INTERNATIONAL STRAY DOG MANAGEMENT

TECHNICAL REPORT
(FIRST MISSION)

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I N D E X

GUIDELINE TO THE CREATION, OPERATION AND IMPLEMENTATION OF A SPECIAL UNIT FOR STRAY DOG MANAGEMENT UNIT

1. Justification: The NWS, is an insect pest of warm-blooded animals which is a zoonoses as well, so it has an economical, political and public health concern. The control of NWS, according with the Natural History of the disease (Level and Clark), should consider the elimination of the fly and myasis and the appropriate surveillance of each animal involved. At present situation (April 2,000) in Jamaica, apparently the most important hosts are dogs, and to a certain extent goats.

The New World Screwworm affecting dogs, has several focusing considerations that justify the project.:

- Dogs have an emotional value for their owners, that is why proper attention to this myasis must be considered a priority.
- Cost of attention of myasis to dogs, represents an extra-cost to the family economy because of the extra-money expended for treatment and medical attention, with the sacrifice of economical resources to the family well-being.
- Screwworm disease in dogs should be considered by the National Screwworm Eradication Programme, the Public Health Authorities, the City Council, as well as the Jamaica Society for Prevention of Cruelty to Animals as a high priority.

The economic impact of the NWS infestation eradication costs not included, estimated in Jamaica nearly eight million $USD (1). Cost benefit of dogs NWS, does not obey to the same considerations as in domestic productive species, because dogs have an emotional and/or utility value to their owners. Impact on epidemiology of the disease in productive animals, as a zoonoses, as well as costs generated by the dog-host individual attention such as insecticides, medicines, etc., all of them very well documented (1).

According with a Rawlins and Sang study (cited in:1), from 3,868 Screwworm cases discovered, dogs represented 2.5 % (97 cases). From the Annual Report of the National Screwworm Eradication Programme (July 1998-Jun. 1999), there were collected 2,165 samples of the New World Screwworm (NWS) in several species (table 1), such as bovine,

caprine, porcine, etc. Among those samples 996 (46.0%) belongs to dogs. Finally, from statistic's date from the Field Operations Unit there has been a total of 1,843 cases from November 1998 to march of 2000 (1,553 cases in 1999). Eventhough there is no mention about the criteria for the selection of samples, it could be assumed that they occur closely related with the frequency and number of reported cases in such species. Dogs, owned or stray, are playing a significant roll in the maintenance of the NWS, and represent a highly potential source of problem.

Based on the document: Assessment of the Stray Dog Population in Kingston, Jamaica (2), the Jamaica Society for the Prevention of Cruelty to Animals (JSPCA), report 40 % of the stray dogs picked up from the streets are infested with screwworms. The situation has two components: it afflicts an unnecessary suffering for dogs, and contribute to the prevalence of the NWS in Jamaica.

During the survey conducted by Dr. Wendel Snow (3), for the estimation of the stray dog population at Kingston, for the period April 1999 to March 2000, there were found 2,388 dogs, distributed with some variations by routes, and months of the year. Goat seems to have a similar roll as do dogs, since they are quite frequent, even in the city areas, as well as in the suburban areas of Kingston. During the survey (3), period of April 1999 to March 2000, a total of 956 goats were identified in the four routes considered. From the total samples already mentioned, goats contributed with 305 cases or 14 %, which means that dogs and goats contributed with a total of 1,310 cases or 60 % of the cases. It should be mention that the observed dogs and goats, were in the same route, so probably there should be discount the observations repeated on the same dogs or goats.

Zoosanitary impact on the stray dog uncontrolled population for the New World Screwworm: The total increase in the cost of production to the Jamaican livestock industry of living with screwworm is estimated to be nearly US$ 5 million annually. Expenditures for labor required for surveillance and treatment of animals comprise 74 % of the additional production costs. Costs of insecticides and medicine represent over 23 % of the disease related costs. These far level control measures incorporated into livestock production

practices have been necessary tradeoffs towards minimizing productivity looses. In sum, the total looses due to mortality and increases in the cost of production are estimated to range between USD$ 5.5 million and USD$ 7.8 million annually. Once eradication is achieved, these costs would be avoided and can therefore be thought as the benefit of the eradication. Total cost for the three years programme has been estimated to be: $USD: 8,988,200.

An approach to a cost-benefit analysis to eradication of the NWS in dogs, can not use the same criteria as with economical importance animals. Cost is based on expenditures made for cure, attention and follow-up of each case, cost of medication, cost of sacrifice, neutering and spay when owners accept to do that. At the same time there should be considered a strong campaign to public education toward the activities mentioned above.

It is really important to mention that many of the activities to be performed, are not really specific to achieve the already mentioned goals. They could be conducted at the same time as other regular activities of the Unit, related to the field activities. Thus, costs are estimated considering a proportion of the true value for each activity.

The cost for the operation and implementation of the special unit for stray dog management has been estimated partially to be so far, and based on the assumptions mentioned in the table which is: $ 37,964.00.

Impact on epidemiology of the disease in productive animals is really important given that dogs are acting as carriers of the NWS. Dogs should be considered as an extremely dangerous “walking” focus for the disease meanly because dogs are closely related to the human beings, his home, and other animals. When deeply affected, they are strongly rejected even by their owners because of the strong disgusting smell of the wound, behaving then as a true stray dog. If they exist under such conditions, and private or governmental institutions do not take care of them, the eradication programme will be seriously compromised.

Other facts that should be considered are that NWS, is a zoonoses. It is believed that human cases are not reported. There are just a few humans confirmed ones, some of them dramatically, generating in the human population a sense of miscarrying from the Public Health Authorities. According to a personal communication from Dr. Luis Ivey, there has been about 20 human cases, with three casualties directly attributable to the disease. This is the reason why this zoonoses should be considered a disease with a social impact, which means a priority for the Veterinary Services Division, and the Public Health Services.

Brandy et al, 1981, mention that hookworm infections *Uncinaria sp*. and *Ancylostoma sp.* Occur in 95-100 % of feral dogs in Kingston (5). Other zoonotic species harbored by feral dogs in Kingston are roundworm *Toxocara canis* (13%). This is a potential serious public health problem, particularly in children because of the rise of development of “ocular and visceral larva migrans”. In a study on well-cared dogs in Jamaica, in addition to the presence of *Strongyloides sp.* (6 %) and *Spirocerca lupi* (6 %), *S. Stercolaris* has been implicated in fatal disseminated infections in Jamaica in immuno compromized individuals. While *S. lupi* has been known to cause esophageal cancer in dogs and human beings (5).

2. Objectives:

General Objective: To eliminate any possibility of participation of dogs, owned or stray as intermediate hosts for the New World Screwworm disease in Jamaica for the next one year period.

Specific objectives:

1. To collaborate with the Unit for the Surveillance and attention of each case reported (focus) as in owned or stray dogs and goats. It will consist on a Central Office at the Veterinary Services Division, and a Mobil unit.

    1.1. To equip a Mobil Unit, conveniently adapted for the clinical, chemical and surgical attention of each case of NWS, in dogs.

    1.2. To equip the Mobil Unit, with the appropriate facilities for the comfort of the technicians and veterinarians attending the reported cases in dogs.

    1.3. To acquire disinfectants, antibiotics, and minor surgery equipment for the attention of the already mentioned cases.

    1.4. To acquire capture equipment for dogs, specially for suburban and rural areas of Jamaica.

2. To attend 100 % of the cases of NWS reported to the unit by means of clinical, disinfecting, and minor surgery if needed.

    2.1. To attend and register 100 % of reports in the Veterinary Service Division (VSD), National Screwworm Eradication Programme, Jamaica; at the JSPCA, the City Council, and private practitioner's veterinarians.

2.2. To register in a map each case finally reported to the VSD for the identification of focus areas for their appropriate attention (Epimap), and inform in a weekly basis to the contributing organizations.

3. To identify 100 % of the NWS cases attended.

3.1. To design and use a codified tattoo or a tag, to be used in an ear or abdomen of each dog treated by the mobile unit. Register a comprehensive description of the dog, and identify the owner when there is one for a follow-up.

3.2. To register each case attended by other collaborating institutions and private veterinarians, in a specific format for follow-up and surveillance purposes (exception made of the tattoo).

4. To control the stray dog population in the urban, suburban and rural environment, by means of an agreement with:

- The Jamaica Society for Prevention of Cruelty to Animals.
- The Jamaica Veterinary Medical Association and Small Animals Practitioners Group, to withdraw stray dogs, and for a low cost neutering and spaying of dogs and cats.
- The Ministry of Health, Veterinary Public Health Unit.
- The Ministry of Health, School of Public Health.
- The Units States Department of Agriculture (USDA), representation in Jamaica.
- The Jamaica Livestock Association.
- The International Atomic Energy.
- The City Counsel of Kingston (KSAC).

3. Co-ordination: professionals, national and international institutions. Agreements already made in annex No. 1.

4. Description of the communications links among the programme units, especially field operations, including, commands, supervisory and reporting line's definition: According to the goals to be achieved by the stray dog management unit, the field activities could be done with the support of the technicians belonging to the operational field unit and distributed in each Parish. Those activities must be closely supervised by the veterinarian in charge of the VSD and collaborators.

Internal communication lines at the Veterinary Services Division must be the same already existing. A single recommendation is to add some information regarding dog attention, identification, and activities derived from them. This additional information is included in the format annexed to this document. Communication among VSD and other agencies concerned with the stray dog management could be a weekly, monthly, quarterly and half-year reports. The information to be reported will be closely related to the nature of responsibilities attributable to each of them.

In any event, reports and information must be sent to the National Director Office and to the Chief Field Officer so as to their international counterparts.

Supervision will be performed by the Veterinary Services Division, which should analyze and give a feed-back information to all those contributing to the programme institutions.

5. Technical Procedures for Stray Dog Surveillance, monitoring and Control (Annex 2).

6. Coordination and Cooperation with Public Information Units, to provide basic guidelines to design special communication campaign target to rural, peri-urban and urban areas. (Annex 3).

7. Estimation of dog population in urban and rural areas of Jamaica (Annex 4)

Budget

Each one of the participant institutions will contribute with their current capacity (buildings), and technical personnel collaborating in the Programme as a part-time contribution in the achievement of the Programme objective. **The project for the operation and implementation of the special unit for stray dog management must be intended as the maximization of those already existing resources.**

Institutional contribution of Veterinary Services Division, such as partial cost of buildings, rentals, facilities, salaries and other possible economical considerations to the calculation of

a proportional contribution (on annual basis) from the VSD to the project, were not offered to the consultant.

Basic Annually General Cost of Operation of the Mobile Unit

Variable	Cost ($USD)
Transport (average of 120 Km/day; gas/vehicle,and rentability, considering 3 years of use and a value of $30,000 already equipped)	4,164
Affected dogs cure, medicines and follow-up (considering 100% of all cases = 1,553, assuming it could be the same as during 1999) $ 10.00 per case.	15,530
Neutering and spaying: $ 40.00/dog. (Assuming 10 % of owner could accept).	6,200
Didactic materials	2,000
TOTAL	**27,894**

General Cost of Equipment and Materials to the Mobile Unit(*)

Equipment and Materials	Cost in USD$
Mobile Unit roadworthy (**)	$ 1,800
Autoclave (**)	$ 2,607
To equip the Mobile Unit as a Spay/Neutering Clinic: (**) Equipment breakdown as follows: a) Anesthetic Machine & Vaporizer b) Six Surgery Packs c) Breading Circuits & Tubes d) Canine Clear Plastic Masks e) Disposable Breathing Bags f) Endotrachael Tubes	$ 5,663
Restraint Equipment: a) Tightens b) Rifle(s) c) Pistols(s) d) Darts e) Dosification implements f) Repairs and maintenance	

g) Others	
Chemicals: a) Anesthetic b) Tranquilizer(s)	
Mobile Unit repair	
TOTAL	

(*) Cost and technical description were offered to personnel of the VSD.

This is assuming the mobile unit will be repaired using a vehicle already existing.

(**) Information from Miss Susan E. Martin Rondon JSPCA, managing Director.

10. Evaluation

The evaluation of the special unit for the stray dog management, based on the achievement of the above mentioned goals, which have by themselves their limits of evaluation. Some of them are qualitative, other quantitative as follows:

Evaluation on the achievement of goals:

Goal	Unit of measurement
1.1. To equip a Mobil Unit, conveniently adapted for the clinical, chemical and surgical attention of each case of NWS, in dogs. (These should be measured according with the list of equipment and materials).	Qualitative: Yes/No.
1.2. To equip the Mobil unit, with the appropriate facilities for the comfort of the technicians and veterinarians attending the reported cases in dogs. (Should considerate space for the veterinarians, security for equipment, and refrigeration for chemicals and medicines.)	Qualitative: Yes/No.
1.3. To acquire disinfectants, antibiotics, and minor surgery equipment for the attention of the already mentioned cases. (Should consider the compliment of acquisitions listed.)	Qualitative: Yes/No.

1.4. To acquire capture equipment for dogs, specially for suburban and rural areas. (it should consider the compliment of acquisitions listed.)	Qualitative: Yes/No.
2.1. To attend and register 100 % of reports in the Veterinary Service Division (VSD), National Screwworm Eradication Programme, Jamaica; from the JSPCA, the City Council, and private practitioners' veterinarians.	Quantitative: Excellent = 100 % Good = 80 % Bad = less than 79 %
2.2. To register in a map each case finally reported to the VSD for identification of focus areas for their appropriate attention (Epimap). To inform in a weekly bais to the contributing organizations.	Quantitative: Excellent = 100 % Good = 80 % Bad = less than 79 %
3. To identify 100 % of the NWS cases attended.	Quantitative: Excellent = 100 % Good = 80 % Bad = less than 79 %
3.1. To design and use a codified tattoo or a tag, to be used in a ear or abdomen of each dog treated by the mobile unit; to register a comprehensive description of the dog, and identify the owner when there is one (suggest a code) for a follow-up.	To design a codified tattoo or tag, qualitative = Yes/No To use the identification procedure selected, quantitative = measure as above. Comprehensive description, qualitative-quantitative, in terms of ratio when a follow -up could be needed = Excellent: 80 %; Good 70 %; Regular: 60 %; Bad: less than 59 %.

3.2. To register each case attended by other collaborating institutions and private veterinarians, in a specific format for follow-up and surveillance purposes (exception made of the tattoo).	Quantitative: Excellent: 80 %; Good 70 %; Regular: 60 %; Bad: less than 59 %.
4. To control the stray dog population in the urban, suburban and rural environment, by means of an agreement with: • The Jamaica Society for Prevention of Cruelty to Animals. • The Jamaica Veterinary Medical Association and Small Animals Practitioners Group, to withdraw stray dogs, and for a low cost neutering and spaying of dogs and cats. • The Ministry of Health, Veterinary Public Health Unit. • The Ministry of Health, School of Public Health. • The Units States Department of Agriculture (USDA), representation in Jamaica. • The Jamaica Livestock Association. • The International Atomic Energy. • The City Counsel of Kingston (KSAC).	Qualitative: Yes/No. Consider yes, when there is an active answer from those institutions at the end of the evaluation period, and an answer with: “no, we do not want to participate."
The evaluation of the epidemiological surveillance and monitoring is considered in the corresponding annex.	See the observations made in that particular annex.
Others:	

References:

1. Trang T. Vo: Economic Impact of Eradicating the New World Screwworm (*Cochlioma hominivorax*) from Jamaica. U.S. Department of Agriculture. Animal and Plant Health Inspection Service. Policy and Program Development. 1998.
2. Snow Wendell: Assessment of the Stray Dog Population in Kingston, Jamaica. April, May and June 1999.
3. Snow Wendell: Survey of Stray Dogs and goats in Different Areas of Kingston, April 1999- March 2000.
4. National Scrwworm Eradication Programme. Jamaica. Annual Report. July 1998-June 1999.
5. Robinson RD, Thompson DL, and JF Lindo: A Survey of Intestinal Helminths of Well-cared Dogs in Jamaica, and Their Potential Public Health Significance. J of Helmintology. **63**: 32-38 (1989).

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TABLES AND FIGURES

Frequency of Samples by Specie in Jamaica (July 1998-June 1999)

Species	Number	%
Dogs	996	46
Bovines	496	23
Caprines	305	14
Porcines	222	10.3
Fly samples	91	4.2
Ovines	21	1.0
Equines	15	0.7
Unknown	6	0.3
Humans	5	0.2
Birds	3	0.14
Llamas	3	0.1
Rodents	2	0.1
TOTAL	2 165	99.94

Reference (4)

(ANNEX 1)
PREVIOUS AGREEMENTS, BY MEANS OF PERSONAL INTERVIEWS

1. Veterinary Services Division, Ministry of Agriculture. (Dr. George H. Grant, Dr. Osbil Watson). During the first talk, and giving the fact that they are the National authorities promoting the Unit for the creation, operation and implementation of a special Unit for Stray Dog Management, they propose the following objectives:

1. To perform a census or a dog population estimation in Kingston and in Jamaica.
2. Creation, operation and implementation of a Special Unit for stray dog management under the NWS Jamaican Programme structure.
3. The capacity to contribute with the Surveillance Unit, for the identification and treatment of affected dogs with NWS, by means of a mobile unite, equipped to restraint and cure dogs.

It was agreed as a priority the creation, operation and implementation of the already mentioned Unit under the NWS Jamaican Program structure. This Unit will be in charge of the Veterinary Services, in coordination with other public, private, national and international institutions. This proposal, with the purpose to have a multi-institutional project, using their facilities, budget and personnel. That means to optimize the already existing human and economical resources. The census or dog population estimation will be performed in parallel with the stray dog management. The technical recommendation for this purpose will be given in annex 4.

The VSD agree to cooperate with the project draft as follows: 1) Description of their own functions and activities. 2) Description of the communication links among other programme units, specially field operations, including commands, supervisory and reporting line's definition.

At the end of two weeks of working the consultant suggests that the terms of the cooperation of other private and public institutions should be based on mutual benefit, and supported by an agreement that should be formalized as soon as possible. They suggested a further meeting involving the representatives of those institutions already interviewed and described in the present annex, to let them know the final draft of this project, give feedback, and finally have their signature to formalize the commitment.

The consultant recommends the constitution of a Consultative Council, integrated by the representatives of each collaborating institution to have their opinion and an external evaluation of the goals of the Unit.

2.- Jamaican Society for the Prevention of Cruelty to Animals (JSPCA). (Miss Susan E. Martin Rondon, Managing Director).

This Society works based on economical contributions from the society and private commercial institutions. Their fields of commitment are:

1. Veterinary Clinic, for consultation and disease prevention and cure.
2. Animal shelter and ambulance rescue.
3. Stray and Rescue Programme.
4. Investigate reports of pet owner's abuse towards their pets animals.
5. Adoption Programme.
6. Spaying/neutering Campaign.
7. Educational Programme.
8. Identification and Registration Service.

Veterinary Clinic- For consultation, disease prevention and cure: They receive any ill animal for treatment, and if needed, give the service of hospitalization, medication, X rays, and treatment until recovery. They have about 20 kennels for this service.

Animal shelter and ambulance rescue: The JSPCA is the only organization in Jamaica that takes stray dogs and cats off the streets of Kingston.

Stray and Rescue Programme: they receive the calls from citizens reporting stray dogs or cats and have a unit to catch them. Once in the compound, they receive attention. If virtual owners claim them they'll go home; if not, they will be offered as pets during a reasonable period of time and/or sacrificed if not.

They investigate reports of pet owner's abuse. If necessary, they take care of these animals away and keep them from further harm.

Adoption Programme: Every animal that arrives to the institution without an owner is available for adoption. They do not allow adopting any aggressive animal.

Spaying and neutering Campaign: strongly supported by the institution based on a minimal cost. The Society makes about 15 neutering and spays a week, which could represent about 720 a year.

Educational Programme: It stress the information about well care and respect for animals, the convenience in giving them medical attention, and the control of dogs and cat's population.

Identification and Registration Service: the JSPCA will issue a tag with an identification number to be attached to the pet´s collar to facilitate identification.

Miss. Martin Rondon agreed to get more involved with the JSPCA, in the fields that are coincident with the Screwworm Program Eradication and the Unit for stray dog management.

Added to that, she suggested that:

The written information the Programme offers regarding the NWS should be according to the languish and local costumes of people, even according to their age.

Built a permanent treatment clinic for dogs affected with NWS, and for neutering and spaying in the Spanish Town, and

In order to succeed with these activities they would even offer people a low, but attractive amount of money for each dog they deliver to the Unit or to the mentioned clinic.

3.- Veterinary Public Health Unit, Ministry of Heath. Dr. Lynette Peters.

This Unit works with two main responsibilities: Food Surveillance and Animal Origen Food Monitoring for Human Consumption; and Control of Zoonotic Diseases. Tuberculosis, and Brucelosis surveillance, with a low prevalence; Leptospirosis as an important zoonoses in Jamaica, and parasite zoonoses. An important fact to emphasize is that there is no legal mandatory towards stray dogs control, neither from Ministry, nor in the Unit, nor the Country.

They have been required to deal with Visceral larva migrans, and Cutaneous larva migrans by the Tourism Ministry, in Negril Island, which is a specific tourist area. At the same time, the private tourist Hotels claim for a stray dog control in beaches since tourists are aware of the problem. It is important to say that the stray dog problem has the awareness of the tourism industry, which is a very important source of income for the Country.

To cope with these duties, the VPHU has a Veterinarian at the Central level, and Public Health technicians in each Parish. All this technicians graduated from the Public Health School of the Ministry of Health.

They develop some activities that could be useful for the NWS eradication project such as:

They use to make public education and give information about zoonoses, added to that, they agreed: to include specific information toward the eradication of the NWS. Talk about the need of reporting any case of affected dogs or any other animals. Cost basis; the need to control dog owned or stray populations by means of neutering, spaying, or humanitarian pass away. The educational information should be given primarily to targeted population.

4.- School of Public Health (MISPH), Ministry of Health. Dr. Lynett Peters on behalf of Miss Limonius Dr. of the MISPH.

The school trains Public Health Inspectors based on two years-training. The students have to make a community study during their last quarter in school. During that time they are in close contact with the selected community; they make observations and interviews with specific important people because of their influence in the community.

During their final quarter in the community, Health education abouth zoonoses, the way they relate with animals and with the environment in general is included.

Dr. Peters agreed to collaborate with, for instance:

Students could include in their community study, their interviews, educational health talks, and final recommendations to the local authorities, specific information about the NWS as zoonoses, particularities about the need of reporting any case of affected dogs or other animals; emphasize in the possibility of being treated; the need to control dog, owned or stray populations by means of neutering, spaying, or humanitarian pass away; all of those services in a low cost basis.
It was required to Dr. Peters to talk with Limonius Dir., to have her comments as the mean authority of the school.

5.- Jamaica Veterinary Medical Association and Small Animals Practitioners. Dr. Cedric Lazarus, as a part of the representatives of the Association. He agrees to discuss with members of the association if interested to participate:

1. Emphasize the reporting activities.
2. Treatment of maggots in pets.
3. Low-cost programme for neutering and spay.
4. Census of dog population.

The association will have their regular meeting on Friday 14, 2000, so he offers me to talk with them and give me their comments on that regard in a formal way.

Kingston and St. Andreus Corp. (KSAC), (Mr. Merchamp), inform that they pick up from the streets pounded animals such as hogs, horses, cows, goats, mainly because of the traffic problems. Nevertheless, he thinks that the control of dog population should be a private responsibility. He refers me to the Jamaica Gazette, Proclamation, Rules and Regulations (July 11, 1961): The Animals (Diseases and Importation) Law. This document and a previous one submitted to the consultant by Dr. George H. Grant and Osbil Watson.

Jamaican Livestock Association (Mr. Henry Rainford). This Association comprises sub-associations organized by species. They do not have economical resourses available to support the programme. Nevertheless they can facilitate the distribution of any somewhat written adductive materials, any personalized information that the VSD, would like to

discuss with them organizing the appropriate meetings, meanly during their regular working reunions.

International organisms such as the International Atomic Energy (IAEA), by means of Dr. J. Wendell Snow, and the United States Department of Agriculture. Animal & Plant Health Inspection Service, by means of Dr. Louis J. Ivey, are strongly compromised in the present project.

ANNEX 2

5. Technical procedure for the surveillance (*) of stray dogs their monitoring and control.

With the present resources for the Programme for the eradication of the New Screwworm and of the Unit Proposals for the control of the street dogs, seems out of reach (unattainable) to apply the model of surveillance and its components to the population of dogs in the country included that of Kingston.

Consequently, the surveillance will be focused on the population of dogs affected by maggots.

For such effect, the following guidelines must be established:

1. **Account of morbidity and mortality** attributed to the NWS, in dogs
   1.1.- information on morbidity will come from those cases reported by the unit as cases affected coming from the sources of internal information of the Programme (field operations) and its own structure; the instructions that have been accepted to collaborate (Attach); as well as the community in general.

2. **Follow-up**.- Each reported case must be searched for, identified and obtained with priority, with the purpose that the larvae does not reach stage three. The attention to the affected dogs can be given by a non-resident of the city assigned for this purpose, in the interior of the country and channeled to JSPCAS in the urban area of Kingston.

3. **Surveys:** Periodical surveys must be carried out in priority affected communities to identify the knowledge of the problem by those communities, as well as for recognition of active cases, where to report and of the answer obtained from the report. Said survey can be written and/or personalized, making use of organized groups in the community, especially in the surveys and with the heads of family previously cited. It should be understood as priority communities, those communities with 20 or more dogs reported. If it refers to a hundred in the urban area, a colony will be considered a unit.

4. **Use of medication.**

To promote and to verify, that in the veterinary pharmacies, in affected priority areas, the appropriate larvicide exists for the control of dog maggots, other animal species and for man.

(*) Karol Raska: Components for an Epidemiological Surveillance Model.

For this reason, it is necessary to have a census of pharmacies and studies of said medications and to verify the 100% of those found in the affected priority areas.

The mobile unit of the Program must rely permanently on these.

5. **Relevant data on the environment to the program.-** To take into account the fact that the rainy season is approaching. To face said situation, provide the resources and intensify the activities of the Program, specifically the situation in the cases of dogs.

6. **Monitoring:**
   a) Cases.- When at all possible, verify the result of a treatment applied to the dogs.
   b) Activities.- Verify that the research procedure, the identification of cases, treatments, follow-up and requirements are properly followed by the technicians in the field.
   c) Report.- Verify that the report formats for cases and activities are properly completed by the technicians in the field. On the contrary, provide the pertinent suggestions.

7. **Evaluation.-** Based on the fact that it deals with a Program of Eradication, the parameters of evaluation must be based on the performance of 100% of the foreseen activities through a monthly, weekly and yearly evaluations. Otherwise, take necessary internal corrective actions.

7.1 **Registration of 100% of cases of morbidity and mortality** attributable to myasic in dogs, from the same program, as well as from collaborating organizations:

Otherwise, take necessary internal corrective actions and a warning to all collaborating organizations for the improvement of the report. For this purpose it will be necessary to identify the cause in each case, and react accordingly.

7.2 **Follow-up.-** The attention to each case, must be understood as successful when in effect myasis treated have been cured and there is an accompanying report. If 100% of success is not attained the procedure for cure will have to be revised and medications used. An inter-consultation with the veterinarian doctors organized by the private initiative would be useful.

7.3 **Surveys.-** Will be evaluated: firstly, in terms of the number planned, by

two parameters: according to considered prioritized areas.

a) Knowledge of the problem. These will be evaluated as follows:
Excellent: if 100% of those surveyed answering positively to the questions; Good: 80%, Average: 70%, Bad: below 69%

b) Response of the Program to the report. How many days have passed from your report to the time of treatment?

Excellent	100%	less than 3 days
Good	80%	less than 5 days
Average	70%	less than 7 days
Bad	69%	more than 7 days

In each case, the expected evaluation should be equal or greater than "good". Otherwise make the necessary corrections.

8. **Use of medications.-** The necessary medications for the treatment of myasis, must be available in each of the veterinarian pharmacies of the main areas affected. Otherwise, the necessary recommendation and verify the response at intervals of a week in each case.

9. **Environmental data relevant to the program.-** The timely revision should accompany the evaluation based on the fulfillment of the aforementioned points.

10. **Monitoring.-** The parameters of evaluation are considered in the Planning.

Recommendations to be achieved at medium term outside of the present project.

To promote a meeting at the Ministers of Health and Agriculture levels with the purpose of clarifying and to establish the boundaries of institutional responsibility in relation to:

1.- The control of the over population of the street dog

1.1 Pick up the street dogs and those roaming the streets
1.2 Retain them for 72 hours for possible pick up by their owners
1.3 The castration of the collected dogs, if their owners claim them or if an adopting party authorizes it
1.4 Its destruction in the absence of a claim in a prudent time frame

2.- Provide neutering and spay services of dogs and cats to voluntary requestors.

3.- Regulate the registration and licensing for the keeping of dogs. The owners of registered dogs will receive periodic information as to its individual care, preventive medicine, on the diseases it can transmit to human beings and its control.

4.- Creation of cities of canine control in the urban suburban areas. These cities could be subsidized by the State with participation of private and commercial institutions and other active organizations of the community whose aim is tied to the social well-being and that of animals.

Once the definition of the Ministerial responsibility is established, it will be necessary to establish the standards and regulations necessary for:

1.- The norm that establishes the responsibility of the corresponding Ministers, on the control of the population of street dogs or those with owners.

2.- The norm for the functioning of the centers of canine control. Said norm must establish the structural organization, the objectives and activities, define the boundaries of interference; mechanisms of internal and external evaluation, as well as its financing.

3.- The norm for registration and tenancy of dogs. The basis for the theoretical and legal responsibility must be established.
Who are those responsible to participate. Mechanisms of registration and its evaluation.

Technical Consulting Council for the control of street dogs.
The representatives of the collaborating organizations of the Project will have to become a Technical Consulting Council with the following functions:

1.- Update the terms of participation.
2.- Dictate the pertinent recommendations for the brief functioning of the Project.
3.- Periodically evaluate the advances achieved.

ANNEX 3.

BASIC GUIDELINES TO DESIGN SPECIAL PROMOTIONAL CAMPAIGN FOR CONTROL OF THE STRAY DOG PROBLEM, HAVING AS TARGET POPULATION THE RURAL, SUB-URBAN AND URBAN AREAS.

The objectives are:

1. To promote dogs registration and licensee for legal and stray dogs control
2. Dogs care, the diseases' prevention and control, their welfare and prevention of cruelty.
3. The risk of diseases that stray dogs could transmit to owned dogs and human being, included the New Screwworm.
4. Dog bites.
5. Promote the dogs neutering and spar.

The Veterinary Public Health is a responsibility shared by the Ministries of Health, and Agriculture, and some other organisms that collaborate to the zoonoses's prevention. ***Promotion for health in the Caribbean*** has been the reference for the sanitary education strategies and health promotion in the Countries of the Region, since its adoption in 1993.

With the cooperation with public information units of the above mentioned institutions, educate population on the stray dog's overpopulation problem. Inform people about the risk of animal health, how they can assist, by now, mainly in the control for NWS eradication and in the control of the zoonotic diseases they can transmit.

In other to make achievable such an education program, it is advisable to make an agreement with: the Jamaican Society for the Prevention of Cruelty to Animals, the Veterinary Public Health Unit, and the West Indies University by means of the Public Health School. These to support educational information at primary schools, organized groups, and society, to collaborate in the already on going and, in practice, to help one each other on this matter.

Education for health will help additionally to persuade people to actively participate in dog population estimation or census of owned and stray dogs in Jamaica, and Kingston. Additionally in an active campaign toward neutering and spay of dogs, eventually cats to their population control.

Objectives 2 and 5, can be achieved with the participation of the Jamaican Veterinary Medical Association and Small Animals Practitioner Group, and the Jamaica Society for the Prevention of Cruelty to Animals.

Guidelines:

The educate campaign should have a national extension. Nevertheless, at the beginning could have priority those areas considered a priority. These means areas in which the eradication campaign has already received more than 25 reports of cases of the New World Screwworm (NWS) disease.

The targeted population should be boys at primary schools, organized social groups such as parents societies in those schools, and governmental groups linked, in one way or another, to the eradication programme.

The verbal or written communications to be given to the marginal population should use an accessible language, even using local terminology, according with the school level and cultural patrons.

Processionals could use some of the next suggestions:

◊ Living with a pet can be beneficial to children: Pets can enhance a child self-stemmed, teach them responsibility, and help to learn empathy. However, children and dogs are not always going to automatically start off with a wonderful relationship. Learn how!.

◊ Diseases which dogs can transmit to human being (zoonoses) could be:
Screwworm, Leptospirosis, Brucelosis, Salmonelosis, Tuberculosis, Nocardiosis, Filariosis, Candidiasis, Visceral and cutaneous larva migrans, Strongylosis, Dog tape worm, Coccidiosis, many others, and... some times bite!.

◊ Dogs are almost humans: they think, they love, they take care of their puppies, they take care of their owners,..... but also suffer many wounds, and maggots due to the New World Screwworm and,.... they even die!.

- ◊ Stray dogs affected with the New World Screwworm, could have and transmit to owned dogs, other animals and human being!. Because of that they easily acquire other diseases such as leptospirosis, Brucelosis, Salmonelosis, Tuberculosis, Nocardiosis, Filariosis, Candidiasis, Visceral and cutaneous larva migrans, Strongylosis, Dog tape worm, Coccidiosis, many others.

- ◊ One female dog and her offspring can produce 67,000 dogs in six years. So you can avoid that explosive overpopulation by neutering and spays.

- ◊ Ill dogs suffer with pain. So sometimes they are in bad humor, then could bite easily. Take care of their diseases, and avoid bites.

Include a wabe-page in internet facilities for general public information on the NWS, with clear answers about what to do if a case is found, when and where to make the report.

RVG/April, 2000/TCP/RLA/8927. Index: 3003 166.

ANNEX 4

ESTIMATION OF DOG POPULATION IN URBAN AND RURAL AREAS OF JAMAICA

Introduction: cost and benefit of particular control strategies cannot be estimated without knowledge, even estimated, about the size, concerned the dog population, the degree of supervision of owned dogs, the proportion of stray, their origin, their accessibility for any kind of activities and the public attitude towards dogs and control measures. Also of great importance is an understanding of the habitat with its man-made resources (food, water, shelter) supporting a variable number of stray unsupervised dogs.

Part of the information can be gathered by simple means (e.g. questionnaire surveys) by the majority of data needs establishing by time-consuming observations using wildlife techniques.

Parameters which could be obtained by simple means, may suffice for administrative purposes. More precise knowledge is not easy to obtain. The acquisition of new knowledge concerning the abundance, habitat requirements, movement, dynamics and behaviour of dogs, along with sociological data regarding dog-human relationship, will result in a significantly better understanding of:

- The incidence and prevalence of dog's zoonoses in urban and rural communities in relation to dog population densities and demography.
- The parameters of physical environment responsible for variable dog population densities, the conditions under which susceptible dog population occur and the ecological requirements necessary to sustain these population.
- The relationship between dog movement, dog social interactions, and transmission of diseases between individuals within population and the spread of some disease into new areas.
- Dog demography, ecology, behaviour and human cultural practices as related to the effectiveness of dog control.

Because the study of dog populations has received little attention, virtually no standardised field techniques are available that have been proved, trough replications, to reliable measure various population parameters. For these reasons, it is not feasible to present specific and detailed outlines for conducting population studies. The following guidelines are therefore intended to serve as a basis for the design of field studies.

The practical importance of investigating dog population size seems clear. The knowledge of the numbers of owned and unowned dogs, and of the abundance is a prerequisite for the planning of animal population control, and for epidemiological and ecological studies. Such is the case of zoonoses control.

Dog population seems to be related to different epidemiological situations, to different culture areas, to different rural and urban habitats to areas of different human settlement patterns and also to different social strata or human rural and urban populations. At the same time seems to be related with availability of food, water and shelter, and human cultural practices and customs. Because of these variations, the selection of sampling "units" or methods of stratification of study areas, the result of which are later extrapolated to estimate total densities, must be carefully considered. For example, the commonly used procedure of sampling to obtain the total human population in a city to estimate total dog numbers, does not take into account variations in the frequency of dog ownership as a result of such factors as economic status. Sampling procedures are therefore an extremely important component of population estimation techniques. Dog population density is commonly indicated as a dog to human ratio.

Population estimation: where the number of owned dogs is not registered by licensing, it may be estimated by questionnaire surveys (Sub-annex 1), or from the records of licensing of dogs In the case of surveys, care has to be taken that randomly selected respondents from representative human population are interviewed. A minimum number of unowed or unsupervised dogs can be estimated by street counts. In orther to do that representative districts of the area under study have to be chosen. These can be a number or streets, or quadrants.

The most important items of information on dog population for planning and surveillance are as follows:

Indices: These techniques involve establishing a relationship between the number of animals present in an area, in relation with some measurable environmental factor. While such techniques were developed for application in rural areas, modification for urban use to obtain indices of relative dog abundance may be feasible. For example, the removal of marking of all dog faeces along sample roadways and subsequent counts of fresh or unmarked deposits for a set number of days (number of faeces/km/day) immediately before and after an intensive stray dog elimination programme, may be a feasible technique-. The difference between the number of old and new deposits should be directly proportional to the reduction in street dogs and thus provide an indicator of the percentage of dogs removed, eventhought the size of the original population was unknown. At the same time faeces could be used to search parasites of zoonotic interest.

Habitat: Dogs inhabit a great variety of different habitats. An analysis of these habitats should reveal the abundance, distribution and predictability of resources (shelter, water, and food) for dogs. Once the resources determining the carrying capacity of a habitat are known, it might become possible to influence dog abundance by habitat control e.g. by removing an important food resource.

Dog movements: The analysis of the use of space by mammal includes the investigation of actual individual movements to feeding places, shelter, breeding places, females in heat, etc. Daily movements within a home range or territory must be distinguished from dispersal

movements. In mammals, most dispersal activity occurs in a short period before or at sexual maturity. The dispersal movement leads away from the place of birth or from the parents to another place or group.

Population structure and turnover of a dog population is determined by a great number of different factors. Its analysis depends on vital statistics, which could be considered in the near future in Jamaica, such as sex and age ratios, natality and rearing success, and survival and mortality rates. Since dog population of free-living wild animals, it might be necessary to evaluate data fore separate sub-populations of owned and unowned dogs, of defined and free ranging dogs, of dogs kept for different purposes, etc. The information on dog demography can be related to the incidence and spread of density-dependent diseases as a basis for predicting the strategy and anticipated results of dog immunisation and control programmes. At present, we should consider mortality causes: traffic accidents and wide variety of different diseases. Experiences in other countries shows the great number of animals die at the hands of man. A conservative estimate has been the fact that many millions are killed annually after being delivered to animal shelters as unwanted pets.

Feeding habits: Studies on feeding habitats of dogs overlap with habitat studies. Spatial and temporal distribution, predictability and availability of food are properties of the habit. Food quality, distribution and availability are heavily dependent on cultural practices and on human attitudes toward dogs. Dog-feeding habits have public health implications (hygiene, spread of parasitic diseases, etc.). They can be of ecological importance through garbage removal in one habitat, and through predation on wildlife in another situation. While the availability of garbage may be similar in many cities, the sources and abundance of water depend more heavily on climatic and cultural conditions.

Activity patterns: The behaviour of dogs varies on daily cycle. Internal factors causing variations are age, sex, phase of breeding cycle, health, etc. External factors are season of the year, weather conditions, other dogs, temporal pattern of food availability, constraints imposed by owners, etc.

Social organisation of dog population: Dogs are gregarious. They aggregate in-groups that are no random, but indicative of social organisation. Depending on the cultural setting, man restricts contact between the individual animals of a varying proportion of a dog population.

The social behaviour of dogs in the context of physical contact with other individuals, or groups of dogs within the population, as well as their contacts with humans, has important implications in connection with the transmission of density dependant diseases. Such behaviour also becomes important when dogs are in contact with other pet species in urban environments, with livestock (screwworm transmission), and with wild carnivores, specially with wild or feral dogs, along urban-rural interface or in wholly rural habitats.

Dog functions in human society: The size of different segments (owned unowned) of a dog population depend heavily on the proportion of the human population keeping dogs, tolerating dogs, or rejecting them in their neighbourhood. Dogs can be kept as pets and

companion, for hunting, as guard dogs, draught animals, for food or commercial buying and selling, etc. For certain tasks special breeds are raised. Dogs can also be rejected because they may be unclean, because they bite, or because they are disease vectors, pests or nuisances. There are qualitative and quantitative differences in what people think the function of dogs are and what dogs really do. Functions and values attributed to dogs and other aspects of the cultural and ecological setting determine the conditions in which dogs are kept how much they are cared for and the degree of supervision. Popular beliefs concerning dogs also influence the acceptance of governmental regulations and diseases control measures.

Ideas about ownership and responsibilities are also quite variable. In western societies the law and public attitude gives people the right to own dogs, but also to take care of them. Care of an animal has to include, but must not limit to, adequate shelter and wholesome food and water. The owner is responsible for ensuring that his dogs do not damage, or defecate, do not cause unsanitary, dangerous or offensive conditions on public or private property other than his own. Do not cause disturbance by exceeding barking, chase vehicles, or molest, attack or interfere with persons or other domestic animals.

Dog diseases and public health: Dogs harbour a great variety of macroparasites, such as myasis due to the NWS, microorganisms and viruses. Some of the more pathogenic ones may be important factors of mortality in dog populations. A good proportion of the infectious agents disseminated among and carried by dogs are also harmful for man. Rabies and hydatidosis are among the most important diseases transmitted from dogs to man. Dogs are also involved in the epidemiology of Rocky Mountain Spotted Fever in South Amereica, Chagas disease, Visceral Leishmaniosis, Diphyllobothriasis, Trichinosis, Dirofilariosis, Strongyloidosis, Larva Migrans of Toxocara canis, *Ancylostoma brasiliensis*. A survey conducted in Kikston, Jamaica (Robinson, 1989) shows that 73 % (n=93) of household dogs in the study area owned one dog or more (mean 1.4). Of 141 faecal specimens, 58 % contained eggs or larvae of one or more of eight helmints: *Uncinaria stenocephala* (26 %), *Ancylostoma sp.* (23 %), *Trichuris vulpis* (9%), *Spirocerca lupi* (6 %), *Strongyloides sp.* (6 %), *Apophallus sp.* (4 %) and taeniids (1 %).

Dog bite accidents are also of considerable importance for man. The amount of dog faeces deposited on public and private property becomes a hygiene problem in many cities. On the other hand there are beneficial effects of garbage and waste removal through dogs. The psychological importance of owning pet dogs has only been recognised quite recently.

The occurrence of dog diseases and their demographic importance have to be studied using the methods of veterinary parasitology, microbiology, pathology and epidemiology. Administrators involved in disease and dog control should be familiar with medical statistics and with surveillance procedures.

According with this basic information there could be outlined a checking list as follows:

PROCEDURAL OUTLINE FOS STUDUING DOG POPULATION

- Develop specific study objectives: abundance of dogs, number of unowed dogs, accessibility of dogs for control and preventive medicine activities.
- Choose study areas(s) of appropriate size: 20-100 km2, 500-5,000 households.
- Prepare and adapt maps of study area(s). (Use Epimap).
- Define major habitat types and cultural usages: natural habitat elements, man-made elements, and socio-cultural elements.
- Determine and plot major concentrations of food, water and shelter for dogs.
- Delineate area size of major elements.
- Tabulate habitat data.
- Determine types of dog population data to be collected: field observations, questionnaire surveys, etc.
- Determine techniques for selection or stratification of sample units: roadways, quadrants, major habitat types, etc.
- Determine method of data analysis.
- Collect data.
- Analysis data: tables, graphs, photographs, descriptive texts, etc.
- Prepare report on procedures, results and conclusions.

Techniques that can be used to obtain estimates of dog population:

Census: When the existing conditions are favourable in terms of a good co-ordination among the Ministries of Health an Agriculture, Universities, Schools associated with public Health activities, could be feasibly to conduct a census of owned dogs population, by

means of an appropriate survey format. Under these conditions, a census house by house, covering the entire population could be achieved.

Alternatively, it could be done taking a "sample" of the population using defined criteria of inclusion, and procedures. Example: consider the entire squares of the chosen city, classify them by socio-economical strata or other comprehensible variables. Decide how many houses are needed to have a representative sample of the entire household in the city. Take a criteria of interview the firs, second, etc, house, the alternate houses, etc. This procedure departs from the statement that the number of dogs in each house is the same for all houses. The resultant data should be multiplied by the number of houses in the considered square, and so on for the entire city or town.

An excellent opportunity to do so should coincide with a national population census, other public health activities such as the child's census for vaccination, the vaccination campaigns, etc.

Total direct counts: this method simply consists of making direct visual counts of individual dogs in a defined geographical area and within a limited period of time. In order to meet the assumptions that: mortality, emigration and recruitment into the population are minimal during the period of census, or that corrective factors can be incorporated into resultant estimates; and that all individuals within the population to be estimated have equal chance of being counted. Direct counts gives reasonable good results in small cities or communities and in rural situation when dog populations are small (Gipson, 1982).

Under certain conditions, estimates of density may also be obtained by counting dogs along stratified samples randomly selected streets or in quadrants. These data can then be extrapolated to the entire study area. If this technique is used, it is important that statistical expertise be obtained to determine appropriate sampling procedures and data analysis.

Ratio: Reliable estimates for dog populations are still rare. In general, American and European countries report a dog to human ratio between 1:10 and 1:6. But there is no doubt that the ratio varies considerably from country to country, or even among areas in the same country. In different areas of Mexico City the ratio varies between 1:10 and 1:1 (Rangel et al, 1981). As a general rule, the ratio of owned dogs to people in greater in the more rural areas of a country.

Very little is known about the abundance of stray and feral dogs in rural areas. A few reports indicate that unowed dogs in rural areas are found wherever they are looked for (McKnight, 1964).

Rate of capture. - Assuming certain constraints such as closed population, equal intensity of capture effort and probability of capture, and unvaried environmental conditions, estimates of dog populations can be obtained by potting on graph paper either the sum of daily captures, the cumulative sum captures, the probability of capture of the catch-effort required. Plots can be smooded and/or extrapolated to provide estimates of dog population

size. A limitation of such procedure occurs when the estimation is performed in conjunction with stray dog elimination programmes.

Estimates from capture-recapture procedures: The reliability of these techniques is dependent upon the same assumption made above. This technique is commonly known as the "Peterson Jackson" or "Lincoln" index, and are based on the use of a simple ratio obtained by capturing a number of individuals, marking or tagging them and releasing them back into the population. The population is subsequently sampled again by trapping and the total dogs caught and numbers that are marked are determined. The population estimate is then obtained as follows:

$$\frac{\text{Estimated dog population}}{\text{No. of dogs caught, marked And released}} = \frac{\text{No. of dogs subsequently caught}}{\text{No. marked dogs recaptured}}$$

Or

$$\text{Estimated Population} = \frac{\text{No. of dogs initially trapped, marked and released} \times \text{Total No. of dogs subsequently caught}}{\text{No. of marked dogs recaptured}}$$

The statistical procedure currently described as the most suitable for analysis of capture-recapture data should be consulted (Jolly, 1965; Caughley, 1977)

Dogs in urban areas do not have to be physically captured to mark them. Studies in Baltimore (USA) used a method whereby dogs were "marked" by photographing them. Subsequent sampling then determined the number of "recaptures" on a given day based on the number of dogs that has been photographed previously. In these studies a modification of Schnabel´s statistical analysis for multiple recaptures was used. This technique has the advantage of reducing sampling error since capture ratios are averaged.

Depending upon local acceptance, this can be done in urban areas, by using a commercial available livestock-marking pistol that fires paint balls containing different colour paints. Another way to mark dogs for later derivations of population estimates is to place permanently affixed coloured collars. One for each captures.

ESTIMATING THE NUMBER OF FREE-ROAMING DOGS

(From: Alan M. Beck. School of Veterinary Medicine. University of Pennsylvania, Philadelphia, PA. 19104, as annex 2.3, in: Guidelines For Dog Rabies Control. WHO. VPH/83.43).

Introduction: Be consistent in your observations. Use the same methods and time or day for your observations and maintain careful records. Make observations during the time of maximum activity for the dogs in the area. As a general rule, free-roaming dogs are best observed in the early mornings, a time of maximum dog activity, less human activity and good visibility. Take advantage of local areas that are best for observation: specific market streets, dump sites and known pathways. Maps of the study areas are very useful; prepare work sheets to aid the user.

Methods for estimating numbers: Several methods require nothing more than being able to observe and photograph each individual animal and plot its location on a map of the area. Doing both at the same time permits estimating the population using two different methods. Once an estimate is developed for a specific study area of known size, the population can be assumed to be the same for similar areas. Several different study areas can be samples when necessary.

Photographic "recapture" method: It is not actually necessary to capture and mark animals if they can be individually distinguishable so as to determine recaptures. Dogs are so variable that they lend themselves to this sampling approach. It is difficult to remember every dog observed, but photographing every individual dog while surveying the same area, in the same way on two or more occasions, will generate the data that can use the recapture proportion:

Where:

N = Mn/n.

M = the number of animals observed for the first time
n = the total number observed te second time

m = the number of animals observed again: recognised by identifying marks; and
N = an estimate of the total population

It is generally better to employ a multiple observation/re-observation technique as the ratio and then averaged, reducing sampling errors. Each day, the study area can be surveyed, by foot or car, and every dog within a given distance, e.g. one-half block, can be photographed. The data can be tabulated and the population estimated using the following formula:

$$N = \Sigma\ (Mn)/\ \Sigma\ m.$$

Where:

M =	The number of dogs photographed each time and considered “marked”, i.e. “observed”.
m =	The number of dogs recognised as being previously photographed i.e. “re-observed”.
Σm =	The summation of m to that point in time
n =	The total number of dogs previously observed, i.e. each day´s observations (M) less those previously observed (m) would be added to each day
Mn =	The product of each days M and n.
Σ(MN) =	The summation of Mn to that point in time; and
N =	The population estimate.

Table 1
Dogs observed during four days of surveying a one-quarter square mile area. All surveys between 6-7:30 am.

Day	M	m	m	n	M – m	Mn	(Mn)	N
1	14	0	-	0	14	0	-	-
2	13	3	3	14	10	182	182	61
3	10	3	6	24	7	240	422	70
4	11	5	11	3	6	341	763	69

If only the first two days are considered, the population would be calculated to be:

$$(14)\ (13)/3 \ = \ 182/3 \ = \ 61$$

If the first three days and the last three days are each grouped and treated as two sampling periods, the observations of the last three days would also be grouped as the observations of the “second” sample and the population would be calculated to be:

$$(14 + 13)\ X\ (10 + 11) / (3 + 5) \ = (27)\ (21) / 8 = 567/8 = 71$$

The multiple observation of all six days would be calculated to be:

$$763 / 11 = 69$$

Photographic identification has many advantages over actual capture as there is no possibility that the dog will develop a fear of trapping and is much faster, and safer, than having to bait and check traps. No handling of animals is necessary.

Methods for estimating numbers with removal

In many areas, intensive dog capture programmes are underway. These programmes often keep records of the number of animals captured and removed from the population. These records can be used to estimate the animals present in the population.

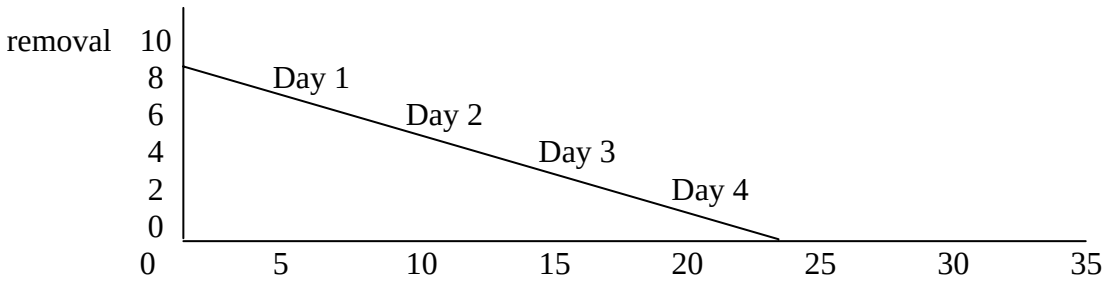
Removal method estimate:

If the removal of dogs lowers the population, it is theoretically possible to calculate the decline to estimate the total number of animals that could be "theoretically" removed. Plotting the numbers removed each day against the accumulated total removed to date could be extended to the point where, theoretically, all animals are removed, i.e. the total population that was present in the area.

Table 2
The number of animals removed on four consecutive days

Day	No. removed	Previously removed
1	9	0
2	6	9
3	5	15
4	3	20

Plot of animals removed from table 1.



In reality, rarely are enough animals removed to make such a plot very useful. However, grouping the numbers removed e.g. totals removed per truck or per day, over a period of time can be treated as two captures and analysed using the following formula:

$$N = \frac{(Y_1)^2}{Y_1 - Y_2}$$

Where:

Y_1 = The number removed the first time
Y_2 = The number removed the second time
N = The estimated of the population

As an example: Treat the total captured on the first two days and the total captured on the last two days. 15 and 8 respectively, from table 2 as two captures:

$$N = \frac{(15)2}{15 - 8} = \frac{225}{15 - 8} = \frac{225}{7} = 32$$

This is approximately the number calculated using the plots of all four days. Unless the capturing significantly lowers the population faster than it can recover, this method is less useful than the capture methods.

Estimator for unidentified individuals:

It is not necessary to actually remove animals from the population, but treat them mathematically as if they were removed. The location of individual dogs (or groups of dogs, including groups of one dog) can be plotted on local maps during daily surveys of an area. These "dogs" (dots on a map) can then be removed on paper and the data can then be treated as if the dogs were really being trapped and removed.

To obtain the needed data, survey the population by marking rapid, cursory observations plotting the location of the animals on a map of the area. The counts are incomplete since not every animal will be seen, nor is it necessary to try to do so. Each day's survey should be plotted on a different, but identical map of the same area under study. After several days' maps are completed, superimpose tracing paper on which identical square plots, representing a small portion of the area, have been drawn. The plots should be small enough so as to include only a few dogs at a time.

Count the number of dogs in a plot, record that number and mark the plot. Place the same tracing paper over each day's map but do not count the dogs that occur in plots that had dogs in previous days. If movement between the plots statistically cancel each other, not counting dogs that occurred in plots on earlier days is analogous to removing them from the population. Groups of dogs, (including as group, just one dog) can be counted instead of individuals, then multiplying the final estimate by the average number of dogs in a group to obtain the estimate of individual dogs present. In practice, the maps can be generated while also photographing the dogs as previously explained. A series of identical aerial photographs of an area can be used if they were taken at the same time every day and dogs are visible of them.

The data are analyzed by the following formula:

$$N = \frac{X_1}{1 - \sqrt{\left(\sum_{i=2}^{n} X_i \Big/ \sum_{i=1}^{n-1} X_i\right)}}$$

Where:

X_1 =	The number "removed" on the first survey
X_i =	The numbers "removed" during any survey from the first (i=1) to the last (i=n) surveys

Example: The number of dogs counted in plots that were removed from consideration of four consecutive days were: 9,6,5 and 3. Using the above formula, the population would be calculated to be:

$$N = \frac{9}{1 - \sqrt{\frac{6+5+3}{9+6+5}}} = \frac{9}{1 - \sqrt{\frac{14}{20}}} = \frac{9}{1 - \sqrt{0.7}} = \frac{9}{1 - 0.84} = \frac{9}{0.16} = 56$$

Change in ratio

Significant removal of animals during a dog catching campaign, should also influence the number of dogs observed, e.g. dogs observed at a dump site between 6-7 am. or their tracks (after old tracks are swept clean).

The logic is simple and easy to use:

$$\frac{C_1}{N_1} = \frac{C_1 - C^2}{R} = \frac{C_2}{N_2}$$ Therefore: $N_1 = R(C_1 - C_2)$ and $N_2 = R(C_2)/(C_1-C_2)$

Where:

C_1	The number of animals counted before removal
C_2	The number of animals counted after the removal
R	The number of animals removed during the study, and
N_1 and N_2	The numbers of animals that were in the population before and after removal, respectively

Example: An average of 14 dogs were observed daily around a dump before a week of intensive dog catching; then the average dropped to 9 dogs per day. During the study period 63 dogs were removed from the area. The population before and after the capture programme can be calculated as follows:

$$\frac{14}{} = \frac{14 - 9}{} = \frac{9}{}$$ Therefor: $N_1 = 14(63)/5 = 176$

N_1 63 N_2 $N_2 = 9(63)/5 = 113$

This method can be implement periodically to monitor the effectiveness of control programmes and detect changes in the population.

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