1. INTRODUCTION

Dog rabies is still present in 87 of the 156 countries and territories listed in the FAO/OIE/WHO Animal Health Yearbook. These reservoirs are responsible for more than 99% of all human rabies cases recorded worldwide and over 90% of all human post exposure treatments. The severity of the disease and the resulting economic burdens are of such a magnitude that elimination of the disease in dogs has become imperative.

One of the research components of the WHO programme for the control of human and canine rabies concerned the ecology of the dog. However, precise information on the dog population in relation to rabies control was largely lacking when WHO launched the Arab Gulf Programme for UN Development Organizations (AGPUND/Radda Barnen/WHO Programme for Human and Canine Rabies Control in developing countries).

Within the framework of this Programme data were obtained on the dog populations, their composition, turnover, supervision, accessibility and vaccination coverage in pilot projects in Ecuador, Sri Lanka and Tunisia. The results led to new concepts in both vaccination and stray dog control policies which may be widely applicable in other areas of the world. The similarity of some major features of dog populations found in the study areas, as well as in dog accessibility studies in some other countries, are of particular significance.

This research revealed that (i) whether owned or unowned, dogs which are not catchable by at least one person are rare and represent generally less than 15% of the dog population; (ii) dog removal programmes are ineffective; (iii) vaccination rates of up to 80% can be attained, although this requires special efforts in mobilizing community participation and organization of immunization campaigns.

As shown in the following report, dog ecology data relative to rabies control can nowadays often be obtained during the vaccination campaign itself, at no, or relatively low cost; data can particularly be obtained regarding assessment of vaccination coverage and the rate of recruitment of young, unvaccinated animals into the population following a vaccination campaign.

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List of participants is attached as Annex 1.
The information provided in this report should encourage national authorities and communities to re-assess rabies control and to plan and initiate projects for increasing the effectiveness of programmes for the elimination of dog rabies. Emphasis will have to be placed on health systems research in order to take advantage of the theoretically high rate of dog accessibility for vaccination. Of immediate concern and great significance is the suggestion that activities aimed at reducing the dog population by killing free-roaming animals should be discontinued unless ecological studies prove their effectiveness outweighs the adverse effects on public cooperation, and the stability of the dog population.

2. DOG ECOLOGY FINDINGS

2.1. Main results from AGFUND/Radda Barnen/WHO pilot project areas (Ecuador, Sri Lanka and Tunisia)

The data below are drawn from report to WHO by Drs Beran and Frith on dog ecology in Guayaquil, as well as from preliminary reports to WHO made by Dr Artois and Mr Matter (Tunisia), and by Drs Wandeler and Wieser (Sri Lanka). Individual and joint publications are in preparation.

2.1.1 Dog population, size and density

The percentages of surveyed households with one or more dogs are 87% in Tunisia, 60% in Ecuador and Sri Lanka. In the Tunisia study area there are, on average, 2.3 dogs per dwelling in Ecuador, 0.8 dogs per household; in Sri Lanka, 7.2% of households own 3 dogs or more. A graph showing the number of dogs per family in Sri Lanka is attached as Annex 2. When compared to the human population one finds 1 dog for every 8 inhabitants in Sri Lanka, 1 for every 7.2 in Ecuador and 1 for every 3.5 in the five rural zones of Tunisia. The Sri Lanka data show that this ratio varies according to land use patterns; 1 dog per 6 - 9.5 inhabitants in paddy fields, suburban and urban zones, versus 1 per 13.5 in areas where 'slash and burn' agricultural practice is used. In Guayaquil, the ratio of people per dog was 7.1:1 in upper class, 8.8:1 in middle class and 9.2:1 in lower class households. By districts of the city, the ratio varied from 5.8:1 in the lowest socio-economic residential district to 11.0:1 in the central commercial district to 7.6:1 in the suburban districts. Dog population density, according to the surveys per km² varies in Sri Lanka from 30 in rural zones of rain-fed crops to 3700 in urbanized areas. In Guayaquil the overall reported density was 1792 per km², with ranges from 2400 dogs (approximately) to 681 per km², according to the urban sector. In Tunisia, a density of 15 dogs per km² in a rural semi-arid area has been observed.

2.1.2 Age structure and sex ratio

Based on the questionnaire surveys, the age group below 1 year of age represents 24% of the total owned dog population in Sri Lanka, 27.5% in Guayaquil and 29.6% in Tunisia (see graph in Annex 3, page 1). The mean age of dogs is between 3 and 4 years in Sri Lanka, and only 2.5 in Tunisia and Guayaquil. A life table for the dog population of Guayaquil is shown in Annex 3, page 2. In Guayaquil, 18.6% of the dogs were classed as purebreds, 21.5% as crossbreds and 59.9% as native breeds. Crossbred dogs had the longest life expectancy (see graphs in Annex 3, page 3).

In all areas surveyed, males predominate, with 65.6% of observed population in Tunisia, 60.9% in Guayaquil and from 50% to almost 89% in various zones of Sri Lanka. This consistency from one study area to the other is easily visualized in Annex 3, page 4.

2.1.3 Reproduction rate and mortality of offspring

In Tunisia, 67% of mature females whelped at least once during the observation period of one year. The average litter size was 3.9 puppies. In Guayaquil, 36.4% of females whelp by one year of age. The mean litter size is 4.9 puppies. In Sri Lanka, postmortem examinations showed a surprisingly high proportion of bitches with inflammation of the uterus and fetal resorptions.
In Tunisia, 61% of the newborn animals are killed by owners. Half the remaining pups die of disease or malnutrition or just disappear in such a way that only 20% of animals born survive weaning. In Guayaquil, where owners do not seem to control the litter size in any way, 16% of pups are reported to be stillborn and 22.5% of liveborn puppies die before weaning. Still, in Guayaquil, almost 64% of mature female dogs have never whelped and only 29% whelped during the six months preceding the survey; 66.4% of the whelping sites were intentionally provided within household premises. Differences in puppy survival between Ecuador and Tunisia are shown in Annex 4, pages 1 & 2.

2.1.4 Population turnover

In Tunisia, mortality, reproduction, immigration and emigration rates ensured a stationary dog population. Dog population growth is directly linked to increase in human population. The calculated annual growth rate of the dog population in Guayaquil is 3.75%, and each year an estimated 13.6% of the total population of dogs (28,600 puppies in 1985) reach vaccination age of 3 months and an additional 18.3% (37,900 in 1985) reach one year of age. This provides an annual recruitment rate into the adult population of 32.1% (66,500 dogs in 1985). In Tunisia, where an estimation of the rates was made, it was observed that 30-35% of the initial dog population is replaced by new animals after one year. After two years, more than half this population is renewed.

2.1.5 Status and origin of dogs

In each study area it has been shown that most dogs were associated with either individual household or several households (semi-restricted dogs). In Sri Lanka less than 10% of the total observed dog population was unowned. In Tunisia, 7% of the dog population is feral, and in the survey blocks of Guayaquil, no dogs were identified which were not associated with any household. Most feral dogs in Tunisia and Sri Lanka originate from the owned dog population, although reproduction within this population may be, under certain conditions, successful.

Considering the origins of the owned dog population, more than 70% of the dogs are gifts made by relatives or neighbours (75.1% in Sri Lanka and 71.6% in Guayaquil), and approximately 10% are bought (8.5% in Sri Lanka and 11.5% in Guayaquil). Only 12-13% are born and retained in the same household, and about 4% are adopted from the streets or neighbourhoods in these two countries (see graphs set out as Annex 5).

2.1.6 Level of dog supervision and utilization

In rural zones of Sri Lanka about 28% of the owned dog population is said to be tied up all the time according to questionnaire surveys. In Tunisia only 14% were observed to be always restricted to the household premises, whereas the percentage obtained by questionnaire was around 43%. In addition, in Tunisia 11% of the owned dogs cannot be caught by their owners. In Guayaquil, 20-36% of the dogs, depending on socio-economic levels of the households, were unrestricted (see graphs in Annex 6, pages 1-3).

With regard to dog utilization, in Sri Lanka, dogs are kept as pets or guard animals. In Guayaquil, 70% are reported to be guard dogs, 18% pets and 12% are both varying among socio-economic classes (see graph in Annex 7). In Tunisia, most owned dogs are guard and/or shepherd dogs.

2.1.7 Rabies vaccination coverage

In Sri Lanka the dog vaccination coverage following a single mass vaccination campaign is estimated to be around 50% of the total dog population in the vicinity of vaccination centres and 30% in a larger public health inspection area. In Tunisia, under the same conditions, the observed vaccination coverage was between 35 and 75% in the surveyed areas. In Guayaquil, an initial citywide dog vaccination campaign through the 21 established health centres reached only 27.5% of the dog population. During the following 9 months, a city-wide house to house campaign by brigades of vaccinators was carried out, and led to an overall dog population coverage of 81.3% with 97.6% coverage of dogs of about 5 years, 96.4% of dogs 1-4 years and 78.8% of dogs 3-11 months of age.
2.1.8 Dog elimination campaigns

In Sri Lanka where wide dog elimination operations have been performed systematically since 1977, it is shown that in spite of apparently high yearly outputs (35-50,000 dogs a year) these activities were not reaching more than 5% of the total dog population. In addition, laboratory examinations of sera collected from eliminated dogs showed demonstrable rabies antibody titers in 4% of the sample. A retrospective analysis of the results of the sustained dog elimination campaigns made in Guayaquil from 1980 to 1983 shows that even an elimination level ranging from 25-12% of the estimated total dog population did not durably affect the size of the target population and did not durably reduce the canine rabies incidence.

2.1.9 Nutritional and other resources of the dog

The three studies demonstrated that almost all resources of the dog populations, including feral dogs (i.e. foodstuffs and shelter) originated from the human population.

2.2 From Zimbabwe

A dog population ecology study in Zimbabwe, carried out by personal interview and questionnaire on 4,740 households gave the following results.

There was an average of 0.91 dogs per household, with 41% of households owning one or more dogs. In those households that owned dogs there was an average of 2.2 dogs.

The dog:people ratio in urban areas was 1:16, and 1:4.5 in communal lands.

The average dog density per km² was 3.4 (68/km² in urban areas and 6/km² in communal lands).

The average age of dogs in Manicaland was 2.3 years (2.0 for female and 2.5 for male). Estimated life expectancy was 4.6 years. The sex ratio of adult male:adult female was 0.56:0.44, with 20% of the dog population less than 3 months old.

Guarding was the predominant reason for keeping dogs and there was a direct relationship between owning dogs and owning cattle. Twelve per cent of the dog population of Manicaland were classified as being feral (fully unrestricted, unsupervised dogs) by the householders interviewed; 2.8% of the owned dogs could not be caught by their owners.

The dog rabies vaccination level for Zimbabwe as a whole was estimated at 40% for 1985/86.

3. Improvement of technologies and techniques for the collection of basic information on dog populations

The experience gained in the ecological research projects under review not only concerns the ecology of dogs but also the methodology used. The following findings and comments supplement the procedures described in the WHO Guidelines for Dog Rabies Control (VPH document 83.43, Rev.1, 1987).

Data should be gathered on the size, settlement patterns and density, social structure, religious affiliations and organization of the human population. Data on the size, sex ratio, age structure and turnover of the dog population should be collected. Data should also be collected on the relationship between people and dogs, the relative dependence of dogs on intentional human provision of essential needs, on the restriction of dogs by people, and on their accessibility to control programme personnel. It is recommended that an assessment also be made of the knowledge, attitude and practices of the community as educational and motivational needs for rabies control programmes.

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1C. Foggin & B. Parry: Dog population study in Zimbabwe, 1987 (in press)
3.1 Technologies and techniques

3.1.1 Surveys

a) Preliminary survey. Qualitative surveys should be carried out in representative communities or neighbourhoods to reveal the most influential social and ecological determinants on the dog population size, structure and relationships to humans. Accessibility of dogs to rabies control personnel and volunteers should be the first factor to be examined. In small communities, where the majority of dogs is easily accessible, the ecological questionnaire survey and/or dog marking can be conducted simultaneously with vaccination campaigns. In communities suspected of having dog accessibility problems, and in larger communities requiring operational research for planning, a formal survey should be carried out in randomly selected sample squares.

b) The main survey. This should associate (i) a questionnaire survey combined with an observation inventory and (ii) visual techniques. Adaptation of the survey methodology to the study area according to the data collected during the preliminary survey and priority given either to questionnaires or visual techniques. The advantages of securing community participation during the implementation of the main survey are given in (iii) participatory research, see below.

(i) Questionnaire survey and observation inventory. This is conducted to quantify and assess through the direct observation inventory the significant parameters that emerge in the preliminary survey. Taking into consideration the population strata and community organization, the following procedure should be followed:

- interview of community leaders and a cross-section of community members.

- obtaining the best census data (man and animals) and available maps of the area concerned.

Sampling techniques should be adapted to the study area. In villages of under 500 families, all households should be surveyed. In larger communities and cities, samples must be large enough to be statistically reliable. Survey findings from one community should be extrapolated to other communities only with great caution. Smaller surveys in these communities may be used to validate the applicability of earlier inventories.

(However, it should be noted that the combination of the two surveys should only be applied where supplementary studies as described above help to assess a possible bias. This is particularly important in the determination of the actual dog population size.)

The team in Ecuador merged the two standard questionnaires (i.e. (a) for dogs and (b) for households), see Guidelines for Dog Rabies Control, VPH/83.43 Rev.1, page 2-49, merging which appears justified since the overwhelming majority of the animals were verified to have a reference household(s). This simplified the procedure and permitted the recording of more than one dog on a single sheet. However, it should be noted that the combination of the two surveys should only be applied where supplementary studies as described above help to assess a possible bias. This is particularly important in the determination of the actual dog population size.

It should be noted that surveys based on questionnaires alone may lead to a preponderance of data concerning restricted and semi-restricted dogs. This is especially true in rural communities where dogs may regularly move around over large areas. In areas where relatively unrestrained dogs predominate, capture/recapture and dog accessibility studies will help to correct such biases, and may be adaptable to cities where a large proportion of dogs are inaccessible to immediate observation.

(ii) Capture/recapture techniques and dog accessibility studies (visual techniques). Where intensive vaccination campaigns are executed or planned, dogs in about 500 neighbouring households may be marked at vaccination and re-observed at subsequent intervals so as to assess unrestrained, semi-restricted and restricted dogs. The proportion of marked/unmarked dogs may be used to estimate the dog population size (see Guidelines for dog rabies control, page 2-5). Where vaccination campaigns are initiated after an initial questionnaire survey, marking/optical recapture methods should be conducted as operational research during the campaign.
It should be kept in mind that any visual technique is only able to provide a valid picture of the real situation at times when most or all dogs are at or near human settlements. In many areas, e.g. in rice-producing countries, this happens when farmers return from their fields (between 16h00 and 18h00) and/or simultaneously when other family members return (from school or other types of work).

In addition to the research projects in Ecuador, Sri Lanka and Tunisia, the consultation reviewed results obtained by simple dog accessibility studies carried out in four locations in Nepal and in several locations in Indonesia (Java and Bali). Accessibility of dogs is therein defined as the percentage of dogs in a given population which can be reached by a person without any special effort. In most cases this person is a member of the household to which the dog belongs. Those dogs which are associated with a household are considered as accessible, as well as dogs which can be approached and touched easily by a stranger (e.g. interviewer). The thoroughness of this inventory can often be augmented when neighbouring children are available to guide the interview team to "hidden" dogs.

Simple recording of any visible marks of ownership (e.g. collar) and interrogation of people about the household relation of the dog revealed in the study areas of Nepal and Indonesia that over 70% of the animals were associated with one or more households. The remaining animals were approached by the interviewer (a stranger) and their reaction recorded (friendly, fugitive, defensive/aggressive). This brought to 85% the proportion of accessible dogs in all places studied above. It should be noted that recording of about 100 dogs in this way can be carried out within a few hours. The consultation group recommends that, at the same time additional information on the sex ratio be noted and possibly be obtained on the extent of supervision (restricted, semi-restricted and whether owner is "nearby"). Puppies should be recorded in respect of litter size. It is also advisable to make enquiries in the neighbourhood on the existence of litters because these tend to be hidden and can be missed by the inventory.

Although accessibility can be recorded in this simple manner, actual mobilization through community participation (see next paragraph and Annex 8) so as to take advantage of the surprisingly high accessibility rates, remains a most important factor. Much more emphasis is needed on this aspect in conjunction with health systems and operational research (see section 5.7 in research requirements and recommendations, and Annex 9).

(iii) Participatory research. Human demographic and social data, dog population and structure, community resources, knowledge, as well as qualitative and quantitative data on all relevant factors can be collected, assessed, applied and evaluated by community residents. The implementation of techniques (i) and (ii) above by community members ensures adequate adaptation to community capacity, and relevance of the data collected to the socio-ecology of the community is assumed. In addition, when ecological research is embedded in the context of a participatory health system control campaign, it increases community awareness in indigenous terms of the rabies problem; it increases the sense of community ownership and control over the rabies problem and its solution; and it builds community self-reliance towards the provision of primary health care.

A "community" is here defined as the smallest self-recognized aggregation of households, i.e. neighbourhood, barrio or kampung. Participatory rabies research should inventory every household in the community and involve as many individual community members as possible. In the case of a collection of such communities in a town or city, intersectoral collaboration should be instituted in support of each neighbourhood programme.

3.2 Basic dog population parameters related to rabies control

3.2.1 Population size

A general deficiency of most rabies control projects is the inaccuracy of the estimates of the actual dog population size. It is neither difficult nor expensive to combine initial vaccination schemes with marking of vaccinated/captured dogs and to assess through visual recapture techniques the true population size supposing that marked and unmarked dogs have equal chances of being recorded so that the bias can be estimated.
Accurate dog population estimates form the basis for marshalling human and material resources, and provide the base-line data for subsequent vaccination coverage and ecological population control programme evaluation.

3.2.2 Sex ratio

Sex ratios can be determined from information collected in questionnaire surveys and/or at the time of vaccination. If differences in the two findings are observed, this may indicate sampling biases which should be investigated. Sex ratio data will be needed for understanding population dynamics and canine reproduction patterns.

3.2.2 Age structure and population turnover

Data regarding age should be collected by months/years in questionnaire surveys and/or at the time of vaccination. The size of the unvaccinatable population (under 3 months of age), of the juvenile dogs entering the vaccinatable population, and the portion of the adult population which is unvaccinated are all data needed in planning vaccination strategies. The annual recruitment into the dog population of unvaccinated dogs may be estimated from the proportion of the population between 3 and 14 months of age. This is important in determining the interval between vaccination campaigns.

Two observations signify the necessity to particularly investigate the dog population up to one year of age, namely: (a) the fact that in Guayaquil rabies cases have predominantly or almost exclusively been reported in this age group after vaccination campaigns of seemingly high population coverage (i.e. 80%), and (b) the fact that the rate and selective killing of puppies by those providing food and care may vary considerably from place to place. In Tunisia, for example, about 60% of puppies and of these 65% of the females were removed from the population during the first months of life. Rabies cases following a vaccination campaign should be thoroughly investigated and include the animal's history (e.g. whether indigenous in the study area, or imported).

3.2.4 Levels of dog supervision

Vaccination strategies are closely related to the level, daily duration and purpose of dog supervision. Information on this important parameter can be obtained through questionnaire surveys as described above, and from the WHO Guidelines for Dog Rabies Control (WHO document VPH/63.43, Rev.1, 1967). Simplified dog accessibility studies requiring less than one day for two persons may also reveal essential data (see 3.5 below). The level of dog supervision must, however, be examined during the first phase, or pilot project, of a large-scale rabies vaccination campaign. Preparation of a vaccination campaign (e.g. through schools), organization (e.g. neighbourhood centres or house to house visits) and implementation (time of day, incentives) may have a considerable influence on the proportion of animals presented as well as revealing varying levels of dog supervision.

In view of the importance of this parameter, the consultation strongly recommends that great emphasis be placed on this question, along with dog accessibility studies in phases of health systems research in relation to rabies control conducted during the implementation of a control programme.

3.2.5 Dog vaccination coverage

A total population vaccination level of 80% is desired. Following each campaign the coverage can be determined by comparing vaccination records to dog population size, or by a separate survey. The vaccination coverage is especially important in juvenile dogs recruited into the vaccinatable population. Repeat vaccination campaigns should be conducted when the population vaccination level drops below 60%. In many areas repeat campaigns must be conducted annually and special efforts made through motivational campaigns to have puppies presented for vaccination on reaching 3 months of age.

The marking of vaccinated dogs is important, using as long lasting a method as possible and definitely until evaluation of vaccination coverage has been completed. Economy of such marking is important if the government has to provide the markers as part of the rabies control programme. Dye or paint marking on the forehead, collars made of plastic
tubing threaded with light wire or of nylon or polyethylene rope may be considered according to local conditions. It is important that collars are not harmful, not easily removed and have no alternate consumer utility.

4. CATEGORIZATION OF INDIVIDUAL DOGS ACCORDING TO RESTRICTION AND DEPENDENCY ON HUMANS

Comparative studies on the ecology of dogs in different countries have been hampered by the lack of distinct nomenclature and clear definitions for dogs living in a variety of relationships with their human host population. While it is important to use terms that have clear local meanings, a method is needed in these studies to translate these terms to a uniform classification.

Some of the terms employed in the past include: pet dog, owned dog, community dog, roaming dog, partially protected dog, feral dog, and stray dog. Especially when translated from two or more indigenous frames of reference, these terms become almost meaningless for comparative purposes. The consultative group felt, therefore, that dogs should be categorized on the basis of two parameters that are observable, measurable and meaningful under the widest range of socio-ecological conditions met so far by dog ecologists. These two parameters are the level of a dog's dependency on humans and the level of its restriction by humans.

The term stray dog has been particularly troublesome in that (i) very few dogs have been found to have absolutely no association with one or more reference households, and (ii) the term has become synonymous with dogs that must be destroyed. The consultation echoes a proposal that the term no longer be used in an ecological context but rather be reserved for use by animal control officers to apply to dogs not in compliance with local dog ordinances, e.g. not confined/restricted, not on leash, not vaccinated and/or marked/identifiable. Stray dog thus refers to a regulatory situation which generally permits removal of the animal temporarily or permanently from the population.

4.1 Level of dependence

Dependence describes a dog-man bond based on intentional provision of food, physical shelter, care and any other action to meet the social needs essential for the survival, propagation and well-being of the dog. Thus it excludes unintentional associations of dogs with humans (e.g. feeding in dumping places, shelter in buildings, etc) as these could also apply to feral dogs in their ecological niche. In this sense, dependency of dogs on humans is a gradient between total and none at all. The consultation proposes the following three categories: full, semi, no dependency.

**Full dependency:** the dog is given its essential needs intentionally by humans.

**Semi-dependency:** the dog is given a proportion of its essential needs intentionally by humans.

**No dependency:** the dog is not given any of its essential needs intentionally by humans.

4.2 Level of restriction

"Under restriction" should be understood as all physical and biological types of restriction which a human intentionally imposes on a dog. This definition refers not only to movement restriction and confinement of a dog in a human's premises but to its supervision outside these premises. A dog which is directly supervised and can be called and thus controlled by a human at any time is considered to be restricted, e.g. dog walking, hunting, herding, leading a blind person, etc). Restriction also includes measures controlling the reproduction of dogs, e.g. neutering. In the social context, restriction refers to the control of any contact, association and communication with other dogs and people. Restriction does not include the degree to which care is provided, e.g. food/shelter, since these provisions are included in the notion behind the term "dependence".
There are three major levels of restriction. In two extreme situations the dog is either totally restricted or not subject to any restriction whatsoever. It is understood that some fully restricted dogs are allowed to roam freely for some time each day near their premises to allow urinating and defaecating. Such situations in which the dog may or may not be under full supervision and control do not qualify a dog as being partially restricted. The principal characteristic of this group is that the person in charge of the animal intends to have them permanently under control.

Semi-restricted dogs are those under supervision during part of the day either through being used, e.g. hunting, herding, guarding, or for reasons of social association, e.g. affection, resting with the family, joint activities. This restriction may range from about 1-23 hours of the day. It is understood that a semi-restricted dog can become, for several days or for longer periods, a fully restricted dog, e.g. a bitch in heat or following delivery, or can become a non-restricted dog, e.g. in periods of a family's absence from their home.

The distinction between non-restricted and semi-restricted is often very difficult, but it is of significance as far as accessibility of dogs for certain disease control measures is concerned, e.g. rabies vaccination. However, the term non-restricted should not be confused with non-accessible since in many societies dogs are allowed to roam freely while being clearly related to reference person(s) and household(s).

4.3 Matrix assisting in the definition of dog categories

The matrix resulting from the two parameters described above permits a further reduction in the number of categories to possible and essential combinations of levels of care and supervision (see Table 1).

Since full restriction of dogs excludes them from being semi-dependent or independent, these combinations can be deleted. The same applies to the combination of semi-restricted and fully independent.

It is relatively easy to define fully restricted dogs which are always fully dependent on humans and those which are not dependent and not restricted which may only unintentionally be given some resources.

After thorough analysis of the other four remaining combinations in the matrix, the consultation concluded that the definition of fully dependent dogs living without any restriction as being more of an academic nature than of any practical value. Certain particular circumstances may force a dog to seek "voluntarily" all its food and shelter from humans who provide this intentionally. However, this situation implies such a close social bond that in most cases supervision and control can be exerted at any time of contact between the dog and the resource-providing person. It is much more common that dogs living under no restriction are semi-dependent, food and shelter being provided to them both intentionally and unintentionally.

5. FURTHER RESEARCH REQUIREMENTS AND RECOMMENDATIONS

5.1 Canine rabies epidemiology

Recent studies in some developing countries show:

i) a lack of knowledge on the circumstances of canine rabies transmission to man.

ii) that puppies and young dogs may be the most important age group in transmission to humans; however, other age/sex classes of dogs (e.g. aggressive males) may also be important.

iii) that non-dog reservoirs may be at the origin of dog rabies case occurrence without any other related cases in dogs.
5.1.1 The data relating to the above conclusions are:

a) existent but as yet unanalyzed (e.g. hospital statistics);
b) not scientifically collected; and
c) important in understanding how to:
   - diminish the risk of human contamination, and
   - implement supervision and/or control measures.

5.1.2 The consultation group therefore recommends the following:

i) reinforcement in standardization of reporting and publicising human exposure
   statistics, including the circumstances of surrounding contact with the virus and the vector
   (e.g. sex, age, status of the dog).

ii) study of rabies transmission between dogs and/or between a dog and an hypothetical
    reservoir (see 5.2 on land use modifications and consequences).

iii) isolation of human and animal rabies strains and their characterization with
     monoclonal antibody techniques and animal pathogenicity studies.

iv) encouragement of routine rabies reporting and diagnosis to improve the epidemiological
    knowledge in a country.

5.2 Dog ecology and land use patterns

Dog ecology can vary with the land use category, and stratification of studies by
land use may be of value. For example, in Zimbabwe, a smaller proportion of dog owning
households is reported from urban and large-scale commercial farming sectors than from
communal, small-scale farms and resettlement areas. A higher dog:people ratio is found in
rural communal areas than in urban areas, a finding also reflected in studies from other
parts of the world.

5.3 Accessibility of dogs

Accessibility of dogs defines the percentage of dogs in a given population which can
be caught by a person without special effort. House to house surveys can easily reveal
essential data if one assumes all dogs to be accessible, as when reference households are
identified or when collars or other marks indicate responsible dog ownership, or when dogs
react in a friendly way to the touch of a stranger (e.g. the interviewer). Dog
accessibility studies in two South-East Asian countries reveal a rate of over 85% of the
population. Health systems research is required on community participation needed to attain
this rate in vaccination programmes.

Accessibility rates can also be used to obtain information on the proportion of
unrestricted and non-accessible dogs which may jeopardize rabies control efforts. Research
is needed on the reliability of results obtained through such dog accessibility surveys
under different socio-economic and epidemiological conditions.

5.4 Categories of dogs

Terms widely used in literature such as owned dog, pet dog, community dog, stray dog,
are not generally suitable for comparison of conditions between different ecosystems since
these terms lack clear definition and delineation.

The consultation suggests categories of dogs according to a matrix using two
parameters, namely the level of dependence of a dog on care (e.g. food, shelter, health,
social needs) provided intentionally, the level of restriction imposed on a dog
intentionally by a human(s). This results in the following dog categories:
1. Restricted (supervised) dog: fully dependent and fully restricted
2. Family dog: fully dependent, semi-restricted
3. Neighbourhood dog: semi-dependent, semi-restricted
4. Unrestricted (unsupervised) dog: semi-dependent, unrestricted
5. Feral dog: independent, unrestricted.

The term "stray dog" should be reserved exclusively for use to define a dog not in compliance with local regulatory regulatory requirements, e.g., veterinary measures for rabies control such as confinement, leashing, immunization, etc. (see section 4).

5.5 Dog elimination

In none of the study areas did the elimination of dogs by any method (e.g., catching, shooting or other) have any significant long-term effect on dog population size. This was true even in Guayaquil, Ecuador, where up to 24% of the estimated dog population was removed in a single year, 1981-82. Since previously immunized animals were not identifiable, there was no selective elimination of unvaccinated animals, hence no positive effect on rabies control. The immediate on-the-spot response to dog removal in Guayaquil was to buy (unvaccinated) puppies or to adopt unrestrained puppies or young dogs entering the ecological vacuum created. Similar observations were made in Sri Lanka and other countries.

Since dog elimination also generally provokes animosity towards programme personnel it thus decreases cooperation in vaccination campaigns. In addition, since dog elimination in general is very cost-intensive and lacks any positive impact on the occurrence of rabies, it is not recommended. If combined with vaccination campaigns and visible marking of vaccinated dogs, however, it could possibly have a positive effect. In this respect dog owners should be given two chances to vaccinate their dogs, and a marking collar should be provided for each dog presented. The population has also to be informed that shortly after the second vaccination opportunity, unmarked (unvaccinated) dogs may be removed. It is most important to keep in mind the socio-cultural background of the population when planning and implementing any campaign. This method proved effective in Sri Lanka.

The consultative group strongly insists that programme administrators obtain proof that dog elimination has a significantly positive impact on rabies endemicity and/or epidemiology before deciding to continue dog removal. Only when negative effects (e.g., disruption of equilibrium of the dog population, loss of cooperation of community members in productive rabies control activities), have been thoroughly investigated should removal be resumed.

5.6 Population structure and dynamics

Only four parameters are useful in characterizing the demography of a dog population when planning and/or surveying a vaccination programme against canine rabies. These are: (i) population size, e.g., density per ha or km² or humans:dog ratio; (ii) sex ratio; (iii) age structure; (iv) annual turnover, e.g., proportion of new dogs entering the population.

In the AGFUND/Radda Barnen/WHO study areas (Ecuador, Sri Lanka, Tunisia) the values of the last three parameters were very similar, with particular note of the following:

i) male predominancy in the adult age groups;

ii) a young dog population with puppies and sub-adults representing between 22%-35% of the total;

iii) a dog population turnover ranging from 30% to 35% in the study areas.
These parameters can, to a certain extent, be transposed to a variety of different situations, but must be adjusted if any doubts exist. On the other hand, regulating factors remain largely unknown (control of reproductivity, immigration/emigration balance, mortality factors) and may vary greatly from one place to another. In any case, it is impossible to apply dog population density data from one country to another. Marking/recapture techniques (visual and others) associated by a questionnaire survey constitute the best method of verifying these variables. Studies must be undertaken to improve marking and ageing techniques.

5.7 Community participation

In Guayaquil, an inexpensive method of eliciting participatory learning in 1000 family circles showed that multiple cleaning objectives were met and that motivational messages can be effectively transferred to about 30% of dog-owning households. These households contain children in the most susceptible age groups. The motivational content led to spontaneous volunteer action and the voluntary offer of transport vehicles and other resources to the vaccination campaign.

In order to elicit community participation the consultative group recommends that:

i) The Quorum process (see Annex 10) should be thoroughly adapted and modified to meet local socio-ecological conditions in communities and countries where a) children are at risk of being exposed to rabies, and/or (b) other means for interactive learning through neighbourhood rabies mobilization are either not feasible or only partly practical.

ii) Other formulations derived from experience in participatory research, informal education and community participation should be adapted to the informational, organizational implementation and evaluation needs of community-based rabies control and maintenance.

iii) Community participation principles should be applied to every phase of rabies control and integrated with intersectoral collaboration in health systems and operational research programmes for rabies control. For this purpose, the following research needs have been identified:

- Community participation should be assessed as a method for instituting community rabies control programmes whose first objective is the creation of a self-sustaining process of community-based maintenance of rabies control, rather than the current planning emphasis on an expensive attack phase.

- the usefulness of community members' participation in rabies control should be thoroughly investigated.

- when vaccine is unavailable, the potential for community participation in helping to create community-specific strategies for raising the average age, health and stability of dog populations should be investigated.

- Participatory research should be employed in assessing the social acceptability of newly-introduced methods of rabies control and maintenance.
### TABLE 1. DOG CATEGORIZATION MATRIX

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. FULL RESTRICTION</strong></td>
<td>Dog is physically separated from the rest of the population on a permanent basis</td>
</tr>
<tr>
<td><strong>2. SEMI-RESTRICTION</strong></td>
<td>Dog has access to the rest of the population some of the time</td>
</tr>
<tr>
<td><strong>3. NO RESTRICTION</strong></td>
<td>Dog has free access to the population at all times</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependency Level</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. FULL DEPENDENCY</strong></td>
<td>Restricted Dog</td>
<td>The dog is given all of its essential needs intentionally by humans</td>
</tr>
<tr>
<td><strong>2. SEMI-DEPENDENCY</strong></td>
<td>Neighbourhood Dog</td>
<td>The dog is given a proportion of its essential needs intentionally by humans</td>
</tr>
<tr>
<td><strong>3. NO DEPENDENCY</strong></td>
<td>Feral Dog</td>
<td>The dog is given none of its essential needs intentionally by humans</td>
</tr>
</tbody>
</table>
ANNEX 1

WHO CONSULTATION ON DOG ECOLOGY STUDIES RELATED TO RABIES CONTROL

LIST OF PARTICIPANTS

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Other Organisations

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Secretariat

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Dr F.-X. Meslin, Scientist, Veterinary Public Health, Division of Communicable Diseases, WHO, Geneva, Switzerland

1Invited but unable to attend
Number of dogs per family
Sri Lanka

Families with
3 dogs
>3 dogs

Families with
2 dogs (14.0%)

Families with
1 dog (57.4%)

Families with no dogs (41.4%)
Age structure of the dog population

Guayaquil, Sri Lanka, Tunisia

% of dogs

<table>
<thead>
<tr>
<th>0-1</th>
<th>1-2</th>
<th>2-3</th>
<th>3-4</th>
<th>4-5</th>
<th>5-6</th>
<th>6-7</th>
<th>7-8</th>
<th>8-9</th>
<th>9-+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- includes all age groups above 6 years.
### TABLE 5

**Life Table for Dogs,**

Guayaquil, Ecuador, 1985

<table>
<thead>
<tr>
<th>Age</th>
<th>Proportion dying in interval</th>
<th>Number alive at age x</th>
<th>Number dying in interval</th>
<th>No. Years</th>
<th>Tot. Years</th>
<th>L_x</th>
<th>T_x</th>
<th>e_x</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>x,x+1</td>
<td>q_x</td>
<td>l_x</td>
<td>d_x</td>
<td>L_x</td>
<td>T_x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 mo.</td>
<td>.17</td>
<td>1000</td>
<td>170</td>
<td>457.5</td>
<td>1441.2</td>
<td>1.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-5 mo.</td>
<td>.21</td>
<td>830</td>
<td>174</td>
<td>371.5</td>
<td>983.7</td>
<td>1.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-11 mo.</td>
<td>.29</td>
<td>656</td>
<td>190</td>
<td>280.5</td>
<td>612.2</td>
<td>.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 yrs.</td>
<td>.48</td>
<td>466</td>
<td>224</td>
<td>177.0</td>
<td>331.7</td>
<td>.71</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4 yrs.</td>
<td>.62</td>
<td>242</td>
<td>150</td>
<td>83.5</td>
<td>154.7</td>
<td>.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6 yrs.</td>
<td>.40</td>
<td>92</td>
<td>37</td>
<td>36.8</td>
<td>71.2</td>
<td>.77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-8 yrs.</td>
<td>.55</td>
<td>55</td>
<td>30</td>
<td>20.0</td>
<td>34.4</td>
<td>.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-10 yr.</td>
<td>.75</td>
<td>25</td>
<td>18</td>
<td>8.0</td>
<td>14.4</td>
<td>.58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-12 yr.</td>
<td>.20</td>
<td>7</td>
<td>1</td>
<td>3.2</td>
<td>6.4</td>
<td>.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-14 yr.</td>
<td>.50</td>
<td>6</td>
<td>3</td>
<td>2.2</td>
<td>3.2</td>
<td>.53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-16 yr.</td>
<td>.50</td>
<td>3</td>
<td>2</td>
<td>1.0</td>
<td>1.0</td>
<td>.33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ l_{x+1} = l_x - d_x \]
\[ d_x = l_x q_x \]
\[ L_x = d_x - 0.5d_x = (l_x + l_{x+1})/2 \]
\[ T_x = L_x + T_{x+1} \]
\[ e_x = T_x / l_x \]
BREEDS OF ALL DOGS
Guayaquil, Ecuador, 1985

Upper Class
Pure 52.1%

Whole City
Native 60.7%
Pure 17.6%
Mix 21.8%

Middle Class
Pure 19.3%
Mix 30.4%
Native 60.3%

Lower Class
Pure 10.1%
Mix 18.0%
Native 73.9%
Sex ratio of dogs

Tunisia, Sri Lanka, Guayaquil

% total dog population

![Bar chart showing the sex ratio of dogs in Tunisia, Sri Lanka, and Guayaquil.]

- Tunisia: 60% male, 40% female
- Sri Lanka: 70% male, 30% female
- Guayaquil: 80% male, 20% female

male dogs

female dogs
Puppies survival

- Disappeared (5.80%)
- Given (7.70%)
- Remained in house (11.20%)
- Died of diseases (13.90%)
- Killed by owners (61.40%)

Tunisia
Puppies survival

stillborn (15.80%)

lived beyond weaning (68.50%)

died before weaning (17.70%)

Ecuador
Origins of the dogs

Guayaquil, Ecuador

Galle, Sri Lanka

- Adopted from the street (3.7%)
- Bought (11.5%)
- Offspring of a bitch owned by the family (13.1%)
- Gift (71.2%)

Guayaquil

- Adopted from the street (4.2%
- Bought (9.5%)
- Offspring of a bitch owned by the family (12.2%)
- Gift (75.1%)
level of dog supervision

Sri Lanka

- Never free (27.4%)
- Free during day (2.5%)
- Always free (34.3%)
- Free during night (35.4%)
Level of dog supervision

Tunisia.

direct observation

questionnaires
RESTRICTION OF DOGS
Guayaquil, Ecuador, 1985

PERCENT

WHOLE CITY: 29.4% REST. 70.6% FREE

UPPER CLASS: 20.4% REST. 79.6% FREE

LOWER CLASS: 20.5% REST. 79.5% FREE

MIDDLE CLASS: 35.9% REST. 64.1% FREE
USES FOR DOGS
Guayaquil, Ecuador, 1985

Upper Class
Guard 63.6%
Both 30.2%

Whole City
Guard 70.1%
Both 12.0%
Pet 17.9%

Middle Class
Guard 68.1%
Pet 10.4%

Lower Class
Guard 74.6%
Both 6.6%
Pet 15.5%
COMMUNITY PARTICIPATION IN RABIES CONTROL

Introduction

Community participation (CP) has been a theme in WHO and PAHO primary health care policy since its inclusion as a goal in the declaration of Alma-Ata. The goals and products of CP are seen to include: building community self-reliance, maximizing the use of community materials and human resources, and decreasing dependency. The lack of implementation in the field can be explained, perhaps, by (i) the absence of a definition of what CP is; (ii) how it works; and (iii) how it is precipitated.

(i) In the context of rabies control CP is the involvement of as many community members and community organizations (cross-sectoral collaboration) in every phase of the selection, definition and research of the community rabies problem, the formulation of a control campaign, and the implementation and evaluation of control.

(ii) CP has a positive impact on problem solution by: fully employing indigenous knowledge in understanding the problem in its unique social and ecological context, thus creating a sense of community ownership and responsibility for the problem and its solution; employing local, sustainable resources in the maintenance of the solution; and by ensuring that actions taken are appropriate and efficient, thus not wasting time, effort or money.

(iii) CP is precipitated and sustained through the use of well-established principles and practices of non-formal education and participatory research in wide use in fields as diverse as community-based development, and farming systems research and development. These principles and techniques are based on praxis and experiential learning models of community social change.

2. A field trial of a method for enhancing community participation in values control in Ecuador

In support of the 1985 Guayaquil anti-rabies campaign, CP practices selected from social marketing, non-formal education and participatory research were combined in the Qforum, an “inverted” survey whose goal was creating social knowledge rather than capturing facts.

The Qforum questionnaire (see appendix for sample) was “broadcast” to over 1000 household learning groups by 4th, 5th and 6th grade schoolchildren from six Guayaquil schools. Families were to check multiple-choice answers to 12 highly reactive questions related to knowledge, attitudes and practices concerning rabies control. A final essay question was designed to elicit a commitment by families to support the city-wide rabies control campaign; 87% of the forms were returned.

The goal of the mass dog vaccination campaign, funded through WHO, was to halt a persistent urban rabies epidemic that had cost over 130 human lives. Since funding was delayed the bulk of the educational phase had to be undertaken with severely limited resources.

Traditional barrio organizing and neighbourhood “chats” to encourage participation would have been too expensive. The only low-cost option was advertising through donated mass media time. However, educational planners were not satisfied that citizens could be expected to commit themselves to action on the basis of public service announcements alone. The costs of the Qforum were comparable to traditional mass media educational methods but it proved highly effective in transmitting multiple educational and motivational messages embedded in the process of interactive learning carried out simultaneously in independent family groups.
The development, trial and results of the Qforum intervention are documented in "Social Marketing, Nonformal Education and Participatory Research in Primary Health Care: Urban Rabies Control in Guayaquil, Ecuador", a dissertation by Dr Michael Frith (University of Massachusetts, 1988).
The Qforum Questionnaire

THE ANTI-RABIES STRUGGLE IN GUAYAQUIL:

DEAR STUDENT:

* This year we are going to mount a massive anti-rabies campaign for dogs and cats in Guayaquil.
* We hope all schoolchildren will work with their families and help us in filling out the following questionnaire.
* Only by understanding the rabies problem will we be able to reach our goals: to free the city of Guayaquil and all its people from rabies.
* Through this task you are helping free your family and neighbors from this disease.

THANK YOU

1. HOW MANY OF YOUR FAMILY ARE HELPING YOU FILL OUT THIS QUESTIONNAIRE? ( )

2. WHEN RABIES SYMPTOMS ARE PRESENT, THE DISEASE IS:
   Minor ( ) Serious ( ) Fatal ( ) Don't know ( )

3. ARE ANY MEMBERS OF YOUR FAMILY AFRAID OF RABIES?
   All of them ( ) Some ( ) None of them ( )

4. WHAT ANIMALS TRANSMIT RABIES: Dogs ( ) Cats ( ) Dogs and cats ( ) Others ( ) Don't know ( )

5. HOW IS RABIES TRANSMITTED TO PEOPLE?
   Biting ( ) Licking ( ) Scratching ( ) All of these ( ) Don't know ( )

6. IN WHAT ORDER SHOULD THE FOLLOWING ACTIONS BE TAKEN WHEN SOMEONE IS BITTEN OR SCRATCHED BY DOGS OR CATS? (indicate the order with numbers on this list)
   ( ) Notify the Health Authorities of the accident
   ( ) Take the victim to the Health Center or a doctor
   ( ) Catch the dog or cat for observation
   ( ) Kill the biting animal
   ( ) Wash the wound with abundant soap and water

7. WHAT'S THE BEST WAY TO PREVENT RABIES DEVELOPING IN SOMEONE BITTEN BY A RABID DOG OR CAT? See that the wound doesn't become infected ( ) Bind the wound with fur from the same animal ( ) Vaccinate the wounded person ( )

8. HOW MANY PEOPLE LIVE IN YOUR HOME? Adults ( ) Under 15 years old ( )

9. HOW MANY DOGS AND CATS ARE THERE IN YOUR HOUSEHOLD? Dogs ( ) Cats ( )

10. HOW MANY OF THESE DOGS AND CATS OLDER THAN THREE MONTHS ARE VACCINATED? Dogs ( ) Cats ( )

11. HOW MANY DOGS AND CATS ARE GIVEN FOOD, By your family? ( ) Neighbors ( )

12. HOW MANY STREET DOGS HAVE YOU COUNTED ON YOUR BLOCK? ( )

13. HOW WILL YOU AND YOUR FAMILY HELP IN THE VACCINATION CAMPAIGN?
   (Please use the other side of this form)
   .................................................................
   PLEASE DON'T READ THE FOLLOWING UNTIL YOU HAVE COMPLETED THE ABOVE!
   These questions are to help us perfect this questionnaire:
   * How many people did help you answer the questions? ( )
   * How much time in minutes did this task take? ( )
   * Was information from the neighbors you interviewed useful? (Yes) (No)
   * Some families filled out more than one form. If this was so in your case, this is form number (1) (2) (3) (4) (5) (More)?

School: ..................................................
Grade: ..................................................

Many thanks for your help. Please give this form to your teacher or send it to:
Julian Coronel #506 y Ximena:
PROGRAMA PILOTO DE Control DE LA RABIA EN GUAYAQUIL

1"Q" = questionnaire
1. Conceptual introduction

Health systems analysis provided a comprehensive framework for dog ecology research and the development of self-sustaining rabies control programmes. Community health systems research and development (CHSRD) in dog ecology research and rabies control programme development is holistic in scope: it allows the examination of the widest range of social, ecological, economic and organizational factors, and helps in the creation and development of increasingly effective control programmes.

CHSRD provides a process for evolutionary change in community-based rabies control programmes. It emphasizes the building of a self-sustainable maintenance infrastructure. It emphasizes the maximum long-term impact on the disease while minimizing undesirable social, economic or ecological impacts on the community.

Rabies control programmes should contain research elements, including dog ecology studies, coverage evaluation, and management information feedback in order to shape their further development as the rabies situation changes in response to their intervention.

CHSRD is a repeated, cyclical process. The results of research are fed into a plan of action, the action is carried out, interim results are evaluated and the new knowledge is used to plan adjustments to the rabies control programme.

Fig. 1. Community rabies health system

- a) Re-assessment
- b) Planning
- c) Control action
- d) Evaluation research
- Changing rabies socio-ecological situation
2. Action

The community rabies health system diagram (Fig. 1) illustrates a single cycle in the development of community control over rabies:

a.1) Assessment. Everything known about rabies and the community is assembled. This will include records of any past or current efforts to bring the disease under control, maps, population figures, resources (human, material and organizational), dog population estimates, relationships of dogs to people, a description of governmental and informal community leadership, and so on.

b.1) Planning. Based on the best available knowledge, a plan is drawn up. The planning group should make sure that the short-term goals are achievable and based on a realistic assessment of the limitations imposed by the resources currently available. Reference should be made at this stage to the recommendations of the WHO Expert Committee on Rabies and the recommendations of the consultative committee, especially with regard to minimizing impact on the stability of the dog population. Plans should include an educational element, both to inform the rest of the community about the planned control action and to enlist support.

c.1) Control action. The plan must contain benchmarks against which the effectiveness of each action can be measured. For instance, if vaccination is being carried out an accurate dog population estimate will serve as the basis for coverage evaluation. Clear, measurable goals should be established for each aspect of the programme: management, education, recruitment of volunteers, ecological control measures, obtaining supplies, etc. Processes for recording data that will allow for a running evaluation should be instituted.

d.1) Evaluation research. The effects – positive or negative – of each aspect of the rabies control programme will be collected. Dog ecology studies and coverage evaluation are conducted at this stage. Techniques should be examined to ensure that they are meeting expectations. Management information and operations research should be conducted where appropriate. Every aspect of the programme should be closely scrutinized.

Most important, the effects of the control programme on the rabies situation must be studied. For example, if habitat control and dog confinement measures are conducted simultaneously and the number of dogs in the street has declined, it must be established which strategy was most effective or easier to implement, given resource constraints. And the effects on levels of knowledge of community members should be measured in the wake of an educational campaign. No indicators of social, ecological or epidemiological change should be overlooked.

a.2) Reassessment. A new cycle including the same phases as above should be initiated in the planning of rabies control activities (b.2), to be followed again by control action (c.2), and evaluation research (d.2). As many cycles as feel necessary should follow. Evaluation data should be analyzed and the new knowledge fed into the planning of a new cycle of rabies control.

3. Application

3.1 Programme development in Ecuador

The rabies situation in Guayaquil, a city of almost two million inhabitants and over 200,000 dogs, presented a major organizational problem to programme planners. Circumstances dictated that the entire city be treated as a single community. It would not be possible, therefore, to help each barrio to organize its own rabies control maintenance infrastructure. This would have taken too long - a rabies epidemic was raging and rapid action on a massive scale was urgently needed.
It was decided to start at the research phase (d.1) of the community rabies health system cycle. A survey that collected demographic (human and dog) data, information on the knowledge, attitudes and practices of citizens with regard to rabies, mass media behaviour, and a wide range of dog and cat ecology was conducted in every household in geographically randomized city blocks. All this information was analyzed and collated with statistics on past rabies control activities. The current situation was assessed (a).

A vaccination campaign was drawn up (phase 2). Logistics and procedures were based on a realistic assessment of needs and resources. An educational and motivational campaign was targeted to segments of the population on the basis of gaps in knowledge exposed in the survey. The number of vaccination certificates issued was compared with the estimated dog population in each sector. Continuous feedback on coverage enabled programme administrators to institute house to house vaccination when temporary vaccination posts did not achieve adequate coverage levels. Loudspeaker vans were sent to areas where access to mass media mobilization messages could be expected to be low.

An evaluated survey (phase a.2) was conducted at the end of the campaign. The data analysis formed the basis for adjustments in goals for the follow-up campaign the following year. These data showed that the campaign had reached an unprecedented high proportion of Guayaquil's dogs - well in excess of the required 80%.

3.2 Vaccination delivery system research in Sri Lanka

In Sri Lanka, the national vaccination campaign uses a system of movable, temporary vaccination posts (VP) to which people bring their dogs. A dog population study showed that a ratio of one dog per 8 inhabitants could be used as a fair enough approximation for the planning and evaluation of mass immunization campaigns in most settlement patterns. Further studies showed that the vaccination coverage in dogs varied greatly from area to area (from 20% to 80%). High percentages were usually found within the immediate surroundings of the VPs, but the estimated overall vaccination coverage did not exceed 40-45%. Problems in programme execution, especially in vaccine delivery, were shown to originate both from central planning and management and from field-level planning and implementation.

Field implementation is in the hands of public health inspectors (PHI), each responsible for a preventive health programme within an area covering, on average, 40,000 to 50,000 inhabitants. Health systems research conducted in 1986 and 1987 showed that the PHIs were the key persons for a rabies control programme to be successful. However, it was found that the PHIs were not sufficiently involved in the planning phase and decision-making process leading to the establishment of their plans of work. In addition, it was found that they often lacked the know-how needed to adequately implement control activities, and especially to deploy VPs appropriately.

At central management level, follow-up of rabies control activities/outcome was essentially made on the basis of elementary reports of mobile vaccination teams. No further evaluation could be made in the absence of locally collected baseline data (i.e. human population, household density, estimated dog population) and independent assessment techniques (visual recapture). In order to improve the situation in the short term, the central office now employs two-range PHIs. Their tasks are to plan the campaign with area PHIs and to advise them on how to set up temporary VPs according to population density,
to increase the number of VPs by shortening their duration at each point, to use a more flexible approach to locating the posts in remote areas, and to assess the campaigns. In addition, they provide rabies control propaganda material and deliver lectures on rabies, its spread and control. Furthermore, they are to temporarily supervise the vaccination since teams do not have a responsible senior vaccinator.

It was found that a substantial improvement in the vaccine coverage was not possible without marking the vaccinated dogs. Collars were provided for this purpose in one of the study areas. The advantages of collars were not limited to helping to identify unvaccinated dogs — vaccine was saved by avoiding multiple vaccination of the same dog, and the collars motivated owners to get their dogs vaccinated.

A pilot project in a low immunization coverage and in a more successful PHI's areas showed that an increase in vaccination coverage of 50% or more could be achieved by the appropriate location of VPs and the free provision of collars.

In the long term, area PHI's should become truly responsible for the planning and implementation of rabies control activities in their area, using local casual manpower, the central office's role thus being changed into coordination of overall activities and procurement of vaccines and injection materials, technical assistance of PHI's area staff, evaluation of local activities, and epidemiological investigations.
EDUCATIONAL COMMUNICATIONS SURVEYS

Experience with rabies has shown that successful control depends to a very great extent on the collaboration of the community with veterinary public health authorities (and vice versa). If technical knowledge alone were sufficient, rabies would no longer be a problem in the urban tropics.

Cooperation can be either by force of law, as in highly regimented industrialized societies, or encouraged in more loosely articulated societies on the basis of mutual self-interest. In either case, the role of sustained education and communication campaigns is an essential ingredient — either to make known the legal requirements or to stimulate action based on a mutually perceived danger.

Piggy-backed onto a dog ecology survey or conducted as a separate enterprise, an educational survey can identify and establish the prevalence of knowledge gaps and misinformation about and attitudes towards rabies and its control; it can provide vital information for the design of a targeted educational and motivational campaign; and it can help decide what needs to be learned by whom and how to reach this audience with the appropriate messages.

In communities with an established, on-going public education campaign supporting rabies control, the extent to which existing learning goals have been met can be measured by the survey. In communities where sustained rabies education has yet to be instituted, the prevalence of misinformation can be assessed. In either case, educational levels (or literacy) and thus the potential utility of printed materials can be evaluated and other communication channels explored. If data on rabies knowledge and attitudes are cross-tabulated with information on the mass-media habits of each respondent, it will be possible to target specific messages to each segment of the population found deficient in any aspect of essential knowledge.

The target audiences and their specific messages will, of course, go beyond those that can be discerned from a survey of the general public. Rabies control is a community-wide concern and the special contributions that can be made by the veterinary/human medical community can only be tapped by reaching them by appropriate means with the specific information needed to bring them into the cause. Educators, police and barrio leaders are other examples of segments of the community with special potential contributions that will need to be reached with tailored information through special channels.

The questions in the sample survey forms appended fit the needs of a large city like Guayaquil which has had an on-going rabies education campaign for many years. They were included to discover if there were any areas of the city or any class which exhibited deficient knowledge and attitudes to the rabies control campaign.

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1In: Guidelines for urban dog ecology surveys, contained in: G.W. Beran and M. Frith, Urban dog ecology in Guayaquil, July 1986, a report to the World Health Organization. (In response to recommendations by the consultative committee, a sub-sample optical verification step will be incorporated. With this exception, these guidelines are in accordance with findings stemming from dog ecology surveys carried out in Sri Lanka and Tunisia as well as in Ecuador.)
THE ANTI-RABIES STRUGGLE IN GUAYAQUIL:

DEAR STUDENT:
* This year we are going to mount a massive anti-rabies campaign for dogs and cats in Guayaquil.
* We hope all schoolchildren will work with their families and help us in filling out the following questionnaire.
* Only by understanding the rabies problem will we be able to reach our goals: To free the city of Guayaquil and all its people from rabies.
* Through this task you are helping free your family and neighbors from this disease. 

THANK YOU

1. HOW MANY OF YOUR FAMILY ARE HELPING YOU FILL OUT THIS QUESTIONNAIRE?
   ( )

2. WHEN RABIES SYMPTOMS ARE PRESENT, THE DISEASE IS:
   Minor( ) Serious( ) Fatal( ) Don't know( )

3. ARE ANY MEMBERS OF YOUR FAMILY AFRAID OF RABBIES?
   All of them( ) Some( ) None of them( )

4. WHAT ANIMALS TRANSMIT RABIES: Dogs( ) Cats( ) Dogs and cats( ) Others( ) Don't know( )

5. HOW IS RABIES TRANSMITTED TO PEOPLE?
   Biting( ) Licking( ) Scratching( ) All of these( ) Don't know( )

6. IN WHAT ORDER SHOULD THE FOLLOWING ACTIONS BE TAKEN WHEN SOMEONE IS BITTEN OR SCRATCHED BY DOGS OR CATS? (Indicate the order with numbers on this list)
   ( ) Notify the Health Authorities of the accident
   ( ) Take the victim to the Health Center or a doctor
   ( ) Catch the dog or cat for observation
   ( ) Kill the biting animal
   ( ) Wash the wound with abundant soap and water

7. WHAT IS THE BEST WAY TO PREVENT RABBIES DEVELOPING IN SOMEONE BITTEN BY A RABID DOG OR CAT? See that the wound doesn't become infected( ) Bind the wound with fur from the same animal( ) Vaccinate the wounded person( )

8. HOW MANY PEOPLE LIVE IN YOUR HOUSE? Adults ( ) Under 15 years old ( )

9. HOW MANY DOGS AND CATS ARE THERE IN YOUR HOUSEHOLD? Dogs ( ) Cats ( )

10. HOW MANY OF THESE DOGS AND CATS OLDER THAN THREE MONTHS ARE VACCINATED?
    Dogs ( ) Cats ( )

11. HOW MANY DOGS AND CATS ARE GIVEN FOOD, BY YOUR FAMILY( ) Neighbors( )

12. HOW MANY STREET DOGS HAVE YOU COUNTED ON YOUR BLOCK? ( )

13. HOW WILL YOU AND YOUR FAMILY HELP IN THE VACCINATION CAMPAIGN?
    ( )

PLEASE DON'T READ THE FOLLOWING UNTIL YOU HAVE COMPLETED THE ABOVE!
These questions are to help us perfect this questionnaire:
* How many people did you help answer the questions? ( )
* How much time in minutes did this task take? ( )
* How many families filled out more than one form? ( )

School: __________________________
Grades: __________________________

Many thanks for your help. Please give this form to your teacher or send it to:
Julian Coronel #506 y Ximena
PROGRAMA PILOTIO DE CONTROL DE LA RABIA EN GUAYAQUIL

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1 "mq" = questionnaire.