



reports

DOG POPULATION MANAGEMENT

FAOWSPA/IZSAM Expert Meeting
Banna, Italy
14-19 March 2011



**Food and Agriculture
Organization of the
United Nations**

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Contents

<i>Acknowledgments</i>	<i>v</i>
<i>Abbreviations and acronyms</i>	<i>vi</i>
<i>Executive summary</i>	<i>viii</i>
1 INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PROCESS	1
2 ANIMAL AND PUBLIC HEALTH	3
2.1 PUBLIC AND ANIMAL HEALTH CONCERNS AS A DRIVER FOR DPM	3
2.1.1 <i>What are the main public and animal health concerns?</i>	3
2.1.2 <i>Behaviour, trends and disease risks</i>	4
2.2 LEGISLATION AND DISEASE CONTROL	5
2.3 ECONOMICS OF DISEASE CONTROL	6
2.4 INSTITUTIONAL ISSUES RELATED TO DPM AND DISEASE CONTROL	6
2.5 THE ONE HEALTH CONCEPT	7
3 DOG POPULATION MANAGEMENT	8
3.1 PLANNING OF INTERVENTIONS	8
3.1.1 <i>Why are initial assessments important?</i>	8
3.2 ASSESSMENT TOOLS	10
3.2.1 <i>Dog ecology studies and modelling</i>	10
3.2.2 <i>Participatory appraisals and KAP studies</i>	11
3.3 FROM INITIAL ASSESSMENT TO PLANNING A COMPREHENSIVE DPM PROGRAMME	12
3.4 OUTCOME INDICATORS FOR SUCCESS AND THE POTENTIAL FOR CBA	12
3.5 POLICIES AND LEGISLATION	14
3.6 DPM IMPLEMENTATION	16
3.6.1 <i>Dog registration, identification and traceability</i>	16
3.6.2 <i>Dog catching, handling and removal</i>	20
3.6.3 <i>Euthanasia</i>	21
3.6.4 <i>Holding facilities</i>	22
3.6.5 <i>Reproduction control in dogs</i>	25
3.6.5.1 How to deliver reproduction control	27
3.6.5.2 Surgical options for reproduction control	29
3.6.5.3 Non-surgical options for reproduction control	30
3.6.5.4 Research needs for reproduction control	31
4 CAPACITY DEVELOPMENT	32
4.1 INTRODUCTION	32
4.2 POLITICIANS AND POLICY-MAKERS	32

4.3 DPM PROFESSIONALS	33
4.4 DOG OWNERS AND CHILDREN	34
5 DATA GAPS AND RESEARCH NEEDS	37
6 RECOMMENDATIONS AND CONCLUSION	39
6.1 GENERAL RECOMMENDATIONS	39
6.2 ANIMAL AND PUBLIC HEALTH	39
6.2.1 <i>Diseases of particular public health interest</i>	39
6.2.1.1 Rabies	40
6.2.1.2 Echinococcosis/hydatidosis	40
6.2.1.3 Leishmaniasis	40
6.3 HUMAN-DOG RELATIONSHIPS	40
6.4 POLICIES AND LEGISLATION	41
6.5 PLANNING, MONITORING AND EVALUATING DPM	41
6.6 DOG POPULATION MODELLING	41
6.7 CBA OF INTERVENTIONS	42
6.8 DPM TOOLS	42
6.8.1 <i>Registration and identification</i>	42
6.8.2 <i>Access and handling</i>	42
6.8.3 <i>Dog removal</i>	43
6.8.4 <i>Euthanasia</i>	43
6.8.5 <i>Holding facilities management</i>	43
6.8.6 <i>Reproduction control</i>	43
6.8.6.1 Surgical sterilization	44
6.8.6.2 Chemical and immunological contraception/sterilization	44
6.8.6.3 Humane confinement	44
6.9 CONCLUSIONS	44
6.10 AFTERWORD	45
7 REFERENCES AND OTHER RESOURCES	48
ANNEX A	
Agenda of the meeting	50
ANNEX B	
Meeting participants	56

Acknowledgments

In many parts of the world, dogs can give rise to a series of human and animal health and welfare concerns. Therefore, a clear need has arisen to manage dog populations efficiently without causing animal suffering. In recognition of this need, the Food and Agriculture Organization of the United Nations (FAO), the World Society for the Protection of Animals (WSPA) and the Istituto Zooprofilattico Sperimentale dell’Abruzzo e del Molise “G. Caporale” (IZSAM) with technical contributions from the World Organisation for Animal Health (OIE) and the World Health Organization (WHO), organized an expert meeting. This meeting aimed to provide updated knowledge and guidance to a wide range of stakeholders including national and local governments, and municipalities, on dog population management (DPM) options and relevant international standards and best practices.

FAO, WSPA and IZSAM wish to extend their sincere gratitude to all the experts and resource persons who attended the meeting and contributed to the preparation of this report by providing their time, expertise, data and relevant information.

We thank WHO, OIE, the European Commission, the Pan-American Health Organization (PAHO) and the International Companion Animal Management Coalition (ICAM Coalition) who provided support toward the attendance of some of the participants at the meeting. Special thanks are also due to Dr Serpell and Dr Reece for their extensive reviews of the report. We are also grateful to the Fondazione Banna per l’Arte for generously hosting the meeting and its participants in its inspiring premises.

Abbreviations and acronyms

ABC	Animal Birth Control
ACAW	Advanced Concepts in Animal Welfare
ACO	Animal Control Officer
AHVLA	Animal Health and Veterinary Laboratories Agency
ASEAN	Association of Southeast Asian Nations
CBA	cost-benefit analysis
CFIA	Canadian Food Inspection Agency
CMC	Colombo Municipal Council
COP	codes of practice
CNR	catch, neuter and release
CNVR	catch, neuter, vaccinate and release
DMZ	dog managed zone
DPM	dog population management
DVO	District Veterinary Officer
EID	emerging infectious disease
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
Fera	The Food and Environment Research Agency
FOCA	Animal Control Officer Course
HIS	Help In Suffering
HPAI	highly pathogenic avian influenza
ICAM	International Companion Animal Management Coalition
IZSAM	Istituto Zooprofilattico Sperimentale dell’Abruzzo e del Molise “G. Caporale”
IFAD	International Fund for Agricultural Development
IFAW	International Fund for Animal Welfare
ITEC	Instituto Técnico de Educação e Controle Animal
KAP	Knowledge, Attitude and Practice Survey
MOU	memorandum of understanding
NGOs	non-governmental organizations
OIE	World Organisation for Animal Health
PAHO	Pan-American Health Organization
PEP	post-exposure prophylaxis
PreP	pre-exposure prophylaxis
PZQ	praziquantel
RAWS	Regional Animal Welfare Strategy
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SEARG	Southern and Eastern African Rabies Group
SPCA	Society for the Prevention of Cruelty to Animals
SOP	standard operating procedures
TAIEX	European Commission’s Technical Assistance and Information Exchange

TNR	trap, neuter and release
UN	United Nations
UNDP	United Nations Development Programme
VPH	Veterinary Public Health
WHO	World Health Organization
WSPA	World Society for the Protection of Animals

Executive summary

The Food and Agriculture Organization of the United Nations (FAO), the World Society for the Protection of Animals (WSPA) and the Istituto Zooprofilattico Sperimentale dell’Abruzzo e del Molise “G. Caporale” (IZSAM) organized an expert meeting to discuss how to manage dog populations efficiently without causing animal suffering while also promoting public health and welfare. FAO engages in the social and economic development of poor populations, especially in rural areas. The prevention and control of dog-transmitted zoonoses, enhances lives and livelihoods and contributes to poverty alleviation. In many different settings, unwanted, unhealthy or unvaccinated dogs are still found roaming. The availability of food waste due to changes in society, such as urbanization and increased human densities, combined with a lack of responsible ownership, are leading to an apparent increase in the number of free-roaming dogs. These dogs can give rise to a series of human and animal health and welfare concerns in urban spaces and other human habitats.

The aim of this meeting was to identify different dog population management (DPM) options that may be adapted to the local context’s ethical, socio-economic, political and religious specificities, and to provide recommendations for successful implementation of relevant international standards and best practices, with special emphasis on animal welfare and public health. In preparation for the expert meeting, FAO conducted an e-consultation in which 230 subscribers from 70 countries participated. The objective was to gather up-to-date, relevant information and expertise on DPM, including recommendations for further action and research at national and international levels. Prior to the meeting held in Banna, Italy, in March 2011, a number of experts selected on the basis of their experience and geographic diversity were asked to write background papers. These, along with documents shared during the e-consultation and the summary of the contributions, constitute the background information of the expert meeting.

During the meeting, the experts specifically addressed animal and public health, as well as animal welfare issues. They reviewed available DPM options, including animal birth control options and best practices of dog catching, handling, housing and euthanasia. Another area of discussion related to public awareness, education and communication on responsible dog ownership and DPM options in different contexts. The group also defined institutional and civil society responsibilities and developed a set of recommendations relating to the implementation of DPM with practical next steps for the meeting participants and organizers.

The expert meeting produced a set of recommendations (detailed in section 6), including the following points:

- Since dogs have diverse functions and values in different societies, any DPM programme needs to define appropriate and culture-specific measures that also take local dog population dynamics into account.
- As a multifactorial issue, DPM fits under the multidisciplinary umbrella concept of One Health (see section 2.5) and requires an integrated approach

that incorporates animal, human and environmental components, and fosters interprofessional collaboration and involvement in the development of comprehensive and sustainable DPM strategies.

- All DPM programmes should aim to foster responsible attitudes towards dogs and human-dog relationships.
- DPM programmes should also increase communities' awareness of possible disease risks and should aim to increase health protective behaviours important for disease prevention (e.g. hand washing, dog vaccination and deworming) so as to foster healthy and safe interactions with dogs.

Several tools were identified to support DPM programmes that should be further developed, including the following:

- A Knowledge, Attitudes and Practice Survey (KAP) template is needed to explore dog populations and their owners and carers.
- Monitoring and evaluation was highlighted as an essential part of DPM programmes in order to improve programme performance. It was, therefore, recommended that a set of outcome-based indicators be developed and validated, including both universal indicators suitable for all programmes and some contextually-specific indicators.
- Understanding the economics of DPM would benefit government and non-governmental organizations (NGOs) when considering investment in DPM strategies. Given the current limited use of cost-benefit analysis (CBA) in DPM, it was recommended that a CBA template be developed following a review of work in this field to date.

Actual implementation of DPM covered several approaches including reproduction control, which is common to all DPM programmes. However, it was agreed that an important tool was the mandatory identification and registration of dogs using a standardized microchip system and national databases, with further links to a regional database where cross-border movement occurs, such as in Europe.

This expert meeting provided expertise to complete a review of DPM internationally and to develop recommendations suitable for the range of stakeholders involved in DPM implementation. Suggestions were also made regarding research needs, the development of tools and the setting up of a working group and a discussion forum to drive these next steps forward. The organizations that provided the secretariat, resource persons and experts value these suggestions and will consider them in their future work on DPM. They also encourage and invite all other organizations working in DPM to reflect on these recommendations and they welcome initiatives that implement these suggestions.

1. Introduction

1.1. BACKGROUND

Dogs play a number of important roles in human societies: they provide companionship and are used for a variety of activities including hunting, herding other animals and guarding property. Animals live in close contact with human beings. In many countries, however, an increasing number of unwanted, unhealthy and unvaccinated dogs are found roaming. This is especially the case in countries with limited social and economic development as well as in places where civil unrest or armed conflict have forced people to flee from their homes and leave their dogs behind. Abandoned and free-roaming dogs can give rise to a series of human and animal health and welfare concerns, in urban spaces and in other human habitats. The availability of more food waste, due to changes in society such as urbanization and increased human densities, combined with a lack of responsible ownership, are leading to an apparent increase of free-roaming dogs.

There is a clear need to manage dog populations efficiently to promote human and animal health and welfare, without causing animal suffering. Abandoned dogs may negatively affect people's lives in a number of ways and can pose risks to human health (e.g. dog bites, transmitting zoonoses such as rabies, echinococcosis/hydatidosis and leishmaniasis). There are a number of different options for DPM; however, each local context's ethical, socio-economic, political and religious specificities will influence how well they may be accepted.

These considerations prompted FAO, WSPA and IZSAM, with technical contributions from OIE and WHO, to organize an expert meeting that could provide updated knowledge and guidance to a wide range of stakeholders. The intended audience includes national and local governments (for instance, municipalities) who may adopt DPM options and implement relevant international standards and best practices.

1.2. PROCESS

Before the expert meeting, FAO conducted an e-consultation¹ between September and November 2010 in which 230 subscribers from 70 countries participated. The objective was to gather up-to-date relevant information and expertise on DPM, focusing on the following four themes:

- current state of knowledge on DPM options with special emphasis on animal welfare and health consideration;
- implementation of existing relevant OIE international standards;²
- case studies and best practices for the development of context specific options for DPM, on the basis of scientific evidence and ethical considerations;
- recommendations for further actions and research needs at national and international levels to address DPM options.

¹ Available at www.fao.org/ag/againfo/themes/animal-welfare/dog-population-blog/en/.

² Available at www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.7.7.htm.

The report of the e-consultation³ along with the documents shared by participants and experts constituted the background literature to the expert meeting.

The preparation of the expert meeting began with an open call for individuals with expertise on relevant topics linked to DPM. Twelve experts were selected on the basis of their experience and geographic diversity. Experts were explicitly required to serve in their capacity as individuals and not to represent the interests or viewpoints of any affiliated organization. Prior to the meeting, they prepared a background document on a specific topic and were asked to share their relevant experience. The experts then met for six days (14 to 19 March 2011) of intensive discussion and report writing. During this time, the 12 experts also had access to 6 resource persons with experience of DPM implementation who were representatives of organizations responsible for providing guidance on DPM policy and practice to governments. FAO, WSPA and IZSAM provided six staff who served as the secretariat for the meeting.

The objective of the meeting was to identify DPM options and to give recommendations for successful implementation of relevant international standards and best practices, with special emphasis on animal welfare and public health.

The meeting:

- assessed DPM options and areas of study relevant to their implementation (e.g. modelling, dog population dynamics, behaviour/ecological and socio-economic studies);
- reviewed animal birth control options and techniques along with selection criteria for euthanasia for public health purposes;
- reviewed best practices of dog catching, handling and housing;
- addressed animal and public health issues, as well as those related to animal welfare;
- identified required actions in terms of public awareness, education and communication about responsible dog ownership and DPM options in different contexts;
- defined institutional and civil society responsibilities;
- developed a set of recommendations relating to the implementation of DPM.

³ Available at www.fao.org/ag/againfo/themes/animal-welfare/dog-population-blog/en/.

2. Animal and public health

2.1. PUBLIC AND ANIMAL HEALTH CONCERNS AS A DRIVER FOR DPM

2.1.1. What are the main public and animal health concerns?

The need to control the number of dogs, especially stray dogs, is motivated in part by public health concerns, particularly in relation to rabies transmission. Additionally, echinococcosis/hydatidosis and leishmaniasis are serious zoonotic diseases transmitted by dogs.

In addition to disease transmission, dog bites and the fear of aggressive dogs also pose a risk to human health and well-being and can lead to panic and the inhumane culling of dogs. Promoting responsible dog ownership with emphasis on behaviour and basic needs, and ensuring that dogs are properly vaccinated and treated against diseases are, therefore, essential. Furthermore, educational and bite prevention programmes for the public and, especially, children should always include guidance on how to interact with animals and what to do when approached by dogs, particularly those that show signs of fear and/or aggression.

When targeted towards unowned and unwanted dogs, DPM can benefit dog-related disease interventions. Preventive measures such as vaccination and deworming to control disease should be promoted. However, euthanasia is recommended for dogs suffering from diseases that cannot practicably be treated, including rabies; methods used for euthanasia should be humane. Sterilization also has animal welfare benefits independent of disease control because, like vaccination, it increases the longevity of dogs. Sterilization programmes also provide an opportunity to deliver vaccination. While, population level sterilization, such as Animal Birth Control (ABC) programmes, may bring the dog population down, it can also lead to increased movement of dogs into communities to meet people's demands for them. It should also be noted that rats and other rodents increase when dog numbers are reduced, giving rise to other public health risks.

Better insight into dog population dynamics is needed, including an understanding of the relationship between disease transmission and animal density, dog population turnover and mobility. The same data, complemented by information on dog-keeping practices and the accessibility of dogs for vaccination and/or treatments, will greatly contribute to the successful design of specific zoonoses control programmes. Dog ecology studies and human Knowledge, Attitude and Practice Surveys (KAPs)⁴ are important tools for obtaining this kind of information. Furthermore, the behaviour of animals, rates of dog-dog and dog-human interaction, and the nature of dog ownership can all influence disease transmission as well as accessibility for vaccination or treatment. Dogs can also transmit a number of diseases (e.g. parvovirus, distemper, leptospirosis, rabies) to other dogs, farm animals and wildlife. The implementation of DPM would also help to control these diseases.

⁴ KAP detailed in 3.2.2.

An estimated 55 000 people die of rabies every year, with over 95 percent becoming infected through a bite from a rabid dog. Rabies in humans can best be prevented by eliminating the disease in dogs and wildlife through vaccination as well as by averting human exposure through education and the timely provision of post-exposure prophylaxis (PEP). At least 70 percent of the dog population must be vaccinated annually in order to halt the transmission of the rabies virus in a population at risk. Rabies can either be absent, endemic or epidemic/newly introduced in a country, and this may have direct influence on how authorities and the community will address DPM. Making rabies a notifiable disease in humans and animals in all countries would generate more data on the number of animal and human cases. Furthermore, the possibility of rabies crossing borders due to regulated or unregulated animal movements requires close collaboration between countries at regional and international levels. Since 2007, the commemoration of World Rabies Day has enhanced awareness and political commitment to address this disease.

In some countries, in addition to rabies, the prevention and control of leishmaniasis and echinococcosis/hydatidosis is also an important driver for implementing DPM. Feeding dogs with uncooked offal, especially condemned offal from slaughterhouses, can pose a serious risk in terms of perpetuating echinococcosis/hydatidosis in a given population. However, if offal is no longer made available to dogs, alternative sources of food need to be provided. While echinococcosis/hydatidosis is frequently not a priority for some national veterinary services, the public health sector might view this disease differently given the number of human cases and the high cost involved in its treatment. Eliminating the access of dogs to offal and dead livestock at abattoirs, community slaughter sites and within the household, along with promoting the anthelmintic treatment of dogs, is critical to the successful control of this disease.

2.1.2. Behaviour, trends and disease risks

Religious beliefs and specific cultural contexts call for different DPM applications. Clearly a ‘one size fits all’ solution cannot apply as dogs have multiple functions in society, necessitating a careful consideration of how people value them – emotionally and practically – when identifying solutions.

In general, people who like dogs will more readily adopt a stray dog. Furthermore, if they have the means and the knowledge, they will vaccinate their animal, have it sterilized and are less likely to abandon it or to allow it to roam freely. Hence, if attitudes to dogs can be changed, this will also influence behaviour in relation to their care, when combined with access to affordable veterinary services. Various demographic factors, including age and gender, appear to be associated with attitudes towards dogs. The most powerful influence for a lifelong positive attitude towards animals is seen when children grow up with dogs in their household. However, there are large social and cultural differences when it comes to dog-keeping practices. For example, in Kenya some people believe that dogs, like wildlife such as jackals, do not get sick and can look after themselves. Sometimes people do not want to invest in their dogs and shy away from having their dogs vaccinated, sterilized or medically treated due to various unfounded beliefs (i.e. the notion that vaccinated or sterilized dogs make less effective hunting or guard dogs).

Often people do not realize the costs entailed in owning and caring for a dog. Acquiring a dog should be given serious consideration and the right type of dog needs to be chosen carefully. The State Government of Victoria, Australia, has introduced the concepts of the cost of pet care and importance of choosing the right pet into the school curriculum to raise community awareness on pet costs and responsibilities.⁵ The high cost of vaccinations, treatments, sterilization and the fear of post-operative complications scare people away from having interventions done on their dogs.

Dog ecology studies complemented with KAP studies would be beneficial as they can assess how communities deal with dogs. These are important tools to understand dog dynamics and identify risk factors when designing effective and sustainable interventions.

Urbanization and the increase of edible waste, especially in developing and transition countries, appear to contribute to a rise in dog populations. In some cultures, dogs are permitted to roam freely (e.g. at night in Kenya and Tunisia, and in the morning in Brazil) as this freedom can be perceived as part of their 'rights'. In addition, dogs are often allowed to breed without restriction. If dogs are not fed correctly they will need to scavenge for themselves. The lack of veterinary care, poor health, as well as the lack of value given to dogs appear to correlate with their neglect and exposure to the risks of contracting and spreading disease.

Circumstances that lead to the intentional or forced mobility of people, such as military conflicts, civil unrest, natural disaster or the death of the owner, cause dogs to become strays. In a number of areas of the globe, the lack of food during protracted crises has led people to consume dogs. In some countries, dog meat consumption is part of a traditional culture, which directly affects the presence and movement of dogs and related diseases.

2.2. LEGISLATION AND DISEASE CONTROL

Although many countries have legislation that regulates the keeping of dogs, their identification and registration, as well as stipulates compulsory vaccination, it is often not adequately enforced. Nevertheless, responsible dog ownership and dog management should be incorporated into dog-related legislation and its implementation supported through education and enforcement. Given public health risks, legislation should apply not only to owned dog but to stray dog populations, especially as many stray dogs are owned but have been allowed to roam by their owners. Moreover, legislation should better address the welfare of dogs, given that inhumane culling methods are often permitted.

Legislation should be evidence-based and context-driven. Involving legal and technical experts when devising legislation would ensure that legislation and policies are not only coherent with the local context but are also implementable. Relevant regulations and recommendations from international organizations such as the Council of Europe, FAO, OIE, WHO and WSPA also need to be incorporated into these policies and legislation. Developing subsidiaries (i.e. mechanisms at local level) would enable their rapid adoption when required. The enforcement of legislation frequently goes hand in hand with the presence of a specific problem or public health risk. Often, too, enforcement is reduced once the problem or risk diminishes.

⁵ See www.pets.dpi.vic.gov.au/02/scp_cost.htm - pur.

This trend can be a challenge for disease control given that a reduction in disease incidence does not necessarily indicate that the disease has been eliminated, as there may be a risk of resurgence.

2.3. ECONOMICS OF DISEASE CONTROL

In many cases, the control of dog-related zoonotic diseases is outweighed by other priorities as the human burden of these diseases is not fully understood. Disease in dogs, too, is of little economic importance because, apart from specific breeds, dogs have relatively little value when compared to livestock. This is especially the case in countries where dog owners with limited resources are reluctant to pay for dog rabies vaccinations. Furthermore, owners can be held responsible for providing financial support for the care of any person bitten by their dog and may also be required to pay compensation to the victim. Awareness-building messages should convey the fact that acting irresponsibly costs you more, be it in fines or loss of social capital due to conflicts with neighbours or other community members.

The implementation of DPM programmes in many countries falls under the responsibility of the same municipalities that are also responsible for slaughterhouses and waste removal in their area. As slaughterhouses and garbage dumps often provide important sources of food for roaming dogs, investing in the rehabilitation of premises, the processing of slaughterhouse waste, proper/safe disposal of carcasses (incineration or burial) and overall removal of waste should be an integral part of any dog control programme. This management should be done with care and in combination with dog population reduction and/or the provision of alternative food sources to avoid the starvation of dogs that rely on these food sources. Governments, however, often only react when dogs become an economic problem (e.g. have a negative impact on tourism or increase the need for human health services). Generally, insufficient resources are allocated for dog management, vaccination, identification, training, education and sterilization. Specific zoonoses control programmes in the area could cover part of the required financial and human resources for wider DPM.

In some countries, mandatory identification and registration programmes for dogs can provide a source of income to fund further dog management programmes, including those for dog vaccination and treatment.

2.4. INSTITUTIONAL ISSUES RELATED TO DPM AND DISEASE CONTROL

Roles and responsibilities between the different sectors involved in zoonoses control and DPM need to be clearly defined. Institutions need to receive adequate resources and support for the implementation of their programmes. Activities need to be well-coordinated and should make the best use of generally scarce resources. The drivers for the activities of most veterinary services relate to economic risks and public health. Generally, livestock issues tend to take precedence over dog-related activities and economic considerations outweigh animal welfare issues.

Where rabies control is focused on vaccination of the reservoir species (commonly dogs), most of the costs are in the animal health field while the benefits are mostly linked to human health. In countries where dog rabies control falls under the responsibility of the ministries of health (e.g. most Latin American countries and Italy), resources are mobilized readily compared to countries where dog rabies

control falls under the responsibility of the veterinary services within the ministries of agriculture. The same applies to echinococcosis and leishmaniasis, where control programmes are mostly driven by the human health rather than the animal health sector. The elimination of unwanted dogs as a source of stray animals is often part of a specific disease control programme. Dog population control programmes can, therefore, ‘piggyback’ on relevant zoonoses control programmes.

Municipalities often implement DPM in a reactive manner when a problem or perceived need arises (elections, bite incidents reported by the press, etc.). Such quick fixes can lead to worsening situations, as DPM requires long-term investment and a strategic plan. It is generally difficult to convince local and national veterinary services about best practices as they are often uninterested, understaffed and under-resourced. Moreover, DPM can be perceived as a burden for those directly implementing DPM activities. Cooperation between municipalities and NGOs involved in DPM and other related activities is essential for a coherent DPM approach and for developing synergies, especially with regard to public health and animal welfare.

2.5. THE ONE HEALTH CONCEPT

The One Health concept addresses health risks at the animal, human and environmental interface in order to enhance human and animal health and welfare, and sustainable management of the environment. The concept promotes a holistic view and fosters cooperation, communication and coordination among sectors. It is in line with the horizontal approach in which different disease control strategies are integrated by making the best use of available resources (i.e. doing more with less). Priorities need to be clearly defined at international, regional, national and local levels and consultation with relevant stakeholders should be an integral part of the development of any disease control strategy. The One Health concept is inclusive and should look at several dimensions of a problem, involving a wide range of professionals. Strategies that are developed to control zoonotic diseases and dog populations need to answer social concerns and must clearly take the existing context into consideration, while ensuring that measures implemented have either a neutral impact or improve the environment. Monitoring and evaluation using outcome-based indicators that are relevant to both human and animal health and welfare will improve communication between sectors as well as the allocation of resources. National and local players are to engage in coordination and priority setting when defining strategies. Overall, intergovernmental organizations subscribe to the One Health concept and engage in disseminating good practices and consolidated experiences.

3. Dog Population Management

3.1. PLANNING OF INTERVENTIONS

3.1.1. Why are initial assessments important?

Due to their close and successful association with people, dogs are almost ubiquitous and managing their populations is a challenge throughout the world. The interventions that will achieve the management of dog populations will vary according to the diversity of attitudes towards dogs and dog-keeping practices around the world. Significant differences may be seen both within and between countries. For example, there can be a difference in dog-keeping practices between rural and urban areas, and between the practices of dog owners of different religions and socio-economic classes. These differences cannot be ignored but must be assessed and understood so that DPM planning can take them into account. In recognition of this diversity, no single DPM method will fit all situations, and interventions need to be tailored to suit the specificities of the location including the desired aim of the intervention.

Interventions require clear aims and need to identify issues to be targeted; for example, reducing human rabies deaths and/or improving dog welfare. Once these are identified, a ‘root cause analysis’ of the problem(s) presented by dogs in a specific location will help to establish the focus for the management programme. For instance, planners are likely to need to know where stray dogs come from, especially those that are seen in a poor state of welfare on the street. If there is an over-population and dogs are being euthanized in shelters because homes cannot be found for them, planners may also need to know where those dogs come from. They also need to identify which dogs are known to transmit diseases such as rabies, echinococcosis and leishmaniasis. A DPM programme that focuses only on tackling the ‘symptoms’ of a dog population problem – commonly, the visible issues that the public and politicians complain about most such as stray and shelter dogs – and does not explore and address its root causes, will tend to create short-term or ‘band aid’ interventions that do not result in sustainable change towards better DPM.

DPM is also seen as a social problem, with a range of human behaviours as root causes. The ultimate goal should be a situation in which all dogs are responsibly owned. Attitudes to and care of dogs vary depending on cultural and individual attitudes. As a result, there needs to be targeted educational interventions in place to address these variations and to improve standards of canine supervision and care so that control measures are effective in providing a healthy environment for humans and dogs. Efficient and financed DPM will have little success if a clear understanding of the variety of factors involved is lacking.

The source of unwanted dogs and the social problems that lead them to become stray or abandoned in shelters also needs to be understood. Both dog ecology and sociology studies are required to assess the nature of the local dog population so that appropriate interventions can be planned. Such studies do not have to be complex, but they do need to answer important questions about the population of dogs and the local community:

- What problems do the dogs cause?
- Where are the ‘problem’ dogs coming from? What is the source of new dogs entering into existing dog populations?
- What is the current dog population size and composition?
- What animal welfare issues do these dogs suffer from?
- What are people’s knowledge, attitudes and practices towards dogs and dog ownership? Are these similar across the location or do they differ? If so, why?

It is also important to assess not only what has been done in the past and what is currently being done to control the dog population so that lessons can be learned about previous control efforts, but also what resources are available for future interventions and sustainability. There will be a range of stakeholders that will have either an interest in the outcome of the programme or have an important role to play in its implementation, or both. These stakeholders should be part of the initial assessment, the subsequent planning of the programme, its later implementation and the evaluation of its effectiveness.

While community support is important, the responsibility for DPM should lie with government authorities. Advocacy activities targeting politicians are, therefore, relevant prior to planning an intervention. However, a number of different stakeholders should be involved in planning and implementation, including the veterinary profession, NGOs and dog owners themselves. Assessing public opinion can be useful not just for determining what intervention is best suited to a given situation, but also for highlighting the importance of DPM to politicians. Moreover, understanding popular opinion may be potentially helpful in terms of utilizing public pressure in advocacy efforts. Unfortunately, politicians are often limited to dealing with challenges that can be tackled successfully within their term of office, while DPM may require a long-term vision to realize benefits, with elaborate consistent policies that last beyond a political cycle. With this in mind, civil servants are also important stakeholders to engage when planning DPM. Intergovernmental organizations such as FAO, OIE, WHO and PAHO are useful partners to work with politicians and public officials, as they are likely to have previously established working relationships and may have greater access to international guidelines and standards that can be used for support.

Particular challenges at the planning stage include a lack of government interest and insufficient resources to tackle DPM. Diversity of attitudes towards dogs and dog-keeping practices, coupled with insufficient research or understanding of this diversity, may result in differences of opinion on how interventions should be run. Opinions at the extremes, such as a call for total eradication of the dog population as opposed to a ‘no kill’ perspective, also tend to be very vocal.

Several existing policies and guidelines may be useful to consult at the planning stage. The concept of a One Health approach (see 2.5 for a more detailed discussion of One Health) may be useful to assist politicians in gaining wider intergovernmental political support and funding. More detailed guidance on DPM can be found in Chapter 7.7 of the *Terrestrial animal health code* of the OIE,⁶ the ICAM Coalition’s *Humane dog population management guidance*,⁷ veterinary associations’ guidelines on veterinary interventions, and rabies control from WHO and the Rabies Blueprint⁸ developed by the Partners for Rabies Prevention.

⁶ Available at www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.7.7.htm.

⁷ Available at icam-coalition.org/resources.html.

⁸ Available at www.rabiesblueprint.com/.

3.2. ASSESSMENT TOOLS

A particular research need that was identified was the development of more tools – ideally, standardized tools – to allow for comparisons when assessing dog populations and human knowledge, attitudes and practices. The following is a summary of the current state of these tools.

3.2.1. Dog ecology studies and modelling

Dog ecology studies can lead to estimates of dog population size, density or dog-to-human ratios, including mark-recapture techniques usually done through visual identification of marked dogs; hence, also termed *mark-resight*. These studies can also provide estimates of the age and sex structure of populations, which are indications of survival and reproductive rates, thereby facilitating the calculation of population turnover. Unfortunately, studies of this nature in dogs are relatively rare; a few examples of different methodologies that have been used may be found in Box 1.

Box 1. Examples of different dog ecology studies

- *Childs et al. (1997) estimated dog density by distance sampling and assessed the potential utility of two marking methods for capture-mark-recapture applications following a mass canine rabies-vaccination campaign in Sorsogon Province, the Philippines. This campaign provided an overall estimate of dog-population density of 468 dogs per km² (95 percent confidence interval, 359 to 611).*
- *Kayali et al. (2003) used a capture-mark-recapture method following a mass vaccination campaign which included collaring of vaccinated dogs to estimate the total number of owned dogs and the ratio of ownerless to owned dogs, and to calculate vaccination coverage. Considering the total dog population, an estimate of 64 to 87 percent vaccination coverage was found and between 1.1 and 10.6 percent of the dog population was defined as ownerless, depending on the area surveyed.*
- *Kitala et al. (2001) utilized questionnaires of households in Kenya to estimate: dog ownership (63 percent of households owned a dog); dog density (6 to 21 dogs per km² in rural areas and 110 dogs per km² in urban areas); population growth from estimates of survival and reproduction (9 percent per annum due to high fecundity of 1.3 pups per female per year outweighing high mortality); and dog-keeping practices such as allowing dogs to roam (69 percent were never restricted and roamed freely to forage for food and to mix with other dogs).*
- *Roaming dog population estimates, or at least indicators of population change over time, can also be found using direct observation of dogs on public property; see WSPA's Surveying roaming dog populations: guidelines on methodology available at www.icam-coalition.org.*

Once dog population size, structure and demography estimates are established, computer simulation models can be used to predict the change in dog population or disease prevalence under different management strategies, either allowing comparison of different interventions before investment begins or as one of the elements of an intervention evaluation. However, model validity needs to be examined and tested for biological plausibility before models are used as a basis for decision-making. Many important issues in model validation are insufficiently addressed by current guidelines. These issues include a detailed evaluation of different data sources, graphical representation of models, computer programming, model calibration, between-model comparisons, sensitivity analysis and predictive validity (Kopeck *et al.*, 2010). As the role of simulation modelling is increasing, there is a need to improve and standardize model validation.

3.2.2. Participatory appraisals and KAP studies

While there have been numerous studies of human-dog attitudes and interactions in a handful of developed countries, few comparable investigations have been conducted in developing nations, thereby making it difficult to generalize cross-culturally. The development of a set of standardized instruments for measuring attitudes to dogs and dog-related issues cross-culturally would provide a valuable set of tools for focusing dog control efforts where they will have the most beneficial impact, and for monitoring progress in dog care and population management. There are several potential tools that could be used; the following are just two examples:

- **Participatory appraisals** attempt to maximize the engagement of local people using flexible and visual tools that do not require people to be literate. This tool allows local people to guide the direction of the appraisal themselves in order to identify their own priorities for the future programme, rather than just supplying information that someone else uses later to make decisions. Participatory appraisals help to raise awareness within the community about its responsibilities regarding abandoned dogs and their involvement in possible solutions. This tool is being applied in Sierra Leone and Uganda through the application of One Health appraisals developed by FAO and funded by the Government of Ireland.
- **A KAP** is a representative study of a specific population to collect information on what is known, believed and done in relation to a particular topic. In most KAPs, an interviewer collects oral data using a structured, standardized questionnaire in face-to-face interviews with individuals or small groups. The questions themselves focus on the knowledge the person or group has about a specific subject and their attitudes towards this subject, including any pre-conceived ideas and practices as reflected by their actions relating to it. These data can then be analysed quantitatively or qualitatively depending on the objectives and design of the study. A KAP can be designed to gather information about a specific topic, but may also include questions about general health practices and beliefs.

Case study: Assessment of dog ownership in Taiwan before developing a DPM programme (Hsu *et al.*, 2003)

This study conducted a quantitative ethnographic analysis of the influence of demographic factors and early experience (childhood exposure to dogs) on Taiwanese dog-keeping practices and behaviour. A telephone survey of a randomly selected sample of 2 001 Taiwan residents determined their dog-ownership histories, current patterns of dog ownership and disposal, and other dog-related activities. The results suggest that low rates of neutering, easy availability of low- or no-cost puppies, a tendency to allow owned dogs free access to the outdoors, unrealistic expectations of dog ownership, canine behavioural problems, and religious and cultural taboos against euthanasia and shelter relinquishment have contributed to the recent increase in the numbers of free-roaming dogs in Taiwan. Logistic regression analyses determined that a relatively small number of demographic and experiential variables predicted dog ownership and disposal patterns. The most important of these was the childhood experience of living with household dogs. In light of these findings, future efforts to reduce the stray dog problem should focus on enforcing registration fees, particularly for unsterilized animals, low-cost neutering schemes and educational programmes designed to promote neutering, to improve knowledge of canine behaviour and behaviour problems, and to develop more realistic expectations and attitudes toward dog ownership. Marked Taiwanese resistance to canine euthanasia and shelter relinquishment suggests a need for alternative methods of managing the existing free-roaming dog population.

3.3. FROM INITIAL ASSESSMENT TO PLANNING A COMPREHENSIVE DPM PROGRAMME

Following an initial assessment, the next stage will be to highlight the most important factors that should be prioritized in a dog management programme. This process will ensure the most effective use of resources and the greatest impact on the wider problem. Preventive, curative and legislative aspects as well as appropriate response to the local situation, needs and resources should be taken into consideration when designing a DPM programme. No single model will fit every situation, and when interventions are employed without a consistent, strategic and long-term framework, their impact can only be localized, limited and short-term.

3.4. OUTCOME INDICATORS FOR SUCCESS AND THE POTENTIAL FOR CBA

All projects or interventions, not least those that benefit from public or charitable funds, should look for ways of measuring their progress and achievements so as to improve performance over time as well as to assure accountability towards donors and stakeholders, including the general public. Article 7.7.7 in Chapter 7.7, on stray dog control in the OIE's *Terrestrial animal health code* discusses monitoring and evaluation of dog population control programmes and provides some suggestions on what should be measured and how.⁹ In order to measure progress over time,

⁹ Available at www.oie.int/fileadmin/Home/eng/Health_standards/tahc/2010/en_chapitre_1.7.7.htm.

Case study: Example of DPM failure due to limited prior assessment and planning

In Sofia, Bulgaria, following much pressure from local animal protection societies, the authorities ceased using a 'catch and kill' strategy and adopted a catch, neuter and release (CNR) approach. This approach was adopted without any public or other stakeholder consultation. The personnel responsible for catching did not have any training or experience in catching or handling dogs. As a result, dogs were mis-handled within the shelter environment and when released after neutering.

There was no strategy behind this CNR programme. Dogs were caught on receipt of public complaints by the local municipality, i.e. when residents notified them about stray dogs causing problems in their neighbourhood. Because there was no prior public consultation, local residents were surprised to see the dogs being returned a few days after capture; they did not want stray dogs in their community and did not understand the rationale behind CNR. This programme has resulted in many residents using their own measures to control stray dog numbers by poisoning the dogs after their return.

Case study: Using initial assessment to inform programme design in Colombo, Sri Lanka

A questionnaire study was conducted with 1 823 households, randomly selected from 8 of Colombo's 47 wards in 2007. One of the questions asked: "Does your dog have access to the streets between 06.00 hours and 09.00 hours in the morning?" If the answer was yes, further questions were asked to establish for what proportion of this time period the dog was actually on the street. At the same time, a direct observation survey of the number of roaming dogs on the streets was conducted between 06.00 hours and 09.00 hours in the morning. By comparing the number of dogs reported by their owners to be allowed to roam the streets in the morning, calculations showed that 46 percent of the roaming dogs seen on the streets were actually owned roaming dogs.

As a result of this finding, the DPM project in Colombo started with a focused owned dog sterilization and vaccination approach using mobile clinics, instead of using a CNR approach, because the project would reach nearly 50 percent of the roaming dogs via their owners. Rather than have government or NGO catchers take these dogs on the street for sterilization and vaccination, the choice was made to engage owners directly in the process of sterilization and vaccination of their dogs, thereby building a sense of responsible ownership. (Available at www.fao.org/fileadmin/user_upload/animalwelfare/Case%20Study_Colombo.pdf).

baseline data are required; hence, many of the methods employed in the initial assessment phase can also be repeated at regular intervals in order to assess progress.

Experts at the meeting agreed that the development of standard outcome indicators for success that could be used in DPM projects across the world would be a valuable step forward. These would provide guidance for projects wishing to

perform their own monitoring and evaluation and would also enable comparison between projects. Furthermore, these indicators would accelerate knowledge sharing on effective methods of DPM. A valid note of caution was that projects that had proved effective in one location might not be suitable for another location with different attitudes and patterns of dog ownership. However, once these variations had been taken into account, the benefits could be significant.

One method of responding to the need for accountability to donors, beneficiaries and other stakeholders is the use of CBAs. These can be used in advance of investing in a project to decide on the most cost-effective intervention or as part of a project evaluation. In order to complete a CBA, the input into the project, both initially and ongoing, should be calculated. This input may include additional staff, infrastructure costs and operational costs such as drugs and medicines. Income may also be generated by some elements of the project, such as licensing or registration fees, which should be balanced against costs as an input. Establishing the input into the project will be relatively straightforward if clear plans and records of expenditure are available. The input then needs to be compared to the outcomes of the project. For DPM projects, outcomes may include changes in medical costs associated with zoonotic disease control, dog bites or road traffic accidents. There will be other relevant outcomes from such a project that will be more difficult to quantify, including improvements in dog welfare and the satisfaction of dog owners, the wider community and authorities themselves. Even if monetary values cannot be established for such outcomes, they should be described and included in the final estimation of costs and benefits.

3.5. POLICIES AND LEGISLATION

Policies and legislation can provide the framework for how DPM should be done and who is responsible for its implementation. Policy may be defined as “a course or principle of action adopted or proposed by a government, party, business or individual”.¹⁰ Legislation implements key policy initiatives and ideally will establish in an act, a fundamental framework of legal principles with defined parameters and responsibilities often detailed in regulations for pet ownership, breeding and selling, abandonment and stray animals. DPM legislation may form part of an Animal Protection or Animal Welfare Act or it may stand alone or be included within related acts such as those dealing with rabies control, or a mixture of these. Regardless of the position within the legal framework, animal welfare principles should be clearly defined. Policy may evolve over time and needs to involve appropriate consultation, and the development or amendment of legislation usually requires formal consultation.

Governments normally represent their constituents and their best interests. Therefore, they must be informed of the specific community attitudes, cultural, health and wider societal issues so as to balance these with safety, the environment and animal welfare to determine an evidence-based, effective and sustainable DPM policy. In addition, policy and legislation should be evaluated on a regular basis and amended, if appropriate, to respond to changes over time or to lessons learned from the implementation of past DPM activities. Governments have not always invested in developing policy and legislation proactively in recognition of their responsibility for DPM; they have then been required to respond reactively

¹⁰ This definition is provided by *Oxford Dictionary Online*.

to disease outbreaks, non-epidemic emergencies, perceived crises, pending international events, media and related public perceptions. Unfortunately, such reactive responses can lead to ineffective, inappropriate and often inhumane policies as they are rarely based on carefully collected and interpreted evidence.

If political will to invest in policy and legislation relating to DPM is lacking, one concept that can help with the development of policy is the One Health concept (see further discussion in section 2.5), as this inspires a comprehensive and intersectoral approach. It may require additional time to involve government ministries of health, agriculture, environment, education, the interior and others, but the resulting policy and subsequent legislation should be improved through this process. Although priority zoonotic diseases such as rabies may provide the initial inspiration for the application of the One Health approach, it can be expanded to encompass dog bites, nuisance behaviours, their impact on wildlife, farm animals, the environment and the welfare of the dogs themselves.

Additional policies exist at the regional and international levels that can inspire and motivate national policies and legislation. Regional organizations may have policies, recommendations or resolutions within particular programmes or themes that relate to DPM such as the Association of Southeast Asian Nations (ASEAN) Plus Three Emerging Infectious Diseases (EID) Programme.¹¹ There may also be regional organizations based around relevant subjects such as zoonotic diseases that relate to DPM such as the Southern and Eastern African Rabies Group (SEARG).¹² The Council of Europe has a European Convention for the Protection of Pet Animals (1987)¹³ that provides a detailed framework from which both policy and legislation can be developed at a national level. Similarly, the Australian Animal Welfare Strategy¹⁴ is for all animal caretakers and key animal sectors and is the agreed national framework for sustainable improvements in animal welfare. OIE and others have used this model to develop regional animal welfare strategies. Intergovernmental organizations may also have policies or guidelines relevant to DPM, such as chapter 7.7 of OIE's *Terrestrial animal health code on stray dog control* and the WHO Technical Report Series 931 *Expert consultation on rabies*.¹⁵ NGOs also have guidelines that can help, such as the ICAM Coalition's *Humane dog population management guidance*¹⁶ and the Blueprint for rabies control and prevention by the Partners for Rabies Prevention.¹⁷ All of these guidelines, recommendations, resolutions and policies can provide information that can help with the development of policies and legislation at local, national or regional levels. The organizations that develop these policies may also be available to help with building political will, so that communities are able to take such initiatives on board or can receive help in interpreting these documents. Again, the characteristics of the dog population in the country in question are crucial for this interpretation. There is no single policy approach that will suit all countries equally.

Education campaigns should be the principal tool to target specific human behaviour changes required for compliance with DPM policy and legislation. Veterinary practices, pet shops, shelters and dog pounds, schools, community and environmental

¹¹ Available at www.aseanplus3-eid.info/.

¹² Available at searg.info/doku.php?id=start.

¹³ Available at conventions.coe.int/Treaty/en/Treaties/Html/125.htm.

¹⁴ Available at www.australiananimalwelfare.com.au.

¹⁵ Available at apps.who.int/iris/bitstream/10665/43262/1/WHO_TRS_931_eng.pdf.

¹⁶ Available at www.icam-coalition.org/.

¹⁷ Available at www.rabiesblueprint.com.

health schemes, and urban planners are just some of the vehicles available for educational information dissemination on the requirements of a good dog owner. Resources that provide an explanation of relevant legislation and requirements in clear and simple language suitable for a public audience are essential to guarantee long-term behavioural changes. Translating legislative ordinances to actual behaviour can be supported by clear guidelines such as codes of practice (COP). These can be used to define the behaviours inherent in responsible ownership by outlining what minimum and ideal care dog owners, breeding establishments, shelters and pounds should provide. Standard operating procedures (SOPs) may be more suitable for professionals engaged in DPM, especially where their actions are covered in the legislation.

The EU based “CARODOG” website (www.carodog.eu) is furthermore playing an important role in promoting responsible dog ownership and directly contributing to the protection of companion animals.

3.6. DPM IMPLEMENTATION

By following a process of initial assessment, learning from past and current examples of DPM, and by developing relevant policies and legislation, a comprehensive programme will emerge which will include a number of tools. Tools should be selected to identify and address root causes of the dog population problem and to bring dog populations under control in a humane way. The following are a list of some of the tools that may be selected. The list is not exhaustive and is not a recipe for successful DPM; rather, it provides examples of those tools that are commonly used. It should be noted that education of dog owners and relevant professionals is extremely important for any DPM programme. These issues are tackled in the next section on education and capacity building.

3.6.1. Dog registration, identification and traceability

A comprehensive registration system should provide a system of returning lost or stolen dogs, instilling a sense of responsibility towards individual animals and creating a clear and irrefutable link between a specific animal and its owner in cases of enforcing legislation. If the collected data are adequately detailed, some measure of change can be determined in the registered dog population including age, breed and status and applied to key veterinary measures such as vaccination and neutering. However, to achieve such a comprehensive system, the following three pillars are required (Trautman, 2008):

- identification of the animals;
- registration of the premises where animals are held;
- recording of the animals’ movements from birth to death (up-to-date database).

If linked to a licensing fee, a registration system can also provide an income for DPM activities and the opportunity to offer incentives for certain behaviours, such as neutering.

Dog identification is an important challenge and should be distinguished from marking. Identification should be specific to the individual animal, while marking will indicate if an animal belongs to a particular population (e.g. ear-notching of dogs sterilized through a particular project). Tattooing and tags on collars are traditional methods of identification; however, microchips are becoming more common

Case study: Example of DPM codes of practice (COP): the code of welfare for dogs in New Zealand

The Animal Welfare Act 1999 (the Act) in New Zealand imposes obligations on every person who owns or is in charge of dogs. This code has been issued following section 75 of the Act and provides guidance on how to comply with the legislative requirements. However, this code does not provide an exhaustive list of the Act's requirements, and owners and those in charge of dogs must comply with the minimum standards in this code and the general provisions in the Act. The code applies to all persons responsible for the welfare of dogs, including dog breeders, those who show dogs, keep dogs as companions (pets), and those who use dogs for sport, as working animals or for any other reason. The code provides general information, minimum standards and recommendations for best practice under each type of important dog-related behaviour, from purchasing or adopting a dog through to specific behaviours such as exercise, preventing infectious disease or euthanasia. Failure to meet a minimum standard in this code may be used as evidence to support a prosecution for an offence under the Animal Welfare Act. However, the code was also designed as an educational tool following the concept of "education first and compliance will follow". Hence, the recommendations for best practices in this code have no legal effect and are included to encourage higher standards of animal welfare. (Amended from www.biosecurity.govt.nz/animal-welfare/codes/dogs).

Case study: Example of DPM standard operating procedures (SOPs): ABC in India

The SOPs for implementation of ABC projects have been developed as a manual by the Animal Welfare Board of India to ensure that uniform and professional standards of care are provided to the stray dogs in the country undergoing ABC. Detailed guidelines on all aspects of the ABC project have been provided in this manual. It is mandatory that all animal welfare organizations in the country implementing ABC projects follow the SOPs. Techniques for humane catching and transportation of stray dogs, identification methods and record-keeping are covered in great detail. The manual provides in-depth information on basic infrastructure that all animal welfare organizations running ABC projects should have. It also gives clear instructions on the anaesthetic protocols and pre- and post-operative care to be followed by veterinary surgeons. (Adapted from the SOPs for the sterilization of stray dogs in the ABC programme available on www.awbi.org/).

as this method is permanent, relatively easy and painless to apply, and provides the opportunity to identify a large number of individuals. Costs and the need for compatible microchip reading instruments should be considered.

The registration system holds the identification codes along with associated owner information to allow for traceability. Traceability is the ability to trace an

animal back to its rightful owner. Ideally, national databases are used where all registration information is held in one place; however, if multiple databases exist, linking databases needs to be considered. Where animals are moved across borders, regional databases should be used that are linked to national databases.

Maintaining accurate registration information, such as up-to-date addresses and telephone numbers of dog owners remains a challenge once identification and registration have been addressed. Two broad approaches may be considered: making updating information as easy as possible and/or making it compulsory; and expanding the range of professionals that can update information to include private veterinarians and shelter staff in addition to government authorities may ease the procedure. Moreover, laws can be introduced that make updating registration information compulsory with fines for failing to do so. One benefit of annual dog-owning licensing fees may be to encourage verification of registration at least once a year.

It should be a government's responsibility to introduce such systems comprehensively, and preferably nationally, including widespread education on procedures, benefits and any related legislation. It should also offer incentives and subsidize services, if needed (e.g. for elderly owners, assistance dogs). The introduction of such a system should be undertaken carefully and strategically with prior planning and consultation to avoid an expensive exercise with limited benefits.

Appreciation of the concept of dog registration and the ease of implementation will depend very much on the country in question. Countries that have successful DPM commonly also have functioning registration, identification and traceability systems, as denoted by low or no stray dogs reported in the *Stray animal control practices in Europe* (Tasker, 2007).¹⁸ What remains to be ascertained is whether the registration system leads to successful management, or whether management has to be developed to a certain level before a registration system can be successfully implemented. Is the concept of registration of property or personal status with the government a common and accepted practice? The local culture and the attitude towards dog ownership will also impact the success of an animal registration scheme. In some countries, community dogs are an accepted population of animals that are managed *in situ* (e.g. ABC projects in India). Whether these dogs should or should not be included in a registration scheme will depend on the willingness of dog owners to respond to the burden of identification and registration in places where roaming dogs are accepted in their locality. In short, a registration system may not be suitable in all circumstances, and the implementation and design of such a scheme needs to fit the local characteristics.

Research gaps that were identified by the experts included the need for developing additional methods of marking or identification. Although microchips offer permanent identification, they are neither visible nor necessarily affordable for many dog owners, implying that there is a need for permanent (or at least long-term) visible marking or identification that is affordable and can be applied in a humane way without anaesthetics.

¹⁸ Available at www.rspca.org.uk/ImageLocator/LocateAsset?asset=document&assetId=1232711401369&mode=prd.

Best experience: Implementation of an innovative Web-based dog registry, in the Molise region (Italy)

In the European Union (EU), dog identification is compulsory for animals travelling beyond national borders (Reg 998/2003). At present, however, there are no communitarian regulations providing for dog registration, as this is only foreseen at a national level in some countries. In Italy, since 1991, law provides for the institution of regional dog registries. Additional norms for the management of companion animal populations were codified later on, providing for compulsory microchipping, the computerization of the regional dog registries and the establishment of a national database. Nevertheless, there is a problem in terms of the multiplicity of the databases because of a lack of communication between regional registries.

The Molise region recently amended a regional law in which innovative tools were presented to manage the regional dog register. IZSAM, given its consolidated competency in relation to the National Animal Identification and Registration System, has been asked to develop a new computerized system. They have generated a Web-based computerized data system, allowing for the standardization of operational procedures at regional level that guarantees a common and structured dataset. Furthermore, this system enables the updating of the National Dog Register, ensuring traceability at a national level.

Some of the innovative features of this system are:

- *multi-level accessibility which permits access to the system via one of the main commercial browsers and through a Web client, to regional, public and private veterinarians, allowing for different levels of actions depending on their respective specific roles;*
- *completeness of the datasets which allows data concerning each dog to be reported including the dog's date of birth, sex, breed, coat colour, microchip number, animal picture, date of death; the owner (name, address, etc.); and a list of all animal facilities in the territory, including sanitary kennels and long-term shelters, as well as public and private veterinary facilities;*
- *a lost and found tool that makes it possible to report lost and found animals, allowing public and private veterinarians to have an overview of the situation on the territory in real time;*
- *the ability to use SMS to consult the database and retrieve information about a dog; a text sent to the system with the animal's microchip code will generate an SMS answer with all the available data concerning that dog.*

This easy-to-use infrastructure allows the exchange of data via the Web with already existing applications, without having to modify pre-existing systems. As multiple Web services can be connected together to create an integrated and complete service, this approach could be the answer to consolidating all existing data and allowing for better traceability at national and international levels without considerable additional costs linked to revamping pre-existing systems.

3.6.2. Dog catching, handling and removal

Most DPM programmes require that roaming dogs be captured, handled and removed from the capture site, even if only temporarily. Depending on the location and the dog itself, the next stage after removal may involve attempting to reunite the dog with its owner, rehoming/adoption, vaccination and immediate release, or sterilization and vaccination followed by return to the local community (or the point of capture). If the dog is sick or cannot be rehomed or returned for other reasons, euthanasia may need to be considered. In any case, the process of catching, handling and removal of the animal will have a significant impact on the dog's welfare.

People tasked with performing dog management activities present a further challenge. In some countries, an Animal Control Officer (ACO)¹⁹ is a member of a recognized profession that has an identifiable skill set and standardized training. However, in other countries this role is not considered a profession. There is limited training or support for these individuals and they tend to engage in these activities due to a lack of alternatives. As a result, they may have very limited knowledge of animal welfare or the humane or safe handling of dogs, leading to poor capture and handling techniques, and avoidance of interaction with the public. These visibly poor techniques can lead to a negative image of the authorities and animosity towards the persons directly involved with DPM, which may lead to a loss of credibility of the involved authorities and their management programme. This perception can have a detrimental impact on the kinds of public partnerships that are essential for effective and sustained improvement in dog management (Garcia, 2005; Instituto Técnico de Educação e Controle Animal (ITEC), 2007).

In recognition of their importance, management programmes should invest in ACOs and provide suitable training and support. They should also include suitable health care such as pre-exposure vaccination, which should be mandatory and provided free to ACOs in rabies-endemic countries or to those who are likely to come into contact with dogs potentially carrying rabies. There may also be a need to invest in developing this profession in the long term, including the creation of standards, recognized training and professional development, and a salary, uniform and job title to reflect their role and status. ACOs, along with veterinarians, are often considered the 'front line' of DPM and have the most frequent and influential interactions with the public.

The process of dog catching and handling should seek to minimize stress caused to the dogs, while protecting the health and safety of the staff and public involved. Humane handling (also known as 'ethological' handling) is defined as causing the minimum amount of stress possible during the procedure to both the animal and the people involved. In order to achieve humane handling, the individual dog's behaviour and the immediate environment need to be taken into account. In addition, suitable equipment and techniques need to be selected and used for catching, restraint and, if needed, transportation. (Calderón Maldonado, 2005; ITEC, 2009). Interactions with dog owners and the public will be necessary to ensure that they understand the programme and, when appropriate, will be directly involved in it. The response of owners and the public may have a significant impact on what will happen to the dog, and whether it should be taken away or not. For example, once

¹⁹ There are many terms used for the role of ACO, including Animal Welfare Officer, Dog Warden, or dog handler or vaccinator.

the ownership of a particular dog is established, the owner should be encouraged to take responsibility for the next stage, whether it involves vaccination, sterilization or more effective confinement; this will encourage the development of responsible ownership and reduce the burden on the ACO. Dog ‘management zones’, within which accepted groups of roaming dogs are managed *in situ*, provide another means of involving owners and local communities in management decisions; (see the case study that follows for more information).

In some countries, killing removed dogs is perceived as sufficient for dog control. In others, dogs are not caught or removed before killing, but killed *in situ*, commonly by poisons, such as strychnine, or by shooting. It has been estimated that 65 percent of countries use some form of inhumane method of killing dogs (WSPA, 2011). The assembled experts concluded that the use of inhumane killing methods (defined by Chapter 7.7, article 7.7.6, paragraph 11 of OIE’s *Terrestrial animal health code*) is ethically unacceptable, and that both indiscriminate killing and population level killing of dogs is ineffective as a means of population management. Indiscriminate, population-level killing is an ineffective tool to control dog populations and/or zoonotic diseases such as rabies because ‘culled’ populations tend to replenish themselves rapidly due to relatively high reproductive potential and rapid immigration from surrounding areas (WHO and WSPA, 1990). Any temporary reduction in population levels will be compensated by increased reproduction and survival rates among those dogs remaining. According to Beck (1973, 1975) and Fox *et al.* (1975), when roaming dogs are removed from a population, the life expectancies of survivors increase due to increased availability of food and shelter resources as a result of less competition. Many studies on cat and dog populations in developing countries have shown that these populations present high replacement rates, low average age and life expectancies, and high rates of fertility, mortality and reproduction (Beran, 1982).

Research needs that were identified by the experts included the need for new methods of humane capture, especially for those dogs that are not used to being handled or approached by humans. These might take the form of a quick-acting drug or drugs that can be ingested in bait and lead to temporary unconsciousness with minimal side-effects.

3.6.3. Euthanasia

While the indiscriminate or population-level killing of dogs was considered ineffective and unacceptable, the experts noted that, ideally, no healthy animal should be killed, but that euthanasia of individual dogs may be necessary once all other practicable alternatives, such as rehoming or managing dog populations *in situ* using CNR, have been carefully considered and excluded. Furthermore, the euthanasia of healthy animals was not considered an acceptable long-term solution as it does not address the root cause of the problem, nor does it identify where these dogs are coming from; hence, every effort should be made to reduce and eliminate the need for euthanasia of healthy animals. It should be noted that euthanasia of sick animals where treatment is not possible or practicable should be performed and is considered an important component of protecting animal welfare. The euthanasia of healthy animals may also send the wrong message to the public that this is a simple solution to the problem, encouraging disposability or disrespect for animal

Case study: Example of Animal Control Officer (ACO) training in Brazil run by Instituto Técnico de Educação e Controle Animal (ITEC)

In 2004, ITEC launched the Animal Control Officer Course (Curso FOCA; see www.itecbr.org/index.php?option=com_content&view=article&id=56&Itemid=66) designed for ACOs and veterinarians working for Brazilian authorities responsible for DPM. The course highlights the importance of changing the image of these professionals, providing an environment that enables participants to become health promoters, educators, friends of the animals and partners of the community (i.e. the definition of an ACO).

The FOCA course has three main objectives: to enable the use of ethology in the management of all activities pursued by zoonoses and animal control services; to enable the implementation of effective actions for the control of dog and cat populations, to comply with technical, rational and ethical ordinances in light of community welfare; and to instruct and sensitize participants to promote overall health in their municipalities by developing effective and successful programmes on dog and cat population control and the zoonoses they can transmit (ITEC, 2008).

Post-course evaluations revealed the following: 56 percent of municipalities reported an improvement in their relationship with the public; in 77.8 percent of municipalities, humane or 'ethological' handling was adopted for the removal of animals on the streets; 66.7 percent of municipalities initiated selective removal based on community responses and the status of individual animals rather than removing all dogs; 97 percent of the participants reported changes in their attitude towards animals and the public. For example, one ACO stated, "now, the population respects us", and another, that "I learned that it is possible to work in animal control with ethics and respect" (ITEC, 2008).

lives. While euthanasia may be a simple solution for the public or dog owners who no longer want their dogs, the process of euthanizing a healthy animal is an onerous and distressing task for shelter employees. With regard to methods for euthanasia, ideally, dogs should be euthanized with intravenous pentobarbitone. However, whatever the method used, death must be immediate and with the least amount of pain and distress possible to the animal, the owner and the technician. Psychological support should be provided to professionals who deal with animal euthanasia on a frequent basis. Fractious animals should be sedated prior to euthanasia to minimize stress. Sedation of animals should be considered on a case-by-case basis prior to the administration of intra-venous or intraperitoneal pentobarbitone. Intracardiac administration causes animal suffering and can be used only on unconscious dogs. Therefore, all dogs should be fully anaesthetized prior to the administration of intracardiac pentobarbitone.

3.6.4. Holding facilities

Holding facilities for dogs can perform many functions including: reuniting dogs with their owners, rehoming unwanted dogs to new homes, housing dogs during sterilization procedures before release as part of CNR projects, and quarantining of dogs, for example, during observation for rabies symptoms. Facilities that are inadequate or provide substandard care can lead to significant animal welfare problems.

Case study: Dog managed zones (DMZs): moving from complaints to confidence in Colombo

In Colombo, the capital city of Sri Lanka, a DPM programme run by the Colombo Municipal Council (CMC) and local NGO, the Blue Paw Trust with WSPA funding, established an approach called dog managed zones (DMZs). These were specific locations where roaming dogs had become established and were causing concern, but where removal followed potentially by euthanasia due to limited rehoming capacity was not acceptable to the local culture. Hence, a programme of management was set up with the owners or workforce in these specific locations to manage the current roaming dog population in a humane way. The process includes initial assessment of the size of the dog population (and any cats) in and around the premises, waste disposal, feeding of dogs, entry/exit points for dogs, and public attitudes and behaviours towards dogs. Following agreement in the form of a memorandum of understanding (MOU) with the owners/workforce, activities begin, including sterilization, vaccination and parasite treatment, education for staff and visitors about the project and expected behaviours (such as feeding in designated areas), set up of designated feeding areas and dog-proof garbage disposal bins, monitoring of DMZs monthly including any new arrivals, and visually rewarding and promoting success.

This novel approach has been trialled successfully in six locations, leading to a healthier and non-reproductive population of roaming dogs that will decline over time through natural attrition if entry of new individuals is prevented. It minimizes conflict with people, especially around garbage points, improves human health due to regular vaccination/parasite treatment and allows for continued feeding of dogs in designated areas by those people who value this interaction; all with maximum involvement of the owners and workforce at these locations.

Number of roaming dogs in six DMZs

Location of DMZ	2008	2009	2010
Maternity hospital	2	8	3
Government printer	9	8	8
Defense college		15	5
Taj hotel		4	5
Kannangara school		3	3
Children's hospital			9

They are also costly to run and should not be embarked upon unless the benefits are assessed to outweigh the costs, and the financial resources are clearly available for the long term. Holding facilities are not a recommended solution for long-term population management and ideally dogs should only be sheltered for short-term management, allowing for reclaiming, adoption or return; hence, the use of the term 'holding facilities' for this section as opposed to 'shelters' or 'sanctuaries' which are terms that tend to be used for facilities that aim to provide lifelong care.

Maintaining dogs with a reasonable standard of welfare during their stay at a holding facility requires good levels of care and facility management. There are

several texts available that provide advice on standards that should be maintained, including the Royal Society for the Protection of Animal's (RSPCA's) *International guidelines for the design and management of animal shelters*²⁰ and the Association of Shelter Veterinarians 2010 guidelines for standards of care in animal shelters.²¹ In addition, it is the responsibility of the holding facility, and any governing body overseeing the facility, such as the local authority, to ensure that the welfare of animals within the facility is monitored, preferably using an objective assessment of welfare such as the Five Freedoms²² as a framework. Where animals are identified to be in a poor state of welfare, action must be taken. Any holding facility should have a clear policy on animal euthanasia, including criteria defining when it is needed and policies in place that ensure that animals are not left to suffer. It was noted that challenges of holding facilities around the world include the lack of standardized guidance on how to recognize animals that are suffering along with barriers to the use of euthanasia when it is needed.

The standard of care and management of facilities are relevant for the animals that are currently in a facility, but it is also important that these facilities have policies in place related to the reception of dogs ('intake') and removal of dogs from the facility ('output'). Policies relating to intake will be significantly affected by who runs the facility and their responsibilities. Government or municipally-owned or funded facilities may be required by law to receive all dogs, while facilities run by NGOs or volunteers may determine their own objectives – usually to promote animal welfare. Output policies will be affected by intake policies and vice versa. Potentially the most significant difference in the output policies will be whether healthy animals are euthanized or not and whether 'unowned' dogs can be legally or ethically placed back on the streets. Where a facility is required to accept all dogs, they may not have the capacity to fulfil these obligations without euthanizing healthy animals.²³ Depending on the culture, religion or focus of a facility, euthanasia of healthy animals may be deemed unacceptable and intake of new animals beyond holding capacity may be restricted. This conscious decision to restrict intake in order to prevent euthanasia of healthy animals protects the lives of the current population in any facility, but may diminish the impact the facility will have on the rest of the unwanted or roaming dog population that are refused entry.

DPM strategies in a community or city can directly affect the policies of a shelter (intake and output). If there are DPM strategies in place for birth control, education, registration and the social participation of stakeholders, the policies of a shelter regarding the requirements for accepting animals can be better managed than when those policies are lacking and a shelter is the only available option. Instituting access to basic health care for dogs can help to decrease the number of abandoned animals. Private veterinarians and veterinary schools could also become involved. Other relevant output policies will include the adoption process. The process of selecting potential adopters and matching dogs to them can improve chances of the dog staying in the new home. Selection criteria should be carefully developed and applied. Some shelters use adoption coordinators and trainers who work with the dogs and those who come to adopt them. While this incurs obvious costs, it can

²⁰ Available at www.icam-coalition.org/resources.html.

²¹ Available at www.sheltervet.org/.

²² Available at www.wspa.ca/food/The-five-freedoms.aspx.

²³ There may be statutory holding periods for healthy animals before euthanasia can be performed.

significantly increase successful rehoming rates. Also, investing in staff who work regularly with dog training, socializing and grooming can also have a positive influence on the potential for successful rehoming. For many developing countries, there is a need to build the interest and acceptability of dog adoption, as this may be a new concept. In addition, there may be a need to promote 'local' dogs which will tend to predominate in the facility but may be perceived as lower in value compared with imported breeds, despite their potentially improved suitability to local conditions. It is recommended that dogs for adoption be sterilized, vaccinated and treated for internal and external parasites prior to adoption. Dogs should also be microchipped whenever this form of identification and registration is used. There may be cases where sterilization is not possible before adoption; in which case, robust follow-up systems should be used to ensure this is done following adoption.

Case study: Holding facilities: just one tool in the toolbox – an example from the United States of America

It is estimated that three to four million dogs and cats are euthanized in shelters in the United States of America every year and that 56 percent of dogs that enter shelters are euthanized (National Council on pet population study and policy; available at www.petpopulation.org). However, the decline in euthanasia has been significant, with nearly 15 million animals euthanized per year in the 1970s (Scarlett, 2004). This reduction in the numbers of animals euthanized has been helped by the increase in adoption and reunion of animals with their owners assisted by the large number of government, NGO and private holding facilities, but it has also been supported by an increase in spaying and neutering of dogs, educational programmes to promote responsible ownership and dog registration systems that reduce intake. Further reductions in rates of euthanasia will require maintenance of successful interventions, as well as the identification of the source of those dogs that continue to be euthanized so as to devise targeted interventions aimed at these specific populations.

3.6.5. Reproduction control in dogs

Dog reproduction control should be part of every DPM programme. It should be carried out along with other strategies such as registration and identification of dogs, movement control, education and social participation.

The aim of controlling or preventing reproduction in dogs is to reduce the population of unwanted animals humanely. A range of methods that can be used includes surgical sterilization, chemical or immunological sterilization or contraception, and confinement during oestrus.

A number of challenges were identified for the successful implementation of reproduction control around the world, particularly in the developing world. These challenges include the lack of suitably trained staff, poor techniques that endanger animal welfare, no or poorly enforced regulation of veterinary procedures such as insufficient anaesthesia during surgery and the use of inappropriate operating techniques, insufficiently sterilized instruments and material bringing about infection, and post-surgical complications. Furthermore, often only limited infrastructure is

available to carry out reproduction control along with limited access to the required medicines. Dog owners and carers, too, often struggle to access or afford reproduction control services. In some countries there may be cultural barriers to sterilizing dogs, especially male dogs, due to beliefs about the animal's 'right to breed', concerns that sterilization will alter desirable behaviour such as guarding or hunting, or simply because people fear this is an unsafe or painful procedure.

Despite these challenges there are significant opportunities to improve reproduction control. Both national and regional veterinary associations have the opportunity to develop standards, protocols and regulations for all aspects of reproduction control, including anaesthesia, analgesia, procedures to ensure asepsis, clinical examination before reproduction control, and monitoring during and post-operatively, or post-treatment if using non-surgical methods. There are protocols already available that can provide the foundation for national standards and protocols, such as the International Fund for Animal Welfare's (IFAW's) *Companion animal field manual; primary veterinary health care standards*.²⁴ There are also opportunities to develop training programmes for veterinarians, veterinary students and veterinary nursing staff in collaboration with NGOs that focus on improving veterinary capacity such as Worldwide Veterinary Service, Vets Without Borders and Vets Beyond Borders, or through OIE's global Performance of Veterinary Services programme. It is important that this training also include aspects of animal welfare and the wider implications of DPM to ensure that reproduction control is performed humanely and takes into account how it fits as a tool within a more comprehensive programme. In the long term, such subjects should become part of the curriculum of veterinary students and veterinary nursing staff instead of being applied post-graduation when opportunities arise.

Additional options were also identified that may help improve the availability or impact of this tool when implemented:

- Early age neutering can be performed from eight weeks of age and can help to avoid unwanted first litters (see Appendix 6 of IFAW's *Companion animal field manual; primary veterinary health care standards* for more information on protocol adjustments for early age neutering). Evidence from population dynamic models suggests that reducing the average age of sterilization, as would occur if early age neutering was used, would also increase the impact of reproduction control on population growth rates (Di Nardo *et al.*, 2007). On the other hand, improving the survival of animals can be seen as an investment when this is done alongside health protective measures such as vaccination. Reproduction control is hypothesized to contribute to the survival of pups in the first period of their life and to their growth into (healthy) adult animals.
- The use of mobile or field clinics to reach geographical locations that do not have access to veterinary services locally would also benefit those communities, although the cost per animal receiving reproduction control may be higher than with stationary facilities.
- Providing additional veterinary treatments at the time of reproduction control is perceived as an efficient use of staff time and may help improve the survivability of the animals. Hence, it is recommended that rabies vaccine (and other vaccines or parasite treatments) be given in conjunction with surgical

²⁴ Available at www.fao.org/fileadmin/user_upload/animalwelfare/asset_upload_file726_61605.pdf.

(and potentially chemical or immunological) animal birth control. It is recognized that the primary aim of each tool may be different although it may be convenient to deliver both together, i.e. the vaccination may target rabies control while animal birth control may be implemented to reduce density or improve welfare.

- The delivery of reproduction control may also be an opportunity for public engagement on other issues relating to population management, including responsible dog ownership beyond reproduction control, zoonotic disease prevention options and bite prevention education.

3.6.5.1. How to deliver reproduction control

The best way to deliver reproduction control will depend on the answer to several important questions:

- Which dogs are producing the next generation of unwanted dogs?
- Are the dogs owned?
- What is the attitude towards dogs on the street?
- Who can perform sterilization? Is this done through the public sector or by private veterinarians, veterinary faculties, NGOs, etc.?
- Do the dog owners need to pay for reproduction control?

The answers to these questions will help target the reproduction control efforts to the right dogs – those that are most likely to produce the next generation of unwanted dogs – thereby efficiently using limited resources. The answers to these questions will also help determine the mode of delivery. If many of these dogs have owners, the intervention should involve them as much as possible, both to promote responsible ownership and encourage financial contributions to help sustainability. Attitudes toward dogs on the street will determine whether it is safe to release dogs back into the community following sterilization. For example, if dogs are poorly tolerated on the street then releasing them back to locations where they are unwanted would be irresponsible and could result in public perceptions that the intervention was a failure. To determine which type of intervention should be implemented, an initial study and assessment of the kind introduced earlier in sections 1.1 and 1.2 would be needed.

CNR is one option for delivering reproduction control and it has many names, including trap, neuter and release (TNR) and ABC. It involves catching free-roaming animals, sterilizing and vaccinating them, and then releasing them back to the place where they were initially caught. This approach may be suitable in locations where the following are true:

- most stray dogs are unowned or are community dogs;
- current stray dog population is a source of the next generation of stray dogs;
- the environment can support free-roaming dogs in a good state of welfare, such as in places where the traffic flow is slow or light and there are reliable food sources available;
- local people tolerate local free-roaming dogs as part of their community.

CNR can lead to a stable and healthy population of animals, if the sterilization rate is maintained at a high enough level. It can also help reduce the incidence of zoonotic diseases such as rabies when CNR includes vaccination (see the case study from Chennai); in this case, it may be termed CNVR for catch, neuter, *vaccinate*

and release. In order to be successful, support from both local communities and the government is necessary. Without such support, the safety of returned animals cannot be guaranteed. An important principle to be taken into consideration is that the welfare of every animal that is caught, sterilized and returned becomes the responsibility of the CNR project. The return of the sterilized stray animal to the streets does not signal the end of this responsibility, as the likely fate of returned animals must be considered. It should also be noted that, if possible, local communities should have substantial involvement in the process. Where dogs are considered community dogs, local people can be asked to help with catching and also postoperative care and future revaccination. This kind of involvement builds upon the basic concern and care provided by the local community and works toward responsible ownership. In order to do this, significant investment must be made in community liaison. While this approach may be more costly initially it should provide improvements in efficiency in the future by reducing the need for project staff to catch or care for dogs after sterilization.

In locations where the following is true, CNR is unlikely to be suitable and other approaches to delivering reproduction control will be needed:

- where there is indiscriminate killing of stray dogs;
- where the environment is unsuitable for stray dogs, such as urban areas with fast-flowing traffic;
- where the local community is intolerant of free-roaming dogs. Not all people like free-roaming dogs and there may be strong religious and cultural reasons for negative views towards them. Efforts should be made to educate people about the positive consequences of a CNR programme. However, the opinions of local people should be considered as they have the right to hold a view about their local environment. It is also very important to consider how local people will react to stray animals once they have been returned. Cruelty and abuse towards stray animals is an unfortunate reality that must be considered;
- where the majority of free-roaming dogs are owned dogs; reproduction control should be delivered through owner-directed services such as subsidized neutering schemes.

Where CNR is not deemed appropriate, the following are different ways that reproduction control can be delivered:

- public awareness campaigns focusing on the benefits of neutering; early age neutering can target specific age groups such as animals prior to their first oestrus, particularly if unwanted litters are most often accidental litters before owners have had their animals spayed;
- training programmes for veterinarians in fast and inexpensive sterilization techniques will reduce costs thereby encouraging owners to sterilize their animals;
- subsidized neutering services offered to owners where the cost of sterilization is causing resistance to it. Here, owners are asked to make a contribution and then one or all of the following can provide the rest of the costs: government, an NGO or a private veterinarian who performs the sterilization;
- veterinary services expanded to include outreach campaigns (i.e. mobile or temporary clinics); this can help in contexts where owners are willing to pay for sterilization of their animals, but cannot physically access services easily.

When using these alternatives, the question of what to do with unowned stray dogs will remain. It may be the case that the majority of the stray dogs are actually roaming owned dogs and that the number of unowned stray dogs is very low. Furthermore, if the breeding success of unowned dogs is very low, owned dog sterilization alone may be sufficient to cause a decrease in numbers. However, if the unowned stray dog population is significant in size and not tolerated by the public, these dogs will need to be removed (see section 3.6.2).

Case study: Catch, neuter, vaccinate, release (CNVR) in Chennai, India

In 1964, the Blue Cross of India started to test a humane approach to preventing the visible increase in the number of 'street' dogs (unowned roaming dogs) and the number of human rabies cases in Chennai (formerly Madras). This approach involved a CNR project coupled with vaccination against rabies. The programme was called the ABC project to show that the control of the street dog population was as easy as ABC. This project was started in recognition of the fact that the number of dogs killed using electrocution by the Madras Corporation had continued to rise along with the number of dogs on the street and the number of cases of human deaths by rabies.

In 1995, the Blue Cross was finally able to convince the Corporation of Madras to abandon killing and adopt ABC as an alternate strategy in a part of South Madras. Although a citywide ABC project was proposed at the time, the Corporation's commissioner asked to start the project in a limited area and then increase its scope. Within six months, results were promising enough to prompt the Corporation to extend the programme to the whole of South Madras. This extension was rapidly followed by further expansion into North Madras by People for Animals. The Corporation also converted its electrocution chamber to an ABC centre.

Chennai and Jaipur were the first cities to start sustained ABC projects that combined reproduction control delivered through CNR with rabies vaccination. The ABC project aims to stabilize and reduce the number of street dogs in a humane manner through reproduction control and to bring down the number of cases of rabies through vaccination.

3.6.5.2. Surgical options for reproduction control

All surgical methods require general anaesthesia and multimodal analgesia. Surgical castration involves surgical removal of the testicles, and may cause swelling and pain postoperatively in adult males, although such reactions are limited in young animals. Vasectomy – the cutting or tying off of the vas deferens – is an alternative for males, but dogs will maintain sex-specific behaviour after a vasectomy as the hormonal production of the testicles is unaffected. This option may not be ideal as male dogs will continue to roam the streets to find a bitch in heat, mark their territory and fight with other males.

Females may be surgically sterilized by ovariectomy (the removal of the entire reproductive tract from above the ovaries to the cervix) or ovarioectomy (the removal of ovaries only). Ovariectomy is becoming more common in the United States of America with the claim that it can be achieved through a smaller incision

than an ovariohysterectomy. Regardless of the surgical technique used, the ovaries in their entirety should be removed. Tubectomy (the tying off or cutting of the fallopian tubes or oviducts) is not recommended as the female will still be under ovarian hormonal influences and will, thus, show sexual behaviour and be at risk of pyometra (infection of the uterus).

The highest surgical standards and protocols should be adhered to, particularly given that many dogs going through a DPM programme may be in a compromised state of health and/or in a compromising environment. Surgical sterilization can only be undertaken by a qualified veterinarian and all veterinarians undertaking medical intervention, surgery and/or training are expected to practice confidently and competently, demonstrating that animals under their care do not face a higher risk of complications than what could be expected under normal circumstances. Surgery should not be considered as an option unless it can be done properly.

It is also recommended that pregnant females, where there is no practical option of rehoming the pups, should be sterilized where it is surgically safe to do so and foetuses should be euthanized. In the scenario where a bitch may be compromised by surgery, it may be preferable to allow her to go to full term and then humanely euthanize the pups at birth, if there is no option of adoption.

3.6.5.3. Non-surgical options for reproduction control

Reproduction control utilizing chemical or immunological routes could offer a humane and less expensive alternative to surgical sterilization. Contraceptives that are increasingly used to control overabundant wildlife could also be employed to manage dog populations (Gupta and Bansal, 2010; McLaughlin and Aitken, 2010). A non-surgical reproduction control approach suitable for large-scale DPM should have the following characteristics: it renders a high proportion of animals infertile for at least two to three years after administration of a single dose; it has no or minimal negative side-effects; it targets females but can also be effective on males; and it is relatively inexpensive to produce.

Many of the contraceptives currently available for companion and zoo animals are either too expensive to be used on a large scale, or require a primer dose followed by one or more boosters at specific intervals, which makes them unsuitable for large-scale DPM programmes. However, there is significant research underway and progress looks promising (Cathey and Memon, 2010). The Alliance for the Contraception of Cats and Dogs Web site provides a description of the Michelson US\$75 million grant and prize money initiative, which has helped to fuel a recent increase in research in this area.²⁵ The development of the immunocontraceptive option of a GnRH vaccine is also promising.

There are a few non-surgical options for reproduction control currently available for dogs. The more inexpensive products include hormonal injections (progestins) and injectable chemical castration (e.g. Esterisol™ or Zeuterin™). It is recommended that hormones should not be used to prevent more than one oestrus cycle due to increased risks of side-effects, and these products should only be administered under veterinary supervision, allowing for clinical examination to ensure each individual dog is a suitable candidate (Romagnoli and Concannon, 2003). Chemical castration can be used as an alternative tool to female surgical sterilization as it may

²⁵ Available at michelson.foundanimals.org/michelson-grants.

be faster and cheaper to administer. It also may be more acceptable to some dog owners as male sexual behaviours are retained and testicles are still visibly intact. However, this method requires post-treatment supervision to ensure a timely response to any side-effects and, if used alone, may not significantly impact population growth as fertile females are assumed to be the limiting factor.

There are several mass vaccination and/or mass reproduction control projects currently in place that could easily adopt non-surgical approaches as these become available. The assembled experts noted that research to find reliable, safe, effective and affordable non-surgical reproduction control is required and current endeavours in this field are to be commended and supported.

3.6.5.4. Research needs for reproduction control

Additional research needs related to reproduction control in general were also identified, including:

- the need for development of improved identification or marking methods for dogs that have received reproduction control; ideally, these should be visible, permanent and applied without the need for anaesthesia;
- the effect of gender selection for sterilization on population dynamics;
- the impact of reproduction control movement of dogs into the population, whether this be due to people acquiring new dogs or dog-mediate immigration into the population;
- the impact of reproduction control on dog behaviour;
- the role of reproduction control in disease transmission, particularly in terms of its effect on population turnover and the reduction of pups, which may be a high-risk group for disease transmission.

4. Capacity development

4.1. INTRODUCTION

DPM requires the combined and coordinated actions of a range of stakeholders to be effective. This chapter considers what the various stakeholders require to create political will, to train field staff and to improve responsible dog ownership. The United Nations Development Programme (UNDP) defines capacity as “the ability of individuals, institutions and societies to perform functions, solve problems, and set and achieve objectives in a sustainable manner”. Capacity development at the individual level requires the development of conditions that allow an individual to build and enhance existing knowledge and skills. It also calls for the establishment of conditions that will allow individuals to engage in the “process of learning and adapting to change”. At an institutional level, capacity development should involve modernizing institutions and supporting them in forming sound policies, organizational structures and effective methods of management and revenue control. Finally, at the societal level, capacity development should support the establishment of a more interactive public administration that learns equally from its actions and from the feedback it receives from the population at large.

4.2. POLITICIANS AND POLICY-MAKERS

Advocacy should address politicians, policy-makers and competent authorities²⁶ to raise their awareness and sensitivity to DPM problems and solutions and, subsequently, lead to change in policy and/or practice. Politicians should seek expertise on DPM with reference to the needs and wants of their local community, developing a DPM solution that is suitable to their locality and is in line with international regulations. They should use media to convey the appropriate messages to support this solution. Policy-makers would benefit from the development of an intersectoral committee that can consult on DPM so as to advise politicians and support their actions. Policy-makers may also be responsible for developing legislation on DPM and directing government resources to invest in DPM solutions. Intersectoral committees can help inform these actions. Ideally, the actions of these stakeholders should be transparent and accountable to the public.

A potential challenge is that politicians only have power for their elected terms, and are very sensitive to media and public opinion. This reality can lead to expedited decisions. The involvement of civil servants who generally maintain their positions across election periods, can contribute to the implementation of more sustainable interventions.

Advocacy targeted at politicians and policy-makers may take the following broad steps, finally leading to appropriate action on DPM:

- identify government agencies that have principal responsibility for DPM; (where there is no existing agency, central governments should be encouraged to allocate responsibilities appropriately);

²⁶ A competent authority is any person or organization that has the legally delegated or invested authority, capacity or power to perform a designated function.

- use appropriate strategies to bring DPM to the attention of politicians, civil servants and decision-makers (e.g. various ‘entry points’ include: public health, cost savings, vote-winning, ethical/animal welfare/social responsibility arguments, international pressure);
- identify all the DPM stakeholders and create a permanent national or regional committee comprising appropriate representatives from these stakeholder groups;
- develop and coordinate DPM strategies, and identify capacity-building needs, including institutional development, legislation and human resource development.

4.3. DPM PROFESSIONALS

Implementation of DPM requires a range of professionals including dog handlers, ACOs (responsible for enforcement and education), shelter operators, veterinarians and veterinary technicians. These professionals may be government employees, private individuals or employed by an NGO. These professions may also be combined; for example, dog handlers who are also veterinary technicians.

Common problems among animal health professionals, particularly in developing countries, include an absence of understanding of DPM, the perception that DPM is work of low value, resulting in a lack of professional pride and rigid professional hierarchies that inhibit peer discussion or criticism (particularly in Asia).

Despite these difficulties, DPM professionals can develop pride in their work and be appreciated for the important contribution they make to public health. This appreciation can be supported by proper remuneration for their work, positive working conditions in which they are not only provided with proper uniforms, facilities and equipment, but are encouraged to express ideas, concerns and opinions in order to improve the impact of the DPM programme.

Ideally, all such professionals should be provided with formal training in order to achieve qualifications prior to working professionally. They should be required to meet agreed standards that reflect best practices; hence, establishing all DPM personnel as skilled and respected professionals. Where formal training is not currently available, training programmes can be developed to raise abilities or skills to the required standard. It is advisable, however, that these training programmes adopt a ‘train the trainers’ approach to expand coverage and invest in future training capacity; moreover, these should be implemented with the goal of establishing formal training and qualification programmes. Where this cannot be achieved, the programme itself should be modified to avoid compromising standards or the quality of animal care and welfare.

Training ACOs in developing countries may be particularly challenging as there tends to be a lack of people with the required skills and capabilities to conduct this training. Improvement in the reputation of this profession, through the development of recognized qualifications and the provision of appropriate remuneration, may help increase retention and, thus, development of experts in this field.

The meeting highlighted the need for awareness raising and capacity building on DPM for veterinarians, especially in developing countries. The following suggestions could improve the attitude and performance of veterinarians in DPM:

- expose candidates to veterinary practice as a prerequisite for entry to veterinary school;
- include companion animal medicine in the curriculum (often only production medicine is taught in veterinary schools in developing countries);
- improve the relevance of the veterinary curriculum/training standards by including animal welfare, DPM and public health components, including shelter medicine;
- develop mandatory continuing professional development for veterinarians and veterinary para-professionals;
- foster involvement or exposure to international fora, such as international Web sites, exchanges, conferences and externships.

Box 2. Available educational resources to build the capacity of professionals in DPM

The RSPCA International's Operational guidance for dog-control staff provides directions on humane methods to capture and hold animals.

- *WSPA Companion and Working Animals Unit's Surveying roaming dog populations: guidelines on methodology provides an excellent resource for establishing a system for efficiently and consistently counting a population of dogs.*
- *AMMRIC have produced a number of tools for professionals including, in collaboration with IFAW, Conducting dog health programs in indigenous communities – a veterinary guide as well as an environmental health practitioners' guide, Dog health – programs in indigenous communities that covers everything from planning a programme, common diseases, local laws, birth control and desexing, through to running a pound. In 2009, with funding from the Australian Animal Welfare Strategy, they produced a DVD as an educational resource for professionals that could also be used in aboriginal communities about the importance of looking after dogs, people, and country and environmental health.*

4.4. DOG OWNERS AND CHILDREN

The most effective form of DPM is for all dogs to be responsibly owned; hence, the actions of dog owners are of key importance and should be a central focus of DPM programmes. Responsible dog ownership involves the following key points:

- meeting the dog's basic needs including food, water, shelter and expression of natural behaviours, including social needs;
- practising preventive health care, in particular, for infectious diseases and parasites that are zoonotic or transmissible between dogs (e.g. vaccination against rabies and other diseases; regular deworming; prevention of echinococcosis by not feeding dogs uncooked offal; application of repellents or repellent collars to prevent tick-borne or insect-transmitted diseases, including leishmaniasis);
- seeking prompt treatment if a dog is sick or wounded;
- recognizing the lifelong commitment and cost of caring for a dog so that acquisition is a serious consideration and the right dog is chosen carefully.

The following aspects of dog ownership will vary with location:

- confinement and supervision of dogs when outside the household. While confinement and supervision will be required for many countries, permanent confinement in kennels and tethering is not acceptable. Dog-proof fencing is ideal for confining dogs. Where roaming dogs are tolerated, owners need to minimize risks to the community through preventive health care for their dogs and they need to accept responsibility when hazards are caused by their animal;
- identification and registration of dogs when systems are available;
- responsibility over community dogs to allow for the progression from compassion to actual responsible ownership action;
- inclusion of dogs in emergency preparedness and response;
- feeding of free-roaming dogs. If stopping the feeding of free-roaming dogs is not realistic due to the reliance of dogs on this resource or the psychological need for people to feed dogs, ask them, instead, to feed free-roaming dogs in designated areas to reduce conflict with other people.

Irresponsible dog ownership may occur where owners have little or incorrect perceptions of the needs of dogs, or where dogs have little value and are provided with minimal care. Education campaigns can be used to inform owners of the needs and required care of their animals, and to frame responsible dog ownership as an important contribution to societal health and well-being. Children are a particularly important target group due to their significant involvement in acquiring dogs and in providing for their care, but also given their vulnerability to dog bites.

Case study: Integrating messages into school curricula,
Victorian Department of Primary Industries, Australia

The Victorian Department of Primary Industries' Responsible Pet Ownership Education Program caters to three target audiences: primary school children, preschool children (and their parents), and prospective and new parents. The School Visitation Program, implemented in thousands of Victorian primary schools, has educated more than one million children. The program offers free visits by trained pet educators and their temperament-tested pets. Visits cover the concepts of choosing a pet, registration, pet housing and husbandry, and, in particular, safety around dogs in order to prevent dog attacks. Research showing that children under five years of age are at particular risk of serious dog attack injury initiated an extension of the School Visitation Program in 2003. The Living Safely with Dogs Program is delivered to approximately 50 000 preschool children and 18 000 parents each year. It involves educating both children and their parents about safety with dogs. The We are Family Program is a guide to nurturing the child/pet relationship. It is aimed at educating expectant and new parents on the many advantages of allowing their child to experience the joys of having a pet in the family. It also informs parents of the potential risks, and provides the knowledge and strategies to ensure that the experience is not only a physically and emotionally enriching one, but a safe one as well. For more information on these programmes see www.pets.dpi.vic.gov.au/01/main.htm.

Educational campaigns should aim to impart some knowledge to owners and children, but these ‘campaigns’ should also lead to behavioural change in the target group. The design of such campaigns would benefit from baseline KAP studies of target groups, in order to tailor messages to the most important behaviour that needs to be changed. These campaigns also need to be culturally appropriate. While campaigns in other countries can provide inspiration, they may need to be amended to work in new locations. In many situations a combination of responsible pet ownership and bite-prevention messages is recommended.

Where possible, integrating appropriate messages and educational tools into existing curricula and formal channels of education will be most relevant for reaching children. Alternatively, other available education and information channels and networks should be explored. There are many communication channels available such as television, radio and social media/networks, along with marketing by pet food companies, which often have an experienced and resourced communications team. There are also key points in a dog’s life including adoption from a shelter, neutering or vaccination when trusted professionals (i.e. shelter workers, veterinarians and public health officials) can provide advice on responsible ownership. A particularly inventive and low-cost example is the posting of rabies vaccination campaign reminders on utility bills and receipts from ATMs in Brazil. There may also be opportunities to encourage the delivery of these messages through community groups such as youth groups, women’s groups, Rotary and Lions clubs.

Messages need to be clear and preferably positive, encouraging responsible and safe behaviour without demonizing dogs. There should also be consistency between different communication channels; hence, a consultation group is advisable, where different organizations involved in educational campaigning can discuss and agree on messaging.

5. Data gaps and research needs

During the expert meeting, gaps in knowledge relating to DPM were identified and resulted in a list of research needs to address them. The aim of this list is to provide guidance on future research to ensure focus on generating and collecting the most useful and relevant data and insights.

To date, DPM has received relatively little scientific research attention. Therefore, it was recommended that a set of outcome-based multifactorial indicators be developed to help guide future research and the measures it employs. These could include indicators of the animal welfare state, zoonotic disease incidence, community satisfaction (including measures of reported nuisance behaviours) and key dog demography indicators.

Key research needs were identified to help understand the dynamics of dog populations in order to inform better management. These included basic information on dog demography (i.e. age structure, survival, fecundity) and dog ecology (i.e. dog ownership, social behaviour) in a range of locations. In particular, there was a need to identify the food source for roaming dogs, as this is often assumed to be garbage, but is rarely verified. As well, more research needs to be conducted on the underlying causes of dog aggression and, in particular, on bites of people by roaming dogs, including both the behaviour of the person that led to the bite and the reason why the dog responded aggressively.

The impact of management programmes on dog populations also requires further assessment. The following research needs were particularly emphasized:

- the impact of neutering on dog population turnover, social behaviour and movement, and whether this subsequently impacts disease transmission; in particular, an assessment needs to be done on how neutering in addition to vaccination supports rabies control;
- the impact of neutering and basic healthcare on the welfare and survival of dogs, including identifying the most common causes of mortality and whether neutering affects these;
- the impact of gender bias in neutering on dog population density; i.e. does neutering male dogs affect the reproductive potential of a population;
- the impact on communities of a sudden change in the number of puppies produced following a neutering campaign.

Data collected through research on dog population dynamics and how these are impacted by management programmes could inform and improve modelling, including providing the opportunity to test models for biological plausibility; i.e. are they an accurate representation of the ‘real world’? Including information on the economics of DPM in models would allow such tools to support decision-making in terms of financial allocations. Hence, an additional research need involves the costs of DPM and attributing financial costs and benefits of the impacts of DPM.

The need for additional or improved tools for implementation of DPM was also highlighted as an area where further research was required. Tools required include: the development of affordable non-surgical options for sterilization and contraception; improvements in surgical sterilization techniques to reduce time

and costs; and innovative methods of marking dogs non-invasively that could be used on unanesthetized dogs, for example, during vaccination, deworming or non-surgical neutering procedures.

Since responsible dog ownership and bite prevention were identified as important aspects of DPM, research needs emphasized the importance of changing human attitudes and behaviour. In particular, recommendations were made for standardized tools such as KAP studies and enhanced research into the most effective ways to create and sustain a positive change in human behaviour towards dogs.

6. Recommendations and conclusion

During the meeting, experts discussed and analysed a range of factors relevant to DPM, exploring geographical and cultural differences in dog populations and dog ownership in order to develop a global picture. Finally, they were asked to clarify key points and recommendations that are summarized in this chapter.

6.1. GENERAL RECOMMENDATIONS

Dogs have diverse functions and values in societies and any DPM programme needs to define appropriate and culturally-specific measures. The best possible outcome for animal welfare, human health and environmental health based on scientific evidence needs to be sought. As a multifactorial issue, DPM fits under the multidisciplinary umbrella concept of One Health (see section 2.5) and requires an integrated approach that incorporates animal, human and environmental components and fosters interprofessional collaboration. All relevant stakeholders should be involved in the development of comprehensive and sustainable DPM strategies that take into account country specificities and include continuous monitoring and evaluation of outcomes.

6.2. ANIMAL AND PUBLIC HEALTH

DPM plays an important role in the prevention and control of zoonoses and should follow the recommendations and standards of WHO, OIE and animal welfare organizations wherever possible. The establishment of epidemiological surveillance, laboratory networks and the strengthening of Veterinary Public Health (VPH) structures in ministries of agriculture and health are of great importance in tackling zoonotic diseases, in general, and especially diseases transmitted through dogs.

All control measures relating to dogs will require a public education component and should address environmental issues (i.e. waste management, abattoir management, integrated vector management). They should also help to establish and enforce the relevant legislation. A horizontal and integrated approach to zoonotic disease control has been recommended (e.g. as discussed during the WHO conference on community-based interventions for prevention and control of neglected zoonotic diseases²⁷). Combining control measures for several diseases, and integrating human and animal health interventions can be both more economical and more effective. For example, a combination of vaccination and deworming could be applied whenever possible within DPM to minimize the transmission of a range of pathogens.

6.2.1. Diseases of particular public health interest

The following recommendations relate to control measures for three specific diseases of public health interest. These control measures should be utilized in addition to sustainable, humane DPM, which is relevant for control of all these diseases.

²⁷ Available at whqlibdoc.who.int/publications/2011/9789241502528_eng.pdf.

6.2.1.1. Rabies

In many countries, rabies has been a driving force behind DPM and has, in some instances, resulted in the culling of dogs. However, WHO and OIE recommend the control of rabies through mass vaccination of the dog population, public awareness about rabies and the creation of appropriate infrastructure for quarantine and epidemiological surveillance. Regional and national rabies control programmes need to follow these recommendations in their design and implementation without embarking on the culling of dogs. However, the euthanasia of dogs showing signs of rabies, and unvaccinated dogs bitten or nursing from rabid dogs is recommended. All professionals, be they government or project staff or volunteers dealing with DPM should receive rabies pre-exposure prophylaxis (PreP).

Appropriate health-seeking behaviour following a potential rabies exposure is also important to the success of rabies control programmes. Hence, children (preferably through the school curriculum) and adults need to be educated to wash wounds with soap and water immediately after they are bitten, and to seek medical care. According to WHO recommended regimens, such individuals should be provided with PEP care.

6.2.1.2. Echinococcosis/hydatidosis

Echinococcosis/hydatidosis regional and national control programmes need to be designed and implemented following the WHO and OIE recommendations that aim for disease elimination in the various animal hosts. Dogs should be treated with praziquantel (PZQ) at the recommended dosage and interval regime, and faecal material should be disposed of safely. Slaughterhouse infrastructure and procedures should prevent dogs from accessing waste and should be subject to regulations to limit disease risk. The prevalence of cystic echinococcosis should be monitored in slaughtered animals, dogs and humans, and investigation should be followed by the implementation of control measures. People need to be educated regarding the importance of hand-washing, especially when in contact with dogs, to reduce health risks. Animal carcasses need to be disposed of safely and the feeding of condemned/infected offal to dogs during domestic or ritual slaughter, or by slaughterhouse employees, should be prevented.

6.2.1.3. Leishmaniasis

Countries where leishmaniasis is present need to adopt the appropriate public policies that implement prevention of the disease. Measures include the control of the insect vector, health education as well as the provision of new preventive interventions (use of dog vaccines and repellent collars) and improved diagnostic methods.

6.3. HUMAN-DOG RELATIONSHIPS

All DPM programmes should aim to foster responsible attitudes towards dogs and human-dog relationships. There should be promotion of Five Freedoms dog ownership, whereby owners provide appropriate resources to meet an animal's needs.²⁸ Ownership should take into account the local context and should support dog-keeping practices that are suitable for the dog's function and the owners' resources. DPM programmes should also increase community awareness of possible

²⁸ Available at www.fawc.org.uk/freedoms.htm.

disease risks. They should aim to increase health protective behaviours important for disease prevention (e.g. hand-washing, dog vaccination and deworming) and for healthy and safe interactions with dogs.

6.4. POLICIES AND LEGISLATION

The experts recommended that all countries have humane DPM legislation and that they regularly revise policies developed through a consultative approach with all stakeholders, taking into account past implementation results. Furthermore, it was recommended that existing and future legislation and policy covering DPM be aligned – e.g. public health, animal welfare, urban planning – using a One Health multidisciplinary approach. To support enforcement, the DPM legislation should be translated into simple layperson’s language and disseminated to all relevant stakeholders (especially the dog-owning public). The government should provide adequate resources (competent people and financial resources) to enforce DPM legislation. Policy tools that recover and direct income to support DPM, such as registration and licensing, should be encouraged. International organizations and animal welfare organizations are encouraged to develop and disseminate to governments model legislative provisions that can be adapted to the local and socio-cultural conditions.

6.5. PLANNING, MONITORING AND EVALUATING DPM

As introduced in the general recommendations, DPM programmes must be developed to suit local specificities and the desired aim. The root cause and source of abandoned dogs or dogs perceived to be suffering can be identified through dog population studies/surveys and the determination of public attitudes and dog-keeping practices. In recognition of the need for tools to explore dog populations and their owners and carers, it was recommended that a KAP template be designed and validated by social scientists.

OIE standards, OIE Regional Animal Welfare Strategy (RAWS) and ICAM Coalition guidelines were mentioned as resources to support planning of DPM programmes. Monitoring and evaluation were also highlighted as essential parts of DPM programmes in order to improve programme performance. A set of outcome-based indicators needs to be developed and validated, including both universal indicators suitable for all programmes and some contextually relevant indicators.

Communities (including representatives of dog and non-dog owners, and community leaders) need to be engaged and consulted alongside all other relevant stakeholders (including public and animal health, social, environmental, urban and rural planning representatives) in the planning, monitoring and evaluation of DPM programmes.

6.6. DOG POPULATION MODELLING

Models can offer insights when planning and resourcing an intervention strategy. However, there was agreement that there is no universal method for dog population modelling, and care must be taken with parameters and assumptions made within models. It was recommended that model outputs be compared to field data in order to test for biological plausibility before being applied to decision-making about intervention. A thorough review of existing peer-reviewed literature was recommended

to highlight problems in model validation, and to identify where research is required to provide further data to inform parameters and assumptions and, hence, improve model accuracy.

6.7. CBA OF INTERVENTIONS

CBA can be used at planning or evaluation stages to compare tools or combinations of tools in order to determine cost-effective intervention strategies. To ensure transparency and comprehensiveness of CBA, a consultative process with all relevant stakeholders is encouraged.

In recognition of the currently limited use of CBA in DPM it was recommended that a review be conducted and templates developed by academics and international organizations. To support this template development, academics, international organizations and animal welfare organizations could provide case studies where costings are available, even if these are imperfect examples requiring qualifications. It was also recommended that governments engage now in transparent CBA of DPM policies and practices.

6.8. DPM TOOLS

DPM programmes need to address root causes by using a comprehensive approach, developing evidence-based and community-supported solutions, towards aims and relevant indicators identified through a transparent and accountable process. In recognition of the need for a comprehensive approach, a number of recommendations were made for a range of tools that could be used to support the operational research of a DPM programme, producing findings that inform and improve the planning and implementation of the programme.

6.8.1. Registration and identification

Ideally, all owned dogs should be permanently marked, preferably by microchipping or, alternatively, by tattooing, or by means of a collar with a tag that is replaced if lost. The method selected will depend on resource availability, local practicalities and regulations, and community preferences. There is a need for developing further reliable and easy/painless-to-apply techniques to identify free-roaming dogs that have been part of an intervention programme.

If microchips are used, a standardized microchip system with corresponding microchip readers and national databases are required. Where cross-border movements occur, a regional database that is linked into national databases is needed. Where this option is not feasible, any dog that passes through a DPM system should be identified and recorded.

6.8.2. Access and handling

Government authorities or organizations catching dogs as part of a DPM programme, and veterinary surgeons, technicians and animal health workers in clinics, pounds and shelters are required to handle dogs on a frequent basis. These personnel and their responsible authorities must ensure that dogs are handled humanely both to safeguard animal welfare and the safety and health of personnel. In order to support animal welfare and human safety, it was recommended that all personnel be provided with suitable training, and that personnel in countries with rabies or

those who are at risk of contact with countries that have rabies should receive rabies pre-exposure vaccinations following WHO recommendations.

6.8.3. Dog removal

The use of inhumane killing methods is unacceptable (Chapter 7.7 of the OIE *Terrestrial code* provides a list of some of the methods, procedures and practices that are unacceptable on animal welfare grounds.²⁹ The indiscriminate killing of dogs is not acceptable under any circumstances, and has been proven to be ineffective as a means of reducing dog population density in the long term, and of controlling zoonotic diseases such as rabies. Handling of dogs for removal must always be done humanely.

6.8.4. Euthanasia

The experts recommended that euthanasia of sick animals where treatment is not possible or practicable should be performed without delay and be considered an important component of humane DPM. Ideally, no healthy animal should be euthanized, but euthanasia of an individual animal may be necessary once all practicable alternatives have been carefully considered and ruled out. The euthanasia of healthy animals is not considered an appropriate or acceptable long-term DPM solution, since it does not address the underlying problem of the source of the dogs. Every effort should be made to reduce and eliminate the need for the euthanasia of healthy animals.

Ideally, dogs should be euthanized with intravenous pentobarbitone. However, regardless of the method used, the dog must rapidly pass into unconsciousness followed by death and with the least possible amount of pain and distress to the animal, owner and technician. Fractious, sick or injured animals should be sedated prior to euthanasia. Sedation of animals should be considered on a case-by-case basis, but should always be used prior to the administration of intraperitoneal pentobarbitone. Dogs should be fully anaesthetized prior to the administration of intracardiac pentobarbitone.

6.8.5. Holding facilities management

Lifelong sheltering of unwanted dogs is not a solution for DPM. Ideally, dogs should only be sheltered for short-term management, allowing for reclaiming or adoption. Efforts should be made to ensure the Five Freedoms³⁰ are met for all dogs in shelters as far as is practically possible. Before dogs are adopted, it was recommended that they be dewormed, sterilized, vaccinated and microchipped. These procedures need to be ensured following adoption.

6.8.6. Reproduction control

Reproduction control was discussed as a key component of DPM programmes. There are a range of methods that can be used to control reproduction in dogs, including surgical sterilization, chemical or immunological sterilization, and humane confinement.

²⁹ For information see www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.7.7.htm.

³⁰ See the specific section in the RSPCA's *Guidelines for the design and management of animal shelters* at www.icam-coalition.org/downloads/Shelter%20guidelines.pdf.

It was recommended that rabies vaccines (and other prophylactics) be administered in conjunction with surgical (and potentially chemical or immunological) animal birth control. The primary aim of each intervention may be different although it may be convenient and cost effective to deliver both together.

Reproduction control can be implemented in a variety of ways: through fixed clinics, mobile clinics, CNR programmes, and/or low-cost or subsidized sterilization programmes for owned dogs. The most appropriate route for delivery will depend on the local context. In general, the aim will be to ensure that reproduction control can be delivered humanely and sustainably; hence, maximum owner and community involvement is desirable.³¹

6.8.6.1. Surgical sterilization

Only qualified veterinarians should undertake surgical sterilization. All veterinarians performing medical interventions, surgery and/or training are expected to practice confidently and competently. The highest surgical standards and protocols should be adhered to, particularly given that many dogs going through a DPM programme may be in a compromised state of health and/or living in a compromising environment. Surgery should not be considered as an option unless it can be performed properly.

Regardless of the surgical technique used, the ovaries in their entirety should be removed. Pregnant females should be sterilized where it is surgically safe to do so, and fetuses should be euthanized when they are found to be alive once removed. In circumstances where a bitch's health may be compromised by surgery, it may be preferable to allow her to go to full term and then humanely euthanize the pups at birth, if there is no option of adoption.

6.8.6.2. Chemical and immunological contraception/sterilization

Male sterilants and hormones used for contraception should only be administered under veterinary supervision and hormones should not be used to prevent more than one oestrus cycle. Further research is required to identify reliable, safe, effective, affordable sterilants and/or contraceptives.

6.8.6.3. Humane confinement

Ensuring that females are inaccessible to males during the oestrus period can prevent unwanted breeding. However, this option must be achieved humanely with recognition of the need to meet the Five Freedoms.

6.9. CONCLUSIONS

During the meeting, different DPM options were identified and the experts emphasized the importance of their adaptation to the local context's ethical, socio-economic, political and religious specificities.

Relevant international standards and best practices, with special emphasis on animal welfare and public health, need further dissemination and adoption. While often public health concerns are a driver for DPM, there was overall consensus that any intervention should never cause any animal to suffer. Public awareness, education

³¹ See the ICAM Coalition's *Humane dog population management guidance* for more discussion; available at www.icam-coalition.org/downloads/Humane_Dog_Population_Management_Guidance_English.pdf.

and communication on responsible dog ownership and DPM options in different contexts were discussed extensively. There was agreement that DPM requires the integration of various factors adapted to the prevailing conditions. Therefore, DPM programmes should cover a wide range of aspects starting with the analysis of the dog population that includes estimating its density or size, understanding dog-keeping practices as well as local beliefs and actions.

There is a need to involve various stakeholders in the planning and implementation of DPM. This involvement includes the engagement of professionals such as veterinarians and animal handlers who will be required for DPM implementation; hence, capacity building of these professionals will also be required. In addition, environmental management will contribute to eliminating unwanted sources of food and shelter. Registration and identification of animals, provision of animal healthcare, reproductive control, and prevention and control of zoonoses should all be an integral part of DPM. The experts further stressed the importance of finding and addressing the root causes linked to the abandonment of dogs. Root causes are likely to be founded in human behaviour and it is, therefore, important to encourage responsible dog ownership through public awareness, education and legislation.

The management of dog populations, and especially of stray and free-roaming dogs, requires political, socio-economic and humane strategies that are socially acceptable and environmentally sustainable.

The concept of a One Health approach needs to be explored as it may provide a useful angle for cross-sectoral collaboration, coordination and communication among the different stakeholders involved.

In the end, DPM is to be achieved through interventions that are acceptable and implementable leading to a harmonious coexistence of societies and their dogs.

6.10. AFTERWORD

Following the DPM meeting held in Banna in March 2011, a number of events and meetings have occurred that address this subject. Progress in DPM requires further dialogue to encourage adjustments as new insights and intervention options are generated.

The Food and Environment Research Agency (Fera) hosted **The 1st International Conference on Dog Population Management** in York, United Kingdom of Great Britain and Northern Ireland on 4-8 September 2012. The event was co-organized with WHO, OIE and the members of the ICAM Coalition.³²

The conference aimed to promote awareness of novel technologies, such as immune-contraception, vaccine delivery systems and software for DPM. It also sought to provide evidence-based information for effective, humane DPM and to promote animal and human health and well-being by reducing the incidence of zoonoses and the environmental impacts associated with dog populations.

This was the first time a scientific conference had been run on this specific subject, and it revealed a significant body of scientific research on DPM that had been relatively disparate. A key outcome was bringing together researchers from around the world to network and establish potential future collaborations. The conference brought together 170 delegates from 35 countries and 5 continents. Delegates came

³² Abstracts and presentations are available at www.dogpopulationmanagement2012.co.uk.

from the public and private sectors with representatives from industry, academia and NGOs, including ecologists, economists and specialists in animal welfare, animal health and education.

Attendees were complimentary about the learning opportunities provided by the conference, not least due to the breadth of scientific endeavor on DPM exposed through the three days of presentations and workshops. As a result, it was proposed that the conference be held once every two years to provide a regular forum for maximizing the benefits of multidisciplinary approaches to DPM.

Several presenters and attendees commented on the need for more research into ways of measuring the progress and impact of DPM; this (among other incentives) led the ICAM Coalition to invest in launching the Indicators project.

ICAM is a coalition of leading international animal welfare and health organizations that have joined forces to share learning and to develop best practice. Almost every country invests in DPM in some form; however, there is no agreed measure to establish whether an intervention is effective. The ICAM Indicators project aims to develop guidance on monitoring and evaluation of DPM that supports academics, practitioners and funders to track progress, and to learn about and subsequently improve their DPM impact through the use of measurable indicators. If we can help people to monitor effectively they could increase the rate at which they adapt and improve their work significantly. This project's goal is to apply scientific solutions to the real world problem of DPM. The scope is international, with a particular interest in underserved communities. The project began in August 2013 and will report its findings within one year.

Several **One Health meetings** have been held and this concept is being further promoted and operationalized. FAO has organized multistakeholder workshops for rabies control in Asia and Africa as well as implementing One Health community-based projects in Uganda and Sierra Leone where they have been gathering testimonials and data on the ground. Different stakeholders have been brought together, including municipalities and animal welfare organizations to discuss DPM as part of rabies control programmes.

In August 2013, the discussion on DPM intensified in Valparaiso, Chile, after one person contracted rabies following an attack by a pack of stray dogs, which resulted in two of them biting him. Although the implicated dogs have not been found, Chile is at risk of losing its canine rabies-free status, recognized by WHO in 2010. This incident has triggered a heated debate regarding the risks associated with large populations of unrestrained and unowned dogs.

In June 2013, the Alliance for the Contraception of Cats and Dogs held its 5th International symposium on non-surgical options for fertility control in companion animals. This meeting included updates on tools currently in the research phase as well as evaluation of current technologies including reports from field implementation with free-roaming dogs. The symposium audience came from a variety of backgrounds, which provided a unique opportunity for a multidisciplinary approach to this issue. A number of considerations for use of non-surgical tools were discussed. In particular, for free-roaming populations, participants considered how to identify and visually mark animals that have been non-surgically sterilized or contracepted. A summary report and the presentation of abstracts/recordings, scientific posters and related reference materials are available at www.acc-d.org/5thsymposium.

Further attention should also be given to emerging issues such as puppy-mills and increases in dog trading, especially in emerging economies and in rapidly growing urban environments.

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Annex A

8. Agenda of the meeting



Expert meeting on

DOG POPULATION MANAGEMENT

15-19 March 2011
Banna, Italy

AGENDA

Monday 14th of March

	Arrival of participants	
13:30	Light Lunch for available for guests	
18:30-18:45	Welcome message	Katinka de Balogh, Elly Hiby and Paolo Dalla Villa
18:45-19:30	Introduction of participants	Ilia Rosenthal
19:30	Dinner	

Tuesday 15th March

07:30-08.30	Breakfast	
	INTRODUCTORY SESSION	Chair: Paolo Dalla Villa
08:30-08:45	Icebreaker	Facilitator: Ilia Rosenthal
08:45-09:15	Objectives of the expert meeting and working methodology (Rules of the game)	Katinka de Balogh, Elly Hiby
09:15-09:30	Report on the FAO E-Consultation on dog population management	Daniela Battaglia
09:30-10:30	International organizations views and perspectives: - OIE - WHO - PAHO - European Commission - ICAM Coalition	Mariela Varas, Giovanna Massei, or Francois Meslin, Marco Vigilato, Andrea Gavinelli, Michelle Morters
10:30-10:45	Defining main challenges for dog population management <i>Brain-storming session</i>	Facilitator: Ilia Rosenthal
10:45-11:00	Coffee break	
	ANIMAL AND PUBLIC HEALTH SESSION	Chair: Elly Hiby
11:00-11:15	Human-dog relationships (including most successful experience)	James Serpell
11:15-11:30	The role of dog population management in the prevention and control of zoonotic diseases (including most successful experience)	Malika Kachani

11:30-11:45	The role of dog population management in the prevention and control of rabies (including most successful experience)	Alexander Wandeler
11:45-12:30	Discussion	
12:30-14:00	Lunch	
14:00-14:30	Most successful experiences: - OIE - WHO - PAHO	Facilitator: Illia Rosenthal
14:30-14:45	Discussion	
14:45-15:45	Group session to identify challenges, gaps, research needs and, policy options, etc. to address animal and public health issues	Facilitators: Illia Rosenthal, Daniela Battaglia, Paolo Dalla Villa
15:45-16:00	Tea Break	
16:00-16:30	<i>Group session to identify challenges, gaps, research needs and, policy options, etc. to address animal and public health issues (continued)</i>	
16:30-17:30	Plenary session	
19:30	Drinks & Dinner	

Wednesday 16th of March

07:30-08:30	Breakfast	
08:30-08:40	Recapitulation of previous day	Elly Hiby
	DOG POPULATION MANAGEMENT PLANNING SESSION	Chair: Daniela Battaglia
08:40-09:55	Dog population modeling (including most successful experience)	Bruno Chomel
09:55-10:10	Dog population management and cost-benefits of interventions (including most successful experience)	Alexandra Hammond
10:10-10:25	Policy and legislation in dog population management (including most successful experience)	Kate Blazak
	Defining main challenges for dog population management <i>Brain-storming session</i>	Facilitator: Illia Rosenthal
10:25-10:45	Discussion	
10:45-11:00	Coffee Break	
11:00-11:30	Most successful experiences: - European Commission - WSPA - ICAM Coalition	Andrea Gavinelli, Natasha Lee, Michelle Morters

Dog population management

11:30-11:45	Discussion	
11:45-12:00	Registration, identification and traceability (including most successful experience)	Paolo Dalla Villa
12:00-12:30	Discussion	
12:30-14:00	Lunch	
14:00-14:15	Dog catching, handling and removal (including most successful experience)	Rita Garcia
14:15-14:30	Shelter management (including most successful experience)	Dganit Ben-Dov
14:30-15:00	Discussion	
15:00-15:45	Group session to identify challenges, gaps, research needs and, policy options, etc. to address dog population management issues	Facilitators: Elly Hiby, Katinka de Balogh, Paolo Dalla Villa
15:45-16:00	Tea Break	
16:00-17:30	Group session to identify challenges, gaps, research needs and, policy options, etc. to address dog population management issues (continued)	
19:30	Drinks & Dinner	

Thursday 17th of March

07:30-08:30	Breakfast	
08:30-08:40	Recapitulation of previous day	Daniela Battaglia Ilia Rosenthal
8:40-9:40	Plenary session on dog population management planning session	Chair: Elly Hiby
	ANIMAL BIRTH CONTROL SESSION	Chair: Katinka de Balogh
09:40-09:55	Different animal birth control systems and alternative methods of sterilization (including most successful experience)	Chinny Krishna
09:55-10:10	Different animal birth control systems and alternative methods of sterilization (including most successful experience)	Jack Reece
10:10-10:25	Castration, neutering and release and alternatives to the CNR approach of reproduction control (including most successful experience)	Elly Hiby
10:25-10:40	Non-surgical sterilization	Giovanna Massei
10:45-11:00	Coffee Break	
11:00-11:30	Discussion	

11:30-12:30	Group session to identify challenges, gaps, research needs and, policy options, etc. to address dog birth control issues	
12:30-14:00	Lunch	
14:00-14:30	Group session to identify challenges, gaps, research needs and, policy options, etc. to address dog birth control issues (continued)	
14:30-15:45	Plenary session	
15:45-16:10	Tea Break	
19:30	Drinks & Dinner	

Friday 18th of March

07:30-08:30	Breakfast	
08:30-08:45	Recapitulation of previous day	
	PUBLIC AWARENESS AND CAPACITY BUILDING SESSION	Chair: Marco Vigilato
8:45-9:00	Communication, awareness building and education (including most successful experience)	Tracy Helman
9:00-9:10	Social issues related to dog population management	Illia Rosenthal
9:15-9:30	Responsible dog ownership options (including most successful experience)	Peter Omemo
9:30-9:40	Most successful experiences - FAO	Katinka de Balogh
9:40-10:10	Discussion	
10:10-10:45	Group session to identify challenges, gaps, research needs and, policy options, etc. to address public awareness and capacity building issues	
10:45-11:00	Coffee Break	
11:00-11:30	Group session to identify challenges, gaps, research needs and, policy options, etc. to address public awareness and capacity building issues (continued)	
11:30-12:30	Plenary session	
12:30-14:00	Lunch	
14:00-15:45	Report writing in groups according to sessions	
15:45-16:10	Tea Break	
16:10-17:30	Report writing in groups according to sessions (continued)	
19:30	Drinks & Dinner	

Saturday 19th of March

07:30-08:30	Breakfast
08:30-09:45	Presentation of reports in plenary and discussions
09:45- 10:45	Finalization of report
10:45- 11:00	Coffee Break
11:00-12:00	Finalization of report (continued)
12:00-12:30	Closure
12:30-14:00	Lunch
14:00	Departure of participants
19,30	Drinks & Dinner

Annex B

Meeting participants

EXPERTS

Dganit Ben Dov

Chief Veterinary Officer Animal Protection - Veterinary Services Israel

During and after studying veterinary medicine, Dganit Ben Dov volunteered and worked in the Society for the Prevention of Cruelty to Animals (SPCA) shelters in Israel. This work included clinical work and shelter management. For the past six years she has been a lecturer on farm and animal welfare at the Hebrew University of Jerusalem.

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Kate Blaszak

Senior Programmes Adviser Melbourne – External Affairs and Policy for WSPA Asia Pacific

In Kate Blaszak's current position she manages projects addressing humane dog and rabies control, responsible pet ownership education and human behaviour change. She is involved in One Health research, integrating animal welfare into tertiary teaching and is a contributor to the first OIE Regional Animal Welfare Strategy.

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Rita de Cassia

Post-doctorate in epidemiology and control of zoonosis

Rita da Cassia is responsible for zoonoses and animal control in the city of Osasco and Taboão da Serra Municipality in Brazil. She is also responsible for the planning and implementation of animal population control in multiple cities and was involved in the implementation of the Population Control of Dogs and Cats programme for Sao Paulo.

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S. Chinny Krishna

Co-founder and former Chairman – Blue Cross of India

S. Chinny Krishna co-founded the Blue Cross of India in 1964 and started a successful ABC programme in 1965 – the oldest continuous CNR programme in the world for street dogs.

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Bruno Chomel

Co-editor in Chief of Comparative Immunology, Microbiology and Infectious Diseases

Before becoming Professor of Zoonoses and Chair of the Infectious Diseases Department, Bruno Chomel worked at the Centers for Disease Control and Prevention in Atlanta and as a consultant for several international organizations. His research includes work on the epidemiology of rabies and plague, and zoonoses of wildlife. For eleven years he was the Director of the WHO/PAHO Collaborating Center on New and Emerging Zoonoses and he has served as Director of the Master of Preventive Veterinary Medicine (MPVM) programme at UC-Davis since 2008. bbchomel@ucdavis.edu

Alexandra Hammond-Seaman

Regional expert – RSPCA

After having worked for the local government in the United Kingdom of Great Britain and Northern Ireland, Alexandra Hammond-Seaman joined the RSPCA in 2001 to develop its international work in Europe. She also developed and managed a number of animal welfare initiatives across Europe. Alexandra is a technical expert for the European Commission's Technical Assistance and Information Exchange (TAIEX) and has been involved in many missions on rabies and DPM. alexandra.hammond-seaman@rspca.org.uk

Tracy Helman

Manager of Domestic Animal Legislation - Bureau of Animal Welfare, Victoria State Government

Tracy Helman has extensive experience in developing and implementing legislation and codes of practice and specifically manages domestic animal legislation. She is the executive officer of two sectorial groups of the Australian Animal Welfare Strategy and is Chair of the Australian and New Zealand Companion Animal Working Group.

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Malika Kachani

Professor Parasitology at College of Veterinary Medicine - Western University of Health Sciences, Pomona, California.

Malika Kachani's current work at the university focuses on zoonoses and VPH. She has worked with FAO and WHO on zoonotic diseases, VPH and One Health on numerous occasions, and also works with WHO on neglected zoonotic diseases. Her research area is the control of cystic echinococcosis.

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Peter Omemo

Lecturer and researcher - Jaramogi Oginga Odinga University of Science and Technology, Kenya

Peter Omemo has numerous degrees, has worked in VPH within the Department of Veterinary Services for over twenty years and is currently a Ph.D. candidate. His research focus is on the health risks at the human-animal-ecosystem interface.

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Jack Reece

Veterinary Surgeon - Help in Suffering (HIS), Jaipur, Rajasthan, India

Following his work in zoos and agriculture, Jack Reece gained a place at the Liverpool University Veterinary School where he qualified as a veterinary surgeon. After four years of rural veterinary practice he took a voluntary post at HIS, an animal welfare charity in Jaipur, India in 1998, where he has been involved in the ABC programme.

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James Serpell

Professor Animal Ethics and Welfare – School of Veterinary Medicine, University of Pennsylvania

James Serpell established the Companion Animals Research Group at the University of Cambridge before moving to his current position. His research focuses on the behaviour and welfare of dogs and cats, human attitudes to animals and the history of human-animal relationships. He has published more than 100 articles and book chapters on these and related topics.

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Alexander Wandeler

Scientist Emeritus - Canadian Food Inspection Agency (CFIA) Carp, Ontario, Canada

Alexander Wandeler joined the Swiss Rabies Centre at the Veterinary School in Bern from 1966 to 1989. He participated in the development of the oral immunization of wildlife against rabies which earned him an honorary doctorate (University of Zürich). He was a research scientist for over 20 years.

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RESOURCE PERSONS

Andrea Gavinelli

Head of Animal Welfare Unit – Director General Health and Consumers, European Commission

Andrea Gavinelli has been a policy official at the European Commission since 1999. Since 2001, he has been an active member of OIE's Working Group on Animal Welfare and of specific working groups at the international level with EU trading partners. He has also been a member of the editorial board of the FAO gateway to farm animal welfare.

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Giovanna Massei

Senior ecologist - National Wildlife Management Centre, Animal Health and Veterinary Laboratories Agency (AHVLA) York, United Kingdom of Great Britain and Northern Ireland

Giovanna Massei's research interests focus on non-lethal methods to manage wildlife, with particular emphasis on fertility control as well as exploring the use of immune-contraception to control rabies in stray dogs. She has led studies on stray dog population dynamics in India and Nepal and is an Associate Editor of the peer-reviewed journal *Human-Wildlife Interactions*.

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François-Xavier Meslin

Manager intercountry project for human and dog rabies prevention and control – WHO

François-Xavier Meslin has recently retired from many years of service at WHO. He has been the convener of a number of WHO consultations and reports covering DPM issues and on oral vaccination of dogs against rabies. He has co-authored publications on dog population studies in Africa and in Asia.

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Michelle Morters

Technical advisor – IFAW/ICAM Coalition

Following work in small animal practices in the United Kingdom of Great Britain and Northern Ireland and in New Zealand, in 2005 Michelle Morters became programme manager for the global Companion Animals programme of IFAW working to develop and implement programmatic strategy and policy. In 2007 she started her doctoral studies on dog ecology and welfare as a means to generate data to support the ICAM Coalition.

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Mariela Varas Ramos

Animal Welfare Focal Point at the International Trade Department – OIE

Maria Varas obtained her master's degree working on the Southeast Asia Foot-and-Mouth Disease Campaign. Following that, she started working at the Animal Health Information Department of OIE as a project officer. At her current post, she supports the activities of the Terrestrial Code Commission and animal welfare ad hoc groups.

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Marco Antonio Natal Vigilato

Veterinary Public Health Adviser – PAHO/WHO

Marco Vigilato was the Chief of the Centre for the Control of Vector-borne and Zoonotic diseases at the Department of Health (Birigui, Brazil) and worked at the Office of the Chief State Veterinarian in Mato Grosso do Sul State, Brazil. Since 2010, he has been working in VPH for PAHO/WHO, to provide technical cooperation to Latin American countries to strengthen their capacities for surveillance, prevention and control of rabies and other neglected zoonotic diseases.

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SECRETARIAT

Daniela Battaglia

Livestock Production Officer – Animal Production and Health Division, FAO

Daniela Battaglia has been at FAO since 2001 and is responsible for activities on animal welfare. Previously, she worked for nine years at the European Commission, during which she was involved in the preparation and follow-up of programmes and projects in the fields of animal production and health, livestock and rural development. She has also worked for a number of years in the field of livestock and rural development in several countries.

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Paolo Dalla Villa

Seconded national expert, Director General SANCO Animal Welfare Unit, diplomat – European Commission

Paolo Dalla Villa worked in Italy as Veterinary Officer at the Pescara province Local Health Unit and later at the OIE Collaborating Centre for Veterinary Training, Epidemiology, Food Safety and Animal Welfare in Teramo, Italy. His current position at the European Commission focuses on issues related to the EU policy on animal welfare development and implementation, particularly international cooperation and the welfare of companion animals.

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Katinka de Balogh

Senior Officer Veterinary Public Health, Animal Health Service – FAO

Katinka de Balogh spent nine years in Africa working as a District Veterinary Officer (DVO) in rural Zambia and was a lecturer at veterinary faculties in Zambia and Mozambique where she conducted dog ecology studies and organized large-scale rabies vaccination campaigns. Presently, she leads the global veterinary public health activities of FAO and has become actively engaged in DPM as part of rabies and echinococcosis prevention and control.

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Elly Hiby

Independent Animal Welfare Consultant and Scientific Coordinator - ICAM Coalition

Elly Hiby has worked at the Dogs Trust and the WSPA with a focus on DPM and humane rabies control internationally. In 2006, while working for WSPA, Elly and colleagues from RSPCA, Humane Society International and IFAW formed the ICAM Coalition. The ICAM Coalition aims to improve understanding of effective population management by sharing experience and data, and by combining knowledge to produce documents outlining best practice.

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Natasha Lee

Veterinary Programme Manager – WSPA office Bangkok

Following her graduation in 2004 Natasha Lee spent over three years working with a Malaysian NGO - the SPCA Selangor - as chief veterinarian. In 2008, she joined WSPA as a Veterinary Programme Manager. As part of this role she has been involved in overseeing programmes of humane DPM and rabies control in Asia. Currently, Natasha is managing the Advanced Concepts in Animal Welfare (ACAW) Program in Asia Pacific.

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Illia Rosenthal

After a career in the private sector and the United Nations (UN) comprising a wide range of duties, Illia Rosenthal worked at the International Fund for Agricultural Development (IFAD) as Learning Coordinator. She managed and participated in qualitative poverty assessment missions in Peru and Madagascar. Illia worked as a consultant in FAO's Animal Protection and Health Division and moderated three e-consultations including one on the consequences of highly pathogenic avian influenza (HPAI) on people's livelihoods, one on DPM and another on working animals. She also co-organized World Rabies Day 2010 and 2011.

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6. Dog population management. Report of the FAO/WSPA/IZSAM Expert Meeting – Banna, Italy, 14-19 March 2011 (E)

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