, methodology, pain, animal welfare.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, stress, analgesics.

NAL Call no: SF910 P34A55 1992
Descriptors: animals, pain, research, drug therapy, analgesics, livestock, laboratory animals, surgical operations, anesthesia.

NAL Call no: 41.8 AM3
Descriptors: animals, stress, feeding behavior, hormones, nervous system, reproduction.

NAL Call no: SF910 P34A55 1992
Descriptors: small animal practice, laboratory animals, local anesthetics, toxicity.

NAL Call no: aQL55.B36
Descriptors: domestic animals, laboratory animals, anesthesia, anesthetics, analgesics, pain.

Language: German.
NAL Call no: SF105.T5 Bd.23
Descriptors: intensive husbandry, abnormal behavior, animal welfare.

Descriptors: animal-human relations, scientific research, abuse.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, suppression, neurophysiology.

Descriptors: animals, pain, immobilization, physiology, literature reviews, tonic immobility, hypnosis.

NAL Call no: QL55.F43 1987
Descriptors: laboratory animals, neonates, pain, animal behavior, physiology.

NAL Call no: 410.9 P94
Descriptors: animal welfare, stress, perception, motivation, adaptation.

NAL Call no: 49 J82
Descriptors: animal cognition, animal production systems.

NAL Call no: QL55.F43 1987
Descriptors: laboratory animals, animal experiments, pain, treatment, analgesics.

Descriptors: laboratory animals, pain, models, animal experiments, duodenal obstruction, analgesics, dosage, immunochemistry.

Doris, Pete A., (1989), Humane principles & procedures in animal research. Animal research training series, Lubbock, TX: Texas Tech University Health Science Center, c1989, 1 video cassette (30 min).
NAL Call no: videocassette no. 804 and 805
Descriptors: animal welfare, law and legislation (US), laboratory animals, animal experimentation.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, measurement, research, guidelines.

NAL Call no: SF910.5.V4
Descriptors: anaesthesia, postoperative complications, pain, therapy, postoperative care.

NAL Call no: 442.9 F31P
Descriptors: pain, sedation, alleviation of pain, sensory receptor.

NAL Call no: SF911.5.45
Descriptors: pain, control, analgesics, drug therapy, opioids, non-steroidal anti-inflammatory agents, application methods, animals.

Fikes, L.L.; Tranquilli, W.J.; Raffe, M.R., (1989), Symposium on pain management. I Understanding pain & analgesic therapy in pets. II Classifying commonly used analgesic agents. III Selecting the right analgesic: Indications & dosage requirements. College of Veterinary Medicine, University, Urbana, Ill., Veterinary Medicine, 1989, 84: 7, p. 677-697, 44 ref. ISSN: 8750-7943.
NAL Call no: 41.8 M69
Descriptors: animal welfare, dog diseases, cat diseases, anti-inflammatory agents, opioids, anesthesia, burns, pain, young animals, analgesics.

Descriptors: laboratory animals, pain, models, animal experiments, duodenal obstruction, analgesics, dosage, immunochemistry.
Descriptors: animals, pain, anesthesia, analgesics, treatment.

Descriptors: animals, pain, trauma, animal welfare.

Descriptors: laboratory animals, animal welfare, experimentation, pain, stress, mammals, neurophysiology.

Descriptors: laboratory animals, pain, opioids, peptides, analgesics, spinal cord receptors, drug effects.

Descriptors: agonists, antagonists, dosage, morphine, laboratory animals.

Descriptors: animal welfare congress, pain congress.

Language: German with a summary in English. NAL Call no: 49 T445
Descriptors: pain, animals, behavior, welfare.

Descriptors: pain, animals, surgery.

Descriptors: chronic pain, management, analgesic drugs, anti-epileptics.

Descriptors: pain, animals, drugs, behavior.

Descriptors: dog diseases, surgery, anti-inflammatory agents, neoplasms, pain, drug therapy.


Descriptors: animal experiment, pain, anesthetics, analgesics, laboratory animals.

Descriptors: pain, treatment, attitudes, veterinary medicine, medical students, teachers, personnel, analgesics.

Descriptors: animal welfare, pain, symptoms, treatment, anesthesia.


NAL Call no: SF910.P34A55 1992
Descriptors: laboratory animals, horses, lami nitis, surgical operations, analgesics, treatment, acupuncture.

ISSN: 0193-1903.
NAL Call no: SF601.C66
Descriptors: pain, analgesia.

NAL Call no: HV4704.A54 1987 0901028347.

Loew, F.M., (1981), Mammals in research. Species and companion animals.

Loeffler, K., (1993), In Innovations and Alternatives.

ISSN: 1062-4805.
NAL Call no: LF55.A1L33
Descriptors: pain, drugs, alleviation.

NAL Call no: QL55.A54 1992
Descriptors: pain, drugs, alleviation.

Descriptors: hyperalgesia, nerve problems, pain, pain mechanisms, pain.

NAL Call no: TRANS13760
Descriptors: pain, reactions, behavior.

NAL Call no: 41.8 AM3
Descriptors: animals, stress, measurements.

ISSN: 0042-4900.
NAL Call no: 41.8 V641
Descriptors: laboratory animals, animal welfare, pain.

Descriptors: laboratory animals, animal welfare.


Descriptors: distress effects, refinement, experiments.


NAL Call no: QL1.D48 v.27

Descriptors: animals, adverse effects, recognition.


NAL Call no: QL55.H8

Descriptors: laboratory animals, pain, animal welfare, stress, stress factors, animal behavior.


NAL Call no: HV4701.149

Descriptors: philosophy and ethics, sensory receptors, pain sensitivity, ethical questions.


NAL Call no: R31.B55

Descriptors: chronic pain, control, pain management programs.


NAL Call no: SF910.T8N4

Descriptors: cancer, pain management.


NAL Call no: SF405.5.C36

Descriptors: laboratory animals, animal welfare, death, pain, experimental design, humane endpoints.


NAL Call no: 41.8 M69

Descriptors: neurology, pain, sensation.


NAL Call no: QL55.A1123

Descriptors: laboratory animals, animal experiments, pain, animal welfare, measurement, invasive procedures.


NAL Call no: Z7994.L3A5

Descriptors: laboratory animals, pain.


NAL Call no: SF604.P82 no.158

Descriptors: degenerative joint disease, pain, management.


NAL Call no: QL750.A6

Descriptors: cattle, horses, sheep, goats, pigs, llamas, analgesics, pain, responses, anesthesia, agonists, dosage, animal behavior, animal welfare, species differences, conduction, literature reviews.


NAL Call no: RA1190.F8

Descriptors: laboratory animal veterinarians, contributions, experiments.


NAL Call no: QL85.S63

Descriptors: laboratory animals, surgery, analgesics.


NAL Call no: HV4930.P73 1980

Descriptors: vivisection, laboratory animals, animals, treatment of (U.S.), animal welfare, animal experimentation.

Prudden, B., (1992), *Myotherapy--my experiences with stopping cycles of pain (it only hurts when I bark, meow, neigh, moo, baa, oink, squawk...or say ouch!)* *Humane


NAL Call no: QL750.A6
Descriptors: animals, pain, neurons, animal behavior, post operative care, veterinary practice, animal welfare, analgesics, anesthetics.

NAL Call no: SF910.P34S45 1997
Descriptors: pain in animals congress.

NAL Call no: SF910.P34A56 1992
Descriptors: pain in animals, laboratory animals.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, animal welfare.

NAL Call no: QL55.A1L33
Descriptors: laboratory animals, cage rearing, stress, prevention.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, analgesics, research, immobilization.

NAL Call no: SF910.P34A55 1992
Descriptors: laboratory animals, rats, pain, alpha andrenergic receptors, drugs, testing drug effects, analgesics, yohimbine, dosage, methoxamine.

NAL Call no: SF405.5.A23
Descriptors: laboratory animals, animal experiments, animal welfare, death & dying, assessment, pain, euthanasia.

NAL Call no: 41.8 AM3
Descriptors: pain research, literature, adequate veterinary care.

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, animal welfare, pain.

NAL Call no: SF910.P34A55 1992
Descriptors: animals, pain, measurement, central nervous system, reflexes, analgesics.

Language: Dutch with a summary in English.
NAL Call no: 41.8 T431
Descriptors: sows, calves, intensive livestock farming, pain, endorphins, stress, abnormal behavior.

NAL Call no: 41.8 AM3
Descriptors: animals, pain, receptors, neurophysiology, thalamus, cerebral cortex.

NAL Call no: QP451.4.A54
Descriptors: spinal cord, sensory reception, nervous system & behavior, pain reception & responses.

NAL Call no: SF406.W64 1994
Descriptors: laboratory animals handbook, mammals, animal welfare handbooks.

NAL Call no: 41.8 J8292
Descriptors: pain, small animals, recognition, control.
LABORATORY ANIMALS

GENERAL

NAL Call no: 41.8 AM3
Descriptors: laboratory animals, pain, stress, adjuvants, monoclonal antibodies, infectious diseases, animal experiments.

NAL Call no: 41.8 R3224
Descriptors: dogs, cats, pain, treatment, analgesics, opioids.

NAL Call no: 41.8 R3224
Descriptors: dogs, cats, analgesics, dosage, drug effects, anesthesia, pain.

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, pain, analgesics.

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, local anesthetics, lidocaine, intravenous injection, ointments, local anesthesia.

NAL Call no: SF77.F5
Descriptors: laboratory animals, anaesthesia.

NAL Call no: SF77.F5 1996
Descriptors: laboratory animals, anaesthesia.

NAL Call no: QL55.L274
Descriptors: laboratory animals, animal welfare, anesthesia, analgesics, pain, stress, pharmacokinetics.

NAL Call no: Z7994.L3G5
Descriptors: laboratory animals bibliography, animal experimentation bibliography, pain bibliography, analgesia bibliography, veterinary anesthesia bibliography.

NAL Call no: HV4704.H85 1999
Descriptors: humane endpoints, animals, experiments, biomedical research.

NAL Call no: 41.8 AM3
Descriptors: laboratory animals, pain, stress, animal behavior, animal experiments, restricted feeding.

NAL Call no: SF406.M36 1992
Descriptors: laboratory animals, animal welfare.

NAL Call no: SF661.14
Descriptors: dogs, spine, pain, spinal cord, radiography, spondylitis, trauma, degeneration, neoplasms, meningitis, drug therapy.

Language: German with a summary in English.
NAL Call no: 41.8-B45
Descriptors: pain, laboratory animals, elimination, control.

NAL Call no: 41.8 AM3
Descriptors: laboratory animals, pain, stress, animal experiments, experimental design, animal husbandry, carcinoma, toxicology.

Descriptors: laboratory animals, animal welfare, pain.

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, pain, relief, animal welfare act.

NAL Call no: QL55.A1L33
Descriptors: laboratory animals, pain, recognition, alleviation, laboratory animals.

NAL Call no: QL751.S55
Descriptors: animal behavior, laboratory animals.

NAL Call no: QL55.H36 1994
Descriptors: laboratory animals, animal welfare, pain prevention, medical treatment, euthanasia.

NAL Call no: QL55.I5 1994
Descriptors: laboratory animals, pain, distress, recognition, alleviation, laboratory animals.

NAL Call no: QL55.A1L33
Descriptors: laboratory animals, animal welfare, pain.

NAL Call no: QL55.I5
Descriptors: laboratory animals, animal welfare, pain prevention, anesthesia, analgesics, animal husbandry.

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, animal experiments, animal welfare, pain.

Workshop on minimizing pain & distress in laboratory animals. (1992 Nashville, TN), National Institute of Health, OPRR, Vanderbilt University Medical Center, Mehary Medical College, present a workshop on Minimizing Pain & Distress in Laboratory Animals, Dec. 3-4, 1992, Nashville, TN.
NAL Call no: QL58.W67 1992
Descriptors: laboratory animals congress, animal experimentation congress, pain in animals, analgesics.

Descriptors: pain, small animals, recognition, control.

Descriptors: laboratory animals, animal experiments, pain, control.
the threshold of pain in animals, rabbits, pigs, sheep, rats.  
Language: Chinese with a summary in English.  
NAL Call no: 385 AC86  
Descriptors: laser acupuncture, animals, pain.

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**FISH, FROGS & SNAILS**

NAL Call no: SF405.5.A3  
Descriptors: vertebrates, fishes, amphibia, reptiles, pain, anesthesia, anesthetics.

Descriptors: PISCES, physiological condition, pain, perception potential, sensory receptor, potential perception of pain, review.

NAL Call no: SH136  
Descriptors: mechanical stimuli, electric stimuli, behavioral responses, inhibitors, neurophysiology, controlled conditions, Gadus-morhua-marisaalibi, Salmo-mykiss, peptides.

NAL Call no: SF405.5.A23  
Descriptors: marine animals, anesthetics, anesthesia, pain, efficacy.

NAL Call no: SH177.S75K47 1994  
Descriptors: fishes, effects of stress on; fishes physiology, pain, physiological aspects, fish culture, animal welfare.

Language: German  
Descriptors: angling, neurophysiology, fish handling, fish physiology, freshwater fish, mechanical stimuli.

Language: German  
Descriptors: angling, legal aspects, biologicalstress, fish physiology, Cyprinuscarpia, Germany.

Language: German  
NAL Call no: 41.8 D482  
Descriptors: sense functions, behavioral responses, sense organs, fish.

ISSN: 0049-3864.  
Language: German  
NAL Call no: QP351.J36  
Descriptors: fish handling, biological stress, sport fishing, aquaculture techniques, ornamental fish, hygiene, Teleostei.

Snow, P.J.; Plenderleith, M.B.; Wright, L.L., (1993), *Quantitative study of primary sensory neurone populations of three species of elasmobranch fish*. Cerebral & Sensory Functions Unit, Department of Anatomy Science, University of: Queensland, St. Lucia 4072 Australia. *Journal of Comparative Neurology*, 1993, v. 334, no.1, p. 97-103. ISSN: 0021-9967.  
NAL Call no: QP351.J36  
Descriptors: dorsal root ganglia, sensory neurons, morphometry, Himantura, Rhinobatus battilum, Carcharhinus melanopterus, neurophysiology, sense organs, ultrastructure, elasmobranch fish.

NAL Call no: SF405.5.A23  
Descriptors: rana pipiens, laboratory animals, xylazine, flunixin, analgesics, pain, duration, dosage, injection, animal welfare.

Language: German  
NAL Call no: 41.8 D482  
Descriptors: government policy, mortality causes, commercial species, fishery technology, fish handling, processing fishery products, Germany.

**MICE**

NAL Call no: QL55.A1L3  
Descriptors: mice, biliary calculi, pain, symptoms, animal husbandry, animal housing, diets.
POST OPERATIVE PAIN


Descriptors: animals, pain, analgesics, surgical operations.


NAL Call no: 41.8 AM3
Descriptors: animals, pain, analgesics, surgical operations.


NAL Call no: 41.8 R3224
Descriptors: analgesics, post operative, dogs, cats.


NAL Call no: 448.8 AR291
Descriptors: retrobulbar hemorrhage, eye disease.


NAL Call no: QL55.15
Descriptors: laboratory animals, pain, standards, improvement, analgesics, surgical operations, animal welfare, anesthetics.


NAL Call no: QL55.A153
Descriptors: laboratory animals, postoperative care, pain, analgesics.


NAL Call no: QL55.A153
Descriptors: dogs, postoperative care, pain, analgesics, duration, blood gases.


NAL Call no: aHV4701.A952
Descriptors: laboratory animals, mammals, surgical operations, pain, analgesics, dosage.


NAL Call no: 41.8 M69
Descriptors: post operative pain, management, dogs, cats.

Descriptors: animals, postoperative care, surgical operations, drug delivery systems, pain, analgesics, anesthetics.

NAL Call no: SF601.C66
Descriptors: canine, spinal surgery, postoperative management.

NAL Call no: 41.8 V6425
Descriptors: analgesics, drug therapy, animal welfare, pain.

NAL Call no: QL55.A1L3
Descriptors: rats, analgesics, postoperative care.

NAL Call no: SF914.A53 1990
Descriptors: dogs, cats, analgesics.

NAL Call no: 51.8 V641
Descriptors: cats, pain, ovaricectomy, hysterectomy, anesthesia, medetomidine, ketamine, acepromazine, thiopental.

NAL Call no: SF910.P34A55 1992
Descriptors: animals, postoperative care, pain, inhaled anesthetics, anesthetics, local anesthetics, opioids, analgesics, agonists.

NAL Call no: SF970.A952
Descriptors: livestock, postoperative care, medical research, analgesics, pain, animal Welfare.

ISSN: 0023-6772.
NAL Call no: QL55.A1L3
Descriptors: medetomidine, pain, alleviation, dogs.

RATS
NAL Call no: 41.8 V641
Descriptors: pain management, rat, options.

NAL Call no: QL55.A1L3
Descriptors: rats, hepatomegaly, pain, assessment.

NAL Call no: Film S-1779
Descriptors: pain, adrenal medullary transplants, spinal cord injury.

NAL Call no: 410.9 P94
Descriptors: rats, newborn animals, droperidol, methoxyflurane, ketamine, pentobarbital, fentanyl, combination, anesthesia, induction, hypothermia, efficacy, safety.

Danneman, P.J.; Stein, S.; Walshaw, S.O., (1997), Humane & practical implications of using carbon dioxide mixed with oxygen for anesthesia or euthanasia of rats. ISSN: 0023-6764.
NAL Call no: 410.9 P94
Descriptors: rats, laboratory animals, man, carbon dioxide, oxygen, mixtures, anesthesia, euthanasia, pain, histology, animal welfare.

NAL Call no: Film S-1779
Descriptors: alleviation, neuropathic pain, cell grafts.

NAL Call no: QL55.A1L3
Descriptors: rats, local anesthetics, opioids, analgesics, postoperative care, timing, body weight, feed intake, water intake, physical activity, laparotomy, pain.
NAL Call no: QP351.N48
Descriptors: nerve injury, immunoreactivity, adrenal medullary grafts.

NAL Call no: 41.8 V643
Descriptors: pain, surgery, abdomen, analgesics, opioids, food intake, water intake, body weight, locomotion, rats.

NAL Call no: QL55.F43 1993
Descriptors: pain assessment, pain relief, rats.

Descriptors: analgesia, sciatic nerve, ketorolac tromethamine.

NAL Call no: RB127.P34
Descriptors: pain responses, attenuation, adrenal medullary transplants.

NAL Call no: QL55.A1L3
Descriptors: rats euthanasia, carbon dioxide, heart rate, blood pressure, oxygen, animal behavior, death.

NAL Call no: 410.9 P94
Descriptors: rats, male animals, pentobarbital, fentanyl, droperidol, ketamine, xylazine, diazepam, pain, drug effects.


NAL Call no: RB127.P34
Descriptors: alleviation. allodynia-like behaviors, spinal cord injury.

NAL Call no: QL55.A1L3
Descriptors: rats, blood sampling, pain, veins, animal welfare, body weight, blood volume, hematocrit, feed intake, water intake, erythrocyte count.

RODENTS

NAL Call no: QL55.A1L3
Descriptors: laboratory animals, rodents, lagomorphs, animal welfare, pain measurements, symptoms, law, rabbits.

NAL Call no: QL55.L342
Descriptors: rodents, laboratory animals, animal welfare, pain.

NAL Call no: SF910.P34A55 1992
Descriptors: laboratory animals, pain, rodents, post operative complications, postoperative care, locomotion, anesthetics, water intake, drug effects, surgical operations, food intake, adverse effects.

NAL Call no: QL750.B5
Descriptors: melatonin effects, behavior, mediation.

NAL Call no: QL55.A1L3
Descriptors: mice, rabbits, pain, anti-inflammatory agents, analgesics, dosage, adverse effects.
The Animal Welfare Information Center
March 8, 2001