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CANINE HOUSEHOLD AGGRESSION

IN THE CASELOAD OF GENERAL VETERINARY PRACTITIONERS

IN MARITIME CANADA

A Thesis

Submitted to the Graduate Faculty

in Partial Fulfilment of the Requirements

for the Degree of

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ABSTRACT

Canine household aggression, or aggression directed toward people living in the same household or familiar to the dog, is a significant cause of human injury and pet relinquishment, and yet there is very little scientific information available concerning the prevalence and characteristics of aggression in dogs in the general veterinary caseload. Because of the complexity of this behaviour, determining risk factors in a manner that will produce clinically useful results requires the use of large sample sizes, appropriate control groups, and adequate details concerning the dog, the aggression, and the home. A two-part study was undertaken to address this problem. The first phase was a cross-sectional survey of dog owners presenting their pets to one of 20 general veterinary practices in maritime Canada in 1996. Single page questionnaires were completed by 3226 owners. This generated the study population for the second phase of the study, a detailed telephone survey of 515 owners. For the detection of risk factors for aggression, dogs were compared on a case-control basis using both univariate and multivariate analytical techniques. Of 110 breeds reported, Labrador Retrievers, Golden Retrievers, German Shepherds, and Shetland Sheepdogs were the most popular, and were each more than twice as common as any other breed. Mixed breed dogs composed 39.9% of the population. Significantly more female than male dogs were neutered ($P<0.001$). The results of both levels of the study indicate that approximately 8% of dogs in the general veterinary clientele had produced an injurious bite, and 1% had caused an injury that received medical attention. Significant risk factors identified for biting a household member included neutering, being female, smaller body size (<20 kg), the presence of teenagers in the home, a history of a skin disorder that had been treated by a veterinarian, aggression over food in the first 2 months of ownership, the dog having slept on someone's bed in the first 2 months of ownership, and the dog having been given a higher rank for excitability (as recalled by the owner) in the first 2 months of ownership. Small body size increased the risk associated with a number of factors, including being allowed on the furniture or having a fear of children. Characteristics of the dogs who had bitten indicated that dominant or possessive type behaviour was associated with a greater fear of a variety of stimuli, but that the presence of this form of aggression was not associated with gender or purebred status. Dominant or possessive type behaviour was associated with 42% of the most severe bite incidents. Dogs that demonstrated this particular motivation for biting in the worst scenario were more likely to be male and purebred, and the owners were more inclined to rank the bite as a serious incident. The results indicate that the relationships between aggression and such factors as neutering, skin disorders, or small body size are worth further investigation. Understanding the co-existence of such apparently conflicting motivations as dominance and fear may prove to be an important key in the successful treatment and prevention of problem behaviour.

DEDICATION

I dedicate this thesis to my father G. Ross Guy M.C., who accomplished so much of value in his own lifetime, and who passed away on December 30, 1996.

ACKNOWLEDGEMENTS

I would not say that I believe in luck or fate, but I do believe that when good things happen it is wise to be grateful and to acknowledge the contributions of those around you. In my case the gratitude belongs to the people I live and work with, those who have taken the time to listen to my ideas, encourage my effort, and who have made this work possible.

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CDCP	:Centers for Disease Control and Prevention, U.S.A
CHIRPP	:Canadian Hospitals Injury Reporting and Prevention Program
95%CI	:95 percent confidence interval
CKC	:Canadian Kennel Club
d.f.	:Degrees of freedom
kg	:Kilogram
ID	:Identification number
n	:Number of observations
na	:Not available
NS	:Not significant
OR	:Odds ratio
P	:Probability of a Type I error
%	:Percentage
SD	:Standard deviation
χ^2	:Chi-square

1. LITERATURE REVIEW

Abstract

Although the literature regarding canine aggression indicates it is a serious problem, the picture remains incomplete and of relatively little clinical value for the general veterinary practitioner. There are typically two forms of information available, the first is provided from a public health perspective, including hospital, municipal, and animal control data, and the second is from a veterinary behavioural perspective, relying largely on populations seen in specialty referral centres. Little information is available on the aggressive behaviour of dogs within households, and for which no formal treatment has been sought. The majority of research into the area of canine aggression is prone to problems of underreporting or presentation bias. Most dog bites are not reported to any authority, particularly if the owner is the victim, and those owners and dogs who are seen by specialists are unlikely to accurately represent the general population. In addition, the failure to identify appropriate control populations of non-aggressive dogs for purposes of comparison means there is little reliable information on the importance of even the most basic potential risk factors such as gender or breed. To find ways of reducing the risk of human injury and pet relinquishment, research is necessary to bridge the gap between public health and veterinary data, using sound epidemiological principles, appropriate control populations, and the collection of sufficient behavioural details.

1.Introduction

No other domestic animal has been as universally adopted into human society as the dog, and none for such a wide variety of purposes. Archeological evidence has strongly supported the dog as the earliest domesticated animal. Recent genetic research has pushed the origin of this relationship back in time, to perhaps 100,000 years ago, when the progenitors of today's dogs first separated from their wolf ancestors (Vilà et al., 1997). The precise origin of man's association with members of the family Canidae remains a mystery, but the behaviour of the modern wolf has illuminated our understanding of why earlier humans may have sought out the help and companionship of wolves, and why wolves may have adapted so relatively quickly to human society.

Wolves and humans share the characteristics of complex social structures, cooperative behaviour, and a strong motivation for social attachment. Although the first wolves which lived in association with man probably filled the role of a camp scavenger (Budiansky, 1994), their adaptability and usefulness in a variety of domestic and hunting situations is evident in the diversity of dog breeds which exist today. It would be unfair, however, to characterize dogs as simply being another tool of human civilization. The main reason people keep dogs today is for companionship, even among hunter-gatherer societies (Serpell, 1987). The simple enjoyment derived from the company of dogs may have always been the true driving force behind canine domestication.

Dogs are welcomed into our homes and our families, but unfortunately the arrangement is

often less than ideal. In North America, they are promoted as the playmates and guardians of children, as surrogate children themselves, and even as highly intelligent beings capable of moral judgements (Donaldson, 1996, p.9). The entertainment industry has successfully characterized dogs as four-legged people with an undying devotion to their beloved masters. For the average person watching Hollywood's depiction of animal behaviour, the line between very effective training and actual intelligence becomes blurred. This is especially true for an audience of children. As intelligent as dogs may be, their normal behaviour is not too far removed from that of the adolescent wolf, a predator armed with both its own weapons and a highly defined set of rules for social engagement. The simple truth is that dogs bite people, just as they will bite other dogs, and just as they will attack prey. Outcomes of canine aggression include human injury, the punishment, social isolation, or euthanasia of problem dogs, and the failure of human animal bonds which might otherwise have provided lifelong rewards for all concerned (Hunthausen, 1997).

The real and potential danger of canine aggression has long been recognized by health care professionals and municipal authorities (Parrish et al., 1959; Berzon and Dehoff, 1974; Beck et al., 1975; Kizer, 1979; Maetz, 1979; Pinckney and Kennedy, 1982; Beck and Jones, 1985; Gershman et al., 1994). Until recently, no adequate recording systems were in place to calculate the human cost on a national basis. The public perception of dogs who may bite continues to be coloured by media reports of the most sensational incidents, especially those involving packs of dogs or a human fatality (Podberscek, 1994). A closer examination of the public health data, however, reveals that stray or roaming dogs are

responsible for a relatively small proportion of bites to people (Berzon, 1978; Szpakowski et al., 1989; Wright, 1990). Most victims are bitten by their own family dog, or at least by a dog they know (Kizer, 1979; Wright, 1990).

This review summarizes current research into canine aggression, with a specific focus on injuries to household members. As it is common to describe this problem in such terms as the percentage of emergency room visits per year, or the frequency of aggression in dogs presented for behavioural therapy, a rigorous examination of the methodology is necessary to determine which conclusions are valid. Appropriate sampling techniques, knowledge of the reference population, and justifiable explanatory statements are just some of the hallmarks of sound research. Ignoring these principles wastes valuable resources and may result in mis-leading conclusions.

1.1 Canine household aggression

Canine household aggression is behaviour directed toward either a person living in or frequently visiting the same household as the dog, and with whom the dog is familiar. "Household aggression" is a descriptive term of convenience for our purposes, distinguishing the behaviour from aggression to strangers or by roaming dogs. Most aggression in this situation is normal but inappropriate canine behaviour, and it may occur for a variety of reasons. Dominance, possessiveness, play, protective, and fear behaviours, as well as their multitude of combinations, are the most commonly reported reasons for a dog biting a family member (Borchelt, 1983; Landsberg, 1991). Less common, but often

very serious incidences of biting behaviour, are the result of maternal or predatory aggression (Beaver, 1999, p. 173; Borchelt et al., 1983). Owners are also bitten by dogs in situations of pain or illness, or when attempting to stop a dog fight (CHIRPP, 1996). All of these reasons can be influenced by both the effect of learning and the way in which family members ordinarily interact with the dog. More rarely, aggression may be truly abnormal in etiology, the manifestation of some pathophysiologic process in the dog. Endocrine imbalances, toxicities, hepatic disease, seizure disorders, neoplasia, and a variety of other causes of central nervous system disturbance can occasionally trigger aggressive behaviour (Towell and Stiell, 1996, pp.116-121; Landsberg et al., 1997, p.28).

The existing data on canine household aggression has been compiled from a wide variety of sources. Traditionally, much of the information has originated from regions where a particular individual or group has had an interest in the problem of biting dogs, or where certain well-publicized incidents have prompted municipal officials to monitor the situation more closely (Lockwood and Beck, 1975; Berzon, 1978; Oswald, 1991). Most publications can be described as coming from one of two sources, either public health (health departments, municipalities, and human hospitals), or veterinary behavioural sources (behavioural specialists and humane societies). More recent advances in information collection and compilation have illustrated the importance of canine household aggression as a source of human injury on a national scale (Sosin et al., 1992; CHIRPP, 1993; CDCP, 1997) as well as the significance of behaviour problems in pet relinquishment (Kidd et al., 1992; Patronek et al., 1996; Serpell, 1996).

2.Public Health Data

2.1 Underreporting of dog bites

In most jurisdictions there is no legal requirement to report a dog bite, especially in areas which are not rabies endemic. Many incidents are not reported unless they are unusually severe, have required the involvement of law enforcement or animal control personnel, or if the attending physician has believed it is important to report the injury (Wright, 1990; Sacks et al., 1996). Owners are highly unlikely to report a bite by their own dog, even if they require medical attention, and there is no comprehensive system to collect information on minor injuries from family physicians (Beck and Jones, 1985; Wright, 1990). Not all victims will seek medical attention after being bitten, or they may only seek treatment if the wound is severe or on a highly visible part of the body such as the face (Karlson, 1984). Information from emergency room and hospital admissions may tend to exclude minor injuries, rural inhabitants, and certain socioeconomic groups (CHIRPP, 1993). Beck and Jones (1985) reported that 45% of school age children (aged 4-18 years) had been bitten by a dog in their lifetime. On an annual basis, this constituted a bite rate 36 times that which was actually reported to health authorities.

Studies suggest that the reported dog bite rate in North America is in the range of 160 to 840 per 100,000 people (Parrish et al., 1959; Beck et al.,1975; Szpakowski et al.,1989). Estimates vary widely depending on geographic factors and the effectiveness of local reporting systems. A study of two U.S. Air Force bases, where health care is provided free of charge and reporting of all animal bites is encouraged, detected an even higher bite

rate of 1,390 per 100,000 people (Hanna and Selby, 1981). This demonstrates the effect of more comprehensive reporting methods on the data and perhaps regional differences in dog and owner characteristics.

The reported bite rate also varies by the age group and sex of the victim. Bites to children are reported at a disproportionately high rate relative to their representation in the population (Beck et al., 1975; Chun et al., 1982; Sacks et al. 1996). Chun et al. (1982) found that children less than 4 years of age are at a greatly increased risk of being bitten on the head or neck by their own family dog, in their own home, and in the presence of their parents. Facial lacerations produced when a dog bites a child tend to be more serious than lacerations due to other causes such as motor vehicle accidents (Karlson, 1984). The severity of such injuries results in an absolute necessity for immediate medical treatment, and thereby a tendency for them to be a prominent factor in hospital reports of injury statistics (Kizer, 1979; Chun et al., 1982; Karlson 1984; Galloway, 1987; CHIRPP, 1996; Sacks et al., 1996). Males of all ages are bitten more frequently than females, and the reported bite statistics repeatedly identify males of approximately 6-19 years of age as the highest risk group for dog bite injuries (Berzon and Dehoff, 1974; Kizer, 1979; Wright, 1990; CHIRPP, 1996).

2.2 Mis-classification of dog bite information

When a dog bite is reported, the information surrounding the incident may be subject to error. Details of the dog's breed or provocation may not only be incorrect, but can be

affected by personal or recall biases of the victim or witnesses (Fletcher et al., 1988, p. 203). For example, people tend to identify any large black and tan dog as a German Shepherd, in spite of the fact that many mixed breed dogs fit this description. Such mis-classification may have a significant impact on breed-specific bite information (Maetz, 1979). Media reports of serious injuries by a particular breed can temporarily heighten public awareness of that breed, and possibly bias reporting (Podberscek, 1994). When young children are injured, it is often in the absence of another person who is old enough to reliably report the details of the incident (Beck et al., 1975).

2.3 Determination of breed-specific bite rates

In 1959, Parrish et al. published an article on the epidemiology of dog bites in Pittsburgh. Because it included those individuals seen by general practitioners, not just officially reported bites or hospital admissions, it stands today as one of the most complete estimates of the epidemiology of biting behaviour. The author compared the frequency of biting dogs among different breed groups to the licensed dog population. Approximately 74% of biting dogs traced to their owners were licensed. When compared to the reference population which was estimated from all licensed dogs, sporting and working breeds were over-represented among the biters. Hounds were significantly under-represented in the biting dog population. There is unfortunately no way of knowing how well the licensed dog population represented the actual population of dogs in Pittsburgh.

A method of identifying the importance of popular versus rare breeds in the biting dog

population has been presented by Szpakowski et al. (1989). Using licensed dog numbers in the city of Guelph, Ontario, as an estimate of the reference population, the authors calculated the population attributable fraction percent (PAF%) of reported dog bites by the different breeds. The population attributable fraction percent is defined as:

$$PAF\% = \frac{(\text{overall rate of biting in licensed breeds}) - (\text{overall rate of biting in licensed breeds except the breed of interest})}{\text{overall rate of biting in licensed breeds}} \times 100$$

This measure takes into account the number of dogs of each breed in the population, and therefore the likelihood of a person coming into contact with that breed. Of all the breeds, only the German Shepherd and the category for mixed breed dogs had a PAF% in excess of 2 percent. In other words, even if German Shepherds (with a relatively high PAF% of 4.6%) were removed from the population and presumably replaced by a mixed population of dogs, it is unlikely that there would be a reduction in the number of dog bites. As the category representing "mixed breed" dogs had the highest PAF% at 8.1%, the authors conclude that breed specific legislation restricting dog ownership is unlikely to be an effective method of reducing human injury.

In an examination of risk factors for dogs biting non-household members in Denver, Gershman et al. (1994) determined that biting dogs were significantly more likely than non-biters to be German Shepherds or Chow Chows. A control population was obtained by using the first five digits of the phone number of the owner of the case (biting) dog, randomizing the last two digits, and calling households until an eligible control dog was found. As is inevitable in these studies, the large number of different dog breeds had the

effect of many breeds being represented by only a few individuals. German Shepherds and Chow Chows happened to be the two most frequently reported breeds in the Denver study. Several other breeds in the same survey appear to have been equally problematic, and yet were not available in sufficient numbers to support statistical significance. For example, only 5 Akitas were included in the study, but all of them were in the biting dog group. It is incorrect to suggest that German Shepherds and Chow Chows bite at a higher rate than other less popular breeds based on this information.

The three publications described above demonstrate the difficulty in establishing accurate breed-specific bite rates. They were all well-conceived investigations, taking into account the need for a reference population. Many municipal reports and articles have been presented without this information (Beck et al. 1975, Maetz, 1979; Daniels, 1986). Until all dogs are licensed or registered, however, identifying which breeds are really a problem using these reference populations will probably lead to false conclusions. In addition, the bias toward the reporting of bites by large dogs means that only biting by the most popular large breeds will be detected as a statistically significant problem (Berzon, 1978). Even when excellent comparison groups are available, the effects of regional and temporal differences in the gene pool and the popularity of individual breeds complicate the interpretation of the data. Given that the characteristics of the victim seem to be more consistently associated with a bite incident than the breed of dog, it is perhaps a misuse of public resources to concentrate much effort on the identification and control of certain breeds. Identifying more aggressive breeds may even have the very undesirable effect of

making them more attractive to individuals who will want to own them for all the wrong reasons.

3.Veterinary Behavioural Data

3.1 Referral bias

In veterinary behavioural research, many publications are focused on the caseload seen by referral or teaching hospitals. The population of dogs and owners seen in such situations inevitably reflect referral bias (Fletcher et al., 1988 p.59, Beaver, 1994b). There are three potential levels of animal ownership and veterinary service use: 1)owners who rarely if ever make use of any veterinary services; 2) owners who make fairly regular use of general veterinary services, but for social, economic, or geographic reasons would be unlikely to utilize a referral service; and 3) owners who willingly seek out or make use of specialty referral services, or whose dogs have problems which are refractory to the usual therapy. In other words, those dogs presented for treatment to a veterinary behavioural specialist are unlikely to be representative of the entire population of dogs and their owners. Patronek et al. (1996) revealed that relinquishment of dogs to humane societies is associated with significantly lower use of veterinary services, which emphasizes the point that the general veterinary clientele may be a unique population, and that caution is required when extrapolating results from one group of dogs and their owners to another.

3.2 Behavioural case reviews

Case reports and case series are valuable methods of disseminating information about

newly recognized or relatively rare problems. There is a long tradition of publishing behaviour case reports in the veterinary literature, possibly because such cases tend to make inherently interesting reading material, even for non-veterinarians. There is no doubt that these reports provide an important source of informal case-based learning for practitioners, and have therefore helped to bring animal behaviour into mainstream medicine. It should be remembered, however, that it is impossible to determine actual disease prevalence from a case series, and that case reviews are an inappropriate way to determine the risk factors for any problem. Explanatory statements are not supportable in the absence of a valid comparison or control group (Dohoo and Waltner-Toews, 1985a).

The case series format is appropriate for determining the relative frequency of different behaviour problems within the referred population (Dohoo and Waltner-Toews, 1985b). Approximately 60% of the caseload seen by behavioural specialists is comprised of dogs which are showing aggression manifested by growling, snapping, or biting directed towards people. The overwhelming majority of these aggression cases belong in the diagnostic categories of "dominance" or "possessive" aggression (Voith, 1981a; Borchelt, 1983; Landsberg, 1991). Household aggression is therefore a very significant part of a behavioural caseload.

The demographic characteristics of dogs presented for treatment of aggression must always be viewed with an eye to the referral bias and the composition of the reference population. Though it would seem reasonable to assume that there are equal numbers of

male and female dogs in the population, this is not necessarily true. There may be an owner bias toward adopting one sex over another, although Patronek et al.(1996) did not detect a significant association between sex of the dog and relinquishment to animal shelters. Alexander and Shane (1994) determined that owners were more likely to adopt female animals from a shelter, which may have been related to the fact that more of the male animals came from stray or unknown sources. In North America, male dogs are more likely to be reproductively intact than female dogs (Patronek and Glickman, 1994). The percentage of dogs of each sex which are neutered, however, can show marked regional variability (Wright and Nesselrote, 1987; Alexander and Shane, 1994; Patronek and Glickman, 1994). The age distribution of the general dog population will also have an effect on the age of dogs presented for behaviour problems. As is normal in nature, there are more young than old individuals. The issue of breed as a risk factor for aggression must also be very carefully assessed by comparison with local referring populations.

Authors of case reviews will sometimes compare the demographic composition of their behaviour caseload with the general medical and surgical caseload of the same facility (Voith, 1981a; Beaver, 1994b; Lund et al., 1996). Alternatively, kennel club registration figures have been used to estimate which breeds may be over-represented in certain diagnostic categories (Blackshaw, 1991; Landsberg, 1991; Lund et al., 1996). These groups should not be regarded as sufficient controls for determining the actual risk of biting behaviour, as they are unlikely to represent the true reference population.

Given these caveats, it is legitimate to summarize the demographic characteristics of aggressive dogs as they are reported in case reviews. Reports by several authors suggest that in North America 60 to 70% of all dogs presented for treatment of behaviour problems are male (Voith, 1981a; Borchelt, 1983; Wright and Nesselrote, 1987; Landsberg, 1991) and that male dogs are more likely to be presented for problems related to aggression than are female dogs (Borchelt, 1983; Landsberg, 1991; Reisner et al., 1994). The proportions of these caseloads which are neutered are highly variable, ranging from 20% to 70%, depending on the geographic region and the sex of the dog. All of the reports listed above indicated that male dogs were more likely to be reproductively intact. Landsberg (1991) listed the predominant breeds treated for aggression at three behavioural referral practices in Toronto, Kansas, and Cornell University. Excluding mixed breed dogs, the Springer Spaniel, Cocker Spaniel, German Shepherd, Golden Retriever, and Lhasa Apso were the five most frequently reported breeds.

3.3 Behavioural surveys

Survey data collected from owners on the behaviour of their dogs has also been prone to some underlying problems of study design. Probably the most serious of these would be the method of selection of participants. Several studies have been published which have either not mentioned the way participants were enlisted, or have described a method which was purely voluntary (Campbell, 1974; Campbell, 1986; Voith et al., 1992; Jagoe and Serpell, 1996). Survey participants have also been recruited by haphazard rather than formal random selection processes (Adams and Clark, 1989). Some information about the

number or characteristics of individuals which have refused to participate in a survey is helpful to the reader, but is usually not included.

Voluntary participation in survey research is known to be subject to several biases. The dog owner's interest in the topic of the survey, the apparent length and difficulty of the form, and their willingness to report personal information are just a few factors which can influence which sub-group of individuals is eventually included (Dillman, 1978, p.53). These problems are compounded when a questionnaire is offered in a facility such as a referral centre, which as mentioned above, already has a caseload affected by referral bias. The clinical relevancy of such surveys is called into question when it cannot be proven that the study population is reasonably representative of the target population (Dohoo and Waltner-Toews, 1985b).

Questionnaire design is always a delicate balance between efficiency and the need to record enough information to adequately measure the factors of interest. Brevity is important to encourage participation and reduce costs, and yet insufficient detail may render the results useless (Dillman, 1978, pp. 79-118). Poorly worded or leading questions, technical language, or even the order of questions on a page may lead to biased responses, errors, or missing responses (Dillman, 1978, pp.119-150).

The importance of questionnaire design was encountered by Campbell (1974;1986) when the results of two different surveys produced very different responses from owners

concerning which behaviour problems they were experiencing with their dogs. The first survey was composed of open-ended questions. It is unfortunate that the actual questions are not included in the article. "Housesoiling" was the most commonly reported problem. "Biting" and "aggressiveness" were the seventh and eighth most common problems respectively. In contrast, Campbell's second survey lists "jumping on people" as the most commonly reported problem. Neither "housesoiling" or "biting" are even among the top ten problems. This second survey differed in design from the first, in that owners were given categories of behaviour problems to which they could respond appropriately for their dog. Even the language of the second questionnaire may have impeded data collection because of the use of certain terms which are unlikely to be clearly understood by all respondents, such as "submissive wetting" and "self-mutilation". The author freely admits that the marked difference between the two surveys may be a factor of the questionnaires themselves (Campbell, 1986). The reader is left wondering which survey (if either) to believe, especially as there is little description of the reference population or the method of selecting participants.

A number of authors have used survey data to try and determine which factors may be important in the development of problem behaviours. Of particular interest to behaviourists is the degree to which the attitudes of the owner and the training of the dog influence the frequency of reported problems. Voith et al. (1992) examined some of these factors in a voluntary survey made available to clients in the waiting room of the Veterinary Hospital of the University of Pennsylvania. The authors concluded that

anthropomorphic attitudes or certain "spoiling" activities of the owner were not significantly associated with owners reporting that the dog engaged in behaviours which they considered to be a problem. Lack of formal obedience training was also not associated with more problems. Contrasting results were found by Jagoe and Serpell (1996). Using a population derived largely from the caseload of behaviour counsellors, they determined that obedience training *was* associated with a reduced prevalence of "competitive" aggression, separation-related problems, and escaping and roaming. Neither report includes the demographic characteristics of their respective study populations or examines the data for the potentially confounding effects of age, sex, weight, or reproductive status.

An example of good survey design is the examination of a large cross-sectional population of English Cocker Spaniels by Podberscek and Serpell (1996). Although the response rate was of a moderate level, which is common for a mail survey, the authors were able to determine risk factors for aggression in a well-defined group of dogs unaffected by referral bias. Their conclusion, that levels of aggression in this breed were related to coat colour, should be valid, since the dog's coat colour would be unlikely to influence the owner's decision to either return the survey or report aggression.

4. Conclusions

There have been many instances in the past when veterinary and public health expertise have combined to produce an outcome which is greater than the sum of its parts.

Economically important and zoonotic diseases have been eradicated from entire populations of domestic animals as a result of this collaboration. The ultimate benefit is derived by both animals and people, each enjoying improved states of health and welfare. Companion animal research has lagged behind that dedicated to food animal species, possibly as a result of funding limitations, and perhaps due to the relatively late recognition of the positive impact pets can have on the physical and psychological health of people (Blackshaw, 1996; Allen, 1997).

Dog bites have been recognized as a serious preventable human health risk for forty years, and yet public health authorities for the most part remain uncertain as to how to reduce the number of victims (Sacks et al., 1996; Chun et al., 1982; Kizer, 1979). When veterinary behaviourists appeared on the scene, they quickly recognized the significance of aggression in their canine patients, and concentrated their efforts on ways of resolving this clinical problem. The end result has been two very different bodies of information, rarely intersecting to produce a clinically useful course of action which would effectively reduce human injury. In order to formulate a plan that will help prevent dog bites and the euthanasia of problem animals, it is necessary to apply the principles of epidemiology to the study of behaviour, and conversely, for veterinarians to help public health authorities ask the right questions when dog bites do occur.

Past research has been prone to the weaknesses of underreporting and referral bias, lack of knowledge about the reference population, insufficient detail in data collection, and

regional differences in both the dog population and reporting systems. The goal of this study has been to produce a body of information on the risk factors and characteristics of canine household aggression, starting from an epidemiologically sound framework. The intent is to provide a relevant addition to this growing area of research, working towards the ultimate goal of improving the lives of both dogs and people.

2. A CROSS-SECTIONAL SURVEY OF AGGRESSION IN THE CANINE CASELOAD OF VETERINARIANS IN MARITIME CANADA

Abstract

A retrospective cross-sectional survey of dog-owning veterinary clients was undertaken in 1996 in the three Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island, to generate a population of dogs for future use in a more detailed survey on canine behaviour. The questionnaire was designed to detect which dogs had or had not bitten someone living in the same household, and included both demographic and behaviour questions. Twenty veterinary clinics were enlisted to administer the questionnaire to their clients. Data was collected on 3226 dogs, a response rate of 81.4%. Dogs were predominantly purebred (60.1%) and neutered (71.6%). The Labrador Retriever was the most commonly reported of 110 breeds. There were slightly more female than male dogs, and significantly more female dogs were neutered ($P<0.001$). Questions elicited information about training to follow simple commands, problems with inappropriate elimination, and three forms of aggression: growling, possessive aggression, and biting. The reported frequencies of aggression problems were significantly associated with age, gender, and neuter status. The highest frequency of biting according to age group was reported for dogs less than 1 year of age. Biting behaviour was reported for 15.6% of all dogs. Relative to intact female dogs of at least 1 year of age, the odds ratio for having bitten a member of the household was highest for neutered male dogs (OR:3.23, 95%CI: 1.83-5.71), followed by neutered female dogs (OR:2.13, 95%CI:1.21-3.75). Similar

trends were seen for growling and possessive aggression. Incomplete housetraining was positively associated with biting, but there was no significant association between training to obey a command and biting. Our results indicate that excellent response rates can be achieved in behavioural research by utilizing general veterinary practices and their clientele, that canine aggression in a household setting is a frequent problem, and that the relationship between neutering and behaviour warrants further investigation.

1. Introduction

Biting behaviour by dogs has received considerable attention in the media and has been an ongoing area of concern in veterinary and human medicine (Parrish et al. 1959; Blackshaw, 1991; Wright, 1991; Sosin et al., 1992; Sacks et al., 1996; Hunthausen, 1997). Research in this area falls into two main categories: the first is conducted from a public health perspective, and the second is conducted from the viewpoint of the veterinary behaviourist.

There are a number of problems involved in the collection and analysis of public health data. The most significant of these would be underreporting of dog bites. With an estimated population of 45-50 million dogs in the United States (Patronek and Rowan, 1995) there are approximately 400,000 reported dog bites to humans annually in that country. That is equivalent to slightly less than 1 reported dog bite per 100 dogs each year, a figure which is widely held to be a significant underestimation of the problem (Beck and Jones, 1985; Elliot et al., 1985, CHIRPP, 1996; Sacks et al., 1996). A contributing factor is the improbability that an owner will report a bite by their own dog to any authority. The reporting of a bite to police, animal control, or public health officials is usually associated with the victim requiring attention in a hospital emergency room, which is not the most typical scenario (Beck and Jones, 1985). It is difficult to determine which breeds or types of dogs are most responsible for bites to people due to the lack of detailed information about the size and composition of the general dog population, even in a relatively small geographic area. Not all dogs are licensed or registered (Wright, 1990).

Unless biting by a particular breed is measured as a percentage of its representation in the population, no comment can be made about the relative likelihood of that breed to bite in comparison with any other.

In addition to the problems with public health statistics, data reported by specialists in the veterinary behavioural discipline may also be misleading. Behaviourists practicing in a referral situation can be expected to receive a selected case load (Fletcher et al., 1988, p.59). Owners who seek out this type of service when they have a problem with their dog may not be representative of the most common situation (Beaver, 1994b). Much of the published information is in case series format (without controls), or is survey data which has been collected from voluntary participants. Voluntary surveys of this nature are of doubtful value as they may attract only those people who have already experienced a behaviour problem with their pet, are in less of a hurry to leave the clinic, or have some personal need to share information (Dillman, 1978, p.53).

Veterinary behavioural practices report that aggression is the leading reason for referral, and the most common form of aggression by dogs in their caseload is due to the diagnostic category of "dominance". Dominance aggression is generally reported as comprising more than 60% of all aggression cases seen (Voith, 1981a; Wright and Nesselrote, 1987; Landsberg, 1991). By definition, this type of aggression is directed toward persons known to the dog, especially members of the immediate household. The social behaviour of the domestic dog is derived from the complex social behaviour of the

wolf, which is its direct ancestor (Vilà et al., 1997). Although domestic dogs in North America do not often live within a pack of their own species, they will easily transfer their social attachments to humans living within the same household (Frank and Frank, 1982; Coppinger and Schneider, 1995). An unfortunate consequence of this close association can sometimes be aggression.

There are other reasons why a dog may bite members of the household. Fear, inadequate socialization, pain, and learning can all result in aggression toward people, as can territorial and maternal behaviour (Borchelt, 1983; Landsberg, 1991). It is not uncommon for owners to be injured by their own dog while playing with it or when trying to interrupt a dog fight (CHIRPP, 1996). Predatory aggression can cause the most serious injuries, as the intended outcome is the death of the target, and victims are often the very young or the elderly, individuals who are least able to defend themselves (Sacks et al., 1996; Galloway, 1987). Predatory aggression may be directed either toward household members or to strangers (Borchelt et al., 1983; CDCP,1997).

This survey was designed as the first phase of a larger project to identify characteristics, risk factors, and predictors of aggressive behaviour by dogs toward people living in the same household. In order to produce meaningful data, it was necessary to look at all dogs, not just those that had bitten, in order that comparisons would be possible between the biting and non-biting individuals. To accomplish these objectives, a study population of owned dogs was developed, which was not limited to licensed or registered dogs, or to

dogs that were already recognized as having a history of aggressive behaviour toward people. To generate this population, we enrolled a proportion of the veterinary practice clientele in maritime Canada. Although these individuals would not necessarily be representative of all dog owners, they should accurately represent those owners who take their dogs to the veterinarian. The objective, therefore, was to identify which dogs did or did not have a history of having bitten someone in the household, while at the same time generating an accessible list of owners who could participate in a more detailed phone interview at a later date.

2. Materials and Methods

2.1 Subjects

In order to minimize the amount of time any one clinic would be required to spend administering questionnaires, and to maximize the number of respondents, twenty clinics were recruited to participate in our survey. These clinics were selected on a convenience basis such that they were distributed among the provinces of New Brunswick, Nova Scotia, and Prince Edward Island. In early 1996, a veterinarian who was either an owner or a partner in each practice was contacted by phone or mail to introduce the project and to request their participation. All of the first 20 veterinarians contacted agreed to participate. On a provincial basis, there were 9 clinics enrolled from both New Brunswick and Nova Scotia, and 2 were enrolled from Prince Edward Island. This constituted approximately 15% of the clinics in these provinces in 1996 according to lists provided by the provincial veterinary associations. Practice types were 75% exclusively small animal,

and 25% mixed.

Each veterinarian was asked to estimate the number of canine patients their practice would see in a one month period in the late spring or summer of 1996. Each clinic was provided with a number of questionnaires equal to 90% of their projected estimate. From the outset, clinics were made aware that the questionnaire was to be offered to all clientele arriving at their practice with a dog, with the following exceptions: 1)people bringing in litters of puppies for vaccination, 2)people bringing in dogs for euthanasia, 3)people who were obviously upset or crying. The process, in other words, was to be as non-voluntary for the dog owners as possible while still allowing the clinic staff to show compassion in difficult situations. Since the questionnaire was to be offered by the reception staff in each clinic, and not usually the veterinarian, provision was made for surveys that could not be offered or completed due to the reception area being too busy. One form was to be set aside with the "completed" pile for every dog owner arriving at the clinic, regardless of whether the form had been filled out. If any owners refused to participate in the survey, this uncompleted form was also placed in the "completed" box. This would permit an estimation of the number of individuals who were unavoidably missed by the process. Staff were reminded to be sensitive to the fact that some of their clients might be functionally illiterate, and that if someone was hesitant or gave an excuse such as they had "forgotten their glasses", then it was permissible to read the questions aloud and complete the form for the client. It was our belief that these guidelines would minimize any important bias in the composition of survey respondents. No restrictions were placed on

the number of questionnaires completed by a client if they owned more than one dog, and had presented more than one dog to the practice during the study. Only one questionnaire was completed per dog, regardless of the number of times the dog visited the practice during the course of the study.

2.2 Questionnaire Design

The questionnaire was a single page format (Appendix A) and each form was coded with a unique number. The top quarter of the page displayed the official logo of the Atlantic Veterinary College, and a brief paragraph describing both the purpose of the project and encouraging the owner's participation. This paragraph deliberately did not mention aggression as the area of research, but only made a general statement about our interest in the relationship between dogs and people. Respondents were also advised that all personal information would be kept confidential.

The second part of the questionnaire, made up of 6 questions, was dedicated to the collection of the name and phone number of the owner, the dog's name, and general information on the dog such as its age, sex, neuter status, breed, and weight. The final question in this section asked how long the owner had owned the dog.

The third section contained 6 closed end questions on the behaviour of the dog, with "yes" or "no" as the only possible response choices. Although we were specifically interested in aggressive behaviour by the dog, three questions on other aspects of behaviour were

included to make the questionnaire feel less negative and threatening to the respondents, and to obtain an overall impression of the owner's success in training the dog. These three questions asked whether the dog was completely housetrained, whether they had trained it to perform any tricks, and finally, whether they considered the dog to be a member of the family. The word "tricks" was deliberately chosen over "obedience" to encourage owners to include their experience with informal as well as formal training of the dog.

The remaining three questions in this section related specifically to various degrees of aggressive behaviour. The design of this part of the survey was intended to be as sensitive as possible at detecting any aggressive behaviour in the dogs. The questions were presented as follows: 1)Has your dog ever growled at any member of your household, even if you thought he/she was just playing?(Yes or No), 2)Does your dog ever growl or snap at anyone when they try to take away food, toys, or other objects? (Yes or No), and 3)Has your dog ever bitten any member of your household, even if you think it may have happened by accident while playing?(Yes or No). Specific situations where the dog might have shown aggression were purposely described in the questions to jog the respondents' memories, and to minimize any bias secondary to the respondents having different criteria for aggression than our own.

The final section of the questionnaire asked for written permission to review the dog's medical records if we required more complete information, and was followed by a line for

both the signature of the owner and the date. Twenty copies of the draft questionnaire were pre-tested at one of the participating clinics. To determine the ability of the questionnaire to collect accurate information, respondents in the pre-test were re-interviewed either in person or by telephone within the same week. Minor adjustments in design and wording were made following the pre-test to produce the format described above.

2.3 Survey Implementation

A total of 5095 questionnaires were prepared for distribution to the 20 clinics. The number provided to each clinic varied from a low of 54 to a high of 700, in direct proportion to their estimated monthly canine caseload. Questionnaire distribution began in April 1996, and all questionnaires were returned by July 1996. Each clinic was visited by the principal investigator to provide the necessary materials, and to speak directly to as many members of the reception staff as possible about the purpose of the project and its implementation. Each clinic was provided with a professionally mounted sign to help introduce the project to hospital clientele. Weekly follow-up calls were made to assess the speed of questionnaire distribution and to determine whether clinics were encountering any difficulties. Receptionists reported no particular difficulties in administering the survey, and that the response of the public was generally quite positive. Many confessed that they did not have time to offer the questionnaire when the reception area was busy, but they were reassured that this was not a problem as long as one form was put aside for each dog seen by the practice.

2.4 Data Management

All questionnaires were coded and entered into Quattro Pro 6.0 (Corel Corporation Limited, Ottawa, Ontario, Canada) by one individual. Whenever a dog's breed was missing, it was coded as of "mixed or unspecified breed". Purebred dogs were classified into 110 different breeds, including additional categories for "poodles of unspecified size or type" and for "huskies". American and English cocker spaniels were classified as one group, as not all owners made this distinction when recording breed. Where the different size types such as "miniature" or "standard" were not given by the owner, the dog was classified according to its weight, if given, and the breed standard. This situation occurred infrequently, and only applied to animals of the poodle, schnauzer, and dachshund breeds.

Statistical analysis was accomplished with Intercooled STATA 5.0 software (Stata Corporation, College Station, Texas, U.S.A.). The association between gender and neuter status was tested using contingency table chi-square analysis (Glantz, 1992, pp.110-154). Odds ratios were calculated to examine the associations between housetraining success, command training, and biting (Fletcher et al., 1988, pp.195-198). In order to identify potential risk factors for biting behaviour, two comparison groups were selected from the population. The members of the first group were dogs of at least 1 year of age which were reported to have bitten a member of the household. The second group was composed of non-aggressive dogs of at least 1 year of age for which the owner had recorded a negative response to all 3 questions on aggression (growling, possessive, and biting behaviour). Potential risk factors for specific behaviours were measured by odds

ratios with 95% confidence intervals. Multiple logistic regression techniques were used to determine the relationship between various aspects of behaviour and reproductive status. As intact female dogs had the lowest reported levels of all forms of aggression, they were selected as the baseline population for comparison. The Hosmer-Lemeshow goodness-of-fit test, with covariate patterns divided into 10 groups, was used to determine the adequacy of the model for housetraining success relative to reproductive status and age (Hosmer and Lemeshow, 1989, pp.135-175).

3. Results

3.1. Questionnaire completion rates

A total of 3962 questionnaires were utilized in this survey, of which 3226 (81.4%) were completed. Completion rates for the clinics ranged from a low of 64.0% to a high of 94.0%. The largest and busiest practice had the lowest completion rate, but as can be seen in Table 1, no consistent relationship between clinic size and completion rate was found. Although the receptionists were not required to explain why a questionnaire was not completed, in some instances they recorded a reason on the form. Reasons given were: the reception area was too busy, the dog was being presented for euthanasia, the dog was injured or seriously ill, the owner was too upset or distracted by the dog, the owner had previously completed the questionnaire, or the owner refused to complete the questionnaire when it was offered. In a few instances it was reported that the questionnaire could not be completed because the client did not understand English.

3.2. Demographic characteristics of the dog population

The responses to each question are summarized in Table 2. Ages of the dogs ranged from 1.2 months to 18 yrs, and were reported by 93.8% (3027) of respondents. Figure 1 illustrates the age distribution of dogs presented to the clinics, demonstrating that 18.5% (561) of the dogs were less than 1 year of age, a number which far exceeds the percentage seen in any other year class. With increasing age, there is a gradual decline in the number of dogs seen. The group of dogs over 10 years of age comprised 11.2% (340) of the population, with the oldest 3 dogs being 18 years of age. The age distribution of all purebred dogs combined followed the same trend as that for all dogs, but there was some breed diversity. Four examples demonstrating this variability are shown in Figure 2 where the Labrador Retriever (most commonly reported breed), the Springer Spaniel (breed most frequently reported to have bitten), the Rottweiler (breed with the lowest proportion of dogs >10 years), and the Miniature Poodle (breed with largest proportion of dogs >10 years) are compared.

The age distribution of male versus female dogs was remarkably similar (Fig. 3) and of the 3124 questionnaires on which the sex of the dog was recorded, 48.2%(1506) were reported as male and 51.8%(1618) as female. Neuter status was reported for 2999 dogs, 71.6% of which were neutered. Significantly more female dogs were neutered (78.3%) than male dogs (64.1%)($P<0.001$). Figure 4 illustrates the percentage of neutered and intact dogs in each year class. Not surprisingly, intact dogs make up the majority of dogs less than one year of age. Beyond 1 year of age, the proportion of neutered dogs in each

year class increases slightly with each succeeding year.

The data for the most commonly reported dog breeds are summarized in Table 3 (complete breed rankings are included in Appendix B). Including "mixed breed" as a classification, only seventeen breed categories contained at least 35 animals, although there were a total of 110 breeds reported. The largest grouping was for dogs of mixed or unspecified breed (39.9%,1287). Purebred dogs made up the remaining 60.1% (1939) of animals. Labrador Retrievers (6.2%, 200) , Golden Retrievers (5.7%, 183), German Shepherds (5.2%, 166), and Shetland Sheepdogs (4.4%, 142) were by far the most popular breeds recorded, and were at least twice as popular as any other breed.

There were 3201 responses to the question on duration of ownership. The majority of dogs (2473, 77.3%) had been owned for at least 1 year. A comparison on the basis of breed indicates that 75.7% of mixed breed dogs and 78.3% of all purebred dogs had been owned for at least 1 year. Of the 17 most popular breeds listed by owners, the Miniature Poodle had the highest percentage of dogs owned for more than 1 year at 97.6%, and the Siberian Husky had the lowest percentage at 55.6% (Table 3).

3.3 Housetraining and command training

Among the completed questionnaires, responses to questions on housetraining and training to perform "tricks" were high, at 3223 (99.9%) and 3212 (99.6%) respectively. Incomplete housetraining was reported by 12.2% of respondents, and 87.3% of owners

reported that they had trained their dog to perform some kind of a trick such as "sit" (training to perform a trick will be referred to as "command training" in the remainder of this work).

The frequency of incomplete housetraining in each year class is illustrated by Figure 5. Not surprisingly, incomplete housetraining was much more common in dogs less than 1 year of age, such that almost half of this age group were incompletely housetrained (256, 45.9%). Using intact female dogs as the baseline and including age in the model demonstrated that there is a significant positive association between reproductive status, increasing age, and successful or complete housetraining (Table 4). The group most likely to be successfully housetrained were the older neutered female dogs (OR: 2.26, 95%CI: 1.24 to 4.13).

Some of the associations between responses to several of the survey questions are outlined in Table 5. For dogs of at least 1 year of age, being command trained was significantly associated with both fewer housetraining problems (OR: 2.93, 95%CI: 1.86 to 4.61) and with neutering (OR: 1.74, 95%CI: 1.27 to 2.37). The odds ratio for biting in a dog which was not completely housetrained, using dogs which were not reported to have shown any form of aggression as the comparison group, was 1.84 (95%CI: 1.16 to 2.93), indicating that there was a significant association between these two problems. Command training was not significantly associated with whether or not a dog was reported to have bitten.

3.4. Household aggression

In response to the question "Has your dog ever growled at any member of your household, even if you thought he/she was just playing?", 41.0% of 3214 respondents answered positively. Growling is the lowest level of aggression which is easily recognized by most owners. The next question, "Does your dog ever growl or snap at anyone when they try to take away food, toys, or other objects?" was answered positively by 20.6% of 3217 respondents. This question refers to possessive aggression. The final question, "Has your dog ever bitten any member of your household, even if you think it may have happened by accident while playing?" was answered positively by 15.6% of 3219 respondents. Once again a specific situation (play) was mentioned to attempt to avoid owner rationalization of the dog's behaviour and a subsequent false negative response. The results indicate that as the potential seriousness of the aggression increases (from growling to snapping to biting), the reported frequency of the behaviour decreases. In other words, more dogs growl than bite, although 180 owners responded positively to all 3 questions on aggression. The highest reported frequency of biting (24.6%) occurred in dogs less than 1 year of age (Fig. 6).

There were no significant associations between reproductive status and aggression in dogs less than 1 year of age. The association between gender, neuter status, and growling or possessive aggression in dogs ≥ 1 year of age is shown in Table 6. Intact males, neutered females, and neutered males were tested against the baseline of aggression reported in the intact female dogs. In dogs of at least 1 year of age, reproductive status was significantly

associated with aggression. In a comparison with intact female dogs, the odds ratios for a report of growling behaviour were significantly increased for intact male dogs and neutered dogs of both sexes (Table 6). Possessive behaviour shows a similar trend but without statistical significance.

Comparing biting dogs to the group of dogs which had shown no aggression revealed a similar positive association with neutering (Table 7). Overall, the odds ratio for a neutered dog having bitten was 1.57 (95%CI: 1.12 to 2.19). In addition, intact male dogs were twice as likely to have bitten (OR:2.04, 95%CI 1.07 to 3.88) relative to intact female dogs. A similar level of biting behaviour was reported for neutered female dogs (OR:2.13, 95%CI:1.21 to 3.75). Neutered male dogs were the most likely to be reported as having bitten (OR:3.23, 95%CI:1.83 to 5.71). In other words, the odds of a report of biting in a neutered male dog were more than three times higher than that for an intact female dog.

The inclusion of age in this model does not alter the significance or trend of the results. Body weight was deliberately left out of the analysis due to the large amount of missing data for this particular variable. Including weight reduces the sample size available for calculations by approximately one-third. The effect of weight, however, does appear to be significant. If weight is included in the model, increasing body size reduces the odds of biting (OR:0.98, 95%CI:0.97 to 0.99), while the risk associated with gender and neutering remains essentially unchanged.

Table 1
The number of questionnaires offered to clients or put aside uncompleted, and the number actually completed in each of 20 participating clinics involved in a survey of the owners of canine patients in May-July 1996 in maritime Canada[a]. Clinics are sorted by the number of questionnaires offered.

Offered	Completed	% Completed
489	313	64.0
430	352	81.9
350	314	89.7
270	236	87.4
257	175	68.1
250	228	91.2
210	158	75.2
187	142	75.9
186	167	89.8
175	162	92.6
160	113	70.6
158	132	83.5
144	135	93.8
140	123	87.9
130	115	88.5
116	109	94.0
112	92	82.1
90	80	88.9
54	45	83.3
54	35	64.8
Total 3962	3226	81.4

[a] Maritime Canada is composed of the provinces of New Brunswick, Nova Scotia, and Prince Edward Island.

Table 2
Summary of the responses to questionnaires completed by the owners of 3226 canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.[a]

Variable	%Response	Results (n)
Sex	96.8	female: 51.8% (1618)
Breed[b]	100	purebred: 60.1% (1939)
Neutered	92.7	neutered: 71.6% (2147)
Weight	66.0	median: 21.3 kg (2108) range: 0.23 to 90.8 kg
Age	93.8	median: 4 years (3027) range: 1.2 months to 18 years
Duration of ownership	99.2	<1 month: 3.8% (123) 1 to 11 months: 18.9% (605) ≥ 1 year: 77.3% (2473)
Is your dog completely housetrained?	99.9	yes: 87.8% (2831)
Have you trained your dog to do any tricks such as "sit"?	99.6	yes: 87.3% (2804)
Has your dog ever growled at any member of your household, even if you thought he/she was just playing?	99.6	yes: 41.0% (1317)
Does your dog ever growl or snap at anyone when they try to take away food, toys, or other objects?	99.7	yes: 20.6% (663)
Has your dog ever bitten any member of your household, even if you think it may have happened by accident while playing?	99.8	yes: 15.6% (503)
Do you consider your dog to be a member of your family?	99.9	yes: 99.3% (3202)

[a] see Appendix A for original questionnaire format

[b] see Appendix B for complete breed data

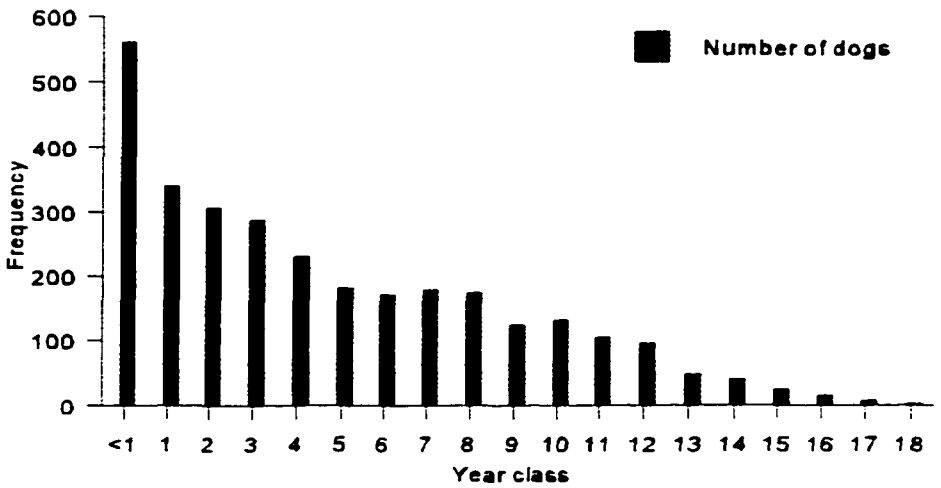
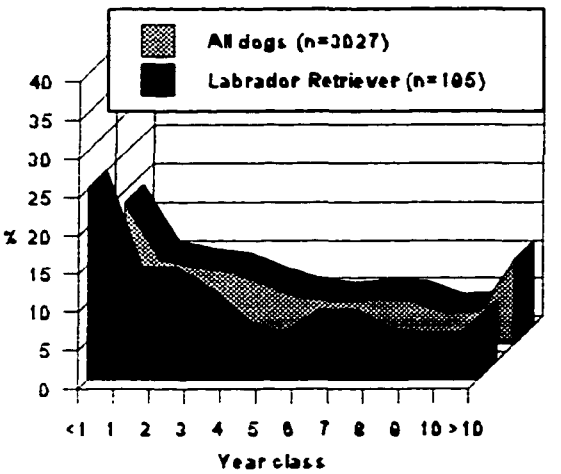
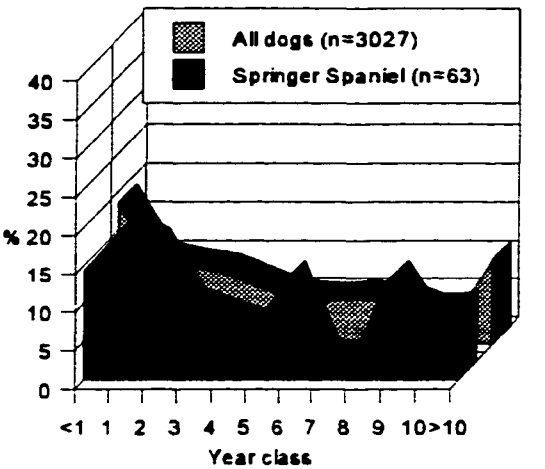


Fig. 1. The age distribution of dogs in a survey of canine patients seen by 20 veterinary practices in maritime Canada in May-July 1996 (n=3027).

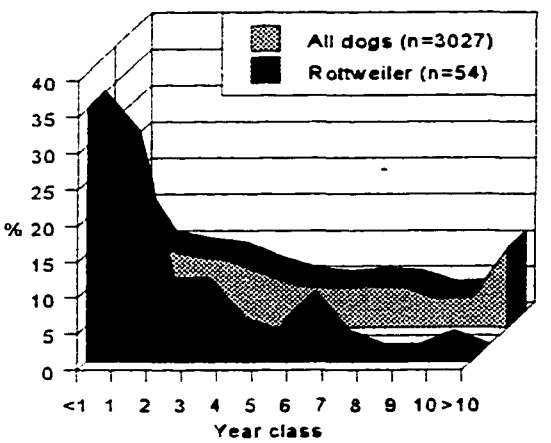
i)Most frequently reported breed:



ii)Breed most frequently reported to have bitten:



iii)Breed with the smallest proportion of dogs >10 years of age reported:



iv)Breed with the largest proportion of dogs >10 years of age reported:

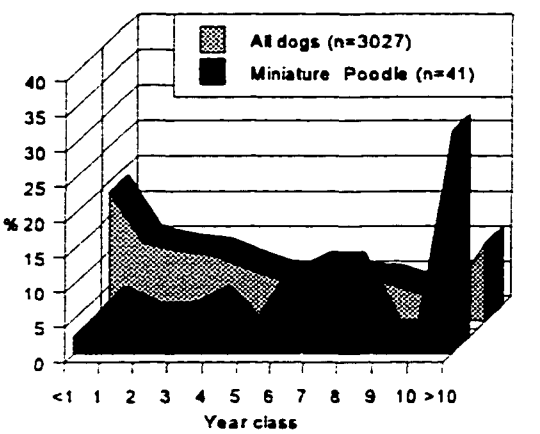


Fig. 2. Age distribution for four selected breeds (Labrador Retriever, Springer Spaniel, Rottweiler, and Miniature Poodle) as compared to the age distribution for all dogs. Data was collected from a survey of the owners of canine patients seen by 20 veterinary practices in maritime Canada in May-July 1996.

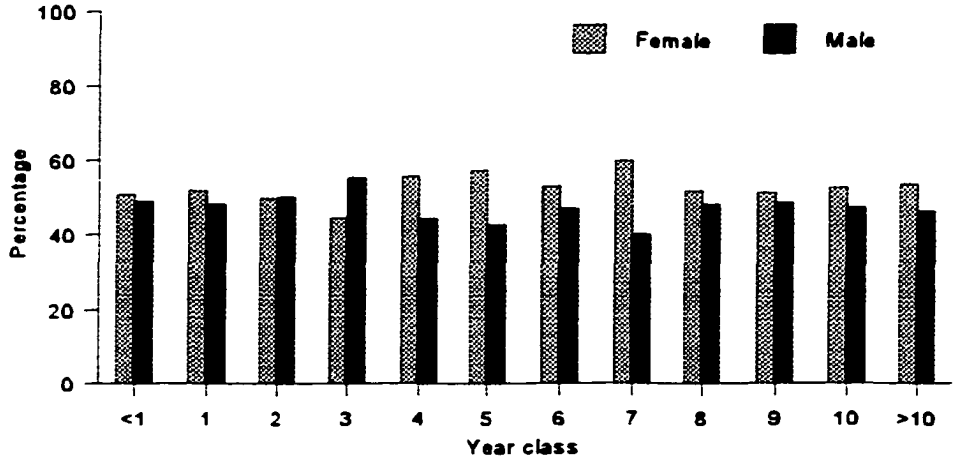


Fig. 3. The percentage of male and female dogs in each year class of the population. Data was compiled from a survey of the owners of canine patients seen by 20 veterinary practices in maritime Canada in May-July 1996. Each bar pair totals to 100% (n=3124).

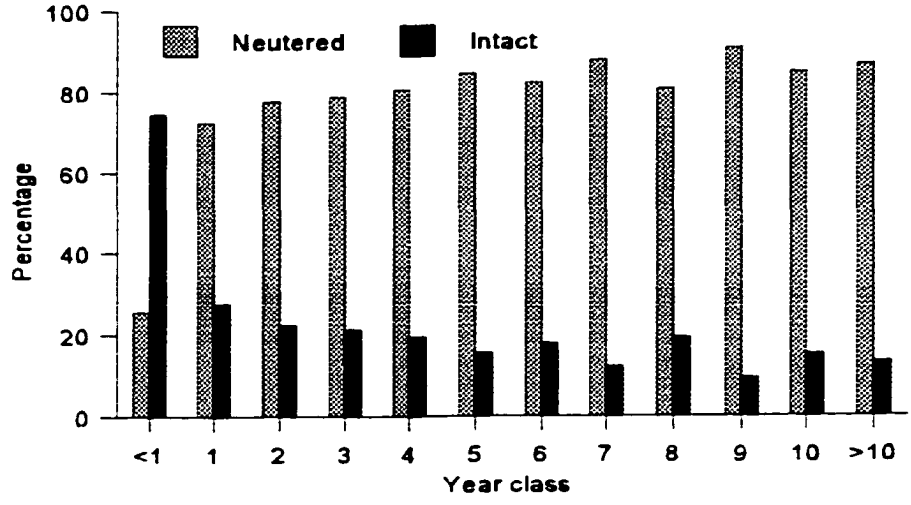


Fig. 4. The percentage of neutered and intact dogs in each year class of the population. Data was compiled from a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996. Each bar pair totals to 100% (n=2999).

Table 3
Characteristics of dog breeds for which 35 or more individuals were reported. Data was compiled from a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.

Breed	n	% Female	% Neutered	% Owned ≥ 1 year	% Bitten[a]		
					≥ 1 year of age	<1 year of age (n)[b]	
Mixed or unspecified breed	1287	53.0	86.4	75.7	14.6	25.7	(237)
Labrador Retriever	200	54.1	82.1	71.0	9.3	36.7	(49)
Golden Retriever	183	47.2	79.6	78.7	7.9	25.8	(31)
German Shepherd	166	48.4	64.9	72.1	9.7	31.3	(32)
Shetland Sheepdog	142	46.4	78.0	84.5	6.3	15.4	(13)
Cocker Spaniel	76	51.4	85.5	84.2	7.5	33.3	(9)
Springer Spaniel[c]	65	60.9	78.6	81.5	26.8	55.6	(9)
Toy Poodle	57	63.2	83.0	86.8	10.0	0	(6)
Rottweiler	55	52.8	63.9	60.0	16.7	15.8	(19)
Shih Tzu	54	40.7	90.0	74.1	22.0	15.4	(13)
Beagle	50	43.8	53.7	80.0	4.7	28.6	(7)
Miniature Poodle	43	58.1	87.5	97.6	9.5	0	(1)
Lhasa Apso	41	45.0	78.8	80.0	33.3	0	(1)
Yorkshire Terrier	38	48.6	85.3	94.6	13.5	0	(1)
Siberian Husky	36	61.8	76.2	55.6	9.1	7.1	(14)
Doberman Pinscher	35	54.3	83.3	68.6	15.4	11.1	(9)
Miniature Schnauzer	35	31.4	77.4	88.2	6.3	0	(3)
TOTAL, all purebred dogs	1939	51.0	77.3	78.3	13.2	23.8	(323)
TOTAL, all dogs in study	3226	52.8	80.8	77.3	13.7	24.6	(560)

[a] percentage of dogs within each age group (≥ 1 year or <1 year) and within each breed which were reported to have bitten a member of the household.
[b] (n) equals the number of dogs in each breed group which are less than 1 year of age.
[c] breed most frequently reported to have bitten when all age groups are combined.

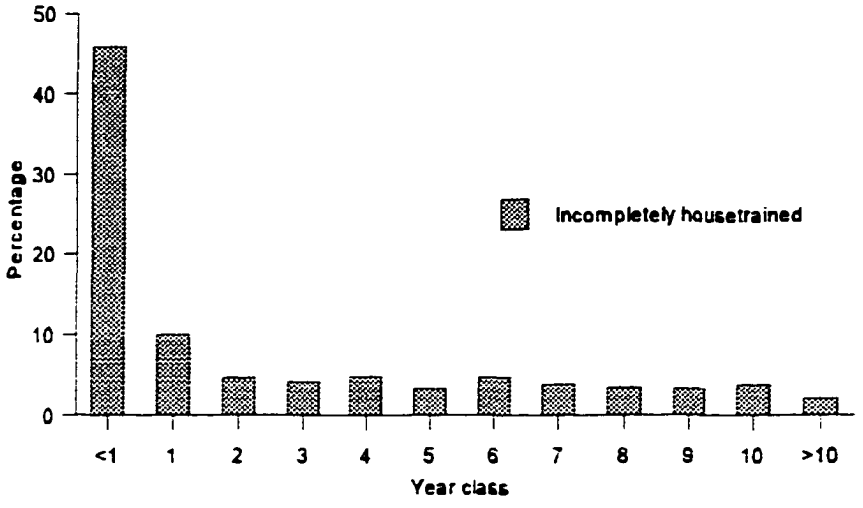


Fig. 5. The percentage of incompletely housetrained dogs in each year class of the population. There were 392 dogs out of a total of 3226 in the study for which the owners reported that housetraining was incomplete. Data was compiled from a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.

Table 4
Logistic regression model for factors associated with complete housetraining in dogs of at least 1 year of age. Data was analyzed in a comparison with intact female dogs. Results were compiled from a survey of the owners of the canine patients of 20 veterinary practices in maritime Canada in May-July 1996 (n=2364).

Variable	Coefficient	Probability	Odds ratio	95%CI[a]
Intercept	1.956			
Intact male	0.003	0.992	1.00	0.52-1.94
Neutered male	0.584	0.057	1.79	0.98-3.27
Neutered female	0.817	0.008	2.26	1.24-4.13
Age (years)	0.105	0.001	1.11	1.05-1.18
Hosmer-Lemeshow goodness-of-fit χ^2=5.04, d.f.=8, P=0.75				

[a] 95% confidence interval

Table 5
Odds ratios (OR) and 95% confidence intervals (95%CI) for significant associations between responses to questions on neuter status, housetraining, command training, and biting behaviour in dogs of at least 1 year of age. Dogs which had bitten were compared to dogs which were not reported to have shown any aggression. Data was collected in a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.

Associations between questionnaire responses	n	OR	95%CI
Command trained and neutered	2342	1.74	1.27-2.37
Command trained and completely housetrained	2455	2.93	1.86-4.61
History of both biting and incomplete housetraining	1593	1.84	1.16-2.93

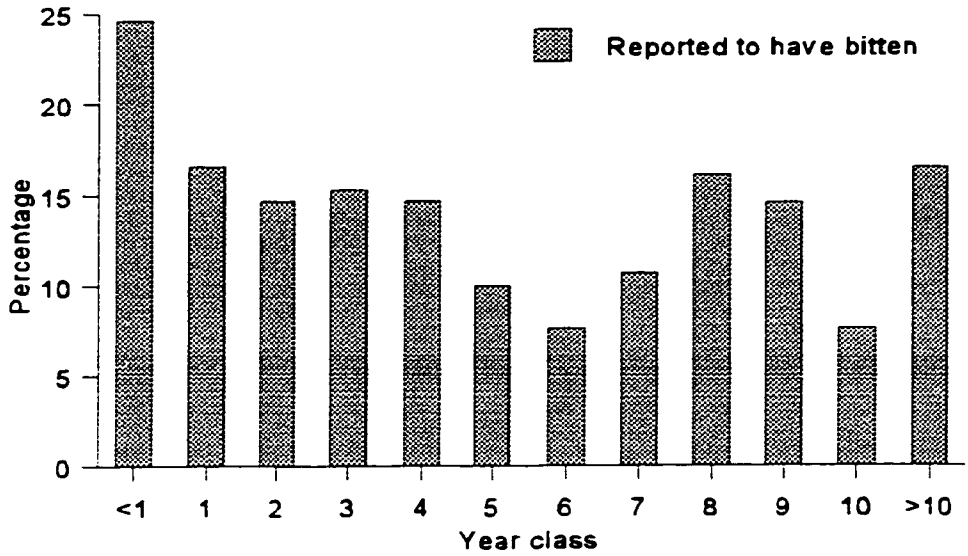


Fig. 6. The percentage of dogs in each year class which were reported to have bitten a member of the household. There were 138 reports of biting in dogs less than 1 year of age, and 80 reports of biting in dogs greater than 10 years of age. Data was collected in a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996 (n=3226).

Table 6
A comparison of the odds ratios (OR) and 95% confidence intervals (95%CI) for a reported history of growling or possessive aggression in dogs of at least 1 year of age. Results are based on a comparison with intact female dogs. Data was compiled from a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.

	Growling (n=2359)		Possessive (n=2362)	
Reproductive status	OR	95%CI	OR	95%CI
Intact male	2.05	1.38-3.03	0.98	0.62-1.55
Neutered female	2.15	1.53-3.02	1.17	0.80-1.71
Neutered male	2.49	1.76-3.51	1.41	0.96-2.07

Table 7
Odds ratios (OR) and 95% confidence intervals (95%CI) for dogs with a history of biting a household member as compared to dogs with no history of growling, possessive aggression, or biting directed toward a household member (n=1523). Calculations are based on dogs of at least one year of age in a comparison with intact female dogs. Data was compiled from a survey of the owners of canine patients presented to 20 veterinary practices in maritime Canada in May-July 1996.

	Biting	
Reproductive status	OR	95%CI
Intact male	2.04	1.07-3.88
Neutered female	2.13	1.21-3.75
Neutered male	3.23	1.83-5.71

4. Discussion

The primary objective of this survey was to produce a study population for an investigation of canine household aggression; and the purpose of the questionnaire was to provide a sensitive method of detecting any form of biting by the dogs, not to provide detailed information on behaviour. Even such a brief questionnaire, however, has delivered an interesting picture of the characteristics and behaviour of canine patients in Nova Scotia, New Brunswick, and Prince Edward Island.

4.1 Owner compliance and considerations for bias

The population of dogs compiled by this survey is a subset of the real population of dogs in this region. It represents those dogs belonging to owners with at least some desire to use veterinary services and having access to those services, and demonstrates the higher frequency of veterinary visits for dogs less than 1 year of age. Because seriously aggressive dogs may be relinquished or euthanized, or simply may not be taken to the veterinarian, it is possible that the mature dogs in our study represent a "cleaned-up" population of animals. We were unable to predict at the outset what level of biting behaviour we would detect with this type of survey, as the level of aggression in the general dog population is an unknown, and there was an expectation that owners might be very reluctant to report this kind of behaviour on a questionnaire that was not anonymous. Even so, the number of people reporting that their dog had bitten was substantial at 15.6%.

The results indicate that veterinarians in general practice are willing to participate in this

type of research, and that dog owners can be relied upon to complete simple questionnaires in the hospital setting. Although the clinic receptionists were not required to record a reason for any questionnaire not being completed, some did so anyway. In many cases, receptionists were at times simply too busy with other work to offer the form. It is possible that staff were more motivated to offer the questionnaire if the client appeared friendly, approachable, or not in a hurry. Very few questionnaires were actually reported to have been refused by owners. People who take their pet to a veterinarian are likely to have relatively more positive attitudes toward issues of animal health and therefore may be motivated to assist in a project of this nature. The bottleneck in compliance seemed to be the time required for a staff member to administer the form or explain the purpose of the research, not owner willingness. As a consequence, there should not be a serious bias in this data secondary to the owner attitudes or to the dogs having pre-existing behaviour problems.

It is possible that some sub-groups were under-represented if there was an unidentified factor which reduced the likelihood of their being taken to the veterinarian. Dogs which had an unusually low level of health problems, or more probably, dogs which owners found difficult to take in the car, or into unusual situations, may have been taken to the veterinarian less frequently than the average. Of concern in this research is the possibility that aggressive dogs might not be presented to the veterinarian as frequently as non-aggressive dogs. For a variety of reasons, such as an owner's unwillingness to admit their dog has a behaviour problem, or the reduced presentation of aggressive dogs to veterinarians, it is possible that the percentage of dogs recorded as aggressive in our

survey is an under-estimate of the true situation. For the same reasons, however, it would be very improbable that we would have produced an over-estimation of aggressive behaviour.

4.2 Demographic characteristics of the study population

The relatively large number of dogs less than 1 year of age encountered in our survey reflects the higher visitation rate to the veterinarian for dogs in this age group. Routine vaccination and neutering protocols predispose young dogs to more frequent presentation to veterinarians. Many dogs are also relinquished to humane societies in the first 1 or 2 years of ownership (Miller et al., 1996; Patronek et al., 1996), so that some dogs seen by the clinics as puppies may not return to the practice in subsequent years.

Although information regarding the demographics of the dog population may be obtained from animal shelters, kennel clubs, and various marketing groups, relatively little is known about the population of dogs that are actually taken to veterinarians. In this study, the number of male and female dogs were fairly equal and the majority of dogs were neutered (71.6%). Significantly more female dogs than male dogs were neutered (78.3% and 64.1% respectively). The results are very close to the model by Patronek and Glickman (1994), which estimates that 79% of all pet female dogs in the United States are spayed. There is likely to be a great deal of regional variation in these statistics. For example, Wright and Nesselrote (1987) found that only 30% of all canine patients were neutered in the caseload of three referring practices in Georgia.

Male and female dogs in this study followed similar trends in age distribution. Neutered dogs appear to have a longer life span, which may account for the slightly larger number of female dogs in the population. There are a number of reasons why there may be a larger proportion of neutered dogs in the older year classes. Neutering may truly have a protective health effect, by reducing deaths secondary to roaming or disease, or it may be that some effect of neutering on behaviour may promote retention of the pet (Salmeri et al., 1991b; Nielson et al., 1997). Breeders of purebred dogs may elect to neuter their older animals as they are retired from breeding. Alternatively, owners which are more attached to their dog, or more concerned about health issues, may be more likely to have their dog neutered, and to continue to make use of veterinary services in the dog's geriatric years. In this case it is not the surgery which is protective, but the owner's underlying positive attitude to pet health and veterinary medicine (Patronek et al., 1996).

Any dog which was not identified as being of a particular breed, or for which breed data was missing, was categorized as being of "mixed or unspecified breed". It was our belief that most owners of a registered purebred dog would correctly identify it as such, especially in the veterinary clinic setting with the dog at their side. It is possible, however, that some dogs which were actually purebred have been mis-classified as of mixed breed simply because the owner failed to respond to the question; and some mixed breed dogs may have been mis-classified as purebred because the owner believed their dog looked like a certain breed.

Mixed breed dogs or those of unspecified breeding made up 39.9% of the population. It

would be interesting to know how this compares to the actual number of mixed breed dogs in this region, as there may be a bias in the presentation of purebred dogs to veterinarians. Previous work has indicated that the purchase price of a dog is positively correlated with its retention by the owner (Patronek et al., 1996), which may in turn be associated with the use of veterinary services. It is possible that breeds which are of greater economic value or more predisposed to health problems are over-represented in this population. The number of clinics participating in this survey and the number of respondents, however, would lead us to believe that the diversity of breeds recorded in this study is an accurate picture of the composition of the canine caseload presented to veterinary clinics in this region. The four most frequently reported breeds in this survery are the same four most frequently registered by the Canadian Kennel Club in 1992 (Appendix C).

An examination of the reported duration of ownership revealed certain breed associations. For example, Miniature Poodles were recorded as having the highest proportion of old dogs (≥ 10 years) and the highest frequency of dogs which had been owned for at least one year. There are a number of conclusions that could be postulated from this information. First of all, Miniature Poodles may have a relatively long life span compared to other breeds. Secondly, Miniature Poodles may have more geriatric health problems which require veterinary attention and which are amenable to treatment, causing them to be presented to the veterinarian at a higher rate. Thirdly, a large number of Miniature Poodle puppies may have been produced and sold to local owners in the time period at least 10 years prior to our study, thus producing a "baby boom" effect in the current population,

such as may occur after the popularization of a particular breed by its appearance on television or in films. And finally, there may be some difference in Miniature Poodle owners and their relationship with their dogs which promotes the use of veterinary services for their geriatric pets. Reversing all of these arguments may explain the relative youth and short duration of ownership reported for breeds such as the Siberian Husky and the Rottweiler.

4.3 Associations between housetraining, command training, and neutering

The questions on housetraining and command training were mainly included in the questionnaire as a diversion from the negative attitude which might be generated by having only questions on aggression. The responses, however, also provide an estimate of the owner's ability and interest in training their dog, and the dog's response to that training. Failure in housetraining is commonly given as a reason for relinquishment (Miller et al., 1996; Patronek et al., 1996). Our data indicates there is a marked decline in housetraining problems in the population by 2 years of age. Some of this difference is obviously due to successful training, but a proportion would also be due to relinquishment. Despite reports that geriatric dogs may have more elimination problems (Chapman and Voith, 1990; Ruehl and Hart, 1998), this age-related change is not supported by our data. In such a brief questionnaire, it was not possible to determine if an older dog had originally been successfully housetrained, but now had an elimination problem related to a physical or cognitive problems. As some owners may have failed to report incomplete housetraining if they could rationalize their dog's behaviour based on age, illness, or other factors, there may have been a number false negative responses to this question. Alternatively, the

sudden onset of elimination problems in a dog may be a presenting complaint to the veterinarian, and some of the dogs in this study were undoubtedly visiting the clinic because of a health or behaviour problem signified by a change in their elimination pattern.

The data does not reveal a significant gender difference in the frequency of inadequate housetraining unless the variable of neutering is included, as neutering is strongly associated with housetraining success in our data. An interesting finding is that the apparently beneficial effect of neutering was more pronounced in female dogs. Gender apparently influences the owner's decision to have a dog neutered, and it may also be related to the effectiveness of neutering as a preventive treatment measure for housetraining problems. Owners who housetrain their young dogs successfully may be more likely to have them neutered, and owners who have made the financial commitment of having their dog neutered may also invest more effort in housetraining. Reported success with housetraining also improved slightly with age, even among dogs that were already at least 1 year old. This may indicate that, in some homes, effective housetraining is a relatively slow process. Alternative explanations for the apparent age effect would be that dogs with chronic elimination disorders were being kept in a different environment (outdoors) such that they were no longer eliminating in the home, or that they were gradually being lost from veterinary practices due to relinquishment or euthanasia.

4.4 Associations between command training and aggression

As obedience training is often recommended as part of the prevention and treatment protocol for almost any type of inappropriate behaviour, especially those problems related

to aggression (Landsberg et al., 1997, p.132; Houpt, 1998, p.68; Schwartz, 1998), it is worth noting the lack of a significant association between the absence of command training and biting in this survey. Dogs which have been trained to respond to at least one command are no more or less likely to have bitten. This is not an assessment of the effect of formal obedience training in preventing or treating aggression, although other authors have noted the lack of an association between obedience training and fewer behaviour problems (Voith et al., 1992). Very often owners will report that their dog has done well in obedience classes, but they are still having difficulty with aggressive behaviour under particular circumstances (Myles, 1991). Owners which have trained their dog to respond to commands may also spend more time in proximity to their pet, thus increasing the opportunity for an aggressive interaction. This emphasizes the need to understand the relative importance of formal training, socialization, and learned bite inhibition in the prevention of aggression.

4.5 Associations between neutering, gender, and aggression

Although neutering appears to have had a beneficial association with successful housetraining, the same cannot be said of its association with aggressive behaviours. As mentioned previously, the data indicated that in dogs of at least 1 year of age, neutering was positively associated with biting. Because castration and spaying are not equivalent procedures, in that they remove different tissues and hormones from a system primed for a gender-specific response, it is obviously important to look at the effects of neutering in male and female dogs independently.

There is little research into the effect of neutering in dogs that do not have a pre-existing behavioural problem. Neilson et al.(1997) examined 57 mature male dogs having at least one of several targeted problems and recorded the behavioural change after castration as reported by the owner. In addition to other problems, owners were questioned about aggression directed toward both familiar and unfamiliar people. The authors determined that although there was a significant reduction in aggression toward family members, this effect was limited to approximately one third of dogs with this problem. The authors freely admit that it is in practical terms impossible to blind an owner to the castration of their dog, and that it may be difficult to distinguish placebo effects from the biological effects of castration in this type of study.

O'Farrell and Peachey (1990) published the results of a prospective study of behavioural changes in 300 female dogs, half of which were spayed. Their conclusion was that spaying has no behavioural benefit in female dogs other than the prevention of estrous, and that in young female dogs already showing some signs of dominance aggression, spaying appeared to be associated with an increase in aggressive behaviour. This scenario occurred in 6 of 12 dogs which were spayed at less than 1 year of age, and which had shown some initial aggression. Wright and Nesselrote (1987) also detected an association between spaying and aggression in their caseload. Based on a case series of 105 dogs with a variety of behaviour problems, they presented the argument that intact male dogs and neutered female dogs were at a higher risk for aggression. Although neutered female dogs were presented for aggression at a disproportionately high rate (86%) relative to their frequency in the local referring population(37%), the difference was not nearly as

pronounced for intact male dogs. The referring practices reported that 79% of male dogs in their caseload were intact, and the frequency of intact dogs in the male patients seen for aggression was 86%. These results would appear to support the idea that spayed female dogs may be more aggressive, but this is not particularly strong support for the argument that intact male dogs are more aggressive, especially as their sample contained only 42 male dogs.

Salmeri et al.(1991a) examined the skeletal, physical, and behavioural effects of gonadectomy in immature dogs in a prospective study of 32 mixed breed puppies from 5 litters. The behavioural observations were unfortunately minimal, and the individuals scoring the behaviour of the dogs were apparently not blinded to either the dogs' age at neutering or current reproductive status. Given these limits, however, the findings were that dogs neutered at 7 weeks or 7 months of age were significantly more active and excitable than their intact litter mates during the 15 months of observation. There was no measurable effect of gonadectomy in relation to aggression toward the handlers. These dogs were raised in an atypical environment for a household pet, with very limited exposure to new stimuli. If gonadectomy does indeed produce an increased level of activity and excitability, it is interesting to speculate on the outcome of such behaviour in a more normal environment, especially a home with children.

In a cross-sectional study of English Cocker Spaniels, Podborscek and Serpell (1996) detected a significant positive association between neutering and aggression, although the association largely disappeared when dogs neutered specifically because they had been

aggressive were removed from the analysis. Even taking the reasons for neutering into account, the authors did determine that neutered female English Cocker Spaniels were significantly more likely to display aggression toward children in the household when compared to intact female cocker spaniels.

The results of these previous studies indicate that a clinically important association between neutering and aggression may only exist in certain sub-populations of dogs. It is possible that our study may have included, as biters, a percentage of dogs that are engaging in relatively harmless mouthing behaviours. Although it cannot be classified as true biting, the idea that this type of behaviour may occur more frequently in neutered dogs is interesting. Because the study design was cross-sectional, it is impossible to determine at this point whether the association we have detected between neutering and aggression is causal.

4.6 Associations between aggression and breed

Whether or not a dog was purebred did not appear to affect the reported frequency of biting. Being a mixed breed dog was significantly associated with more growling and possessive behaviour, and there were definite breed differences in the amount of aggression reported. It is interesting to speculate on the heritability of different types of aggression and the likelihood of their appearing together in the same dog. Labrador and Golden Retrievers apparently deserve their reputation as relatively non-aggressive adult dogs, even though they record quite a high frequency of biting behaviour at less than 1 year of age (Table 4). This is in line with the popular perception of retrievers as gentle

dogs with a propensity for playful mouthing behaviour as puppies (Hart and Hart, 1988, pp. 116, 124). The German Shepherd, which is often singled out by the public as being a dangerous breed, had a reported bite frequency which was essentially equivalent to that of the Golden Retriever. Either the German Shepherd has been unfairly maligned, or there are other factors involved which are restricting the presentation of aggressive adult members of this breed to the veterinarian. It is possible that German Shepherds have attained their reputation by being involved in more cases of extra-household aggression (Gershman et al., 1994; Reick, 1997). The Rottweiler is also often cited as a dangerous dog (Podberscek, 1994; CDCP, 1997; Reick, 1997). In this case, it is interesting to note how Rottweilers differed from Labrador Retrievers. Although the level of biting in Labrador Retrievers decreased markedly from 36% to 9% after 1 year of age, it remains virtually constant, at about 16% for the Rottweiler, regardless of age. Although we are unable to comment on the severity of bite incidents, our survey indicated that owners of Springer Spaniels in maritime Canada are reporting the highest frequency of biting behaviour by their dogs, both as puppies and in adulthood. Springer Spaniels have previously been reported by both Landsberg (1991) and Reisner (1994) as having relatively frequent problems with aggression towards their owners when compared to other breeds.

5. Conclusions

The results have demonstrated that it is possible to administer a multi-centric survey on the subject of dog behaviour, and achieve an excellent level of compliance from both veterinary clinic staff and their clients. Although there is always the possibility of false

negative responses to a questionnaire of this type, owners were apparently willing to reveal the presence of undesirable behaviours in their dogs, given the frequency with which aggression was reported by the respondents. Relative to intact female dogs, neutered male dogs of at least one year of age were at the highest risk for having previously shown biting behaviour, followed by neutered female dogs, and intact males. In North America, elective neutering of young dogs is commonly recommended for reasons related to health, behaviour, and population control, but the results of this survey indicate that the behavioural outcomes of this surgery are worthy of further investigation.

3. A CASE-CONTROL STUDY OF BITING AND NON-BITING DOGS IN THE CASELOAD OF GENERAL VETERINARY PRACTITIONERS IN MARITIME CANADA

Abstract

In order to determine risk factors for biting behaviour by dogs in a household setting, a detailed telephone survey of dog owners was undertaken using individuals selected from a cross-sectional population of veterinary clientele in the Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island. Interviews were successfully completed with 515 of 640 individuals selected from a study population of 3226 dogs by a formal random process. For the purpose of risk factor analysis, 227 biting and 126 non-biting dogs were further selected according to strict criteria for a case-control study, to evaluate the association of potential risk factors with biting behaviour. Biting behaviour was carefully defined in the telephone interview to avoid including activity associated with playful mouthing by the dog. All dogs were at least 6 months of age. Both the mean weight and age of biting dogs were significantly lower ($P<0.05$) than that of non-biting dogs. Significant risk factors for an outcome of biting were: the dog being female (particularly if small), the presence of 1 or more teenage children in the home, a history of a pruritic or malodorous skin disorder which had received veterinary treatment, aggression over food in the first 2 months of ownership, the dog having slept on someone's bed in the first 2 months of ownership, and the dog having been given a significantly higher ranking for excitability based on its behaviour in the first 2 months of ownership. Small dogs were

also determined to be at a higher risk of having bitten than large dogs when exposed to certain lifestyle and health factors, suggesting a relationship between body size and reactivity, or possibly greater owner tolerance of aggression in smaller dogs. Biting dogs were more likely to have exhibited fear of children, men, and strangers. The risk factors identified provide a useful focus for the veterinarian in general practice when counselling owners in the prevention of canine aggression.

1. Introduction

Most people who obtain a dog do so out of a belief that their relationship with the animal will be a rewarding experience. Many dogs fulfill the role of companion, confidant, playmate, and protector. They can exhibit extraordinary patience with children or other pets, tolerating overly-rough play and teasing with apparent good nature. What is it about these particular dogs that has made them the wonderful pets they are? The relationship, after all, is not always so perfect. Statistics indicate that many people are bitten every year, and that most are actually victims of their own dog, or at least of a dog they know (Kizer, 1979; Wright, 1990). Presumably, if only some dogs bite members of their household, then there may be some inherited or situational characteristics that put them at a higher risk for expressing aggression. Preventing dog bites to humans should follow the same course as reducing any other cause of injury or illness, by starting out with an estimation of the prevalence of the problem and the identification of potential risk factors.

Looking for risk factors requires that biting dogs be compared to non-biting dogs, meaning that representative samples of both groups must be identified and examined. Characterization of biting dogs has received considerable attention by veterinary behaviourists, but their examination of dogs which do not bite has been less intense. This is a natural outcome of the referral process, in which behavioural specialists, who generally work in teaching hospitals or other specialty referral centres, are obviously presented with only those dogs that have ongoing problems. Defining a valid control population of non-biting dogs that would otherwise match the referral population is

difficult. Some authors have elected to compare their caseload to that of the other medical or surgical specialities within the same facility, but under such circumstances the investigator is often limited to demographic information with very little behavioural background (Voith, 1981a; Line and Voith, 1986; Wright and Nesselrote, 1987; Lund et al., 1996). As a result, these authors have made comparisons based only on the reproductive status or breeds of dogs presented. In addition, the effect of referral bias may mean that the population of dogs receiving any medical attention at a veterinary teaching hospital is very different from those dogs and owners that ordinarily utilize primary veterinary services (Fletcher et al., 1988, p.59).

Obtaining a reference population for owned dogs is not a straightforward matter. There is no complete list of owned dogs, as not all dogs are licensed, and not all dogs are purebred and registered. Even specifically identifying a control group using formal random selection processes can be difficult. For example, Gershman et al.(1994) conducted a case-control study of dogs who had bitten a non-household member. Case animals were dogs within the Denver area who had caused a reported bite in 1991. Control dog households were identified using a geographically matched random digit dialing procedure. Both case and control owners were requested to complete a telephone interview. Using this process, the authors were only able to include 50% of eligible cases, largely because of the inability to contact the owner and complete the interview by phone. This comprised only 18% of the cases of reported dog bites for that year.

Veterinarians are most in need of information relevant to the treatment of cases they see on a daily basis, and these are the cases presented by their regular clientele. In truth, there are many dogs who never see a veterinarian, and this population is largely inaccessible to the profession except perhaps through public service work. The possibility that veterinary patients may have unique qualities, however, should not exclude them from use as a reference population.

The objective of this survey was to identify risk factors for canine household aggression by using a study design that had the capability to produce clinically relevant results. This necessitated obtaining detailed information about a large number of both biting and non-biting dogs so that the two groups could be compared. It was decided that the population of dog owners who are veterinary clientele were the most accessible for research purposes, and could be expected to provide information that was representative of the general population of dogs taken to veterinarians. An additional advantage of using veterinary clientele was that we believed they would probably hold veterinarians in a positive regard, and might therefore be more willing to discuss their dog's behaviour with a representative of a veterinary college in an interview situation.

Based on a population derived from a multi-clinic survey in maritime Canada, a case-control phone survey was undertaken to determine significant differences between biting and non-biting dogs and their respective households. As most dog bites are considered to be preventable injuries, the identification of significant risk factors could have the

beneficial effect of reducing the number of victims of canine household aggression.

2. Materials and Methods

2.1 Subjects

In 1996, twenty general veterinary practices in the Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island were recruited to administer a one page questionnaire to their dog-owning clients. Each owner was offered a questionnaire by the clinic staff unless they were presenting a litter of puppies for vaccination, the dog was being presented for euthanasia, or the owner was visibly upset or crying. Receptionists were also given the option not to offer the questionnaire if they were at times simply too busy with other duties. Dogs were not selected for inclusion on the basis of their behaviour, but were a cross-section of the canine caseload. This questionnaire requested the owner's name and phone number, basic demographic information on the dog, and contained 5 questions on the dog's behaviour. Three questions pertained to any history of aggression, and were worded to detect even those incidents that may have occurred over the relinquishment of objects or in play (Appendix A). The final section of the questionnaire advised owners that they might be contacted by the Atlantic Veterinary College for a more detailed telephone interview. A total of 3226 questionnaires were completed, giving a response rate of 81.4%. These individuals formed the study population for the telephone survey that was implemented 6 months later.

In response to the question: "Has your dog ever bitten any member of your household,

even if you think it may have happened by accident while playing?" 15.6% of respondents replied positively. These individuals were designated members of a tentative case population solely for the purpose of selection for the telephone survey. All other respondents were designated members of a control (presumptively non-biting) population, even if they had demonstrated less severe forms of aggression such as growling. Each questionnaire had a unique identification code (ID) which also identified the clinic of origin. A formal random sampling procedure was used to draw a group of 500 individuals from the control population using the STATA statistical software package (Stata Corporation, College Station, Texas, USA). Using the randomly selected control group ID numbers, cases were selected by matching first for clinic and then choosing the next largest ID number among the biting dogs. Although matching cases to controls by clinic was initially done on a 1 to 1 basis, in the latter part of the study 4 case animals were matched to each control animal by clinic. Overall, approximately 3 case animals were matched to each control, thereby enhancing the number of owners interviewed who had reported a history of biting by their dogs. If owners had completed a questionnaire for more than one dog in their household, only the first dog selected by the matching procedure was included in the survey. The matching procedure was continued until there were no more case animals remaining unselected. A total of 640 owners were selected for inclusion in the telephone survey.

2.2 Telephone questionnaire design

The telephone questionnaire was 17 pages in length, including a standard cover sheet and

introductory page (Appendix D). All questions except one were in closed-end format, requiring either a yes/no/don't know response, a numerically ranked response, or selection from a list of possible responses by either the respondent or the interviewer. Text was worded in a conversational style to include the name of the dog, and separate questionnaires were produced for male and female dogs. Telephone interviewers knew the clinic of origin for each dog, but were blinded to its case or control assignment.

The questionnaire was divided into the following six sections: 1) information about the home, 2) demographic information about the dog, 3) behaviour in the first 2 months of ownership, 4) general behaviour of the dog, 5) behaviour of the dog in the last 2 months of ownership, and 6) specific behaviour of the dog in respect to biting. Only those owners who reported during the telephone survey that their dog had ever bitten a member of their household completed the last section on biting behaviour. A bite was carefully defined in the instructions to the interviewers as *"the upper or lower teeth making contact with the victim's skin with sufficient pressure to cause a visible injury such as an indentation, welt, scrape, bruise, puncture, or tear in the skin. A dog mouthing a person's skin without applying sudden pressure is Not considered a bite"*. All respondents were given the opportunity to ask questions or make comments at the end of the survey.

2.3 Telephone survey implementation

The survey was conducted by four female interviewers. Training was provided related to the objectives of the survey, and in telephone survey techniques as described by Dillman

(1978, pp.257-269). Each interviewer pre-tested the questionnaire with three respondents without difficulty. No changes to the questionnaire were necessary after pre-testing. The survey was conducted mainly during the evening and weekend hours of November 1996 to January 1997. There were no limits on the number of attempts that could be made to contact a respondent. Respondents were given the opportunity to select a more convenient time to complete the questionnaire if they were reluctant to cooperate when first contacted. The questions were to be answered by an adult who lived in the home and took some responsibility for the care of the dog, but who did not have to be the same individual who completed the original clinic questionnaire. Respondents were advised at the outset that the questionnaire would take 15 minutes to complete, although this eventually proved to be an underestimate of the average time required. Every reasonable effort was made to contact owners who had moved or who had incorrect numbers.

2.4 Data management

All questionnaires were coded by one individual. Data was entered into Quattro Pro 6.0 (Corel Corporation Limited, Ottawa, Ontario, Canada) by three individuals. Any response of "don't know" was recorded as missing data. Interviewers were instructed to record the details of a response if they were unsure of how to assign it to a category. Such entries were subsequently categorized by the first author. Demographic information from each dog was checked against the results from the original clinic survey to detect any errors or mis-classifications. The originating clinic or respondent was contacted if the correct response could not be determined by comparing the two questionnaires. Unusual values

were double-checked against the original telephone questionnaire form, but were not altered if they were deemed biologically plausible and were not the result of a data entry error. Any values which did not seem plausible and which could not be substantiated were re-coded as missing.

A positive response to the following question: "*Has your dog ever bitten any member of your household or any person who is a frequent visitor in your home and is well known to the dog, even once, even if you think it may have happened by accident while he was playing?*" resulted in the dog being classified as a case for the purpose of analysis. Dogs belonging to owners who responded negatively to both this question *and* to the question on biting from the original clinic survey were classified as controls. Some dogs, therefore, shifted position from their original case or control designation based on the response to this more definitive question.

Statistical analysis was accomplished with Intercooled STATA 5.0 software (Stata Corporation, College Station, Texas, USA). Univariate statistics were performed on the responses to each question to determine the significance of their association with the outcome of biting as defined above. Means for continuous variables were compared between case and control dogs using Student's *t*-test (Glantz, 1992, pp. 67-109). Categorical variables were analysed using contingency table chi-square analysis (Glantz, 1992, pp. 110-154). Independent variables found to be significantly different ($P \leq 0.10$) between biting and non-biting dogs were grouped into the following four categories:

1)demographic and health, 2)early behaviour in first 2 months of ownership, 3)training and behaviour, and 4)recent behaviour. Variables in each of the first three groups were selected for a risk factor analysis of biting behaviour using multiple logistic regression and stepwise, forward, and backward selection procedures (Hosmer and Lemeshow, 1989, pp.82-134). For our purposes, a risk factor was any variable which could be associated with an increased risk of a dog developing household aggression (Fletcher et. al., 1988, p.91). This does not mean that the presence of a risk factor predicts aggression absolutely in an individual dog, but rather that it is a measure of an increased potential for the problem to occur in a dog. Variables identified as possibly useful predictors of eventual aggression at the $P<0.05$ level were included in the final model building procedure. Four variables (sex, age, neuter status, and weight) were locked in during model building due to their potential to act as confounders. The model generated by this process was tested for the presence of significant ($P<0.05$) interaction terms. A significant interaction between sex and body weight was detected and included in the model. The general fit of the model to the data was assessed with the Hosmer-Lemeshow goodness-of-fit chi square statistic with the data divided into 10 groups. The Pearson residuals, the standardized Pearson residuals, and the delta Betas ($\Delta\beta$'s) were computed for all 267 covariate patterns to rule out the possibility that any specific pattern was having an undue influence on the model (Hosmer and Lemshow, 1989, pp. 135-175).

The fourth category of independent variables, "recent behaviour", contained a number of measurements which were very highly associated with the outcome of biting using

univariate statistical techniques (chi square and Student's t-test) and which also produced a number of significant interaction terms in logistic regression. These variables were not included in the aforementioned model, as the temporal relationship between exposure to these risk factors and the outcome of aggression was unclear, and the number of overlapping interactions occurring made interpretation impossible. For example, the amount of time the dog spent outdoors, or whether it was currently afraid of men, could easily be either a cause or a result of aggressive behaviour. In addition, some questions asked the respondent to give their assessment of the dog's behaviour in the last two months. An owner's perception of their dog's recent aggressiveness or trustworthiness with children would obviously be influenced by a history of biting.

As body weight showed the potential to be a confounding factor for biting behaviour, a number of odds ratios (Fletcher et al., 1988, pp. 195-198) were calculated after stratification of the population into large (≥20 kg) and small (<20 kg) dogs. A confounding factor is defined as being related to both the risk factor of interest (i.e. being allowed on the furniture) and the outcome of interest (i.e. biting) (Dohoo and Waltner-Toews, 1985a). Stratifying the analysis, so that the risk factor and outcome relationship is analyzed separately for large and small dogs, was used to determine whether body weight was a confounding factor, and other factors (i.e. being allowed on the furniture) were spurious. In some cases, an interaction was detected, indicating that the effect of one variable (i.e. weight) was altering the effect of another (i.e. being allowed on the furniture). These additional interaction terms were not significant, however, when

included in the multiple logistic regression model (Glantz and Slinker, 1990, pp. 94, 564-565).

3. Results

3.1 Interview completion rates

Phone contact was attempted with the 640 selected subjects from which 515 (80.5%) phone interviews were successfully completed. Unsuccessful interviews were due to the respondent no longer having the dog (58, 9.1%), inability to make contact with the respondent due to a wrong, disconnected, or unlisted number, or no one being home (46, 7.1%), and refusals to participate (21, 3.3%). Table 1 lists the reasons given by respondents for no longer having their dog, the majority of which were death due to advanced age or illness. A report of biting behaviour on the clinic survey was not associated with an increased risk of the respondent no longer owning the dog by the time of the phone survey. Six dogs had been euthanized or given away because of a behaviour problem. No dogs were reported to have been relinquished to the humane society. No reason was provided for the euthanasia, death, or giving away of 9 of the dogs. There was no significant difference among the interviewers in their ability to successfully complete an interview or record a case of biting behaviour. The mean time to complete an interview was 22.9 minutes, although interviews with owners of biting dogs took significantly longer ($P<0.01$) due to the additional questions regarding biting incidents. Of the successful phone contacts for which gender was recorded, 28% of the respondents were male and 72% were female.

3.2 Demographic characteristics of case and control dogs

For the purposes of case-control analysis, 227 dogs were classified as biting (cases) and 126 were classified as non-biting (controls) for a total of 353 dogs. A positive response to the biting question on the phone survey resulted in a dog being designated a case, a negative response on both the phone and the clinic survey were required for a dog to be designated a control (Table 2). The estimated predictive value of a positive test on the clinic survey completed six months earlier to detect injurious biting as described in the phone survey was 0.57. The estimated predictive value of a negative response on the clinic survey to detect a non-biting dog as described in the phone survey was 0.81 (Fletcher et al., 1988, pp.54-61).

The demographic characteristics of case and control dogs are described in Table 3. The mean weights and ages of biting dogs were significantly lower ($P<0.05$) than those of non-biting dogs. The number of male and female dogs in the study were virtually equal at 177 and 176 respectively. The overwhelming majority of dogs were neutered (87.5%), although significantly more males than females were still sexually intact ($P<0.01$). There were no significant differences in either gender or neuter status between the case and control groups.

Among the 353 dogs which met either the case or control criteria, 202 dogs were purebred, of which 196 were reported to be registered with either the Canadian or American Kennel Club. The remaining 151 dogs were classified as of mixed or

unspecified type. Purebred status was not associated with whether or not a dog had bitten (P>0.05). The most frequently reported breeds were the Labrador Retriever (22 dogs), the Golden Retriever (18), the Springer Spaniel (11), the Lhasa Apso (10), the Shih Tzu (9), and the Shetland Sheepdog (9). In all there were 62 different breeds reported, the majority of which were represented by only a few individuals.

Whether or not the respondent had paid to obtain the dog, its age at adoption, and its age at neutering, were not associated with biting (P>0.05). Other factors which were found not to be significant were receiving treats other than regular dog food at least once a week, and the frequency of daily feeding.

3.3 Variables identified individually as being potential predictors

Responses to all survey questions were assessed, and those deemed to be both potential predictors of biting and having a significance of $P \leq 0.10$ are included in Table 4. In spite of their lack of significance in a univariate association with biting, sex and neuter status were included with this group of variables due to the possibility of their acting as confounders or in interaction terms. The dog having been obtained from a friend or relative (P=0.021), and being a member of either the spaniel, toy, terrier, or "other" breed group were positively associated with biting (P=0.100) (see Appendix E for breed groupings).

The number of teenagers in the home was positively associated with a bite having

occurred (P=0.004). The mean number of teenagers aged 13-17 years in the home of biting dogs was 0.45, as compared to a mean of 0.23 in the home of non-biting dogs. One or more teenagers were reported to be living in the homes of 26.3% of the respondents. Although there were also more young children (<13 years old) living in the homes of biting dogs, the difference was not statistically significant. Using the total number of offspring in the home (teens+children) as the independent variable, or assessing the effect of whether or not there were any offspring at all in the home did not reveal any stronger associations with biting than that already detected with the number of teenagers.

The responses to two questions on the health history of the dog were significantly associated with the outcome of biting. A serious illness or injury requiring overnight hospitalization of the dog was associated with fewer respondents reporting biting (P=0.022). Conversely, the respondent reporting that the dog had received veterinary treatment for a pruritic or malodorous skin disorder was more common among the biting dogs (P=0.050). A history of dental extractions or cleaning was not associated with biting.

For dogs that were adopted when less than 6 months of age, responses to several questions on the behaviour of the dog in the first 2 months of ownership showed significant associations with the outcome of biting. The owner recalling aggressive behaviour, either in response to discipline or over food, was significantly associated with biting (P<0.05). Biting dogs were ranked by owners as having been more excitable

(P=0.031), and less interested in people (P=0.100) than non-biting dogs in the first 2 months of ownership. More biting dogs were also reported to have slept on someone's bed during this initial period in the home (P=0.018).

No significant associations with biting were detected at the $P \leq 0.10$ level for either crate use or attendance at puppy classes, even if these measures had been undertaken because of some problem with the dog's behaviour. The owner having previously taken another dog to obedience class was not associated with whether or not biting was reported. Dogs which had been taken to obedience class because they had a behaviour problem were significantly more likely to have bitten (P=0.023), even if the original problem reported by the owner was not aggression. Dogs which had been taken to obedience class for reasons unrelated to problem behaviour were no more or less likely to have bitten than dogs who had never been to obedience class. The owner reporting a physical method of punishment of the dog for general misbehaviour or elimination problems, as either a puppy or an adult, was not significantly associated with biting.

Potentially compulsive behaviours were examined in a series of 11 questions about specific and unusual behaviours of the dog (Appendix D). The responses to three questions relating to oral behaviour had significant positive associations with biting. Respondents with biting dogs were more likely to report that the dog "chewed objects excessively" (P=0.070) and "chewed and swallowed sticks or rocks" (P=0.030). Barking for long periods at "nothing in particular" was also associated with biting (P=0.034).

Growling at any household member, even if it was in play, was very strongly associated with the respondent reporting biting by the dog ($P<0.001$). Snapping at a household member, even if over food or a toy, was equally significant, but this result is difficult to interpret as some respondents may have misunderstood the term "snapping" (in the air) to mean "biting"(making skin contact). Aggression directed toward strangers on the dog's own territory was also strongly associated with biting a household member ($P<0.01$), although biting of strangers was a relatively uncommon behaviour, being reported in only 8.6% of all the dogs.

3.4 Selection and testing of a model for the prediction of biting

Variables included in the final model (Table 5) were sex, weight, age, neuter status, the number of teenagers in the household, a history of a skin disorder requiring veterinary treatment, having slept on someone's bed in the first 2 months of ownership, having shown aggression over food in the first 2 months of ownership, a high rank for excitability in the first 2 months of ownership, and a single interaction term including sex and weight. The sex, weight, age, and neuter status variables were included as potential confounders and as main effects for the interaction term. Of these four, only sex was close to being statistically significant ($P=0.055$). Female dogs were almost 3 times more likely to have bitten than male dogs (OR=2.98, 95%CI: 0.98 to 9.07). This was most apparent when the (sex x weight) interaction term was included (OR=0.95, 95%CI: 0.91 to 0.99), indicating that reports of biting by female dogs decreased as body weight increased, an association which was not detected in male dogs. With every additional teenager in the household,

the odds of biting increased. Dogs which had a history of veterinary treatment for a skin disorder were almost twice as likely to have bitten (OR=1.87, 95% CI: 1.03 to 3.38), a similar association to that determined for dogs which had slept on someone's bed in the first 2 months (OR=1.93, 95%CI: 1.06 to 3.53). Biting dogs were 3 times as likely to have a history of aggression over food in the first 2 months of ownership (OR=3.08, 95%CI: 1.05 to 9.01), and were given higher excitability rankings for the same time period (OR=1.14, 95%CI: 1.02 to 1.26).

The variables describing whether the dog had ever growled or snapped at any household member were excluded from the model when it was discovered that they were acting as indicators of biting, and masking the presence of other more clinically useful predictors. The variable for "biting strangers", although highly associated on a univariate basis with biting a household member, also acted as an indicator of biting a household member, and would severely restrict the number of observations included in the model and cause the exclusion of several other potentially useful predictors. "Biting strangers" was therefore deliberately excluded from the final model.

Using the probability cut-off value for classification as a biting dog of 0.5, the sensitivity and specificity of the model were 89% and 31% respectively. These values indicate that more biting dogs would be correctly detected by the model than would non-biting dogs, and that there are likely to be a low number of dogs with a false negative classification. The predictive value of positive and negative tests were 72% and 60% respectively. In

other words, the proportion of dogs predicted to be biters which actually were biters was higher than the proportion of dogs predicted to be non-biters which actually were non-biters. Lowering the probability cut-off to 0.4 (for example) has the effect of increasing the sensitivity of the model to 98% and decreasing the specificity to18.9%. It does not radically change the predictive value of a positive test (71%), but improves the predictive value of a negative test result to 85%.

3.5 Associations between recent behaviour and biting

A number of other variables were strongly associated with an outcome of biting but could not logically be classified as potential predictors (Table 6). These variables described the recent behaviour or lifestyle of the dog, and might therefore be associated with biting because they are actually the outcome of aggressive behaviour, or because they appeared concurrently with aggression. For example, being confined to a leash, yard, or pen when outdoors was associated with biting ($P<0.01$) as was the dog spending less than 3 hours outdoors on an average weekday ($P=0.004$). Dogs that spent 3 or fewer hours outdoors on a weekday were significantly smaller than dogs that spent more than 3 hours outdoors ($P<0.001$). Sleeping on someone's bed, being allowed on the furniture, and playing tug-of-war in the last 2 months were all positively associated with biting ($P<0.05$). Dogs that were allowed on the bed or furniture were significantly smaller than dog that were not permitted on these surfaces ($P<0.001$). Biting dogs were more frequently reported to be afraid of children, men, strangers, delivery people, or dog groomers ($P<0.10$). Three questions asking the owner to rank the dog's behaviour in the last 2 months were

significantly associated with biting. Dogs that had bitten were judged to be more excitable, less trustworthy with children, and generally more aggressive in the last 2 months ($P<0.005$).

3.6 The relationship between body weight and other variables

When the dogs were stratified into 2 groups according to weight, small (<20kg, n=176) and large (≥20 kg, n=166), a number of interactions were detected between body size and the risk of another variable being associated with biting (Table 7). Small dogs were at a greater risk of biting than large dogs if they had either shown aggression over food or were allowed to sleep on the bed in the first 2 months of ownership. They were also more likely than large dogs to have bitten if they had been treated for a skin disorder, were currently allowed on furniture, or were afraid of children. For dogs that played tug-of-war, being larger increased the risk of biting. Size was a confounding factor for dogs that had been allowed to sleep on someone's bed in the past 2 months. If the analysis was controlled for size, the risk associated with sleeping on someone's bed in the past 2 months decreased and became non-significant.

Table 1
Reasons given by phone survey respondents for no longer owning their dog (n=58).[a]

Reasons given by respondents for no longer owning dog at the time of the phone survey	*n*	Response from clinic survey	
		biting	non-biting
Died or euthanized due to advanced age or illness	33	26	7
Given away due to moving or allergies	6	3	3
Euthanized due to a behaviour problem	5	4	1
Died or euthanized, no reason provided	5	2	3
Given away, no reason provided	4	3	1
Lost	2	1	1
Other	2	1	1
Given away due to a behaviour problem	1	1	0
Relinquished to humane society	0	N/A	N/A
TOTAL (%)	58	41 (70.7)	17 (29.3)
Comparative values for dogs still owned at time of phone interview	515	358 (69.5)	157 (30.5)

[a] Respondents ceased to own their dogs in the six month time period between the clinic survey and the phone survey.

Table 2
Responses to the question on biting in the original clinic survey as compared to the response on the phone survey six months later*.

		Phone Survey		
		Biting	Non-biting	TOTAL
Clinic Survey	Biting	198	151	349
	Non-biting	29	126	155
	TOTAL	227	277	504

*The predictive value of a positive response on the clinic survey to detect actual injurious biting as described in the phone survey was 0.57 (198/349).

Table 3
Demographic characteristics of case (biting) and control (non-biting) dogs[a].

Variable	All dogs	Biting dogs		Non-biting dogs	
Total dogs (%)	353	227	(64.3)	126	(35.7)
All females (%)	176	110	(62.5)	66	(37.5)
Intact females (%)	12	8	(66.7)	4	(33.3)
Neutered females (%)	164	102	(62.2)	62	(37.8)
All males (%)	177	117	(66.1)	60	(33.9)
Intact males (%)	32	20	(62.5)	12	(37.5)
Neutered males (%)	145	97	(66.9)	48	(33.1)
Mean age in years (range)	5.0	4.7	(0.5-15)	5.6	(0.6-17)
Mean weight in kg (range)	20.5	19.5	(1.8-58.5)	22.4	(3.6-58.5)

[a] Case (biting) dogs were those belonging to owners who responded positively to the question about biting in the phone survey. Control (non-biting) dogs were those which had no history of biting reported in either the clinic or phone survey.

Table 4
Means and frequency distributions (%) of independent variables identified as potential risk factors for biting behaviour directed toward household members ($P \leq 0.10$), where 0 = negative response, 1 = positive response.

	Biting dogs		Non-biting dogs		
Variable (units)	n	Mean or %	n	Mean or %	*P* value*
Demographic and Health					
Age (years)	221	4.7	123	5.6	0.035
Weight (kg)	221	19.5	121	22.4	0.046
Sex (1=female)	227	0 = 51.5% 1 = 48.5%	126	0 = 47.6% 1 = 52.4%	NS
Neuter status	227	0 = 12.3% 1 = 87.7%	126	0 = 12.7% 1 = 87.3%	NS
Origin of dog: 1.Breeder 2.Relative or friend 3.Humane society 4.Pet shop 5.Private shelter, stray, or own dog's litter. 6.other	227	1 = 40.5% 2 = 27.8% 3 = 10.6% 4 = 8.8% 5 = 3.5% 6 = 8.8%	125	1 = 44.0% 2 = 20.8% 3 = 10.4% 4 = 10.4% 5 = 11.2% 6 = 3.2%	0.021
Breed group: 0. Mixed breed 1. Retrievers, setters, pointers 2. Spaniels 3. Hounds 4. Toys 5. Working - guard 6. Working - husky, spitz 7. Giants 8. Terriers 9. Herding 10. Other purebred	227	0 = 41.9% 1 = 11.0% 2 = 6.6% 3 = 2.6% 4 = 9.7% 5 = 2.6% 6 = 1.0% 7 = 1.3% 8 = 8.8% 9 = 3.5% 10=11.0%	126	0 = 45.2% 1 = 15.1% 2 = 4.0% 3 = 4.0% 4 = 6.3% 5 = 1.6% 6 = 4.0% 7 = 3.2% 8 = 3.2% 9 = 6.3% 10= 7.1%	0.100
Number of teenagers (13-17 yrs) in home	227	0.45	126	0.23	0.004
Ever had a serious illness or injury requiring overnight hospitalization	226	0 = 74.3% 1 = 25.7%	126	0 = 62.7% 1 = 37.3%	0.022
Ever needed treatment for a skin disorder involving pruritus or an unpleasant odour	226	0 = 59.7% 1 = 40.3%	125	0 = 70.4% 1 = 29.6%	0.050

* The statistical significance of differences between biting and non-biting dogs

Table 4 cont'd

Variable (units)	Biting dogs n	Biting dogs Mean or %	Non-biting dogs n	Non-biting dogs Mean or %	*P* value
Early Behaviour in first 2 months of ownership as recalled by owner					
Any aggressive response to discipline	190	0 = 81.1% 1 = 18.9%	99	0 = 90.9% 1 = 9.1%	0.028
Any aggression over food	190	0 = 85.3% 1 = 14.7%	98	0 = 94.9% 1 = 5.1%	0.015
Score of dog's excitability (1 to 10)	190	6.93	98	6.22	0.031
Score of dog's interest in people (1 to 10)	191	8.65	98	9.08	0.100
Slept on someone's bed, first 2 months	191	0 = 59.7% 1 = 40.3%	99	0 = 73.7% 1 = 26.3%	0.018
Training and Behaviour					
Obedience class 0. Never attended 1. Attended, but not because of problem 2. Attended because of behaviour problem	225	0 = 63.1% 1 = 22.7% 2 = 14.2%	125	0 = 72.0% 1 = 23.2% 2 = 4.8%	0.023
Chews objects excessively	227	0 = 69.6% 1 = 30.4%	126	0 = 78.6% 1 = 21.4%	0.070
Chews and swallows sticks or rocks	226	0 = 62.4% 1 = 37.6%	126	0 = 73.8% 1 = 26.2%	0.030
Barks for long periods at nothing in particular	227	0 = 76.2% 1 = 23.8%	126	0 = 85.7% 1 = 14.3%	0.034
Ever growled at any household member, even in play	226	0 = 18.1% 1 = 81.9%	126	0 = 61.1% 1 = 38.9%	<0.001
Ever snapped at any household member, even over food or toy	226	0 = 25.7% 1 = 74.3%	126	0 = 89.7% 1 = 10.3%	<0.001
Ever growled or snapped at a stranger as they came into home	226	0 = 61.9% 1 = 38.1%	126	0 = 79.4% 1 = 20.6%	0.001
Ever bitten a stranger while on dog's property	225	0 = 88.4% 1 = 11.6%	126	0 = 96.8% 1 = 3.2%	<0.001

Table 5
Logistic regression model of risk factors for injurious biting of human members of the same household.

Variable	Coefficient	Probability	Odds ratio	95% CI*
Intercept	-0.819			
Sex (female=1)	1.092	0.055	2.98	0.98-9.07
Age (years)	-0.042	0.261	0.96	0.89-1.03
Neuter status (neutered=1)	-0.184	0.660	0.83	0.37-1.89
Weight (kg)	0.013	0.380	1.01	0.98-1.04
(Sex x weight) interaction term	-0.052	0.021	0.95	0.91-0.99
Number of teenagers in home	0.735	0.002	2.09	1.30-3.35
History of treatment of a skin disorder by a veterinarian	0.625	0.039	1.87	1.03-3.38
Slept on someone's bed in first 2 months of ownership	0.659	0.032	1.93	1.06-3.53
Aggression over food in first 2 months of ownership	1.125	0.040	3.08	1.05-9.01
Score for excitability in first 2 months of ownership on a scale of 1 to 10	0.128	0.018	1.14	1.02-1.26
Hosmer-Lemeshow goodness-of-fit $\chi^2 = 9.43$, d.f. =8, $P = 0.31$				

* 95% Confidence Interval

Table 6
Means and frequency distributions (%) of independent variables describing the recent behaviour and lifestyle of case (biting) and control (non-biting) dogs which were identified to be significantly associated with biting directed toward household members, where 0 = negative response, 1 = positive response ($P<0.10$).

	Biting dogs		Non-biting dogs		
Variable (units)	n	Mean or %	n	Mean or %	*P* value*
Slept on someone's bed	226	0 = 43.4% 1 = 56.6%	125	0 = 58.4% 1 = 41.6%	0.007
Allowed on furniture	225	0 = 24.4% 1 = 75.6%	126	0 = 42.1% 1 = 57.9%	0.001
Played tug-of -war	226	0 = 34.1% 1 = 65.9%	122	0 = 46.7% 1 = 53.3%	0.021
Time spent outdoors in an average weekday 0. More than 3 hours 1. ≤ 3 hours	227	0 = 14.5% 1 = 85.5%	126	0 = 27.0% 1 = 73.0%	0.004
How dog spent most of time when outdoors 0. Free outdoors 1. On walks, or confined in yard or pen	205	0 = 30.7% 1 = 69.3%	114	0 = 46.5% 1 = 53.5%	0.005
Score of dog's excitability (1 to 10)	227	6.69	126	5.70	0.001
Score of dog's untrustworthiness with children (1 to 10)	226	4.31	126	2.34	<0.001
Score of dog's overall aggressiveness (1 to 10)	226	3.98	125	2.17	<0.001
Fear of children	223	0 = 86.5% 1 = 13.5%	123	0 = 92.7% 1 = 7.3%	0.084
Fear of men	227	0 = 80.6% 1 = 19.4%	125	0 = 92.0% 1 = 8.0%	0.005
Fear of strangers	227	0 = 72.7% 1 = 27.3%	123	0 = 82.9% 1 = 17.1%	0.032
Fear of delivery people	220	0 = 78.6% 1 = 21.4%	121	0 = 90.1% 1 = 9.9%	0.008
Fear of dog groomers	152	0 = 73.0% 1 = 27.0%	92	0 = 83.7% 1 = 16.3%	0.055

* The statistical significance of differences between biting and non-biting dogs

Table 7
Odds ratios (OR) and confidence intervals (95%CI) for the risk of biting in small (<20kg, n=176) and large (≥20kg, n=166) dogs exposed to various lifestyle and health factors.

Variable	All dogs		Small dogs (<20 kg)		Large dogs (≥20kg)	
	OR	95%CI	OR	95%CI	OR	95%CI
Slept on someone's bed in first 2 months of ownership	1.90	1.12-3.22	2.58	1.17-5.69	1.46	0.68-3.11
Aggression over food in first 2 months of ownership	3.21	1.23-8.32	4.69	1.14-*	1.46	0.39-5.41
History of treatment of a skin disorder by a veterinarian	1.60	1.01-2.55	2.09	1.04-4.21	1.30	0.68-2.49
Allowed on furniture in past 2 months	2.24	1.41-3.57	4.03	1.78-9.09	1.50	0.81-2.81
Fear of children	1.97	0.92-4.23	2.89	0.98-8.43	1.03	0.34-3.15
Played tug-of-war in past 2 months	1.70	1.08-2.66	1.27	0.65-2.47	2.23	1.18-4.22
Slept on someone's bed in past 2 months	1.83	1.18-2.85	1.79	0.94-3.45	1.70	0.88-3.26

* unable to estimate upper limit of 95%CI due to small number of dogs (2) who had shown aggression over food in the first 2 months of ownership and had *not* bitten.

4. Discussion

4.1 Effectiveness of using general veterinary clientele in behavioural research

This study has utilized a unique population for the investigation of risk factors into canine household aggression. It has neither relied on the population of dogs involved in reported bite incidents or the population seen by behavioural specialists in referral centres, but it is based on a cross-sectional sample of owned dogs seen by veterinarians in general practice. These are not necessarily dogs which are on the verge of relinquishment or euthanasia, but are for the most part on-going members of a household, some of whom happen to have bitten a family member. This data provides a new perspective on the problem, as victims may tend not to officially report bites by their own dogs (Wright, 1990), and problems in those dogs that do reach the level of tertiary behavioural care are likely to be more severe (Fletcher et al., 1988, pp.59).

The use of general veterinary clientele as subjects appears to have minimized problems with missing data, as the response rate to both the original cross-sectional survey and the phone survey were excellent. Only 3.3% of owners contacted for the phone survey refused to participate. Of the 58 respondents who no longer owned their dog, it is surprising that no one reported relinquishing it to the humane society. Veterinary clients may be reluctant to use this route to dispose of unwanted pets, or they may have felt social pressure not to admit to this outcome in an interview situation connected with a veterinary college (Dillman, 1978, pp.62). Patronek et al. (1996) have identified lack of veterinary care as a strong risk factor for relinquishment of dogs to the humane society. Other

publications have noted that it is not necessarily the presence of a behaviour problem that increases the risk of relinquishment, but whether the dog's behaviour differs markedly from what was originally expected by the owner (Kidd et al., 1992; Serpell, 1996). Veterinary clients may be both relatively more knowledgeable about normal canine behaviour, and more attached to their dogs. It is impossible to know if people who no longer had their dog were being truthful when they reported that it had died, been given away, or was lost. Some of these dogs may have in fact been taken to the humane society.

4.2 Study design and the use of multivariate analytical techniques

In this study, logistic regression was utilized to determine significant risk factors for the outcome of the dog biting a household member. With such exceptions as Gershman et al. (1994), who examined risk factors for non-household aggression, and Reisner et al. (1994), who established risk factors for behaviour-related euthanasia in dogs seen for dominance aggression, the use of multivariate analysis is unusual in canine behavioural research. Patronek et al. (1996) used multiple logistic regression to determine risk factors for the relinquishment of dogs to an animal shelter, but was not specifically looking at behaviour as an outcome. The advantage of a multivariate technique is that it allows for the possibility of interaction, both seen and unseen, between a number of factors, rather than proceeding on the assumption that factors are acting independently of each other. Examining the combined effects of environmental and inherited variables on a dog's behaviour may identify factors which would not otherwise have been recognized as significant.

If a factor has a subtle effect, it may only be detected if there is a relatively large number of subjects and if the study design is appropriate. Many published veterinary case-control studies and case reviews have tended to involve quite small numbers of dogs and have been based on referral populations (Voith, 1981a; Beaver, 1983; Borchelt, 1983; Wright and Nesselrote, 1987; Chapman and Voith, 1990; Blackshaw, 1991). The cohort study, a prospective examination of the effect of a treatment on a particular group, is relatively uncommon (Neilson et al., 1997; Salmeri et al., 1991a). Surveys using larger numbers of dogs have been reported, but there are frequently underlying problems with validity in that they have been voluntary, unintentionally haphazard, or conducted solely within referral centres (Campbell, 1974;1986; Adams and Clark, 1989; Voith et al., 1992). One recent example of good survey design is the work by Podberscek and Serpell (1996) into the relationship between coat colour and aggressive behaviour by the English Cocker Spaniel. In a similar manner to this study, it relies on a cross-sectional survey , and not just those dogs with a history of aggression.

The subjects in our study were drawn from a cross-sectional sample of 3226 dogs originating from 20 different veterinary clinics, located in both urban and rural areas. Phone interviews were successfully completed with 80.5% of the 640 subjects which had been selected from this population by a formal random process. This design, in combination with the ability to obtain detailed responses through long telephone interviews, has enhanced the external validity and statistical power of our study. The results from a study with external validity can be expected to hold true in other settings

(Fletcher et al., 1988, pp. 12).

4.3 Case definition for purposes of risk analysis

In order to be certain that the behaviour reported in the phone survey by the owner was true aggression, a case dog was defined very precisely as one which had produced a bite with some degree (even minor) of skin injury. Biting was used as a surrogate measure of the severity of aggression. This excludes all dogs which may have snapped and missed the victim, although there is no doubt that some of those incidents involved the intent to actually injure. It was necessary, however, to be able to clearly define our outcome of interest in the course of the telephone interview. On the other hand, given our definition of a case, we believe it is unlikely that an owner would accidently report their dog as having bitten when it had not. Although respondents appeared to be quite willing to report misbehaviour by their dog, it is impossible to know how many responses to the question on biting were false negatives because the owners had forgotten, not been aware of, or had not wished to reveal a bite incident.

The definition of a control animal was equally conservative. Dogs must have been reported as non-biters on both the clinic and telephone surveys to be included in the control group. It was possible that the clinic and telephone surveys were completed by two different respondents living in the same household with the dog in question, and that these two individuals would have either different knowledge or perceptions of the dog's behaviour. Although this selection process reduced the number of subjects available for

the analysis of risk factors, it enhanced our confidence in stating that the control dogs were free of a history of biting.

4.4 Demographic risk factors

Analysis of the demographic characteristics of the phone survey population indicated that biting dogs were on average smaller than the controls. Officially reported bite statistics tend to list larger dogs as the cause of injury, which may reflect a bias toward the reporting of bites by this sub-group, especially if the dog is not owned by the victim (Wright, 1990). Reisner et al. (1994) have described body weight greater than 18.2 kg as being a risk factor for behaviour-related euthanasia in dominant-aggressive dogs. Owners may perceive bites by larger dogs to be a more serious problem, and our results may reflect not just relatively more household aggression by small dogs, but perhaps increased relinquishment of large biting dogs. A bite by a small dog is probably less injurious and frightening to the victim, so that smaller aggressive dogs may be retained by owners for a longer period of time. It is also possible that owners of large biting dogs were less likely to present them to the veterinarian. Being a member of the terrier, spaniel, or toy breed groups was a risk factor for biting in a univariate analysis. These are all relatively small breeds, which may partly explain the discovery that lower body weight was a risk factor for biting.

It appears that body size is associated with a higher risk of biting given particular situations. Small dogs are more likely to be allowed on the furniture and this lifestyle

made the risk of biting higher in small dogs than it did in large dogs. This is in contradiction to the results of Voith et al.(1992), who determined from a voluntary survey that owner attitudes that allowed this sort of so-called "spoiled" behaviour were not associated with an increased number of behaviour problems. It is possible that small dogs are more reactive, or more easily irritated by certain stimuli. Possessive aggression over food, irritability secondary to a skin disorder, and fear of children may all be indicators of excessive reactivity or anxiety, which may eventually lead to aggression. It is important to remember the possibility that large aggressive dogs with this same history may be selectively lost from the general veterinary caseload due to owner intolerance of their behaviour (Reisner et al., 1994). This attrition would have the effect of making small dogs look riskier in these circumstances. Interestingly, though, tug-of-war is associated with a greater risk of biting in large dogs, and no significant risk in small dogs. Tug-of-war is an activity which is not typically associated with any form of anxiety, and can even be used as a reward in training (Donaldson, 1996, pp.37-43). Because tug-of-war is an oral behaviour overriding bite inhibition in a context associated with the owner, it is perhaps not surprising that it is associated with an increased risk of biting, regardless of the dog's motivation.

In the univariate analysis, reproductive status was not detected as a risk factor for biting. Other authors have determined that neutering is associated with aggression. Most recently, Podberscek and Serpell (1996) reported that neutering was positively associated with aggression in English Cocker Spaniels, although they argued that the effect largely

disappeared if dogs neutered because they were aggressive were removed from the analysis. Of the subjects in our study, only a small number (12.5%) were still intact, which made detection of any statistically significant association with neutering difficult. Veterinarians in this region of Canada have obviously been successful in their promotion of neutering to owners. Although information was collected on the age at which dogs were neutered, their age when they had first bitten, and other signs of aggression in the first 2 months of ownership, owners were not asked if there had been a particular reason for neutering their dog, and what that reason was.

In the final version of the logistic regression model, a significant interaction term was detected between sex and body weight. For female dogs, lower body weight was associated with an increased risk of biting. This relationship between body weight and the risk of biting did not appear for male dogs. Inclusion of the (sex x weight) interaction term made the factor of sex in the model far more significant, in that the odds of biting were almost 3 times higher for female dogs. This is contrary to the results reported by most authors of case reviews, who have stated that males are the predominant sex seen for problems with aggression (Borchelt, 1983; Line and Voith, 1986; Wright and Nesselrote, 1987; Landsberg, 1991; Wright, 1991). This inconsistency with published results may either reflect an important difference between general and referral populations, or possibly that the type of aggression seen in male dogs is more serious or frightening, and therefore more likely to cause the owner to seek help. Podborscek and Serpell (1996) suggest that there is a significant sex difference in the discrete types of aggression seen, as was

detected in their cross-sectional survey of English Cocker Spaniels. Among a number of specific situations, they determined that male Cocker Spaniels were more likely to show aggression than females toward a member of the family, when disciplined, and when reached for or handled. Female Cocker Spaniels were more likely to be aggressive toward other dogs in the household, and when neutered, toward children in the household. Perhaps small female dogs bite more frequently but less severely. Most published reports of referral cases will list different types of aggression as the reason for presentation, which is different from our outcome of "biting". It is possible that there is a gender difference in the degree of bite inhibition.

4.5 Strongest risk factors for canine household aggression

From a survey containing approximately 140 individual questions on the behaviour and home of case and control dogs, a number of variables were identified which were strongly associated with the risk of biting. Some factors can be altered by intervention, some cannot. Good preventive medicine should probably include advising the owners of all dogs of the most significant risk factors for aggression as detected by this analysis. The veterinarian in general practice could inquire about the household environment, the young dog's behaviour, and demographic characteristics of the dog, to formulate an impression of the risk of eventual biting. Humane society staff could use the same information in the arrangement of dog adoptions. For example, factors which cannot be changed, such as the number of teenagers in a home, should be taken as a reason to deliberately select a less excitable breed.

It is difficult to know whether owners recalling that their dog was relatively more excitable as a puppy had somehow been affected by the dog's current behaviour. Perhaps owners of biting dogs are selectively remembering incidents of excitable behaviour in puppyhood. Another possibility is that owners who are not particularly good at handling dogs are likely to perceive them as being overly excitable as puppies, and are also more likely to end up with a biting dog. Inconsistent interactions between the owner and the dog may cause both excitability and aggression. The actual sequence of events is irrelevant to the usefulness of this information. Veterinarians should simply be aware that owners who find that their puppy is too excitable need to be offered effective strategies for coping with the problem.

A number of questions in the survey inquired about permissive behaviour on the part of the owner. Several of these were significant in their association with household aggression, but only the puppy being allowed to sleep on someone's bed in the first 2 months of ownership could logically be used as a predictor and included in the model. Sleeping on the same surface as the owner has traditionally been thought to be associated with dominance aggression, and aggression is often associated with the owner approaching the dog's resting area (Landsberg et al., 1997, pp.19-20; Beaver, 1999, pp.157-163). Not all biting dogs that slept on the bed as puppies were still sleeping on the bed in adulthood, so that if there is a causal relationship, the effect may be occurring in the early developmental stages of the dog. For dogs which were no longer allowed to sleep on the bed, owners did not report that this change was due to a behaviour problem.

Certain dogs may have been more demanding of attention as puppies, and may have ended up on the bed because the owner couldn't tolerate the puppy whining or crying at night. A puppy sleeping on the bed may be an indicator of the owner's attitude, the puppy's temperament, or both. Since not allowing a puppy to sleep on the bed is a relatively simple lifestyle change that may ultimately reduce the risk of aggression, it is worth counselling owners to find other sleeping arrangements for their dog when they first bring it home, at least until the mechanism of this association is better understood.

From the perspective of the veterinarian who has been in general practice, the association between biting and a history of a skin disorder is very interesting. This question was included because the author had encountered a number of owners who reported that their dog's mood was markedly improved after successful treatment of a chronic skin disorder such as seborrhea. Dermatological conditions involving pruritus are very common in dogs (Scott et al., 1995, pp.ix-x). From a biological standpoint, the outcome of aggression may not be too difficult to understand, given the potential for irritability secondary to constant pruritus and sleep deprivation. Sleep deprivation in humans is known to produce irrational and aggressive behaviour (How et al.,1994; O'Reilly, 1995).

Early evidence of possessive behaviour, demonstrated by the puppy showing aggression over food in the first 2 months of ownership, is an important risk factor for biting. This is a very useful predictor, as it is possible to intervene and modify this behaviour in puppies without much risk of human injury. A dog protecting its own food or toys is rationalized

by many owners to be showing normal and acceptable canine behaviour, but owners should be educated that this behaviour may eventually place family members at a higher risk of injury. Many dogs are only aggressive in very limited situations, and the most effective way to resolve these problems is to train a specific non-aggressive response (Ban, 1994; Landsberg et al., 1997, pp.136-137). Behaviour modification is relatively easy in puppies, who are learning rapidly and are highly motivated by food.

4.6 Other risk factors for household aggression

A number of variables were significant risk factors for biting on a univariate basis, but were not significant at the $P<0.05$ level when included in the regression model. These variables should not be completely ignored as they may still have some clinical value. For example, obtaining a dog from a relative or friend was associated with biting behaviour. The National Council on Pet Population Study and Policy has reported in their Regional Shelter Survey that animals previously owned by friends were relinquished in higher numbers than animals from any other source (Hawn, 1998). It is unclear why this source should be a risk factor for biting, although it may be due to dogs which are already aggressive being passed on to another family member or friend as an alternative to euthanasia. Another possible scenario is that people are talked into adopting a puppy when a bitch belonging to an acquaintance has a litter, and the puppy ends up in a home where it is not truly wanted or in which the owners are not ready to care for it.

A dog having had a serious illness or injury which required overnight hospitalization was

associated with a decreased risk of biting. It is interesting to speculate on why this relationship would exist. It could simply be the effect of people who own "good" dogs being more willing to invest in intensive veterinary treatment, or veterinarians being more likely to offer intensive treatment for such patients. Two patients with the same illness can receive very different levels of medical care and both still recover. Alternatively, the reduced risk of aggression may be an actual outcome of hospitalization, the temporary separation from the home having affected the dog's relationship with its owner.

In practice, veterinarians are often presented with puppies for routine vaccination. Sometimes owners will report that, even at this early age, the dog is showing definite signs of aggression towards people, and it may actually show aggression during the course of a physical exam. In a univariate analysis, growling or snapping in response to discipline in the first two months of ownership was significantly associated with biting. Owners having used a physical method to punish their puppy was not associated with biting, so it cannot be assumed that these puppies are aggressive because they have been physically abused. There is undoubtedly an escalation of the problem when a puppy which happens to be genetically more fearful or is poorly socialized encounters frightening or inconsistent behaviour by people, such as often occurs when an owner attempts to punish the dog for misbehaviour. It is evident from the results of this study that more dogs which show aggression at an early age will eventually bite. Owners which have encountered this behaviour should be counselled appropriately and not left to believe that the puppy will outgrow the problem.

Much consideration has been given in the literature to the issue of the importance of obedience training in the prevention or treatment of behaviour problems. In this survey, formal obedience training was not associated with a reduced risk of biting, but dogs that were enrolled in obedience classes because they already had some sort of behaviour problem were at a higher risk for biting. The original problem reported by the owner was more often excitability than aggression. The relationship between training techniques and an eventual outcome of biting is worth investigating, as evidence increasingly points to aversive (choke collar) training methods as causing increased anxiety and aggression in dogs, and failing to prevent aggression outside of the obedience class (Myles, 1991; Beaver, 1994a). This also illustrates the importance of inquiring about the reason for any sort of behavioural intervention, such as obedience training or crate training, before drawing the conclusion that there is a causal relationship between the intervention and the behaviour. A question was included in the survey to determine if any form of command training, not just formal obedience, was associated with a decreased risk of biting behaviour, but no significant relationship was detected. It would appear that the interest of the owner in doing even informal training with their dog is not an important factor in reducing aggression.

Out of a list of potentially compulsive behaviours, two were significantly associated with biting at the $P<0.05$ level in the univariate analysis. Both were oral type behaviours, though not self-directed or mutilating. Chewing and swallowing sticks or rocks, and barking for long periods at nothing in particular may be displacement activities for dogs

that are socially isolated or otherwise deprived. Such behaviours may be the forerunners of compulsive disorders in dogs (Hewson and Luescher, 1996). Questions on unusual behaviours by the dog were very brief and subject to the judgement of the respondent, so that it is difficult to assess whether or not these behaviours were truly compulsive. They were, however, occurring frequently enough or were troublesome enough to have been noted by the owners. The number of owners reporting that their dog engaged in some form of behaviour which they considered to be unusual was quite high. For example, 10% of respondents reported that their dog "snapped at imaginary flies", which has previously been reported as a compulsive disorder in dogs (Luescher et al., 1991). Either compulsive type activity in dogs is very common, owners have poor knowledge of what constitutes normal dog behaviour, or owners are inadvertently reinforcing many attention-getting behaviours.

4.7 Associations between current behaviour and biting

In the design of this survey, a great deal of attention was paid to trying to determine whether factors were influencing aggression or were actually the outcome of aggression. For example, if the owner had used a crate, taken the dog to obedience class, or had stopped allowing the dog on the bed, they were questioned if this change was a result of the dog's behaviour. That being said, some questions were related to very recent or on-going behaviour, or to the owner's perceptions of the dogs behaviour, and therefore could not be included as predictors of aggression (Table 6). These responses were analyzed separately as a measure of the current lifestyle of biting versus non-biting dogs, and the

respective attitudes of their owners.

The dog spending relatively little time outside on an average weekday was a risk factor for biting, which was not simply a confounding effect related to the smaller size of biting dogs. It is interesting to note that of the 6 dogs who never went outside, all were reported to have bitten. Dogs which spend more time indoors are more likely to interact closely with household members, theoretically increasing the opportunities for an aggressive incident. It is also possible that the lack of regular exercise or a predictable routine, in addition to inadequate exposure to stimuli outside of the home, will contribute to problems with either anxiety or aggression. The amount of exercise a dog receives may be an important indicator of an owner's attitude in regard to interactions with their dog.

Respondents were questioned about their dog's reaction to a number of stimuli which are commonly reported to evoke fear in dogs. Fears of non-human stimuli (vacuum cleaners, cars, thunder, other dogs) were not associated with household aggression, although fears of human stimuli (children, men, strangers, delivery people) were associated with the dog having bitten a household member. Clearly, some of these individuals, such as children or men, may actually be members of the same household as the dog. A fear of strangers or delivery people, however, could be an indicator that the dog is either inadequately socialized to people or generally fearful. This might have the effect of increasing the potential for household aggression. A dog may be aggressive toward strangers out of a motivation of fear or territorial behaviour, but these same dogs are also at an increased

risk for directing aggression toward their owners.

Although most biting dogs were being retained by their owners, it was not because the owners incorrectly perceived their dogs to be non-aggressive. Respondents appeared to have a fairly clear idea of the potential for injury, in that biting dogs were judged to be less trustworthy with children, and generally more aggressive. This presents the interesting concept that owners are still attached to their dogs in spite of the aggression. All of the dogs in this survey had been retained for at least 6 months, which was the approximate time elapsed between the clinic and telephone surveys. As aggressive behaviour is estimated to be the primary reason for canine euthanasia in North America, the degree of aggression which is tolerated by these owners is interesting. Veterinary clientele may be retaining aggressive dogs because they are more attached to them, because the severity of aggression is relatively low compared to other dogs which are not taken to veterinarians, or because there is some protective effect against relinquishment for dogs taken to veterinarians (Patronek et al., 1996).

Without having done a controlled prospective study, it is impossible to state that a causal association exists between any of these factors and the outcome of biting. Sometimes, however, significant progress can be made in the management of a problem by identifying and avoiding risk factors, without any real certainty of the cause or the mechanism of the effect. Most of the risk factors identified in this study as being associated with household aggression would fall into this category. For example, the fact that female dogs, and

particularly small female dogs, are at a higher risk for biting a household member does not necessarily mean that being female directly causes aggression. It does mean that we don't know enough about gender differences in behaviour, and until a more thorough explanation of this relationship is available, veterinarians may want (for example) to take gender into account when counselling potential owners on pet selection.

5. Conclusions

The following were identified as the most significant risk factors among general veterinary clientele for the injurious biting of people who live in the same household as the dog: 1) being a female dog (particularily a small female dog), 2) the presence of 1 or more teenagers in the home, 3) a history of a pruritic or malodorous skin disorder which had received veterinary treatment, 4) the dog having slept on someone's bed in the first 2 months of ownership, 5) the dog having been aggressive over food in the first 2 months of ownership, and 6) the dog having a relatively higher rank for excitability based on the owner's recall of it's behaviour in the first 2 months of ownership. Body weight of less than 20 kg was specifically associated with an increased risk of biting when the dog: 1) had slept on someone's bed in the first 2 months of ownership, 2) had been aggressive over food in the first 2 months of ownership, 3) had a history of treatment for a skin disorder, 4) had been allowed on the furniture in the past 2 months, and 5) was afraid of children. The misbehaviour of the dog in the first 2 months of ownership , a time when problems are generally most easily corrected, was strongly associated with an eventual outcome of biting.

This study has produced a valid and clinically relevant picture of the factors involved in canine household aggression. By using a two-stage survey, it was possible to identify a representative study population, and from that foundation, investigate the details of each dog's life in a case versus control format. This is a reliable method to determine both the prevalence and risk factors of a particular problem, with the study design rendering the results valid for application to the majority of North American general veterinary practice situations.

4. A CASE SERIES OF BITING DOGS: THE CHARACTERISTICS OF THE DOGS, THEIR BEHAVIOUR, AND THEIR VICTIMS

Abstract

The characteristics of 227 biting dogs, their homes, and their victims, were gathered in a detailed telephone survey of general veterinary clientele in the Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island. All of the dogs had bitten either someone living in the same household, or someone who was a frequent visitor and was well known to the dog. There were 117 male and 110 female dogs included in this case series. Significantly more female dogs were neutered (P=0.03), 58% of the dogs were purebred, and the most commonly reported breed was the Labrador Retriever (n=15). The mean number of people living in each home was 3.13 (SD +/- 0.08). Dominant or possessive type aggression had been demonstrated by 75.6% of the dogs in at least one of 17 specific situations outlined in the questionnaire. Dogs with a history of this type of aggression were significantly older (P=0.02) and of lower body weight (P<0.001) when compared to the remainder of the dogs, and were more likely to be fearful of a variety of stimuli. The effect of fear in these dogs may be important in understanding the motivation for and treatment of aggression problems. For what the owner considered to be the worst bite incident, 42.4% could be attributed to behaviour which appeared to be characteristic of dominant or possessive aggression. If the reason for the worst bite incident was related to the commonly accepted criteria for dominance aggression, then the dogs were more

often male and purebred. Owners of these dogs were also more likely to rank the bite as a more serious event (P=0.001). Adults were the most common victims of dog bites, and most injuries were to the hands and arms (56.2%). A minority of injuries (9.3%) received medical attention, supporting previous evidence that dog bites are greatly underreported. A bite requiring medical attention was scored as a more important incident by the owner and was more likely to have caused the owner to take precautions to prevent further injuries. Although the presence of aggression related to dominance was not associated with gender or breed status, the severity of this form of aggression and its significance to the owner were greater for male and purebred dogs. These factors may explain the characteristics of dogs as they are reported by behaviour specialists working in a referral setting.

1. Introduction

Aggressive behaviour by dogs is a serious problem, as is evidenced by the reported number of human injuries, the distribution of cases seen by behavioural specialists, and the reasons given for the relinquishment of dogs to humane societies (Landsberg, 1991; Wright, 1991; Miller et al., 1996; Hunthausen, 1997). Unfortunately, the information derived from these sources may not be applicable to the majority of dogs and owners seen in general practice. Most dog bites to humans are not reported to authorities (Beck and Jones, 1985; Wright, 1990; CHIRPP, 1993), and most people do not consult a specialist when they have a problem with their dog's behaviour. If owners don't think to report an aggression problem or have learned to live with it, veterinarians simply do not hear about it, even though human injury may have already occurred. The normal formation of an emotional attachment to a dog includes making some allowances for undesirable behaviour, therefore dogs which are relinquished for purported behaviour problems may in fact have originated in homes where this attachment process was comparatively unsuccessful (Serpell, 1996). Most owners do successfully form an attachment to their pet, and may actually be quite tolerant of problems related to its behaviour.

Public health data derived from emergency room records and police reports describes some of the most serious incidents of canine aggression toward people. But it is also biased against the collection of data for those incidents when the owner is the victim. Owners are not predisposed to report bites by their own dog to any authority, and yet owners are probably the most common victims of dog bites (Kizer, 1979; Wright, 1990).

When a dog bite is reported, minimal information is collected on the characteristics of the dog, the victim, and the setting of the attack. Data gathered by veterinary behaviourists, on the other hand, includes a great deal of information detailing the aggression and possibly the lifestyle of the dog, but it is also based on a population of owners who conceivably have a greater than average sense of attachment to their dog, are having more serious problems with its behaviour, or who feel more responsible for the way their pet behaves. Cases seen by specialists are subject to a referral bias, and cannot be expected to represent the usual level of problem behaviour (Fletcher et al., 1988, p.59). The referral process increases the likelihood of detecting a more serious problem in the patient.

This case review is based on part of the population of dogs which made up the caseload of 20 general veterinary practices in maritime Canada. These are dogs with a history of having produced an injurious bite to a person living in the same household. As Patronek et al. (1996) have already identified that the use of veterinary services is associated with a protective effect against the relinquishment of dogs, the population of owned dogs who are taken to veterinarians may deserve investigation as a unique group. For the veterinary profession, more understanding of the typical interactions between clients and their dogs will enhance our ability to offer advice and services which both promote and improve the human animal bond.

In referral practice, the majority of cases of canine aggression directed toward owners have traditionally been attributed to problems with "dominance", or the dog attempting to

achieve a higher social rank among household members (Voith 1981a; Borchelt, 1983; Landsberg, 1991). Whether or not a dog truly transfers the canine social hierarchy to humans is difficult to prove, and yet this has been the focus of behaviour modification recommendations for decades*. Recent work has recognized the influence of anxiety, conflict, and ambivalent behaviour in many cases that were formerly attributed solely to the dog's drive to achieve an alpha position among family members (Borchelt and Voith, 1996a; 1996b; Reisner, 1997). As the ultimate goal of behaviour modification in these situations should be to develop a reliably non-aggressive response by the dog to troublesome stimuli, understanding the motivation for the aggression is extremely important.

This case review examines the characteristics of dogs which have already shown aggression in the form of biting behaviour toward people in a household setting. These dogs have not typically received any specialized intervention as a result of their behaviour. It also characterizes the victims of dog bites, and the severity of their injuries. The information presented is another step towards bridging the gap between public health data on bite injuries, and the characteristics of dogs treated by veterinary behavioural specialists.

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* Dominance aggression is a commonly used diagnostic category in behavioural medicine, and is generally used to describe aggression that is theoretically derived from challenging the dog's rank in the social hierarchy of the household. For our purposes, the term "dominance" will represent only those behaviours described in the questionnaire (Appendix F) without any comment as to the dog's underlying motivation.

2. Materials and Methods

2.1 Subjects

In 1996, twenty general veterinary practices in the Canadian provinces of New Brunswick, Nova Scotia, and Prince Edward Island were recruited to administer a one page questionnaire to their dog owning clients (Appendix A). Dogs were not selected for inclusion on the basis of their behaviour, but were a cross-section of the canine caseload. This questionnaire requested the owner's name and phone number, basic demographic information on the dog, and contained 5 questions on the dog's behaviour. Three questions pertained to any history of aggression, and were worded to detect even those incidents which may have occurred over the relinquishment of objects or in play. The final section of the questionnaire advised owners that they might be contacted by the Atlantic Veterinary College for more detailed telephone interview. A total of 3226 questionnaires were completed, giving a response rate of 81.4%. This formed the study population for the telephone survey which was implemented 6 months later.

Phone contact was attempted with 640 owners, including all of those who had responded positively to the question: "Has your dog ever bitten any member of your household, even if you think it may have happened by accident while playing?". As part of a case-control study described earlier (Chapter 3), a number of individuals who had responded negatively to this question were also included through a formal random selection process. If an owner had completed a questionnaire for more than one of their dogs, they were only required to answer questions about the first dog to come up in the selection process.

A positive response on the telephone survey to the following question: "Has your dog ever bitten any member of your household or any person who is a frequent visitor in your home and is well known to the dog, even once, even if you think it may have happened by accident while he was playing?" resulted in the dog being classified as a case for the purposes of this review. A bite was carefully defined in the instructions to the interviewers as *"the upper or lower teeth making contact with the victim's skin with sufficient pressure to cause a visible injury such as an indentation, welt, scrape, bruise, puncture, or tear in the skin. A dog mouthing a person's skin without applying sudden pressure is Not considered a bite."* Contact with clothing was not considered a bite unless the dog had also contacted skin.

2.2 Telephone questionnaire design

The telephone questionnaire was 17 pages in length, including a standard cover sheet and introductory page (Appendix D). All questions except one were in closed-end format, requiring either a yes/no/don't know response, a numerically ranked response, or selection from a list of possible responses by either the respondent or the interviewer. Text was worded in a conversational style to include the name of the dog, and separate questionnaires were produced for male and female dogs.

The questionnaire was divided into the following six sections: 1) information about the home, 2) demographic information about the dog, 3) behaviour in the first 2 months of ownership, 4) general behaviour of the dog, 5) behaviour of the dog in the last 2 months

of ownership, and 6) specific behaviour of the dog in respect to biting. All respondents were given the opportunity to ask questions or make comments at the end of the survey.

2.3 Telephone survey implementation

The telephone questionnaires were administered by four female interviewers. Training was provided for the interviewers in the objectives of the survey, and in telephone survey techniques as described by Dillman (1978, pp.257-269). Each interviewer pre-tested the questionnaire with three randomly selected respondents without difficulty. No changes to the questionnaire were necessary after pre-testing. The survey was conducted mainly during the evening and weekend hours of November 1996 to January 1997. There were no limits on the number of attempts that could be made to contact a respondent. Respondents were given the opportunity to select a more convenient time to complete the questionnaire if they sounded reluctant to cooperate when first contacted. The questions were to be answered by an adult who lived in the home and took some responsibility for the care of the dog, but who did not have to be the same individual who completed the original clinic questionnaire. Respondents were advised at the outset that the questionnaire would take 15 minutes to complete, although this proved to be an underestimate of the average time required. Every reasonable effort was made to contact owners who had moved or who had incorrect phone numbers.

2.4 Data management

All questionnaires were coded by the author. Data was entered into Quattro Pro 6.0

(Corel Corporation Limited, Ottawa, Ontario, Canada) by three individuals. Any response of "don't know" was recorded as missing data. Interviewers were instructed to record the details of a response if they were unsure of how to assign it to a category. Such entries were subsequently categorized by the first author. Demographic information from each dog was checked against the results from the original clinic survey to detect any errors or mis-classifications. The originating clinic or respondent was contacted if the correct response could not be determined by comparing the two questionnaires. Unusual values were double-checked against the original phone questionnaire form, but were not altered if they were deemed biologically plausible and were not the result of a data entry. Any values which were not plausible and which could not be substantiated were re-coded as missing.

Descriptive statistics were performed to characterize the demographic, behavioural, and household aspects of the biting dogs. Whether or not a victim had received medical attention following a bite was examined to determine the relationship between bite severity and other factors. In order to summarize behavioural characteristics, each dog was given a score for "dominance" aggression and fearful behaviours. The "dominance" score was calculated as the sum of positive responses to a series of 17 questions concerning a history of aggression in situations typically attributed to dominant or possessive behaviour (Appendix F). There were originally 20 such questions but three were discarded in the analysis due to a large number of missing responses. These three discarded questions asked about the dog's response if the owner 1) "grabbed the dog by the scruff", 2) "held

up a stick or a newspaper, or raised their arms as if to threaten", or 3) if they "hit or slapped" the dog. A score for fearfulness was calculated based on the sum of positive responses to 10 questions about potentially fear-inducing stimuli (Appendix G). Chi-square analyses, Student's t-tests (Glantz, 1992, pp.67-109, 110-154) and odds ratios (Fletcher et al., 1988, pp.195-198) were used to measure significance using the Intercooled STATA statistical software program (Stata Corporation, College Station, Texas, U.S.A.).

3. Results

3.1 Demographic characteristics of biting dogs and their homes

The telephone survey identified 227 dogs which met the criteria for a case (history of biting) as described above. When compared with the responses to the cross-sectional clinic survey, 29(12.8%) of the dogs had originally been classified as non-biters, and 198 (87.2%) were classified as biters by both surveys. Interviews required on average 25.6 minutes to complete, and 76% of the respondents were female.

Characteristics of the biting dogs are described in Table 1. All of dogs in the survey were at least 6 months of age, due to there being a six month interval between the original clinic survey, which had generated the study population, and subsequent contact by the telephone interviewers. There were a total of 117 male and 110 female dogs, and the majority of dogs were neutered (87.7%). A significantly larger proportion of the female dogs were neutered when compared to the males (P=0.03). Purebred status was reported

for 58% of the dogs, the remaining being of mixed or unspecified breed. The Labrador retriever was the predominant breed and was represented by 15 individuals, or 6.6% of all cases. The majority of breeds were represented by only a few individuals. The most commonly reported sources for dogs were breeders (40.5%), family members or friends (27.8%), the humane society (10.6%), and pet shops (8.8%).

The mean number of adults, teenagers, and children sharing the home with case dogs are also presented in Table 1. Most respondents (67.4%) reported that there were 2 adults living in the home, and 10 (4.4%) of the respondents said they lived alone. Approximately half of the homes (50.7%) were without any children or teenagers. Dogs living in homes without children or teenagers were on average older (P=0.001), but there was no significant difference in their body weight. The mean number of people living in each household was 3.13 (SD +/- 0.08) which is similar to the average Canadian family size of 3.1 published by Statistics Canada in the report of the 1996 national census.

3.2 Behavioural and health characteristics of biting dogs

In their first 2 months of ownership, 15% of biting dogs had shown aggression over food in the form of growling or snapping (Table 2). Approximately a quarter of the dogs had eliminated in the house within the past 2 months, and 64.6% had done something destructive when left alone in the house at some time in the past. Responses to questions about 11 potentially compulsive behaviours (see Appendix H) indicated that 85.7% of dogs exhibited at least one problem of this type. Seventeen questions regarding common

scenarios believed to be associated with dominant or possessive behaviour revealed that 75.6% of the dogs had shown aggression in at least one of these situations (Appendix F). Sixty-two (27.8%) of the respondents reported that their dogs were afraid of men and or children.

Biting dogs with any history of dominant or possessive type aggression, regardless of the reason given by the owner for the worst bite incident, differed significantly from all other biting dogs in a number of aspects. They were older at the time of the telephone interview (P=0.02), and of lower body weight (P<0.001). They also had significantly higher fear scores, as they were reported to be afraid of more stimuli by their owners (P=0.01), and were more likely to be described by owners as being generally fearful (OR:3.92, 95% CI: 1.19-12.73). In dogs with any history of dominant or possessive aggression, their owners considered the worst bite incident to be of greater importance on a ranking scale of 1 to 10 when compared with the responses of the owners of all other biting dogs (P=0.03). There were no significant differences between male and female biting dogs in either: 1) their mean fear score, 2) their mean"dominance" score, or 3) any history of dominant or possessive type aggression. Neutered and intact dogs were also not significantly different when compared for these same factors, and neither were differences detected between purebred and mixed breed dogs.

Most dogs (95.2%) had been trained to follow at least one command, and 65.9% had played tug-of-war with a person within the past 2 months. Allowing the dog to sleep on

someone's bed, either in the first 2 months of ownership (40%) or the most recent 2 months (56.6%), or allowing it to get up on the furniture in the past 2 months (75.6%) were relatively common situations. A history of veterinary treatment for a pruritic or malodorous skin disorder was reported in 40% of the cases.

3.3 The relationship between victim, injury, and dog characteristics

Respondents were asked to estimate the number of times their dog had bitten members of three different age groups. The results are presented in Figure 1, showing that adults were the most common victims of client-owned dogs. Most dogs had bitten no more than 5 times, although a number of respondents reported that their dog had bitten "too many times to count".

Respondents were asked to describe which parts of a person's body their dog had bitten. These results are given in Table 3, indicating that injuries to the hands and arms are the most common (56.2%). A total of 63 (27.8%) dogs had bitten more than 1 area of the body, though not necessarily on the same occasion. As a surrogate measure of the severity of the wound, the worst injury ever produced by the dog was classified as to whether or not the victim had received medical attention. Of the 226 dogs for which this information was reported, 21(9.3%) had caused an injury which had been seen by a physician. No dogs which had bitten the feet, legs, or torso of the victim had produced an injury which required medical attention, unless the victim had also been bitten on the head. Individuals which had received medical attention were more likely to have received bites

from dogs which had at some time bitten a victim on the head.

Dogs which had caused a bite requiring medical attention were older than other biting dogs when they bit for the first time (P=0.05, Table 4). They also tended to score more highly for the number of situations in which they had previously shown aggression related to dominant behaviour (P=0.07). There was no significant difference in the body weight, sex, neuter status, or age at neutering between dogs that had or had not produced a bite needing medical attention.

If the dog had produced a bite needing treatment, it was scored as a significantly (P<0.001) more important incident by the owner on a scale of 1 to 10, where 10 was equivalent to the owner considering immediate euthanasia of the dog. An injury requiring medical attention also tended to be associated with more owners now taking precautions to prevent biting by the dog (OR: 2.26, 95%CI: 0.93-5.49). Bites by males dogs were ranked as more important events by the owners than bites by female dogs, although this difference was only marginally significant (P=0.10).

3.4 Etiology of the worst bite incident

A summary of the reasons given by owners for the dog having bitten at the time when the worst injury occurred are presented in Table 5. This was an open-ended question. Based on the descriptive terms used by the respondents, the behaviour was classified into 7 different categories. The predominant etiology at 42.4% was behaviour that appeared to

be characteristic of dominance or possessive aggression. Play (28.6%) and fear (16.5%) were the next most common situations described by the owner. Another 11.6% of cases were attributed by the owner as being related to the dog's health or grooming, protection of a person in the household from another household member, or as having occurred while interrupting a dog fight. There was insufficient information available to classify two of the cases.

Upon comparison of the characteristics of dogs which had apparently bitten (at the time of the *worst* incident) for a reason related to dominance, to those dogs which had bitten for any other reason, there were several significant differences. The dominant biters were more often male (OR:1.70, 95%CI:1.00 to 2.91), and purebred dogs were at a higher risk for this type of aggression (OR:1.79, 95%CI:1.03 to 3.11). The differences between breeds of dogs are shown in Table 6. The worst bite incident was also ranked as a more serious event by the owner (P=0.001) if they had given an explanation which tagged the biting behaviour as being potentially attributable to dominance. There were no significant differences between these two groups of biting dogs for their current age, weight, or neuter status, the age at which they had first bitten, fearfulness, whether or not the victim had received medical attention, and the owner's ability to predict when aggression was going to occur.

Table 1
Demographic characteristics of 227 client-owned dogs which had bitten a person living in the same household. Data was collected in a telephone survey of owners who were clients of 20 general veterinary practices in maritime Canada[a] in 1996.

Variable	Mean	SD[b]	Range	Total responses
Age (years)	4.66	3.85	0.5 - 15	222
Weight (kg)	19.51	12.95	1.8 - 58.5	221
Age at adoption (months)	6.35	16.40	0 - 168	226
Age at neutering (years)	1.09	1.48	0.33 - 10	182
Number of adults in home	2.22	0.73	1 - 5	227
Number of teenagers in home	0.45	0.78	0 - 4	227
Number of children in home[c]	0.47	0.76	0 - 3	225

	Description	Number of dogs (%)	
Sex and neuter status	intact male	20	(8.8)
	neutered male	97	(42.7)
	intact female	8	(3.5)
	neutered female	102	(44.9)
Breed	mixed breed	95	(41.9)
	Labrador retriever	15	(6.6)
	Springer spaniel	9	(4.0)
	Golden retriever	8	(3.5)
	Lhasa apso	7	(3.1)
	Shih tzu	7	(3.1)
	Cairn terrier	6	(2.6)
	Cocker spaniel	5	(2.2)
	Shetland sheepdog	5	(2.2)
	other purebred	70	(30.8)
Origin of dog	breeder	92	(40.5)
	family or friend	63	(27.8)
	humane society	24	(10.6)
	pet shop	20	(8.8)
	other	28	(12.3)

[a] Maritime Canada is composed of the provinces of New Brunswick, Nova Scotia, and Prince Edward Island
[b] SD = standard deviation
[c] individuals ≤ 12 years of age

Table 2
Selected behavioural and lifestyle characteristics of 227 client-owned dogs which had bitten a person living in the same household. Data was collected in a telephone survey of the clients of 20 general veterinary practices in maritime Canada in 1996.

Variable	Postive responses (%)		*n*
Aggression over food in first 2 months of ownership	28	(14.7)	190
Shows aggression potentially related to dominance in at least 1 of 17 situations listed in survey[a]	127	(75.6)	168
Shows at least 1 of 11 potentially compulsive behaviours listed in survey[b]	192	(85.7)	224
Ever been destructive when left alone in home or car	146	(64.6)	226
Eliminated in home in past 2 months	58	(25.7)	226
Fearful of men and or children	62	(27.8)	223
Follows at least 1 command	216	(95.2)	227
Slept on someone's bed in first 2 months of ownership	77	(40.3)	191
Slept on someone's bed in past 2 months	128	(56.6)	226
Allowed on furniture in past 2 months	170	(75.6)	225
Played tug-of-war in past 2 months	149	(65.9)	226
Veterinary treatment for a pruritic or malodorous skin disorder	91	(40.3)	226

[a] List of survey questions on aggression potentially related to dominance given in Appendix F
[b] List of survey questions concerning possible compulsive behaviours given in Appendix G

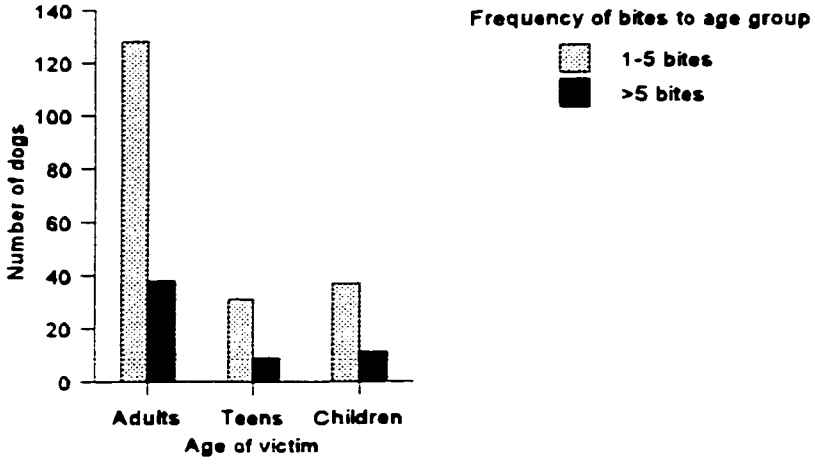

Fig. 1. Frequency of bites to people of different ages by 227 dogs. The number of dogs who had bitten adults (>18 yrs), teenagers (13-18 yrs) and children (≤ 12 yrs), are displayed by the frequency with which they had bitten people living in the same household. In total, 73.5% had bitten an adult at least once, 17.9% had bitten a teenager at least once, and 21.5% had bitten a child at least once. Data was collected from the clients of 20 general veterinary practices in maritime Canada in 1996.

Table 3
The relationship between the parts of the body which had been bitten by dogs and the number of victims receiving medical attention for what the owner considered to be the worst injury ever caused by the dog.

	Medical attention (%)					
Body part(s) bitten by the dog	Yes		No		Total cases (%)	
Hands or arms	10	(47.7)	117	(57.1)	127	(56.2)
Feet or legs	0	(0)	15	(7.3)	15	(6.6)
Torso	0	(0)	7	(3.4)	7	(3.1)
Head	3	(14.3)	11	(5.4)	14	(6.2)
2 or more parts, *not* including head/neck/torso	4	(19.0)	37	(18.0)	41	(18.1)
2 or more parts, including head/neck/torso	4	(19.0)	18	(8.8)	22	(9.7)
Total	21	(100)	205	(100)	226	(100)

Table 4
The relationship between whether a dog had ever produced a bite requiring medical attention and other survey responses. Of 226 dogs, 21(9.3%) caused a bite requiring medical attention.

Factors	Medical attention		P[a]	Total for all biting dogs (n)
	Yes	No		
Mean age of dogs in years at the time of telephone survey	5.5	4.6	0.28	4.7 (222)
Mean age of dogs in years when bit for the first time	3.8	2.4	0.05	2.6 (212)
Frequency of male dogs	0.57	0.52	0.60	0.52 (227)
Frequency of neutered dogs	0.76	0.89	0.10	0.88 (227)
Mean age of dogs in years when neutered	0.6	1.1	0.24	1.1 (182)
Mean body weight in kilograms	18.8	19.6	0.80	19.5 (221)
Mean "dominance" score[b]	4.2	2.6	0.07	2.7 (168)
Mean bite "importance" score[c]	5.4	2.6	<0.001	2.8 (224)
Proportion of respondents who now take precautions to prevent biting by their dog	0.57	0.37	0.07	0.39(226)

[a] The statistical significance of the difference between values for dogs that did or did not produce a bite requiring medical attention.
[b] The "dominance" score is calculated as the sum of the responses to 17 questions on the survey describing situations where the dog has shown aggression potentially related to dominance. The 17 questions are given in Appendix F.
[c] The relative importance of the worst bite incident to the owner on a scale of 1 to 10, where 1= "of very little importance", and 10= "considered immediate euthanasia of the dog".

Table 5
Summary of the reasons given by owners as their explanation for why their dog had bitten at the time when the worst injury occurred.

Classification	Owner's explanation for their dog's behaviour	no. of dogs (%)
Dominance	possessive, moody, spoiled, jealous, tired, irritable, bothered when sleeping, when disciplined dog, restraint, lifting dog, unpredictable	95 (42.4)
Play	excitement, accidental	64 (28.6)
Fear	cornered, threatened, inadequate socialization, easily startled	37 (16.5)
Health related	pain, illness, medication	13 (5.8)
Protective	dog protecting person from another household member	7 (3.1)
Re-directed	victim interrupted dog fight	5 (2.2)
During grooming or bathing		1 (0.5)
Unable to classify		2 (0.9)
Total		224 (100)

Table 6

A comparison of the reasons given for the worst bite injury according to breed. Results for the 10 most commonly reported types of purebred dogs are included. The owners' explanations for the incidents are divided into 2 categories: aggression potentially related to "dominant" behaviour (n=95), and all other reasons (n=129).

Breed	Potentially dominant behaviour	All other behaviour (non-dominant)*	Total
All dogs	95	129	224
Mixed or unspecified breed	32	61	93
All purebred dogs	63	68	131
Labrador Retriever	4	11	15
Springer Spaniel	6	3	9
Golden Retriever	4	4	8
Lhasa Apso	4	3	7
Shih Tzu	5	2	7
Cairn Terrier	2	4	6
Cocker Spaniel	5	0	5
Shetland Sheepdog	1	4	5
Chihuahua	1	4	5
Toy Poodle	4	0	4
All other purebreds	27	33	60

* Other reasons given for biting were: play, fear, health-related, protective, re-directed, associated with grooming or bathing, and 2 cases which could not be classified with the information provided by the owner.

4. Discussion

4.1 Effectiveness of survey design

The conclusions of this survey are dependent upon the respondents' interpretation of their dog's behaviour, and their memory of events. Events as significant as a dog causing an injurious bite to a household member are unlikely to be completely forgotten, although some of the details may have changed with re-telling, and there is a potential for recall bias due to the influence of the dog's current behaviour (Fletcher et al., 1988, p.203). Problems related to recall bias, however, are not a sufficient reason to disregard this type of research, as the owner is often the only available witness, and their assessment of the aggressive incident also provides important information about their relationship with their dog. To be practical, even prospective research into the behaviour of dogs within households would likely have to rely on an owner's report of their dog's behaviour, rather than objective measurements. As most owners live in fairly close contact with their dogs, they should be able to provide a reasonable, if not entirely scientific, description of the dog's typical behaviour and lifestyle. Although there is no way of knowing how many owners falsely reported that their dog had not bitten, it is likely that those owners who did willingly report as unpleasant an event as a dog bite would also be willing to report the details of the incident. The telephone interviewers consistently reported a generally positive response by the owners, with some respondents stating that although they did not enjoy talking about their dog's aggression, they did believe it was important to do so.

When reviewing the results, the reader should bear in mind that this is a case series of

biting dogs, not dogs showing only more moderate forms of aggression. Biting was chosen as the standard because of the relative ease of defining it as a level of aggression in a telephone survey situation. Most owners, for example, would have difficulty identifying or describing many of the more subtle signs of canine aggression such as changes in posture. It was possible, however, to train telephone interviewers to identify and record an injurious bite from the owner's description of events. As a result, the conclusions reflect the behaviour of dogs which have shown aggression to the level of biting, but as human injury is the most significant outcome of canine misbehaviour, these are useful pieces of the aggression puzzle.

4.2 Dog bite injuries and medical attention

This study has determined that for the population of dogs which are part of the veterinary caseload, less than a tenth of the bites they have inflicted upon household members have been seen by a doctor, perhaps reflecting the tendency for owners not to seek medical care for a bite by their own dog unless it is severe (Wright, 1990). The Canadian Hospital Injury Reporting and Prevention Program report (CHIRRP,1996) has summarized the scenarios for bite incidents. It is based on emergency room admissions in a total of 16 pediatric and general hospitals across Canada. Although 30% of victims reported they had been bitten by the family dog, the majority had been bitten by the dog of a friend, acquaintance, neighbour, or relative, or by a stray or unknown dog. In spite of evidence that a family member is the most common victim of their dog (Kizer, 1979; Chun et al., 1982), our results and the CHIRRP data indicate that there may be a bias against the

presentation of owner-victims for medical care. It should be noted that the CHIRRP system is biased toward the collection of data on children, and does not include patients who were seen by their family doctor. There are a number of reasons why people may be more likely to seek emergency medical attention if they have been bitten by a dog they do not own. It may be that such injuries are more serious, although this is not necessarily the case, as other research has indicated that a reported bite to the owner by their own dog tends to involve a more serious injury (Wright, 1990). It is probable that even minor bites by an unknown dog are inherently more worrisome or frightening, particularly when the victim is a child, and the parent is concerned about zoonotic disease or infection (Wright, 1990; Chun et al., 1982). In situations with the potential for litigation, victims may seek medical treatment in order to substantiate their claim of injury (Hattaway, 1997).

Our data indicates that adults are actually the most common victims of household aggression by the population of dogs taken to veterinarians, which may partially explain the apparently low level of medical attention. Hospital reports show that children are presented for the treatment of dog bites in disproportionately large numbers when compared to their representation in the population (Beck et al., 1975; Chun et al., 1982; Sacks et al., 1996). In addition, children are more often bitten on the head (Karlson, 1984), a type of injury that is likely to receive immediate medical care. Sacks et al. (1996) have established that a higher proportion of dog bites among children resulted in medical care. Facial lacerations associated with dog bites in children are disproportionately severe when compared with lacerations from other common sources such as motor vehicle

accidents (Karlson, 1984). It cannot be determined from the results of this survey whether the victims who had received medical attention were more often children. The results did show that when a dog had produced a bite requiring medical attention, it was also more likely to have a history of having inflicted an injury to the head.

4.3 Demographic characteristics of biting dogs and their households

The average family size recorded in this survey (3.1) is essentially identical to that reported by Statistics Canada for the same year (1996), suggesting that there is nothing unusual about the family size of people who own biting dogs. Dogs living in homes without children were significantly older, which may be attributable to a variety of factors. Some of these dogs may have been raised with the teenagers in the family, who have subsequently moved away from home, leaving an older dog behind with their parents. Another possibility is that aggression is better tolerated by owners in homes without any children. In other words, aggressive dogs may be relinquished at an earlier age when there are children in the home. It has already been reported by Kidd et al. (1992) that parents obtaining a dog with the intention that it will entertain their children is a risk factor for relinquishment. The risk to adults does not increase if there are children in the home, suggesting that adults are not necessarily being bitten because they are intervening between a dog and a child.

Much has been written about the characteristics of dogs presented to behavioural specialists for problems related to aggression (Voith, 1981b; Beaver, 1983; Borchelt,

1983; Line and Voith, 1986; Reisner et al., 1994). Although the dogs examined in this series were drawn from a large cross-sectional population having a breed distribution similar to the 1992 Canadian Kennel Club registrations (Appendix C), the distribution of breeds among the biting dogs differed from that of the general population. The Labrador Retriever, Golden Retriever, German Shepherd, and Shetland Sheepdog are the four most popular breeds in Canada, but the German Shepherd does not appear among the ten breeds most frequently reported in this study to have bitten. Aside from this simply being the effect of random error, it is possible that a larger proportion of German Shepherds are maintained for purposes other than as family pets, and are therefore less likely to become involved in household aggression, or perhaps that they are just less aggressive toward household members. Labrador and Golden Retrievers maintain their position in the top four, and are joined by the Springer Spaniel. Of the ten most common breeds among the biting dogs, only the retrievers would be classified as large dogs. The Springer Spaniel has been identified by behaviourists as a breed with aggression problems (Landsberg, 1991; Reisner et al., 1994), so its relatively high ranking is perhaps not too suprising. The large number of different dog breeds makes the assessment of the relative aggressiveness of less popular breeds difficult, as most are represented by only a few individuals.

4.4 Associations with apparently dominant behaviour

In reviewing cases presented for aggression, behavioural specialists have repeatedly identified male and purebred dogs as forming the majority of their caseload, particularly in

those cases where the aggression has been attributed to to "dominance" (Borchelt, 1983; Line and Voith, 1985; Landsberg, 1991; Beaver, 1994a; Reisner et al., 1994;). The classical definition of dominance aggression has been examined from two perspectives in this case review. The first was to record the responses of owners to a series of questions which are typical of those used by behaviourists to identify dogs which may be showing aggression secondary to a perceived challenge to their social status. The second measurement of dominance was achieved by asking the owner to explain, in their own words, why they believed that their dog had bitten at the time when the worst incident had occurred. As a result, we have a measurement of the typical level of dominant or possessive type background aggression in biting dogs, in addition to an assessment of the circumstances at the time of the most serious event. This has made possible some intriguing comparisons. Not all of the biting dogs had a history of showing dominant or possessive aggression. This behaviour was more common in older or smaller dogs. It is of particular interest that dogs with some history of dominance aggression were also reported to be fearful of more stimuli and were more likely to be described as "generally fearful" by their owners. This lends strength to the argument that dogs which are diagnosed as showing dominance aggression combined with ambivalent behaviour may actually be responding out of anxiety and learning (Campbell, 1985). The presence of this type of aggression as well as fearfulness was unrelated to the gender of the dog, its neuter status, or whether or not it was purebred.

More differences appear, however, in an examination of the reasons given for the *worst*

bite incident. If the owner gave an explanation which would typically be attributed to a potential problem with dominance, such as if the dog were aggressive when restrained, disciplined, or challenged over the possession of valued resources, male and purebred dogs were over-represented, just as they are in the caseloads of the aforementioned behaviour specialists. It is possible that although the appearance of dominant and possessive behaviour is fairly consistent among all dogs, the culmination of that aggression in a serious bite incident is more common in male and purebred dogs. In most mammals, sexually dimorphic behaviour patterns depend on the exposure to testosterone *in utero* and in the first few weeks after birth (Salmeri et al., 1991b). With or without castration, the behavioural framework of the adult male dog differs from that of the female. Reisner et al. (1994) discuss the possibility that serious aggression problems in dogs are not so much the outcome of the dog challenging the social heirarchy of the family, but are due to a lack of inhibition of the aggressive response. In other words, the dogs that are most dangerous are those which are most impulsive or reactive. Our data indicates that the owner considered the worst bite incident to be a more serious event if it could be attributed to dominance. The likelihood of a dog being seen by a behaviour specialist is obviously increased if the owner is more concerned about the behaviour, ultimately causing a referral bias for male and purebred dogs.

4.5 The owners' interpretation of the aggression and its importance

In a study of the risk factors for euthanasia in dogs presented because of dominance aggression, Reisner et al. (1994) determined that body weight was a significant factor in

the prediction of the owner's decision whether or not to euthanize the dog. Dogs that were aggressive in response to benign dominance challenges and weighed more than 18.2 kg were 24 times more likely to be euthanized than dogs which were not aggressive in response to benign challenges and weighed less than 18.2 kg. Aggression in response to a benign dominance challenge is often perceived by owners as unpredictable or irrational behaviour by the dog. This type of behaviour is understandably more frightening for owners of large dogs. One could interpret the results of Reisner et al. to mean that owners are more likely to tolerate, and not euthanize, smaller aggressive dogs. The finding in our study that smaller dogs tend to show more dominance aggression may be a reflection of owner tolerance. Indeed, tolerance of this form of aggression may be more common among breeders of smaller dogs, such that small dogs with relatively unpredictable aggression are more likely to be retained within the gene pool. Line breeding for the desired physical qualities of smaller dog breeds may actually enhance the expression of some forms of aggression. Reisner has shown that increased body weight can be associated with more predictable aggression and a lower frequency of aggression. In spite of the theoretical potential for a large dog to inflict more damage when it bites, there was no significant difference between the size of dogs in our survey and whether or not the bite they produced had required medical attention. The seriousness of aggression to the owner, therefore, is not related solely to the medical outcome for the victim, but also to the physical and behavioural attributes of the dog.

Many owners will tolerate a low degree of aggression by their dog for a long period of

time. When the bite had required medical attention, this was evidently a significant and memorable event for the owner, in that they ranked it as being more important, and were more likely to take precautions to prevent further incidents. It is unfortunate for victims that the potential danger of the dog's behaviour was not recognized until after the fact.

5. Conclusions

Our data confirms previous reports that the majority of dog bites are to the hands or arms of the victim, and that bites to the head predispose the victim to receiving medical attention. At the same time, however, most of the victims of dog bites within the homes of veterinary clients are actually adults, and not children, which is contrary to available public health information. This supports the idea that children are more likely to be presented for medical attention when they are bitten, either due to differences in the severity of injury or perhaps a parental sense of responsibility. It is evident that the perception of massive underreporting of dog bites by owned dogs is true, in that fewer than 10% of victims had received medical attention.

Three-quarters of the biting dogs in this study had demonstrated various levels of aggression in a variety of situations that would diagnostically be attributed to dominance or possessiveness. This background level of dominance aggression was generally not too worrisome for owners, but the form or intensity of this behaviour in male and purebred dogs may predispose them to presentation for behavioural therapy. The potential for interaction between impulsivity, fear, and signs of dominance is clinically very relevant and

requires further investigation, as it will greatly influence the success of behaviour modification.

5. GENERAL DISCUSSION

The main objective of this study was to bridge the gap in knowledge between public health reports of dog bite injuries, and the information available from veterinary behavioural specialists. At the same time, it was hoped that the study design would produce results that were useful in general veterinary practice. Although the survey process itself is at times imperfect, the design and scope of the project have afforded the opportunity to estimate the prevalence of aggression in the general dog population and to detect significant risk factors for this unwanted behaviour.

Using general veterinary clientele as a study population has both advantages and pitfalls for the investigator. The original belief that veterinary clients would be relatively willing to participate in the process appears to have been true, as compliance was very high for both levels of the survey. As a result, it is unlikely that there is a significant bias due to the exclusion of individuals who refused to participate. A potential bias which is difficult to assess, however, is that dogs who were excessively aggressive or difficult to handle may not have been presented to the veterinarian or may have been presented less frequently. Using veterinary clientele may inadvertently exclude such dogs and their owners. It is important to remember, therefore, that this survey reflects the behaviour of only those dogs who are seen by veterinarians, not all dogs in the community.

The results indicate that canine household aggression is fairly common in the homes of

general veterinary clientele, but that the majority of injuries do not require or receive medical attention. The cross-sectional survey, using a simple but intentionally highly sensitive question to detect all biting behaviour, identified 15.6% of all dogs in the veterinary caseload as biters. The more highly specific definition of biting used in the case-control survey refined the estimated prevalence of truly injurious biters to about 8% of all dogs. Only a tenth of dogs that had actually bitten produced a bite which received medical attention. This is equivalent to about 1% of all dogs in the general veterinary caseload of maritime Canada causing a bite that would receive medical attention. Contrary to public health data (Beck et al., 1975; Szpakowski et al., 1989; Wright, 1990; CHIRPP, 1996; Sacks et al., 1996), it is more common for adults than children to be bitten by the family dog. The high reported frequency of bites to children in hospital reports is likely to be a reflection of the potential for children to receive more severe injuries, particularly involving the head (Chun et al., 1982; Karlson, 1984; CHIRPP, 1996; Sacks et al., 1996).

The cross-sectional survey identified neutering as a potentially important risk factor for biting in dogs of at least 1 year of age. Relative to intact female dogs, neutered male dogs, followed by neutered female dogs, were the most likely to have bitten. In the case-control study, so few dogs were reproductively intact that it was impossible to determine the risk of neutering in this smaller group. Two previous studies have identified spaying as a potential risk factor for aggression in female dogs (Wright and Nesselrote, 1987; O'Farrell and Peachey, 1990), but there is also evidence that the castration of male dogs is

associated with a reduction in aggression, or at least in the severity of aggression (Wright and Nesselrote, 1987; Nielson et al., 1997). A question not asked in this study was the reason for having had the dog neutered, which may have been aggression or unruly behaviour. It is common practice for most veterinarians in this region to recommend neutering to all owners of non-breeding animals as a component of good preventive medicine, and it may generally be accomplished without the owner desiring a change in the dog's behaviour. The association between neutering and aggression may be spurious in at least some situations, so that it is not the effect of biology, but rather the outcome of those owners who are more attached having their dogs neutered (Patronek et al., 1996), and perhaps being less likely to relinquish neutered dogs when they behave aggressively.

A previously unreported risk factor for household aggression is lower body weight. In both parts of the survey, smaller dogs were more likely to have bitten, particularly if they were female. Size apparently interacted with other variables, so that factors such as being allowed on the furniture or having a history of a skin disorder were associated with a higher risk of biting in small dogs than in large dogs. Small dogs were also more frequently reported to be afraid of children. Dogs expressing aggression in response to situations that are diagnostic for dominance aggression were also smaller on average. Small dogs, for our purpose, were those less than 20kg, which therefore included many popular breeds such as Cocker Spaniels, Shetland Sheepdogs, and Poodles, as well as the small toy breeds. Perhaps smaller dogs are more reactive and less bite inhibited, or there is a greater tolerance on the part of the owner for aggression in a small dog. A small dog

may be retained in spite of behaviour that would cause a large dog to be relinquished or lost from the veterinary caseload (Reisner et al., 1994).

Looking at the etiology for the worst bite incident recalled by the owner confirms the results of published case reviews, in that dogs with a history of serious events related to dominance are more likely to be male and purebred (Voith, 1981a; Borchelt, 1983; Landsberg, 1991; Lund et al., 1996). Our results indicate that the emotional impact on the owner is greater in such situations, so that they may be more predisposed to seek out behavioural advice. The background level of dominance aggression, however, does not appear to vary between the sexes or between purebred versus mixed breed dogs as has been suggested in the literature. Although most biting dogs expressed aggression in at least one situation typically associated with dominance, such as when being moved from a favourite resting spot, the behaviour of male and purebred dogs was apparently more disturbing or more important to the owner when compared to that of female or mixed breed dogs.

The media has made much of the propensity for certain breeds to bite. Popular breeds of large dogs are obviously more capable of being involved in tragic but still relatively rare events such as fatal attacks on children (Pinckney and Kennedy, 1982; Borchelt et al., 1983; CDCP, 1997). Most people would quickly identify Rottweilers, German Shepherds, and Pit Bull Terriers as the most dangerous breeds as a result of the attention they have been given by the press in recent years (Oswald, 1991; Podberscek, 1994). The results of

this study, however, indicate that on a day-to-day basis within households, smaller dogs are more problematic in that they are biting more frequently, at least among the population presented to veterinarians. There was no relationship between the size of the dog and whether or not the victim had required medical attention. Because the reference population defined by the cross-sectional survey gives a good estimate of the demographics of the regional dog population, as is proven by its similarity to Canadian Kennel Club registrations (Canadian Kennel Club, 1995), the breed-specific bite rate for household aggression could be estimated in a valid manner. This process identifies the Springer Spaniel, Lhasa Apso, and Shih Tzu breeds as those with the highest proportion of biting members among dogs of at least 1 year of age. The prevalence of biting in Rottweilers in the veterinary caseload was actually lower than the value for these smaller breeds, and was similar to both the average for mixed breed dogs and for the entire population. Biting was even less frequently reported in the German Shepherd breed, and there were only 2 Pit Bull Terriers in the entire population, neither of which were reported to have bitten. As mentioned above, there may be a bias against the presentation of large aggressive dogs to the veterinarian, or some breeds of dogs may be more likely to bite in only extra-household, protective, or territorial type situations, an effect which is beyond the scope of this survey.

In the case-control survey, a number of factors were identified as being associated with a higher risk of the dog having bitten. It should be remembered that these were not necessarily causal associations, as it is was impossible to identify all the contributing

elements in each relationship detected between a factor and biting. Some factors, however, could be altered through management of the dog, and therefore deserve consideration until such time as the presence or lack of a causal association is finally proven. For example, the presence of a skin disorder, or allowing the puppy on the bed in the first 2 months of ownership are situations which can be changed, particularily by the intervention or advice of the veterinarian.

Aggression related to dominance is the most common reason for the presentation of dogs to veterinary behaviourists (Voith, 1981a; Borchelt, 1983; Landsberg, 1991). Based on an analogy to wolf behaviour, these dogs have traditionally been treated as challengers to the "alpha" position in the social hierachy of the human household. Early treatment methods involved physical domination of the dog in an attempt to elevate the status of the owner. A number of dogs, however, display ambivalent behaviour which is inconsistent with the highly ritualized interactions seen in wolves (Campbell, 1985; Reisner et al., 1994). Out of a concern for owner safety, physically challenging the dog is now rarely recommended, as the outcome of this method is often more severe aggression (Landsberg et al., 1997, p.132; Beaver, 1999, pp.160-161). This study has determined that there may be more involved than social status in the motivation behind what has commonly been called dominance aggression. Most signficantly, dogs with a history of this form of aggression were also concurrently afraid of more stimuli (human and inanimate) and were more likely to be described as generally fearful by their owners. This may explain the success of non-confrontational behaviour modification strategies which encourage desirable behaviour

through positive reinforcement. Dogs that are aggressive out of a motivation related to anxiety or fear should theoretically benefit from an environment which is non-threatening and more predictable.

The lack of a significant association between formal obedience training and less aggression suggests that common methods are not effective in preventing dog bites, at least as they are currently taught. Interestingly, dogs which had been taken to obedience class because the owner felt they needed help dealing with excitable behaviour were more likely to have bitten. Many dog trainers continue to recommend confrontational or aversive techniques for the management of unwanted behaviour (Myles, 1991; Ban, 1994). It may be worth a closer look at the potential for such methods to produce aggression in an excitable dog. Owners were also unsuccessful in correcting early aggression in puppies, as this was associated with eventual biting. Some owners may have even been responding in ways that produced more aggression, perhaps by using punishment rather than distraction to try and stop unwanted behaviour. Very few owners had taken their dog to a puppy class, so the relative benefits of this early form of intervention could not be assessed.

In conclusion, it was demonstrated by this study that veterinary clients have significant problems with aggression in their dogs, and that there are a number of risk factors which deserve further investigation, especially gender, neutering, and smaller body size. Large sexually intact male dogs do not appear to be the most troublesome in the household setting, contrary to popular belief. It is obvious that dog owners require better advice in

the management of behaviour problems at an earlier stage in their relationship with their dog. Promotion and demonstration of simple methods to positively reinforce desirable behaviour, as part of routine puppy care at the veterinary clinic, may give owners the necessary skills to prevent aggression problems related to anxiety. This study has shown that the aggressive behaviour of dogs in the general veterinary caseload differs from that reported in dogs presented to behaviourists, or even those portrayed in the media, and that there are many potentially worthwhile avenues available toward the goal of reduced canine household aggression.

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APPENDIX A

Questionnaire for clinic survey

Atlantic Veterinary College
DOG BEHAVIOUR STUDY

_____

Your veterinarian has been selected to participate in a research project being conducted by the Atlantic Veterinary College. The information gathered from this study should help to improve the welfare of dogs, as well as increase our knowledge about the relationships between people and their family pets. It would be greatly appreciated if you could take a few moments to answer the following questions. Please try to be honest in your responses, and be assured that all personal information will be kept strictly confidential. The more accurate the data we collect, the better veterinarians will be able to help dogs and their owners!

OWNER'S NAME(S):_____ PHONE:(____)_____
DOG'S NAME:_____ (1) SEX: _____female _____male
(2) BREED(if purebred)_____ (3) NEUTERED?: ____yes ____no
(4) WEIGHT(approx.) _____ LBS?__ or KGS?__ (5) AGE: _____ years _____months

(6) How long have you had this dog? _____years _____months _____weeks

(7) Is your dog completely housetrained? YES____ NO____

(8) Have you trained your dog to do any tricks such as"sit"? YES____ NO____

(9) Has your dog ever growled at any member of your household, even if you thought he/she was just playing? YES____ NO____

(10)Does your dog ever growl or snap at anyone when they try to take away food, toys, or other objects? YES____ NO____

(11) Has your dog ever bitten any member of your household, even if you think it may have happened by accident while playing? YES____ NO____

(12) Do you consider your dog to be a member of your family? YES____ NO____

OFFICE USE ONLY
1____ 2____
3____ 4____
5____
6_____
7_____
8_____
9_____
10_____
11_____
12_____

In order to make the information we collect on your dog more complete, we would like to have your permission to review his medical records.

I give my permission for the release of my dog's medical records to the Atlantic Veterinary College,

Signed_____ Date_____
(owner or agent)

Thank-you for taking the time to complete this short questionnaire. In the second phase of this study, approximately 20% of dog owners who have completed this form will be contacted by the Atlantic Veterinary College for a more detailed telephone interview. We hope we can count on your continued support of this project if you are selected to provide additional information.

APPENDIX B

Frequency of different dog breeds as reported by their owners.

Rank	Breed	Frequency	Percentage
1	Mixed or unspecified breed	1287	39.89
2	Labrador Retriever	200	6.20
3	Golden Retriever	183	5.67
4	German Shepherd	166	5.15
5	Shetland Sheepdog	142	4.40
6	Cocker Spaniel (American and English)	76	2.36
7	Springer Spaniel	65	2.01
8	Toy Poodle	57	1.77
9	Rottweiler	55	1.70
10	Shih Tzu	54	1.67
11	Beagle	50	1.55
12	Miniature Poodle	43	1.33
13	Lhasa Apso	41	1.27
14	Yorkshire Terrier	38	1.18
15	Siberian Husky	36	1.12
16	Doberman Pinscher	35	1.08
	Miniature Schnauzer	35	1.08
17	Dalmation	32	0.99
	Poodle - unspecified size or type	32	0.99
18	Border Collie	31	0.96
19	Bichon Frise	26	0.81
20	Cairn Terrier	24	0.74
21	Airedale Terrier	20	0.62
	Pomeranian	20	0.62
22	Rough Collie	19	0.59
	West Highland White Terrier	19	0.59
23	Chinese Pug	18	0.56
	Jack Russell Terrier	18	0.56

24	Samoyed	17	0.53
25	Newfoundland	15	0.46
26	Border Collie	14	0.43
	Boxer	14	0.43
27	Pekingnese	13	0.40
28	Cavalier King Charles Spaniel	12	0.37
	Miniature Dachshund	12	0.37
	Shar Pei	12	0.37
29	German Short Hair Pointer	11	0.34
	Old English Sheepdog	11	0.34
	Soft Coated Wheaton Terrier	11	0.34
30	English Setter	10	0.31
	Welsh Corgi	10	0.31
31	Brittany Spaniel	9	0.28
	Chow Chow	9	0.28
	Maltese Terrier	9	0.28
	Standard Poodle	9	0.28
32	Great Dane	7	0.22
	Irish Setter	7	0.22
	Keeshond	7	0.22
33	Bernese Mountain Dog	6	0.19
	British Bulldog	6	0.19
	Bull Terrier	6	0.19
	Scottish Terrier	6	0.19
34	Alaskan Malamute	5	0.15
	Australian Shepherd	5	0.15
	Basset Hound	5	0.15
	Bouvier	5	0.15
	Standard Schnauzer	5	0.15
	Toy American Eskimo	5	0.15
	Welsh Terrier	5	0.15
	Wire Hair Fox Terrier	5	0.15
35	Akita	4	0.12
	Boston Terrier	4	0.12
	Bull Mastiff	4	0.12
	Silky Terrier	4	0.12
	Staffordshire Terrier	4	0.12
	St. Bernard	4	0.12

36	Bearded Collie	3	0.09
	Great Pyrenees	3	0.09
	Husky (unspecified type)	3	0.09
	Irish Wolfhound	3	0.09
	Tibetan Spaniel	3	0.09
	Whippet	3	0.09
37	Afghan Hound	2	0.06
	Akbash	2	0.06
	American Eskimo	2	0.06
	American Pit Bull Terrier	2	0.06
	Belgian Shepherd	2	0.06
	Belgian Malinois	2	0.06
	Belgian Tervuran	2	0.06
	Chesapeake Bay Retriever	2	0.06
	Irish Terrier	2	0.06
	Italian Greyhound	2	0.06
	Japanese Chin	2	0.06
	Miniature Pinscher	2	0.06
	Papillon	2	0.06
	Saluki	2	0.06
	Smooth Collie	2	0.06
	Spitz	2	0.06
	Toy Manchester Terrier	2	0.06
38	Bloodhound	1	0.03
	Borzoi	1	0.03
	Canadian Eskimo	1	0.03
	Gordon Setter	1	0.03
	Harrier	1	0.03
	Llewellyn Setter	1	0.03
	Norfolk Terrier	1	0.03
	Norwegian Elkhound	1	0.03
	Portuguese Waterdog	1	0.03
	Rhodesian Ridgeback	1	0.03
	Skye Terrier	1	0.03
	Tibetan Mastiff	1	0.03
	Vizsla	1	0.03
	Weimareiner	1	0.03

APPENDIX C

1992 Canadian Kennel Club Registrations

1.	German Shepherd	7,141
2.	Labrador Retriever	6,920
3.	Golden Retriever	6,688
4.	Shetland Sheepdog	4,940
5.	Poodles (all types)	4,125
6.	Cocker Spaniels (Amer. + Eng.)	3,165
7.	Rottweiler	3,148
8.	Shih Tzu	2,336
9.	Miniature Schnauzer	2,090
10.	Yorkshire Terrier	1,926
11.	Siberian Husky	1,849
12.	Pomeranian	1,789
13.	Boxer	1,674
14.	Rough Collie	1,604
15.	Bichon Frise	1,519
16.	Beagle	1,404
17.	Springer Spaniel	1,263
18.	Lhasa Apso	1,205
19.	Doberman Pinscher	1,154
20.	Dalmation	1,144

APPENDIX D

Telephone questionnaire for owners of male dogs

MALE
DOG BEHAVIOUR QUESTIONNAIRE

ID#____ _____

Owner: _____

Phone: _____ _____

Dog's name: _____

CALL RECORD: elapsed time for completed interview: _____minutes

DATE	TIME	INTERVIEWER	RESULT	COMMENTS

Abbreviations:

NA = no answer
NAH = no adult or person responsible for dog at home
MESS = left message on machine/voice mail
REF = refused (give reason why and at what point)
IC = interview completed
PIC = partially completed
WN = wrong number
DISC = number disconnected

RESPONDENT'S GENDER: MALE FEMALE

MALE

Hello. My name is _____ and I'm calling from the Atlantic Veterinary College. Do you have a male dog called _____? *Check that have correct questionnaire.*

If ***NO*** *Check that the number was dialled correctly.* Do you know the owners of that dog or where we could reach them?

If ***NO*** *thank them for their time and terminate call.*

If ***YES*** Do you still have _____?(dog's name)

If ***NO*** I'm sorry to hear that. We were calling as part of a research project that was designed to examine the relationship between dogs and their owners. Would you mind telling me what happened to your dog?

_____

That's too bad, but thank you for the information. Because you no longer have _____ you won't be required to answer any more questions at this time. Thank you for your time anyway. I hope you have a pleasant evening/afternoon/weekend. Good-bye. *Terminate call.*

If ***YES*** That's great. Do you remember filling out our questionnaire at your veterinarian's office last summer? *May indicate that they do or don't remember doing it, or that someone else in the family filled out the questionnnaire.* That's fine. What I need to do is speak to an adult who helps to take care of _____ . Is someone available?

IF ***NEW PERSON ON PHONE****:*

Hi, my name is _____ and I'm calling from the Atlantic Veterinary College. Several months ago someone from your household filled out our questionnaire on dog behaviour at your veterinarian's office. Do you remember doing that?*They may indicate if they were or were not the person who filled out the first questionnaire.* That's fine, as long as I'm speaking to an adult who helps to care for _____.

The reason I'm calling is because you have been selected to participate in the second part of our research project. What it will involve is about 15 minutes of your time to answer some additional questions on the health and behaviour of _____. We are trying to find out a lot more about how dogs and families get along together, and what sort of advice veterinarians need to give people when they have a problem with the way their dog behaves. It would be great if we could do the questionnaire right now, but if that's a problem we can easily set up another time to talk to you. What do you think?

NOT A ***GOOD TIME***- What time would be most convenient for you?
TRY TO SET UP AN APPOINTMENT FOR CALLBACK

STILL UNWILLING - The more people we can talk to, the more likely it is that we can really have a positive impact on the welfare of dogs. We really would like to include your experiences.

If still "no", thank them and terminate call.

if ***OKAY****:*

Thank-you. That's great. You'll probably find it kind of interesting.
The questionnaire is divided into several parts and all your answers will be kept completely confidential. I'll ask you questions about both your family and your dog. If there are any questions which you cannot answer or don't wish to answer please let me know.

PART I

First I'd like to ask you a few simple questions about your home and anyone who lives there. We need to know a bit about the households most dogs live in to understand why some dogs behave the way they do.

1. How many adults over the age of 18 live in your household? ..... _____ 1

2. How many teenagers between the ages of 12 and 18 live with you? ..... _____ 2

3. How about the number of children who are 12 years old or younger? ..... _____ 3
(Include any children in the home for daycare)

4. What type of home do you have? *READ LIST:* 4
- a house 1
- townhouse or duplex 2
- farm 3
- apartment 4
- mobile home 5
- or other 6
- don't know 99

5. How would you describe the area where you live? Is it: 5
- urban 1
- suburban 2
- or rural 3
- don't know 99

6. Has anyone in your household ever taken any other dog besides _____ to an obedience or puppy class? 6
- no 0
- yes 1
- don't know 99

7. Has anyone in your home ever watched a video or read a book on dog training? 7
- no 0
- yes 1
- don't know 99

PART II

This next group of questions are specifically about _____. Some of the questions may require you to think back to when you first obtained this particular dog.

8. Is your dog a male or female? *Check to make sure you have the **correct questionnaire** for male or female.* 8
- Male 0
- female 1

9. Has he been neutered? 9
- no 0
- yes 1
- don't know 99

If yes: 9.1 How old was he when the surgery was done? 9.1
- months ..... _____
- years ..... _____
- don't know 99

10. Is this dog a purebred? 10

No 0
yes 1
don't know 99

If yes: 10.1. What breed is he?_____ 10.1

10.2. Is he registered? (*With Canadian or American Kennel Club*) 10.2

No 0
Yes 1
Don't know 99

11. What is your best estimate of his weight? *Probe to clarify pounds or kilograms.* 11

lbs ..... _____
kgs ..... _____
don't know 99

12. Where did you get_____?*Don't read list but probe for clarity.* 12

humane society or SPCA 1
private shelter 2
breeder(hobby or pro) 3
pet shop 4
found as stray 5
family member or friend 6
own dog's litter 7
other *specify*_____ 8
don't know 99

13. Did he have a previous owner other than his birth home? 13

No 0
yes 1
don't know 99

14. What was the **MAIN** reason behind the decision to get _____? *Don't read but probe for clarity.* 14

companionship 1
learning experience for children 2
was a gift 3
didn't decide (dog was stray, needed home) 4
competitive obedience, flyball, agility 5
hunting, field trials 6
as breeding stock 7
personal protection 8
service dog(police, guide dog etc) 9
showing for conformation 10
other, specify_____ 11
don't know 99

15. Did you purchase, or have to pay anything, to obtain this dog? 15

No 0
yes 1
don't know 99

16. How old is he now? 16

Months ..... _____
years ..... _____
don't know 99

17. What is the main type of food he eats? *READ LIST:* 17

Commercial dog food 1
table food 2
or other *specify* _____ 3
don't know 99

18. Which of the following foods is your dog given at least once a week? *READ LIST: (More than one response possible)* 18

dog treats such as milk bone 1
real bones 2
or table leftovers 3
don't know 99

19. How many times a day is your dog fed? *READ LIST:* 19

once a day 1
twice a day 2
three or more times a day 3
or is the food available most of the time? 4
don't know 99

20. Has _____ ever had a serious illness or injury, for example something which required him to be in the hospital overnight? *Does not include spay or neuter.* 20

No 0
yes 1
don't know 99

21. Has he ever had his teeth cleaned or any teeth extracted by a veterinarian? 21

No 0
yes 1
don't know 99

22. How about problems with his skin? Has he ever needed treatment from the vet because he was really itchy or his skin had an unpleasant odour? 22

No 0
yes 1
don't know 99

PART III

23.How old was _____ when you first brought him home? 23

weeks ..... _____
months ..... _____
years ..... _____
was from own dog's litter 88
don't know 99

If don't know: 23.1 Do you think he was less than 6 months old? 23.1

No 0
Yes 1
Don't know 99

If dog was from own dog's litter or was adopted at less than six months of age then proceed to ***PUPPY LINE*** *(#24) of questions.*
If dog was greater than six months old at time of adoption, then skip immediately to ***ADULT LINE*** *(#33) of questions.*

PUPPY LINE *for dogs in home at less than six months of age.*

I'm going to ask you some questions about how _____behaved in the first **two months** he was in your home. Try and think back to those first two months when he was a new puppy as we go through the questions, okay?

24. Using a scale that goes from 1 to 10, how would you describe his behaviour back then if:
Don't know=99

.1 1 was very shy and 10 was very outgoing ..... _____ 24.1

.2 1 was very calm and 10 was very excitable ..... _____ 24.2

.3 1 was not at all interested in people and 10 was very interested in people ..... _____ 24.3

25. Still thinking back to those first two months, did _____ ever: *READ LIST:*

	SITUATION	NO	YES	DON'T KNOW	
.1	growl or snap at people over food				25.1
.2	stand over and guard food				25.2
.3	take food and hide with it				25.3
.4	cry a lot when left alone				25.4
.5	hide under furniture and resist being pulled out or coaxed out				25.5

26. In those first two months, did he usually sleep on someone's bed at night? 26
No 0
yes 1
don't know 99

27. Did you use a kennel or crate inside your house as a place for your puppy to sleep, or to help you with his training ? 27
No 0
yes 1
don't know 99

If yes 27.1 Did you decide to use the crate because you were having some sort of problem with your puppy's behaviour? 27.1
No 0
Yes 1
Don't know 99

28. In those first two months, did you teach _____ to obey any commands? 28
No 0
yes 1
don't know 99

29. Did he attend a puppy class? 29

No 0
yes 1
don't know 99

If yes 29.1 Did you decide to join the puppy class because you were having a problem with his behaviour? 29.1

No 0
Yes 1
Don't know 99

If yes: 29.1.1. What kind of problem was it? *Don't read list but probe for clarity.* 29.1.1

Aggression to people 1
Aggression to dogs 2
Fearfulness 3
Housebreaking 4
Other *specify*_____ 5
Don't know 99

30. Puppies being what they are, it's not unusual for them to misbehave or get themselves into some sort of trouble. For example, they will often do things like jump up on people or nip at them. Can you think back again to those first two months you had_____, and try to recall how the person who was most reponsible for his care reacted when he did something wrong? What we would like to know is if that person scolded him verbally or disciplined him physically. You know, by saying "bad dog" or giving him a swat. Can you remember what happened when he misbehaved? *Don't read list but probe for clarity.* 30

verbal reprimand only (*scolded*) 1
physical reprimand only (*push, swat, slap, hit, kick*) 2
verbal and physical reprimand combined 3
other *specify*_____ 4
don't know 99

31. What about if he was caught having an accident on the floor? What happened then? *Be careful not to sound judgemental. Don't read list but probe for clarity.* 31

verbal reprimand only (*scolded*) 1
physical reprimand only (*push, swat, slap, hit, kick*) 2
verbal and physical reprimand combined 3
other *specify*_____ 4
don't know 99

32. Did he ever growl or snap in response to being disciplined during those first two months? 32

No 0
yes 1
don't know 99

PART IV : ADULT LINE

Now I'd like to ask you some questions about the current situation with _____. What we want to do is get a general idea of his behaviour in all the time you have owned him. Sort of a personality profile. You may need to think back a bit for some of the questions.

33. First I am going to read a list of things and people. I'd like you to tell me if your dog seems to be afraid of any of them. *READ LIST:*

	SITUATION	NO	YES	DK	
.1	thunder				33.1
.2	vacuum cleaners				33.2
.3	riding in the car				33.3
.4	children				33.4
.5	men				33.5
.6	strangers				33.6
.7	delivery people				33.7
.8	veterinarians				33.8
.9	dog groomers				33.9
.10	other dogs				33.10

34. Would you ever describe your dog as being just generally fearful? 34

No 0
yes 1
don't know 99

35. A lot of dogs have some funny habits, or odd things that they seem to want to do. Could you tell me if your dog does any of the following: *"excessively" = for prolonged periods beyond what the owner believes would be normal for most other dogs.*

	BEHAVIOUR	NO	YES	DON'T KNOW	
.1	Carries rocks, toys, or other objects for long periods				35.1
.2	Chews objects excessively				35.2
.3	Chews and swallows sticks or rocks				35.3
.4	Licks one leg excessively				35.4
.5	Chews some other part of his body excessively				35.5
.6	Paces for long periods as if he can't relax				35.6
.7	Turns in circles for long periods (other than just before lying down)				35.7
.8	Chases his tail for long periods				35.8
.9	Digs a lot of holes in the yard				35.9
.10	Snaps at imaginary flies				35.10
.11	Barks for long periods at nothing in particular				35.11

36. Many dogs seem to be easily upset or bothered by people in certain situations. Does your dog ever respond to any of the following situations by(*read slowly):* **growling, lifting a lip, snapping, lunging or biting?**

	SITUATION	NO	YES	DK	
1	touching his food when he is eating				36.1
2	walking past his food when he is eating				36.2
3	adding food to the dish while he is eating				36.3
4	taking away a bone, rawhide, or toy				36.4
5	taking back an object he has stolen (like socks)				36.5
6	trying to move him from a favourite resting spot				36.6
7	disturbing him while he is sleeping				36.7
8	walking past him in a hallway or doorway				36.8
9	patting him on the head or shoulders				36.9
10	putting his collar on or taking it off				36.10
11	pulling on his collar				36.11
12	staring at him eye to eye				36.12
13	trying to lift him				36.13
14	wiping his feet or cutting his toenails				36.14
15	grabbing him by the scruff				36.15
16	if someone raises their voice at him				36.16
17	If someone holds up a stick or newspaper, or raises their arm as if to threaten him				36.17
18	grooming him				36.18
19	cleaning his ears				36.19
20	if someone were to hit or slap him				36.20

Thanks, I know that was a long list. We have some more questions to do but you're doing really well.

37. Has your dog **ever** growled at a member of your household, even if you thought it happened while he was playing? 37

No 0
yes 1
don't know 99

38. Has he **ever** snapped at a member of your household, even if you think it might have happened when someone was trying to take away a toy or some food? 38

No 0
yes 1
don't know 99

39. Has _____ ever barked or growled when a stranger approached your yard or home? 39
Stranger equals anyone not well known to dog.

No 0
yes 1
don't know 99

40. Has he ever growled or snapped at a stranger as they came into your home? 40

No 0
yes 1
don't know 99

41. How about biting a stranger who was on your property or in your home, has he ever done that? 41

No 0
yes 1
don't know 99

All these questions make dogs sound pretty bad, don't they? What we find out will hopefully help us sort out why many people have certain specific problems with a dog that would otherwise be an ideal pet.

42. A lot of dogs seem to get into the most trouble when they are home all by themselves. 42
Has_____ ever done anything destructive when he was left alone in your home, such as chewing or scratching furniture, scratching at doors, or getting into the garbage?

No 0
yes 1
don't know 99

43. We've talked a lot about how a dog may misbehave. Now I'd like you to tell me a little about how the person most responsible for _____ has reacted if they happened to catch him doing something wrong. We're looking for what sort of discipline was used if, for example, he chewed something he shouldn't have or he had an accident on the floor. For example, was he scolded verbally or was he given a swat? Nobody really likes to talk about this, but it would be very helpful if you could let us know what actually happened. 43

verbal reprimand only (scolded) 1
physical reprimand only (push, swat, slap, hit, kick) 2
verbal and physical reprimand combined 3
other *specify*_____ 4
don't know 99

44. Has anyone in your household ever taken _____ to an obedience class? 44

No 0
yes 1
don't know 99

If yes: 44.1 Did you decide to enroll your dog in the class because you were having some problem with his behaviour? 44.1

No 0
Yes 1
Don't know 99

If yes: 44.1.1 What kind of problem was it? *Probe for clarity.* 44.1.1

Aggression to people 1
Aggression to dogs 2
Fearfulness 3
Housebreaking 4
Other *specify*_____ 5
Don't know 99

45. Does your dog obey any commands or know any tricks? 45

No 0
yes 1
don't know 99

if yes: 45.1 Has he ever been in any kind of obedience competition, including field trials, agility, or flyball, or done any kind of guard or service work? 45.1

No 0
Yes 1
Don't know 99

PART V

You're doing really well, and we're getting very close to the end. This next section is quite short. I want to ask you a few questions about things that may have happened in the last **two months**. We'll start with some really easy ones.

46. Over the last **two months**, has _____ been sleeping on someone's bed at night? 46

No 0
yes 1
don't know 99

If no: 46.1 Was there a time before two months ago when he **did** sleep on someone's bed? 46.1

No 0
Yes 1
Don't know 99

if yes: 46.1.1 **Did you stop letting him up on the bed because of some problem with his behaviour?** 46.1.1

No 0
Yes 1
Don't know 99

47. How about the furniture? Has he been allowed up on the furniture in the last two months? 47

No 0
yes 1
don't know 99

48. In the last two months, has anyone ever fed _____ directly from the table while they were eating? 48

No 0
yes 1
don't know 99

49. A lot people use a kennel or crate in their home as a place for their dog to sleep or to keep their dog out of trouble. In the past two months have you used such a crate for your dog? 49

No 0
yes 1
don't know 99

if yes: 49.1 Did you start using the crate because you were having some sort of problem with your dog's behaviour? 49.1

No 0
Yes 1
Don't know 99

50. Now I'd like you to rank his behaviour over the past two months on a scale of 1 to 10. How would you describe your dog's personality if *Don't know*=99

.1 1 is very shy and 10 is very outgoing ..... _____ 50.1

.2 1 is very calm and 10 is very excitable ..... _____ 50.2

.3 1 is very good with children and 10 is never trusted with children ..... _____ 50.3

.4 1 is not at all aggressive and 10 is extremely aggressive ..... _____ 50.4

51. Still thinking of the last two months, how much time would you say your dog has spent outdoors on an average weekday? *READ LIST: Includes ALL time outdoors for urination etc. even if for just a moment.* 51

up to 1 hour 1
up to 3 hours 2
up to 10 hours 3
more than 10 hours 4
or not at all 5
don't know 99

52. How about on the weekends? How much time would he spend outdoors each day? Would it be: *READ LIST:* 52

Up to 1 hour 1
up to 3 hours 2
up to 10 hours 3
more than 10 hours 4
or not at all 5
don't know 99

if dog has never been outdoors in past two months go to question #56

53. How has he spent most of his time when he was outside during the last two months? Was it spent 53

on walks with someone 1
confined in your yard or in a pen *(includes tied)* 2
free in your yard or neighbourhood 3
or some other way? *Specify*_____ 4
don't know 99

54. On an average weekday in the last two months, how many times was _____taken for a walk, and not just let outside on his own? *A walk equals deliberate exercise with one or more people outside of the owner's yard, not just being outside the house in the presence of the owner. READ LIST:*

54

once 1
twice 2
three times 3
more than three times 4
or not at all 5
don't know 99

55. How about on the weekends, how many times per day did _____ go for a walk? *READ LIST:*

55

once 1
twice 2
three times 3
more than three times 4
or not at all 5
don't know 99

55.1

If dog is ***walked:*** 55.1 Is your dog ever let off the leash when he is out for a walk?

No 0
Yes 1
Don't know 99

55.2

55.2 What kind of collar does he wear on walks? *Don't read list but probe for clarity.*

collar with buckle 1
Choke collar (sliding rings) 2
Prong collar 3
Harness (around shoulders) 4
Halter 5
Other specify_____ 6
Don't know 99

56

56. In the past two months has _____had any housetraining accidents in your home?

No 0
yes 1
don't know 99

57

57. Did anyone play tug of war with your dog in the last two months? *Tug of war equals the dog and a person holding onto and pulling opposite ends of some object like a toy or towel. Not tug of war between two dogs.*

No 0
yes 1
don't know 99

PART VI

How are you doing? We're very close to the end of the questions.
I know we're asking a lot of questions which may make you feel as if you haven't had the chance to say anything positive about your dog. It's just that we want to understand why some dogs act the way they do, and why some families may be more willing to keep a dog in spite of a few behaviour problems.

In these next few questions I'm going to ask specifically about biting. Some of these questions aren't very pleasant, but even a dog which is ordinarily very gentle may have bitten someone at some time in the past.

58. Has your dog ever bitten any <u>member of your household or any person who is a frequent visitor in your home and is well known to the dog</u> even once, even if you think it may have happened by accident while he was playing?(*A bite is defined as the upper or lower teeth making contact with the victim's skin with sufficient pressure to cause a visible injury such as an indentation, welt, scrape, bruise, puncture, or tear in the skin. A dog mouthing a person's skin without applying sudden pressure is Not considered a bite.)* 58

No 0
Yes 1
Don't know 99

If NO or Don't know: Go to final page

59. Some dogs bite only once in their lifetime, but there are a **lot** of dogs kept as pets which have bitten a number of times. *Don't know=99*

.1 How many times would you say your dog has bitten an adult member of your household (someone older than 18 years of age)? ..... _____ 59.1

.2 How about a teenager between the ages of 12 and 18 living in your home? ..... _____ 59.2

.3 How about a child living in your home?(*equal to or less than 12 years*) ..... _____ 59.3

.4 How many times has he bitten an adult who is a family friend or relative who is visiting your home? ..... _____ 59.4

.5 How about a child or teenager who is a family friend or relative, but doesn't live in your home? ..... _____ 59.5

60. How long ago was the last time he bit someone? *Record number* 60

days ..... _____
weeks ..... _____
months ..... _____
years ..... _____
Don't know 99

61. How easy is it for you to predict when your dog is going to be aggressive or try to bite?(*aggression equals growling, snapping, lunging, or biting)* 61

Would you say you can

never see it coming 1
occasionally see it coming 2
usually see it coming 3
or can **always** see it coming 4
don't know 99

62. How old was _____ the first time he bit either a member of your household or a visitor he knows well? 62

months ..... _____
years ..... _____
don't know 99

63. Depending on the situation, dogs may try to bite at different parts of a person's body. What area or areas of someone's body has your dog bitten? *READ LIST: More than one response possible.* 63

hands 1
arms 2
feet 3
legs 4
torso 5
neck 6
or head 7
don't know 99

64. Do you now take any special precautions with your dog because you are worried that he may bite someone? 64

No 0
yes 1
don't know 99

65. Thinking of a time when your dog bit either a member of your household, or a frequent visitor to your home, what was the most serious injury he has caused by biting? *Don't read list but probe for clarity. Make sure victim is well known to dog, not a delivery person.* 65
Ask if they needed medical care etc.

Grabbed clothing but not skin 1
bit once but didn't break skin (*includes bruises, welts)* 2
bit once, broke skin, no MD required 3
bit once, broke skin, required MD 4
bit once , broke skin , req'd stitches 5
multiple bites, no MD required 6
multiple bites, req'd MD 7
multiple bites, req'd stitches 8
one or more bites, required at least overnight in hospital 9
other, specify_____ 10
don't know 99

66. If you had to rank the importance of this particular incident to you as the dog's owner, what would you say if : 66

1 is that it is of very little importance, and 10 is that it made you consider having the dog put to sleep immediately. *Don't know= 99*

..... _____

67. Could you tell me, in your own words, why **you** think your dog bit on this particular occasion? 67

_____
_____
_____

PART VII

Thank-you.
We're all done. I really appreciate your patience with all this. This is one of the largest studies on dog behaviour that has ever been designed, and hopefully it will help veterinarians give more effective advice to dog owners BEFORE they start having problems with their dogs. Dr. Guy will be presenting the results at a seminar in your area next summer and you're welcome to attend. Your own vet clinic will be given the information on time and location or we can let you know by mail if you would like(*will require mailing address)*.

If Dr. Guy had any points she needed to clarify, would it be alright if she contacted you? 68

68. No 0
Yes 1

If this research project is extended, would you be willing to participate if we were to conduct another survey? 69

69. No 0
Yes 1

if yes May I have your mailing address?

NAME_____

STREET_____

CITY_____**PROVINCE**_____

POSTAL CODE_____

Did you have any questions or comments you wanted to make? I'd be interested to know how you felt about doing the survey.

70. 70

Thanks again, and have a pleasant evening/afternoon/weekend/morning.
Terminate call

APPENDIX E

Breed groupings for multiple logistic regression

Breeds are grouped according to a modification of the Canadian Kennel Club regulations.

0. Mixed breed

1. Retrievers, Setters, Pointers
   - Labrador Retriever
   - Golden Retriever
   - English Setter
   - German Short Hair Pointer
   - Nova Scota Duck Tolling Retriever
   - Llewellyn Setter

2. Spaniels
   - Springer Spaniel
   - Cocker Spaniel
   - Brittany Spaniel

3. Hounds
   - Miniature Dachshund
   - Beagle
   - Standard Dachshund
   - Basset Hound

4. Toys
   - Toy Poodle
   - Chihuahua
   - Pomeranian
   - Cavalier King Charles Spaniel
   - Yorkshire Terrier
   - Maltese Terrier
   - Pekingnese
   - Chinese Pug
   - Silky Terrier
   - Japanese Chin

5. Working - guard
   - German Shepherd
   - Rottweiler
   - Doberman Pinscher
   - Standard Schnauzer

6. Working - husky, spitz
    - Keeshond
    - Samoyed
    - Siberian Husky
    - Alaskan Malamute
    - Akita
    - Unspecified Husky

7. Giants
    - Newfoundland
    - Great Dane
    - Bernese Mountain Dog

8. Terriers
    - Cairn Terrier
    - Airedale Terrier
    - Miniature Schnauzer
    - Wire Hair Fox Terrier
    - Jack Russell Terrier
    - Irish Terrier
    - Scottish Terrier
    - West Highland White Terrier
    - English Bull Terrier
    - Soft-coated Wheaton Terrier
    - Welsh Terrier

9. Herding
    - Shetland Sheepdog
    - Border Collie
    - Rough Collie
    - Old English Sheepdog
    - Australian Shepherd

10. Other
    - Lhasa Apso
    - Shih Tzu
    - Miniature Poodle
    - Dalmation
    - Shar Pei
    - Unspecified Poodle
    - Tibetan Spaniel
    - Bichon Frise
    - English Bulldog

APPENDIX F

List of questions from the telephone survey which were used to describe dominance aggression

Does your dog ever respond to any of the following situation by: growling, lifting a lip, snapping, lunging, or biting?

1. Touching her food when she is eating
2. Walking past her food when she is eating
3. Adding food to the dish while she is eating
4. Taking away a bone, rawhide, or toy
5. Taking back an object she has stolen (like socks)
6. Trying to move her from a favourite resting spot
7. Disturbing her while she is sleeping
8. Walking past her in a hallway or doorway
9. Patting her on the head or shoulders
10. Putting her collar on or taking it off
11. Pulling on her collar
12. Staring at her eye to eye
13. Trying to lift her
14. Wiping her feet or cutting her toenails
15. Grabbing her by the scruff
16. If someone raises their voice at her
17. If someone holds up a stick or newspaper, or raises their arm as if to threaten her
18. Grooming her
19. Cleaning her ears
20. If someone were to hit or slap her

This list of questions was adapted from a similar list by N. Dodman. Situations 15, 17, and 20 were not included in the analysis due to the large number of missing responses.

APPENDIX G

List of questions from the telephone survey which were used to describe the dog's fear of stimuli.

I am going to read a list of things and people. I'd like you to tell me if your dog seems to be afraid of any of them.

1. Thunder
2. Vacuum cleaners
3. Riding in the car
4. Children
5. Men
6. Strangers
7. Delivery people
8. Veterinarians
9. Dog groomers
10. Other dogs
11. Would you ever describe your dog as being just generally fearful?

APPENDIX H

List of questions from the telephone survey used to describe potentially compulsive behaviour

Could you tell me if your dog does any of the following:

1. Carries rocks, toys, or other objects for long periods
2. Chews objects excessively
3. Chews and swallows sticks or rocks
4. Licks one leg excessively
5. Chews some other part of her body excessively
6. Paces for long periods as if she can't relax
7. Turns in circles for long periods (other than just before lying down)
8. Chases her tail for long periods
9. Digs a lot of holes in the yard
10. Snaps at imaginary flies
11. Barks for long periods at nothing in particular

Telephone interviewers were instructed that the word "excessively" equalled "for prolonged periods beyond what the owner believed would be normal for most other dogs".