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The identification and management of pain, suffering and distress in cephalopods, including anaesthesia, analgesia and humane killing ☆☆☆

Paul L.R. Andrews^{a, b, *}, Anne-Sophie Darmaillacq^c, Ngaire Dennison^d, Ian G. Gleadall^e, Penny Hawkins^f, John B. Messenger^g, Daniel Osorio^h, Valerie J. Smithⁱ, Jane A. Smith^j

^a Division of Biomedical Sciences, St George's University of London, Cranmer Terrace, London, SW17 0RE, UK

^b Stazione Zoologica Anton Dohrn, Villa Comunale, 80121, Napoli, Italy

^c Groupe Memoire et Plasticite comportementale, University de Caen Basse-Normandie, F-14032, Caen cedex, France

^d Home Office, Animals in Science Regulation Unit, Dundee, DD1 9WW, Scotland, UK

^e Department of Applied Biosciences, Faculty of Agriculture, Tohoku University, Amamiya 1-1, Sendai, 981-8555, Japan

^f RSPCA Research Animals Department, Southwater, RH13 9RS, West Sussex, UK

^g University of Cambridge, Department of Zoology, Cambridge, CB2 1TN, UK

^h School of Life Sciences, University of Sussex, Brighton, BN1 9QG, UK

ⁱ Scottish Oceans Institute, Gatty Marine Laboratory, School of Biology, University of St. Andrews, St. Andrews, Fife, KY16 8LB, Scotland, UK

^j The Boyd Group, Hereford, UK

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Abstract

From January 2013 scientific projects involving cephalopods became regulated by Directive 2010/63/EU, but at present there is little guidance specifically for cephalopods on a number of key requirements of the Directive, including: recognition of pain, suffering and distress and implementation of humane end-points; anaesthesia and analgesia, and humane killing. This paper critically reviews these key areas prior to the development of guidelines and makes recommendations, including identifying topics for further research. In particular: a) Evidence on how cephalopods might experience pain is reviewed; and a draft scheme of behavioural and physiological criteria for recognising and assessing pain, suffering and distress in cephalopods used in scientific procedures is presented and discussed. b) Agents and protocols currently used for general anaesthesia and analgesia are evaluated. Magnesium chloride, ethanol and clove oil are the most frequently used agents, but their efficacy and potential for induction of aversion need to be systematically investigated, according to the species of cephalopod and factors such as body weight, sex and water temperature. Means of sedating animals prior to anaesthesia should be investigated. Criteria for assessing depth of anaesthesia, including depression of ventilation, decrease in chromatophore tone (paling), reduced arm activity, tone and sucker adhesiveness, loss of normal posture and righting reflex, and loss of response to a noxious stimulus, are discussed. c) Analgesia should be provided for cephalopods used in scientific procedures, whenever this would be the case for vertebrates. However, research is needed to evaluate effective agents and administration routes for cephalopods. d) Techniques for local anaesthesia need to be defined and evaluated. e) Currently used methods of killing and criteria for confirmation of death in cephalopods are evaluated. Based on present knowledge, a protocol for humane killing of cephalopods is proposed. However, further evaluation is needed, along with development of humane methods of killing that will not compromise study of the brain. On humane grounds: *i.* mechanical (as opposed to chemical) methods of killing should not be used on conscious cephalopods (unless specifically authorised by the national competent authority); and *ii.* hatchlings and larvae should be killed by overdose of anaesthetic and not by immersion in tissue fixative.