



Early age desexing of  
**puppies & kittens**



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ISBN 1 74146 193 6

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### Early age desexing video disk

Video produced by the Cat Protection Society Victoria and RSPCA Victoria, 1999

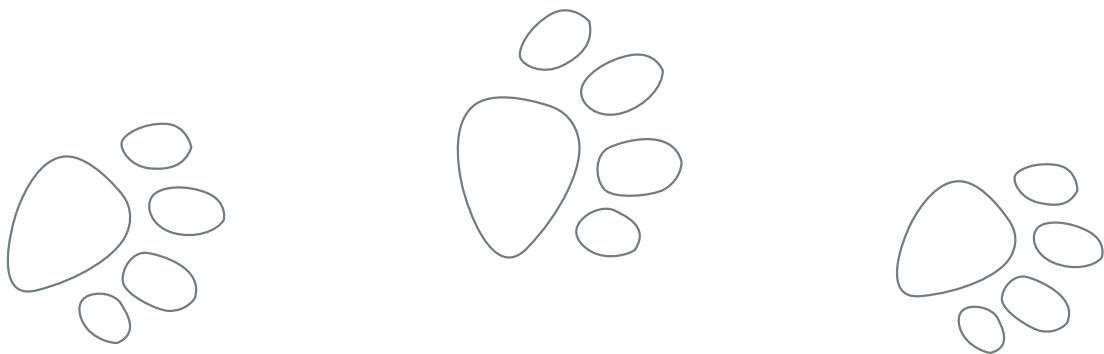
This disk can be played in DVD players and computers.

For a VHS copy of the video, email [animal.welfare@dpi.vic.gov.au](mailto:animal.welfare@dpi.vic.gov.au)



## Early age desexing of puppies & kittens

Proceedings of seminars held by the Australian Veterinary Association and the Minister for Agriculture's Animal Welfare Advisory Committee between October and December 2003



# Contents

**Foreword** **5**

Dr Matthew R Makin, President,  
Australian Veterinary Association – Victorian Division

**Why Promote Paediatric Desexing** **6**

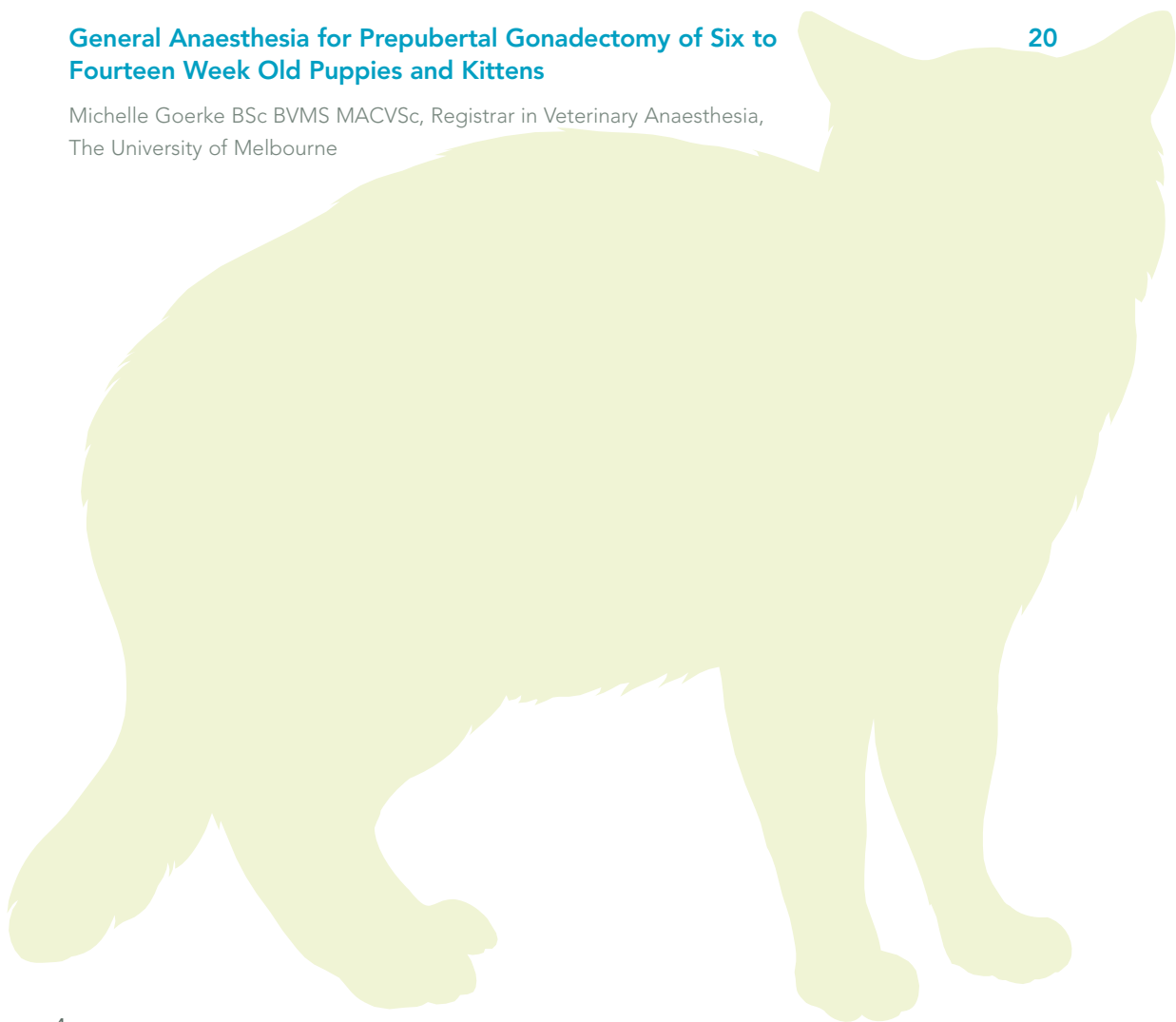
Carole Webb BVSc (Hons) MACVSc, Executive Director,  
Cat Protection Society of Victoria

**Dispelling The Myths About Long-term Side-effects of Early Age Desexing** **15**

Virginia P Studdert, Emeritus Professor, Faculty of Veterinary Science,  
The University of Melbourne

**General Anaesthesia for Prepubertal Gonadectomy of Six to Fourteen Week Old Puppies and Kittens** **20**

Michelle Goerke BSc BVMS MACVSc, Registrar in Veterinary Anaesthesia,  
The University of Melbourne



## Foreword


Dear Veterinary Colleagues,

In late 2003, the AVA in conjunction with State Government's Animal Welfare Advisory Committee coordinated a series of veterinary seminars throughout Victoria addressing issues associated with paediatric desexing. The proceedings of the seminar and enclosed video disk provide a summary of that information, aimed at assisting practitioners in the performance of such procedures and in understanding the importance of early desexing to the wider community.

The recent Government decision to reduce the mandatory age of pet registration from 6 to 3 months has also highlighted the importance of veterinarians being competent in anaesthetising and desexing younger cats and dogs. It is expected this legislative change, to be enforced by local government, will result in more animals being desexed at a younger age in order for owners to access reduced pet registration fees. These changes have been supported by the AVA and related organisations following feedback and advice from our membership and available research. Hence it is important that veterinarians are competent at paediatric desexing and are aware of the associated complexities.

I trust that you find the proceedings a valuable resource pertaining to paediatric desexing and that it facilitates the conduct of your clinical work.

Yours sincerely,



Dr Matthew R Makin

President – AVA Victorian Division

## Why Promote Paediatric Desexing?

**Carole Webb BVSc (Hons) MACVSc**  
**Executive Director**  
**Cat Protection Society of Victoria**

In introducing this topic for consideration and debate, it is important firstly to define for our purposes what is meant by paediatric or early age desexing (EAD). For this paper it is defined as the desexing of both puppies and kittens from 8 weeks until 4 months of age, but with very strong focus on the 8-12 week old bracket.

Why then, should we as a profession, be promoting such a practice? Historically cats and dogs have been desexed at six months of age when they have been basically physically mature, so why would we want to be advocating an earlier age? Ultimately, it is the recommendation of our profession that will set the trend in the wider community - we are after all as practitioners the ones who will be performing the procedure - so what are the reasons that we may change our traditional viewpoint and possibly move out of our comfort zone?

EAD began in the USA in the 1980s and arose from the need to address the pet overpopulation problem. It was found that many kittens and puppies adopted from shelters with desexing vouchers never returned for desexing and that this problem could be overcome by desexing them before they left the shelter. This necessitated desexing at around 8 weeks of age. In searching the literature at this time, there were no studies that indicated that desexing could not be done before the traditional six months of age and so EAD was pioneered. From similar needs to address the pet overpopulation problem, particularly in relation to cats, Australia followed the USA in the early 1990s and to date many thousands of EADs have been performed safely and with no long term deleterious side effects. The profession is now being asked to help promote this to the wider community and there are several good reasons to do so:

### There are no deleterious side effects

Many very comprehensive studies have now been conducted over long periods of time, comparing those animals that have been desexed at an early age with those done at the traditional time, looking for any short term and long term side effects. This topic is addressed in Professor Studdert's paper, in great detail, but suffice to say that there are no deleterious side effects with EAD.

### EAD is technically easier and there is better recovery by the patients

Firstly, from a purely practical point of view, desexing puppies and kittens at 8 weeks of age is much easier and faster technically. This relates largely to the fact that in these young patients, the ovaries and uterus are easily found (as they are as developed as those of a cat at 6 months of age) and there is far less fat and bleeding. This thereby reduces surgical time and trauma, leading to faster recovery and healing with less stress on the animal. Since 1993, the Cat Protection Society of Victoria has done some 56,000 kitten desexings uneventfully and many of these cats are now approaching their senior years in good health and without side effects.

In surveying shelters in 2001 as part of the Cat Project (a joint project of CPS with Animals Australia to collect statistics and data relating to the cat problem in Australia), the veterinary staff were asked how they felt about EAD. Interestingly, the overwhelming majority reported it was easier as a procedure and that recovery was superior to adult desexing. The results of the survey are collated in Table 1.

There also appears to be less psychological stress for the animal. Adults admitted for surgery to veterinary clinics often undergo a separation anxiety from their owner and some disorientation whilst at the clinic for their operation. Puppies and kittens in contrast have not yet formed such close attachments and generally show great curiosity and interest in their surroundings.

### Financial incentives

Financially, early age desexing is very cost effective - the procedure is faster, thereby there is less input of veterinary and nursing time, and requires less materials. As a result some clinics are offering early age desexing at substantially lower rates making this very attractive to new clients. This can therefore provide some market pressure to introduce the technique to your practice.

**Table 1. Shelter survey re Early Age Desexing 2001**

Shelter Code	Age/weight at desexing	Year EAD commenced	No. kittens EAD/year	Problems with EAD?	Advantages with EAD?
1	6 weeks	~ 2 years	429 (00/01)	Nil	Yes
2	8 weeks	2-3 years	~ 400	Nil	Yes – better recovery
3	5-6 mths*	N/A	Nil	Private Vets refuse.	
4	8 wks or 800gm	2-3 years	1,358 + (2000/01)	Nil	Yes – better recovery, less nuisance
5	8 weeks or 750gm	~ 7 years	~ 500 year	Nil	Yes – recover quicker
6	12 weeks	~ 1 year	~ 1,000	Nil	Shorter surgery
7	5 months	N/A	N/A	Private Vets refuse	
8	> 800gm	7 years	300	Nil	Yes – reduce overbreeding
9	8 weeks	3 years	~ 2,000	Nil	Prevents early pregnancy
10	8 weeks	8 years	~ 6,000	Nil	Quick recovery, improved long term health
11	8 weeks, but min. 1 kg weight	21 yrs male kittens, ~15 yrs female	2,500 –3,000	Nil	Quick surgery, fast recovery, better behaviour
12	7 weeks or > 700gm	9.5 years	~ 1400	Nil	Grow quicker, rapid recovery
13	700gm	1 year	650	Nil	Quick recovery, no early preg'y
14	8 weeks or 1kg weight	9 years	230	Very rare anaesthetic problem	Recover quicker & less stress
15	8 weeks	15 months	50	Nil	Fast recovery
16	6 months	N/A	N/A	Private vets refuse	

Most puppies and kittens are acquired by their new owner between 8 and 12 weeks of age. EAD can therefore be done before acquisition by the new owner from the shelter/breeder/pet shop/family home. From a welfare perspective, this is important in reducing the numbers of unwanted animals born; and from a responsible breeder's perspective, it is important in protecting pedigreed lines and reducing cross bred litters born because new owners do not have pet quality animals desexed and set up a back yard trade. In obtaining a kitten or puppy that is already desexed, the new owners generally report that they are pleased with this as it ensures they won't forget to have it done and that they have not been exposed to the risk that their new pet may have problems with the procedure (it has been done before they have become attached). In dealing directly therefore with the breeder, shelter, pet shop etc these EADs can be done in litters - making for efficiency and allowing the practice logo to go out with all the offspring thereby providing good advertising for the practice.

From an individual animal and an individual practice point of view therefore, there are some very significant advantages with EAD.

### Legislative trend

Looking now at a community orientated approach, it is fair to say that there is an increasing legislative trend towards EAD. The concept is gaining the interest of politicians in the animal welfare field as a solution to decrease the number of unwanted cats and dogs and to help reduce the nuisance that undesexed animals can cause within the community:

- Shelter statistics reflect the tragic numbers of dogs and cats euthanased annually - an average 60-70% of all cats entering shelters and some 40-50% of dogs. These figures have remained constant despite increased awareness about responsible ownership and existing legislation.
- Analysis of the desexing voucher scheme operated by shelters in the past showed only a 60-80% redemption rate with many animals having had at least one litter before desexing.
- In many studies it has been shown that the majority of nuisance caused by dogs and cats within the community is done by undesexed animals. CPS data compiled from cat management activities with local municipalities over the last five years shows the majority of nuisance complaints relate to entire cat behaviour and the majority of the cats causing the complaints are not desexed:

**Table 2. Formal Complaints Received by CPS 1996 - 2001**

7 Councils Total No of complaints = 10,291

**Type of Nuisance caused:**

Spraying/Noise/Garden damage	82%
Wildlife threat	6%
Other (just hate cats)	12%
Of cats causing the complaints 84% were NOT desexed	

Suggested solutions currently being explored include:

- Reducing the registration age of dogs and cats from 6 months to 3 months. In order to obtain the reduced fee for desexed animals, the owner will need to have their cat or dog desexed at 3 months.
- Requiring pet shops, breeders etc sell only desexed animals ie desexing before acquisition or at point of sale. Currently animal shelters and pounds are required to desex their puppies and kittens before acquisition by the new owner. Those animals specifically required for breeding would be exempted with certain provisions.
- Educating the community to have their dogs and cats desexed at an earlier age.

### Animal welfare - reducing the overpopulation problem

The primary reason for promoting early age desexing is to improve animal welfare. It is a powerful tool to reduce the tragic, large, and not decreasing numbers of animals euthanased in Victorian shelters annually. Some of these animals are certainly the old, the sick, the wild and the problem animals that society rejects, but the overwhelming percentage are young and healthy and are euthanased simply because supply has outstripped demand and put bluntly - no-one wants them. If they had not been born, they would not need to be euthanased. As the veterinary profession moves to a new generation, there is a cry not to euthanase - a cry with which all would totally empathise - but the reality of this is that there is then a large oversupply of cats and dogs that have nowhere to go - the solution, desex them before the unwanted litters are produced. The figures speak for themselves - in Victoria alone, 30,000 dogs and 48,000 cats enter pounds and shelters annually - these unwanted animals place a huge financial, physical and emotional burden on those in shelters. The need then to advance early age desexing within the community is also an ethical one - should we continue to euthanase thousands of unwanted kittens and puppies each year, when a technique exists to prevent this and help control the problem of overpopulation? In a civilised society, the answer is an unequivocal NO and help is sought from the profession to address this.



## 1. Dogs

The outcomes for dogs entering Victorian RSPCA shelters since 1990 are presented in Tables 3 and 4 and displayed graphically in Charts 1 and 2. These statistics show that on average, one third of the dogs entering the shelters are reclaimed, one third are rehoused and one third are euthanased. Since the introduction and implementation of the Domestic Animals Act in 1996, it can be seen that the reclaim figure has risen significantly, as responsible dog ownership awareness and the need for identification of dogs has improved. This has led to a reduced euthanasia rate overall, but interestingly the percentage rehoused has remained static. This would suggest that supply is still outstripping demand ie there are not enough homes available.

Overall throughout Victoria some 30,000 dogs will enter pounds and shelters annually. On average 40 - 50 % of these will be euthanased.

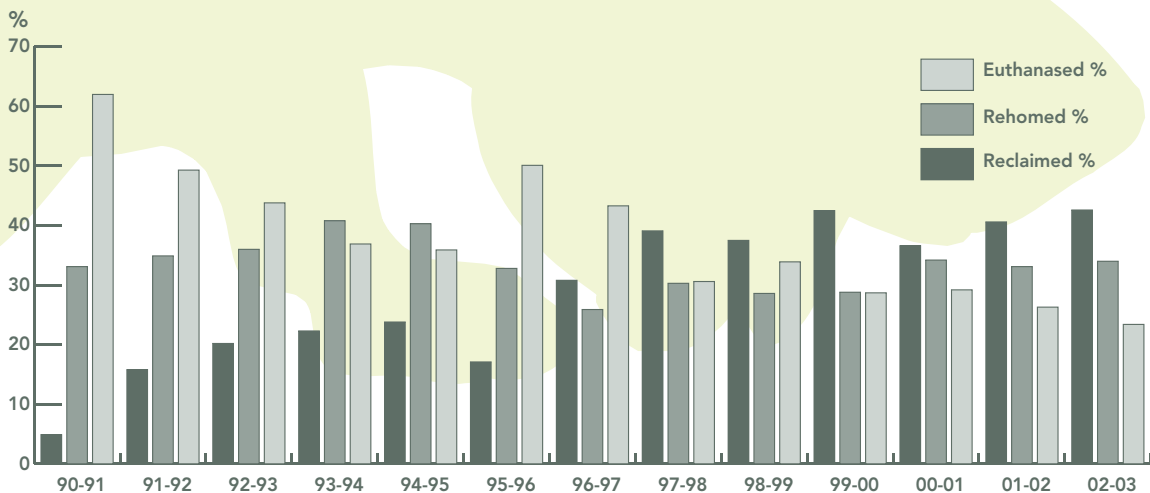
**Table 3. Statistics of animals received by the RSPCA headquarters over a thirteen year period (adapted from RSPCA, 2001)**

	02-03	01-02	00-01	99-00	98-99	97-98	96-97	95-96	94-95	93-94	92-93	91-92	90-91
<b>Total Dogs Received</b>	6,820	7,175	7,580	8,739	8,797	8,294	8,042	5,182	4,313	4,126	4,432	4,678	6,414
<b>Dogs received (% of all animals)</b>	39.4	37.4	38.4	39.4	38.9	38.6	34.2	25	23.1	21.4	21.6	23.8	25.1
<b>Reclaimed (%)</b>	42.6	40.6	36.6	42.5	37.5	39.1	30.8	17.1	23.8	22.3	20.2	15.8	4.9
<b>Rehomed (%)</b>	34	33.1	34.2	28.8	28.6	30.3	25.9	32.8	40.3	40.8	36	34.9	33.1
<b>Euthanased (%)</b>	23.4	26.3	29.2	28.7	33.9	30.6	43.3	50.1	35.9	36.9	43.8	49.3	62

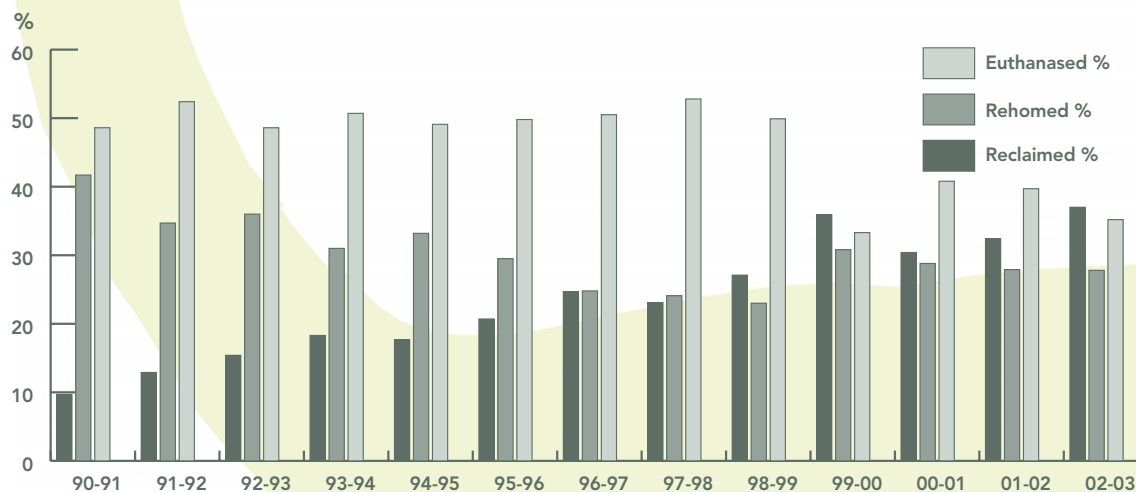
**Table 4. Statistics of animals received by the RSPCA branches over a thirteen year period (adapted from RSPCA, 2001)**

	02-03	01-02	00-01	99-00	98-99	97-98	96-97	95-96	94-95	93-94	92-93	91-92	90-91
<b>Total Dogs Received</b>	11,457	10,362	9,738	9,517	10,447	10,231	9,019	7,853	7,033	7,019	6,057	5,999	5,607
<b>Reclaimed (%)</b>	37	32.4	30.4	35.9	27.1	23.1	24.7	20.7	17.7	18.3	15.4	12.9	9.7
<b>Rehomed (%)</b>	27.8	27.9	28.8	30.8	23	24.1	24.8	29.5	33.2	31	36	34.7	41.7
<b>Euthanased (%)</b>	35.2	39.7	40.8	33.3	49.9	52.8	50.5	49.8	49.1	50.7	48.6	52.4	48.6

**Chart 1. Outcome of dogs received at RSPCA headquarters**



**Chart 2. Outcome of dogs received at RSPCA branches**



## 2. Cats

The overall picture for cats entering shelters and pounds is much bleaker than for dogs. In Victoria annually, 48,000 cats enter shelters and pounds, nationally the figure is 112,000. In 2001, The Cat Protection Society of Victoria and Animals Australia started 'The Cat Project'. This has involved compilation of statistics, data and studies from across Australia as a baseline to define the cat problem and its magnitude.

From the compilation of these figures it can be seen that numbers entering the shelters have not changed significantly through the years. The Cat Protection Society of Victoria has received in the order of 16,000 cats and kittens per year for some ten years (see Table 5 and Charts 3 & 4). In stark contrast to dogs, the euthanasia rate for cats entering shelters around Australia is some 65-70% - these figures are remarkably consistent between different shelters eg CPS and RSPCA (Table 6) and across the nation (Table 7). Since the introduction of the Domestic Animals Act in Victoria the reclaim rate has risen from 0.01% to some 4% (2003 figures) - slightly higher than the national average of 3.2%, but almost negligible in comparison to the 41% for dogs. This to some extent reflects the difference between the cat and dog problem - for cats the problem is one largely of overpopulation, the large numbers entering shelters reflecting thousands of unwanted kittens which have no 'owner' and therefore cannot be reclaimed.

It can be seen from Chart 5 that the shelter intake of cats fluctuates seasonally. The figures are those from CPS, but are typical for shelters handling large numbers of cats, and have been graphed over five years by monthly intake. Whilst some of these cats are old, sick, wild, unweaned or surrendered for euthanasia for various reasons, the majority are healthy and in the right circumstances would make excellent pets. It can be seen that there is a base intake of some 500-600 cats per month and that this increases to nearly 2,500 per month

in kitten season (generally October - April) with the peak intakes in December and January. The spikes in this chart reflect the large numbers of kittens entering the shelters as a result of overbreeding. These are young healthy animals with good temperaments that would make excellent household pets. The reality is that there are simply not enough homes for these to go to and many are euthanased as 'surplus' to demand. This contrasts to the dog problem where seasonality is much less marked.

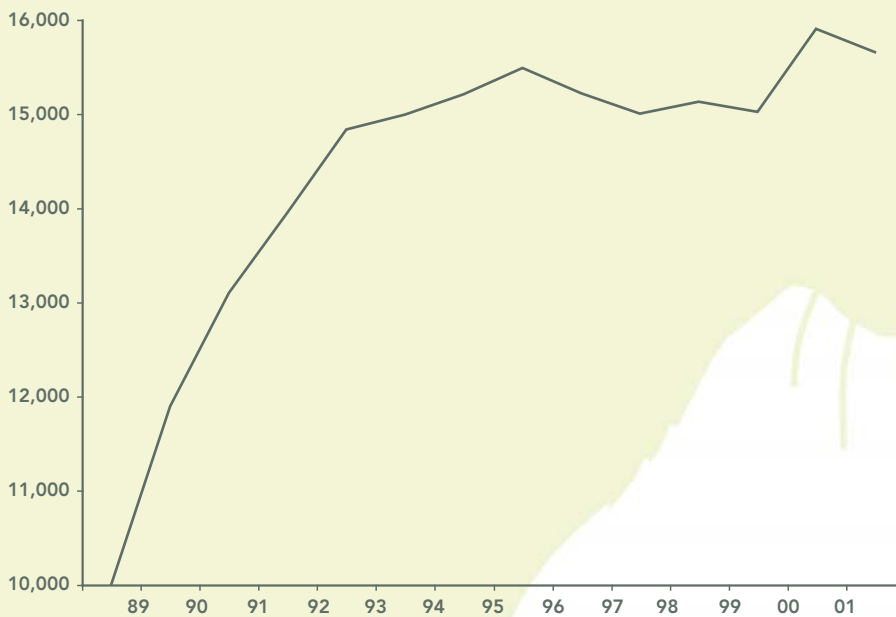
Overpopulation is a far greater problem with cats than dogs because of the cat's tremendous reproductive capabilities and the fact that unlike dogs, cats are not always confined to their properties. Basically cats are designed to reproduce:

- Female cats begin to cycle at 4 months of age and therefore can have their first litter by 6 months of age
- Female cats ovulate when mated so become pregnant
- One female cat can produce 41 offspring in 12 months
- Cat populations require 97.5% of the population desexed to stabilise
- Female cats continue to come into season until mated, calling incessantly and are extremely difficult to confine
- Entire male cats roam widely, fight, spray territory and cause much of the nuisance complaints received by local Councils.

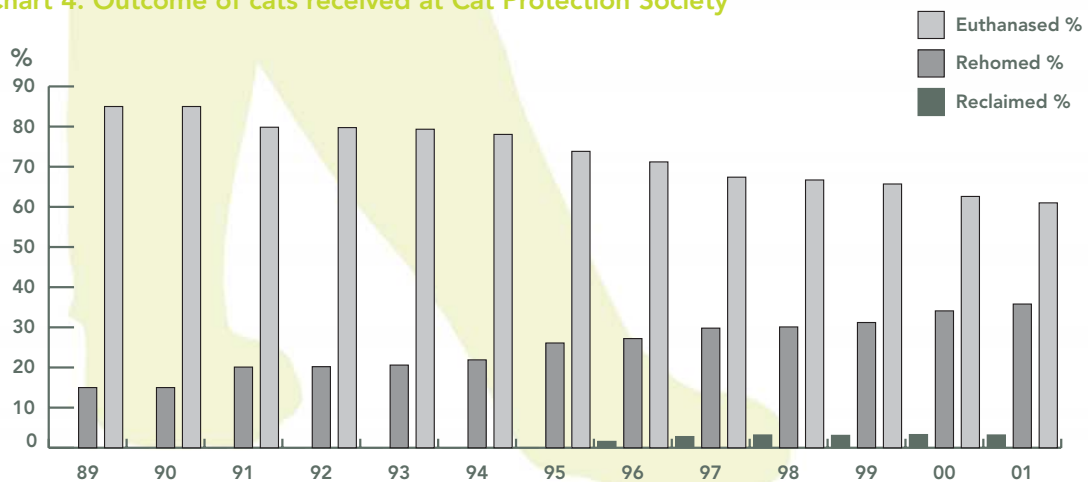
**Table 5. Statistics of cats received by the Cat Protection Society of Victoria over a seven year period (own statistics, 2001)**

	2002	2001	2000	1999	1998	1997	1996
Total no Cats Received	15,654	15,898	15,016	15,129	15,004	15,217	15,483
Reclaimed (%)	3.2	3.2	3.3	3.1	3.2	2.8	1.6
Rehomed (%)	37.1	34.4	34.1	31.2	30.1	29.8	27.2
Euthanased (%)	59.7	62.4	62.6	65.7	66.7	67.4	71.2

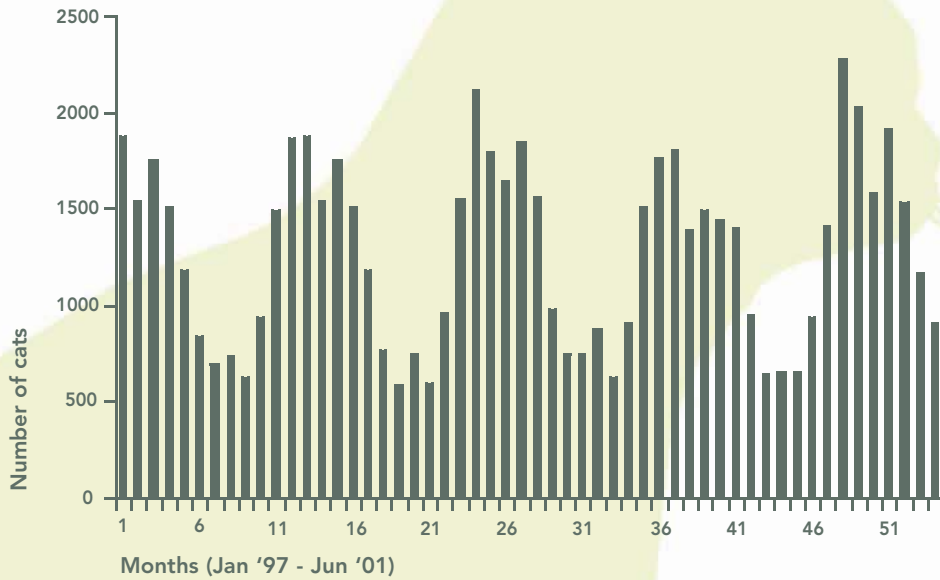
**Chart 3. Total number of cats received by Cat Protection Society**



**Chart 4. Outcome of cats received at Cat Protection Society**



**Chart 5. Intake of cats at Cat Protection Society by month**



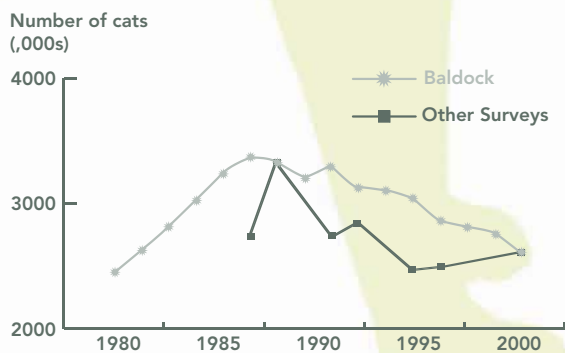
**Table 6. Statistics of cats received nationally by the RSPCA over a five year period (adapted from RSPCA, 2001)**

	99-00	98-99	97-98	96-97	95-96
Total no Cats Received	50,485	59,006	59,028	62,163	58,632
Cats received (% of all animals)	36.4	38.4	36.9	39.3	41.4
Reclaimed (% cats)	3.2	2.1	2.8	1.8	2
Rehomed (% cats)	30	25.2	23	23.1	23.9
Other (% cats)	5				
Euthanased (% cats)	61.8	72.7	74.2	75.1	74.1

**Table 7. Statistics of cats received nationally by all shelters (2000 - 2001)**

Total no Cats Received	116,740
Reclaimed (% cats)	3.2
Rehomed (% cats)	35
Euthanased (% cats)	61.8

**Chart 6. Owned Cat Population Statistics (Australia)**



Baldock, C. (1999) Australia's declining household cat population: forecasts, impacts and reasons. [citing AC Nielsen surveys]. Report to Pet Care Information and Advisory Service. Australia.

Other Surveys:

1. Australian Bureau of Statistics Survey (quoted figure by phone).
2. Mangosi, S. (1993) Contribution of the pet care industry to the Australian economy. BIS Shrapnel Report No. 1956. Australia.
3. Roy Morgan. (1989) Uncle Ben's of Australia Market Research. Roy Morgan Research Centre, Australia.
4. Pias Pet Care Information and Advisory Service. Internet Website <http://www.petnet.com.au>. "Pet Ownership in Australia" (1989).
5. McHarg, M., Baldock, C., Headey, B. and Robinson, A. (1995) National people and pets survey. Report to Pet Care Information and Advisory service. Australia

So with forecasts of declining cat populations and loss of work for veterinarians in private practice as a result, how do these two pictures reconcile? The graph at Chart 6 is one with which many of will be familiar - the upper line is the prediction for the owned cat population in Australia by Baldock using AC Nielsen surveys and population modelling techniques; and the lower line has been plotted using other available research statistics as listed. The graph shows a decline in the owned cat population in a fairly steady fashion from 1989, the upper line showing this continuing and the lower line showing a plateauing of the population. Some of the decline in the population as shown by this graph relates to the change in definition of 'owned' cat from the early 1990s to the present day. In 1990, prior to any legislation being introduced relating to cats, the question "Do you own a cat?" would have been answered in the affirmative by many who were feeding a stray, but not taking overall responsibility for it. After the introduction of the Domestic Animals Act in 1996, the term 'owned' also carried the definition of being registered with the local municipality (and a penalty for not doing so), and if questioned after this point in time, many respondents would now answer "No", although may still be feeding the stray and still taking no overall responsibility for them. Some of the decline therefore can be related to change in definition of an 'owned' cat through time.

However, in stark contrast to the above, shelter statistics indicate no decline in cat numbers. To investigate this discrepancy further, and to try to explain it, the Cat Project surveyed shelters around Australia and asked for data relating to desexing percentages for different categories of cats. As to be expected, the percentage of reclaimed cats that were desexed was very high - 92% reflecting the high percentage of owned cats that are desexed (see Tables 8 & 9). These are owned cats by the definition and this percentage reflects the results of surveys of households owning cats. Also as expected, the percentage of wild unowned cats that were desexed was 0%. However the survey detected a third group of cats called 'stray' of which only 22% on average are desexed. This group are semi-owned. There is usually a feeder, but the feeder takes no overall responsibility, the cats are friendly and generally in good condition but are not desexed and will usually be presented to shelters when they produce their first litter and the feeder can no longer care for all of them. These will make perfectly good household pets. The low desexing percentage in this group is more than sufficient to be producing the oversupply of kittens.

The Cat Project also re-examined the Reark surveys (Reark Research Pty Ltd. The Metropolitan Domestic Cat, April 1994, conducted for Pet Care Information and Advisory Service, Melbourne, 1994) conducted on desexing percentages of owned cats and found that whilst across the board the percentage was 88% (still not sufficient in this author's opinion to prevent overpopulation), the percentage of cats under 12 months of age that are desexed is only 36% (see Tables 10 & 11). In addition surveys conducted by the Cat Project and supported by an international literature search, indicates

that 15-18% of female cats have had at least one litter before they are desexed.

In collating this information, both the declining 'owned' cat population and the large intake of cats by shelters can be explained by what this author has termed The Gap:

- 88% of the owned cat population is desexed
- Only 36% of cats under 12 months of age are desexed
- Only 22% of stray cats are desexed
- 15-18% of female cats have had at least one litter before being desexed

These four statistics fully explain the reason that shelters are still inundated with kittens despite a declining owned cat population. Using these and a population size of 500,000 cats it can be seen that approximately two and a half times the number of kittens required to maintain the population are produced each year.

The Gap also clearly illustrates the usefulness of EAD in curbing the overpopulation as EAD will prevent 18% of cats having at least one litter and increase the desexing percentage of cats under 12 months of age.

#### POPULATION MODEL - CITY FELINE (Cats Rule!!!)

Owned cat population	= 500,000
Average life span of a cat	= 7 years
Hence	
Number of kittens required for replacement each year	= 71,428
On average population spread of 52% females, Number of female cats in population	= 260,000
Average litter no/year	= 2.1
Average litter size/year	= 2.85 kittens (allows 30% mortality)
Average no kittens/year /undesexed female	= 5.99
% of females not desexed	= 9.8%
Number of females not desexed	= 25,480
hence kittens produced per year	= 152,625
% of females having one litter before desexing	= 18%
hence contributing kittens per 7 years	= 133,380
thus kittens produced per year	= 19,054
<b>TOTAL KITTENS PRODUCED PER YEAR</b>	<b>= 171,679</b>

In conclusion, the need for EAD, before the new owner acquires their new kitten, is of great importance in addressing what is very much an overpopulation problem. In reducing the surplus of kittens born, not only is the pressure on shelters reduced, but there are fewer cats able to enter the wild unowned colonies, nuisance is reduced and overall the cat's image will be improved. This will hopefully lead to increased owned cat populations as their value as a companion animal is fully recognised and appreciated.

**Table 8. Cat Protection Society Statistics**

AVERAGE INTAKE STATISTICS FOR CPS 1996 – 2003 (per annum basis)

Total Number of Cats Received = 15,000 per year

Category of Cat	Number Received	% Desexed
Unowned wild cats	9,000	0.01
Owned lost cats (reclaimed)	500	92
Stray/unwanted cats	5,500	22
Euthanised	10,500	4
Rehoused	4,000	100

% Females - 52%      % Males - 48%

**Table 9. Category of Cat and % Desexed - National Average**

Category of Cat	% of cats received	% Desexed
Number identified	5	
Unowned wild cats	52	0%
Owned lost cats (reclaimed)	3.2	Comment that most are and will be desexed before reclaimed
Stray/unwanted cats	44.8	20% (17 - 51%)
Euthanased	61.8	
Rehoused	35	100%

**Table 10. Desexed males and females and total desexed cats across Australian States in the 1993 - 1994 year (Reark, 1994)**

Proportion of desexed cats (%)	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Total
Male	84.4	86.5	79.6	90.0	86.2	61.2	73.3	84.7
Female	89.0	92.2	86.3	94.2	89.9	80.2	91.8	90.2
Total	87.1	89.7	83.5	92.1	88.2	72.3	83.7	87.8

**Table 11. Domestic Cat Population by Age and Gender/Neuter Status (Reark, 1994)**

	1-11 mth	12-23 mth	2-3yrs	4-5yrs	6-8yrs	9-11yrs	12+yrs	Total
Entire	63.4	17.4	7.2	8	2.6	3.3	2.6	12.2
Desexed	36.6	82.6	92.8	92	97.4	96.7	97.4	87.8

# Dispelling the Myths about Long-term Side-effects of Early Age Desexing

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Evaluating the effects of early-age desexing necessarily involves evaluating the basis for current practices and making comparisons with the effects associated with desexing at currently accepted 'traditional' ages. As well, many of the arguments used against desexing (at any age) are encountered because many of those resurface in the debate about early age desexing.

**'Spaying:** This is an operation occasionally performed on bitches to prevent breeding. Though it succeeds in this respect, it seldom prevents the bitch operated upon coming into heat to a more or less extent, and being troublesome with male dogs. For this and other reasons, the operation is not recommended.'

The Dog's Medical Dictionary (1908)

A.J. Sewell, MRCVS, Canine Surgeon to H.M. the King, also to H.M. the Queen, and to the Kennel Club, the Dogs' Home, the Dumb Friends' League, and Bulldog Club, etc. etc.

Fortunately, we've progressed substantially from this view, expressed in 1908, but it is surprisingly difficult to find the basis for the recommendations proposed in following decades.

'The best age for spaying depends upon a number of factors that are more or less important in different parts of the country. Differences of opinion regarding the "best" age for spaying are based upon habit or convenience.'

Canine Surgery, Mayer, Lacroix and Hoskins, Fourth Edition (1957)

By 1957, this and other standard textbooks certainly dealt with desexing, but none actually put forward an optimal age. More was said about pros and cons of desexing versus not desexing, than the optimal age. Probably the key phrase here is "habit or convenience" – to which we might all add, "it's how we were taught".

Over time, various recommendations for desexing have been proposed. These include:

- it's not recommended at all
- spay only after at least one litter
- spay after 1st oestrus
- desex 'around' 6 months
- prepubertal desexing

Most of these might be viewed as of historical interest, but in fact all these recommendations are still actively supported in various locations. Desexing is not routinely promoted in a number of European countries. Surveys and presentations at recent BSAVA Conferences have demonstrated that a significant percentage of UK practitioners support each of the recommendations listed.

## Early age desexing

'Sutureless spaying operation:

In larger breeds the best age for operation is two months, in smaller breeds three to four months.'

Flynn, J.C. (1925)  
North American Veterinarian, 6:31-36

From this, we can see that early age desexing isn't a new concept. But, it has become a major topic since about the mid-1980s when large scale promotion began in the US as a means of population control, particularly in animal shelters.

**In 1993, the American Veterinary Medical Association House of Delegates resolved to..**

'...support the concept of early (8-16 weeks of age) ovariohysterectomies and gonadectomies in dogs and cats, in an effort to stem the overpopulation problem in these species. ....for the benefit of animal shelter and humane society spay/neuter programs. Individual veterinarians have the right/responsibility to decide at what age they will perform the procedures.'

Even before, large numbers of animals had been desexed at ages as young as 8 wks. The number has grown greatly in the past 10 years.

## Are there adverse effects of early age desexing?

Acceptance was initially slow with resistance largely based on what were predicted to be harmful effects. Many of the concerns are the same as those that have been and still are used to argue against desexing, itself. It may be reasoned that if these adverse effects do occur following desexing at an older age, they would be worse if it is done at an earlier age.

Short term	Long term
Anaesthesia Stress/recovery rate Infectious diseases	Stunted growth Obesity Infantile genitalia Urinary incontinence Urethral obstruction Behavioural problems

Surgical aspects are covered elsewhere in these proceedings. Clearly veterinary science has moved on from days when anaesthetic and surgical risks were too great to contemplate surgery in this age group. Control of infectious diseases has also improved greatly in recent years, although it can still be a concern in this age group in certain settings.

### Examining long term effects:

Since the early age desexing issue gained a following in recent years, there have been a number of very good studies carried out to test, once and for all, whether there are legitimate concerns (and in some cases whether they ever were legitimate). These studies have also given us an opportunity to test some widely accepted views about the effects of desexing at any age.

Many of these studies have had a similar design so they are easy to compare: Three groups of dogs or cats are allocated to one of three categories: (a) desexed at 7 months, representing the 'traditional' age for desexing, (b) desexed at 7 weeks, representing the young end of early age desexing, and (c) not desexed. The groups of desexed animals are compared with each other and then with the intact control group. There has now been time for follow up studies of more than 4,000 dogs and cats for up to 11 years following desexing, so we are really able to get convincing evidence of whether any of these adverse effects of desexing are valid concerns – in any age group.

## Stunted growth?

It has been postulated that desexing before maturity can result in stunted growth. If valid, that might have more severe effects on bone growth. In fact, several good studies have shown that just the opposite occurs!

Closure of growth plates			
	Intact	Desexed at:	
		7 mo	7 wk
	Age at closure	Closure delayed by:	
Puppies	9.7 mo	+12 wk	+17wk
Kittens	11.3 mo	+ 8 wk	+8 wk

Using proximal and distal radial growth plates as indicators, studies showed there was delayed closure of growth plates when puppies or kittens were desexed at either age. This shouldn't be unexpected. Along with other factors, oestrogens and androgens actually promote maturation of cartilage and calcium deposition. Desexing before growth plate closure, prolongs the period of growth, but not the rate of growth. The extended period of growth meant that bones were slightly longer resulting in taller stature (albeit very slight) in some. This appearance can be accentuated by the reduced muscular development in desexed dogs, especially in males.

Extended periods of open growth plates might theoretically contribute to bone growth abnormalities or increased susceptibility to Salter-Harris fractures. Neither has been shown to be the case in long term follow up studies.

## Obesity?

This is, of course, a frequent argument against desexing - at any age. Nobody wants the lazy, fat dog or cat they think will result. Fortunately, obesity and its aetiology have been objectively studied very thoroughly in both dogs and cats, using many different parameters, including food intake, back fat depth, glucose half-life and peak serum insulin concentrations, not just body weight.

In cats, it is well established that desexing reduces basal metabolic rates by around 30%. In turn, lowered energy requirements without a reduction in food intake leads to obesity. But, the important point is that age of desexing makes no difference.



#### Desexed compared with intact cats:

- More likely to be obese
- Decreased metabolic rates, males requiring 28% and females 33% fewer calories
- No difference between cats desexed at 7 wk or 7 mo of age

In dogs, findings from three sources are less consistent:

#### Spayed compared with intact bitches:

1. Beagles spayed at 18 mo of age were more likely to be overweight after 12 mo
2. Spayed working bitches were no more likely to be overweight after 12 mo
3. Survey of UK practices: spayed bitches were 2 x as likely to be overweight

But in controlled studies:

#### Puppies desexed at 7 wk, 7 mo or left intact:

- No significant differences in body weight, food intake or back-fat depth within 15 mo follow up

Desexing may well predispose to obesity, but there doesn't appear to be any additional risk in either puppies or kittens when it's done at an early age.

#### Infantile external genitalia?

Under-development of external genitalia is commonly attributed to desexing, particularly if it's done at an immature age. It is mainly of concern because it may predispose to other medical conditions.

#### Puppies desexed at 7 wk or 7 mo of age:

- Females had infantile vulvas, but no perivulvar dermatitis up to 15 mo of age
- Males had immature development of prepuce, penis and os penis, but no gross penile adhesions
- There was no difference between those desexed at 7 wk or 7 mo of age

Two studies on male kittens desexed at 7 wk or 7 mo of age produced conflicting results. The significance of lack of penile spines or inability to fully extrude the penis is unclear. Accumulation of preputial secretions, if it occurred, might predispose to balanoposthitis, but that was not observed in any of the follow up studies (more than 3 years).

#### Male kittens desexed at 7 wk or 7 mo of age:

1. Absence or atrophy of penile spines; no preputial adhesions
2. Penile adhesions and inability to fully extrude penis when desexed at 7 wk; variable when desexed at 7 mo

#### Feline Lower Urinary Tract Disease?

Likely to be of greater concern, however, is whether a similar lack of development occurs in the urethra and whether there is an increased risk of feline lower urinary tract disease, especially in males.

#### Kittens desexed at 7 wk, 7 mo or left intact:

- No difference in urethral size or dynamic function
- No difference in urethral diameter in males, but narrower in females desexed at 7 wk
- No correlation between age of desexing and occurrence of lower urinary tract disease

Comparative studies, using urethral pressure profiles and contrast studies, showed there was no difference in urethral diameter in intact males or those desexed at any age, but in the younger females the proximal urethral diameter was slightly decreased. Most important, there was no correlation between age of desexing and the occurrence of lower urinary tract disease in follow up studies, now up to 3 years after desexing.

#### Urinary Incontinence in bitches?

That spaying is a risk factor for the development of urinary incontinence (urinary sphincter mechanism incompetence; hormone-responsive, or oestrogen-responsive incontinence) at some stage in life is a widely held view, supported by many studies. The condition is very uncommon in intact bitches. It is a reasonable concern that early age spaying might increase the risk of developing this condition.

Several studies on the role of age of spaying, however, give conflicting information ranging from a significant increase, to a reduced risk, to no difference.

**Findings in studies of urinary incontinence in spayed and intact bitches:**

a. spayed vs intact: 7.8 x greater risk

Early age compared with 'traditional age' spaying:

- b. 2.4 x greater risk
- c. risk reduced by half
- d. no differences
- e. no differences

(a) is a summary of several studies from the UK where urinary incontinence has been investigated for many years, including some studies that looked for any link with breed, body size and even tail docking! [Some large & giant breeds were predisposed; there was no connection with tail docking, although breeds with docked tails predominated.]

(b) also from the UK, these studies show that the risk increases with earlier spaying.

(c) is a summary of studies from Switzerland which reported urinary incontinence to be a 20% risk in spayed bitches. That figure seems high, so demonstrating a 'reduced risk' in bitches spayed at an early age may not be surprising. But this study also reported that incontinence in those spayed at early ages, while less common may be worse, ie more persistent and more frequent.

(d) and (e) are two retrospective surveys of bitches spayed at an early age, one from the US and one covering early age spaying at the RSPCA (Vic). Together, they include about 500 bitches with follow up periods ranging up to 4 or 5 years.

**Behavioural problems?**

Since behavioural problems are a major reason for dogs and cats to be relinquished to animal shelters, this could be an important non-medical consideration if early age desexing makes it worse. 'Behavioural problems', of course, include a whole range of traits deemed to be 'unsatisfactory'. In some cases, it's probably a mismatch between the owner's expectations and the animal's normal development. But destructive behaviour, inappropriate elimination (cats), aggression and other antisocial behaviour – to humans or other animals - are commonly cited as reasons to relinquish the animal.

There is also the long standing belief that desexing leads to a lazy dog, lazy cat which nobody really wants. If this is really the case, does early age desexing make it worse?

Again, studies seem to indicate the opposite of what is the popular belief:

**Compared with intact controls:**

- At 12 mo of age, no differences in kittens desexed at 7 wk or 7 mo of age
- At 15 mo of age, dogs desexed at 7 wk or 7 mo of age scored higher for 'general activity'; those desexed at 7 mo scored higher for excitability
- In follow up studies, there was no difference in numbers surrendered to shelters

In addition to these convincing results, dogs desexed at an early age have been shown to be more suitable for training as guide dogs at institutions in Australia and the United States.

## Summary

### What are long term effects of prepubertal desexing?

- x stunted growth
- x perivulvar dermatitis
- x lower urinary tract disease
- x behavioural problems

#### Cats:

- ✓ obesity

#### Dogs:

- ✓ x increased risk of urinary incontinence

- Stunted growth from desexing (at any age) has been disproven. Desexing at even 7 mo of age is associated with delayed closure of growth plates and a longer period of growth.
- Perivulvar dermatitis is no more common in early age spayed bitches than in those spayed at the 'traditional ages'.
- There is no evidence that early age desexing increases the risk of lower urinary tract disease in male cats.
- Behavioural problems are not increased by early age desexing.

The potential problems remaining are:

- Obesity in cats, but the risk is no greater than that associated with desexing at any age.
- Possibly an increased risk of urinary incontinence in bitches. Advice from Bristol researchers, following their long term interests in urinary incontinence, is that spaying be delayed if:
  - juvenile vaginitis is present
  - infantile vulva is present
  - urinary incontinence is present.

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# General Anaesthesia for Prepubertal Gonadectomy of Six to Fourteen Week Old Puppies and Kittens

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## Anaesthetic risk:

The risk of paediatric anaesthesia is a justifiable concern for clinicians contemplating early age desexing. Consideration of their specific requirements may reduce this risk. However, whether privately owned paediatric patients should be potentially subjected to any additional risk during an elective procedure is debatable and should be carefully considered by the veterinary profession as a whole.

Studies conducted in American veterinary teaching hospitals have presented encouraging statistics based on thorough anaesthetic protocols and procedures. These however, are no substitute for prospective evaluation of anaesthetic morbidity and mortality during paediatric desexing in the *general practice* setting.

In my opinion, an objective assessment of the true risk of paediatric anaesthesia in general practice cannot be made from the current literature. However, I believe that paediatric anaesthesia can be consistently successful, but not without a thorough familiarity and understanding of specific physiologic considerations which may reduce the increased risk of anaesthetising these patients.

Howe (1997) reported that at the Texas A and M University, the incidence of anaesthetic complications in puppies and kittens anaesthetised for desexing at less than 12 weeks of age was not greater than in patients older than 12 weeks of age. The implication of this study is that when similar anaesthetic techniques and standards are utilised, the risk of anaesthesia for paediatric desexing is comparable to that for adult desexing. The application of this information to general practice, however, must include consideration of the achievability of similar standards of anaesthetic practice. The anaesthetic protocols in this and references cited later in this paper, each describe:

- Minimal withholding of food preoperatively (ie only 2-4 hours for six to eight week old patients), with resumption of eating within two hours of surgery.
- Reduced drug doses and careful titration of doses.
- Maintenance of high heart rates and high respiratory rates.
- Endotracheal intubation.
- Oxygen supplementation with or without additional inhalant anaesthesia.
- Peri-operative heating.

- Glucose and fluid support if necessary. All had intravenous catheters placed. In this study, all received IV fluids at 10ml/kg/hr with the exception of kitten castrations. Other papers state that IV fluids should be given where anaesthesia exceeds one hour.

## Howe LM, Short-term results and complications of prepubertal gonadectomy in cats and dogs, JAVMA, Vol 211, No.1, July 1, 1997.

In this study, all cats and dogs presented to two local humane organizations were desexed by students at Texas A and M University. They were grouped by age:

Group 1: < 12 weeks old	723 animals
Group 2: 12 – 23 weeks old	532 animals
Group 3: ≥ 24 weeks old	733 animals

Dogs were premedicated with butorphanol and glycopyrrolate, with the addition of acepromazine in those greater than 5 months of age. Anaesthesia was induced with thiopentone and maintained with halothane or isoflurane. Kittens were premedicated with acepromazine, butorphanol, glycopyrrolate and ketamine. The dose rates were different for the different age groups. Anaesthesia was then induced in kittens by mask and maintained with halothane or isoflurane.

Intravenous catheters were placed in all animals and a balanced electrolyte or dextrose solution administered IV with the exception of the kitten castrations. All animals except for the kitten castrations were intubated and were placed on a non-rebreathing circuit.

Circulating warm water blankets were utilised.

Surgical times were longer than would be expected with experienced veterinary surgeons. For example, spays took up to 60 minutes to complete while castrations took up to 25 minutes to complete.

#### Anaesthetic mortality:

Group 1: < 12 weeks old	2 cardiac arrests, (one 8 week old kitten died).
Group 2: 12 – 23 weeks old	2 cardiac arrests, (one 16 week old puppy died).
Group 2: ≥ 24 weeks old	1 cardiac arrest, (one 1.5 yo cat died).

#### Anaesthetic morbidity:

Group 1: < 12 weeks old	none
Group 2: 12 – 23 weeks old	one regurgitated and aspirated
Group 2: ≥ 24 weeks old	two regurgitated and aspirated

**Conclusion:** The incidence of anaesthetic complications in pups and kittens anaesthetised at less than 12 weeks of age was no greater than in those sterilised between 12 and 24 weeks, nor greater than in those sterilised at greater than 24 weeks of age

## The Specific Anaesthetic Requirements of Paediatric Patients

### The Respiratory System

1. The risk of airway obstruction is greater in young animals due to their less rigid airway cartilage (Howe LM, 1999).

#### Implications:

*Anaesthetised paediatric patients should be intubated.*

The exception to this may be kittens undergoing castration where the procedure often takes less time than the time taken to intubate.

Puppies and kittens are as easily intubated as adult dogs and cats. However, their small size requires that care be taken during intubation to avoid trauma to the larynx and during cuff inflation to avoid trauma to the trachea. Un-cuffed ET tubes remove the potential for trauma caused by cuff inflation. An un-cuffed tube of at least one size larger than the usual cuffed tube size can be placed. This maximises airway diameter. A size

3mm un-cuffed endotracheal tube easily fits a 500g kitten. The tip of the blade of a laryngoscope (eg a curved size 0 or 00 MacIntosh blade) can be used to depress the base of the tongue, thereby depressing the epiglottis and opening the larynx without touching the epiglottis itself.

2. The metabolic oxygen requirement of young animals is two to three times greater than that of adults (Howe LM, 1999; Grandy JL, Dunlop CI, 1991).

Their higher metabolic oxygen requirement implies that the alveolar ventilation rate of young animals must be two to three times greater than in an adult patient. However, since paediatric patients are only able to generate a tidal volume (ie breath size per kg) equivalent to that of adults, they must breathe faster in order to meet this oxygen demand. Thus, the respiratory rate of puppies and kittens must be two to three times that of adult dogs and cats. The functional residual capacity is also smaller in paediatric patients, resulting in a smaller oxygen reserve in the lungs.

#### Implications:

- *The respiratory rate of paediatric patients should be 2-3 times the adult respiratory rate.*
- Inhalant induction is more rapid in paediatrics due to their higher alveolar ventilation rate.
- The use of potent respiratory depressants should be minimised.
- Positive pressure ventilation should be used to assist those patients exhibiting respiratory depression. Failure to do so may result in hypoxia and hypercapnia. The normal respiratory rate is determined by observing the patient in quiet surroundings prior to anaesthesia. It is usually 15 to 35 breaths/minute.
- Oxygen supplementation is desirable and will help offset the effects of respiratory depression.

## The Cardiovascular System

1. Young animals have lower ventricular compliance (Howe LM, 1999; Grandy JL, Dunlop CI, 1991).

### Implication:

- Fluid therapy to treat hypotension may be less effective because paediatric patients have reduced ability to increase their cardiac output in response to volume loading.

2. Young animals have poorly developed baroreceptor responses and also have a reduced ability to vasoconstrict (Grandy JL, Dunlop CI, 1991; Howe LM, 1999).

### Implication:

- Paediatric patients are less able to compensate for haemorrhage.

3. Young animals have immature sympathetic innervation of the heart making it less able to increase the force of contraction (Howe LM, 1999; Grandy JL, Dunlop CI, 1991).

### Implication:

- The cardiac output of young animals is heart rate dependent and thus the heart rate should be kept above 150 beats/min. The normal heart rate is approximately 200 beats/minute.

Anticholinergic agents (atropine or glycopyrrolate) should be administered as premedicants.

4. A greater proportion of paediatric animals' cardiac output goes directly to the brain (Root Kustritz MV, 2002).

### Implication:

- Paediatric patients are more sensitive to intravenous and inhalant anaesthetics.

## The Hepatorenal System

1. In dogs and cats, the hepatic enzyme systems responsible for drug metabolism do not mature until 3 to 5 weeks of age (Grandy JL, Dunlop CI, 1991), or 4 weeks of age (Howe LM, 1999). Hepatic function is not mature until 12 to 14 weeks of age (Root Kustritz, 2002).

2. The immature liver also has low glycogen stores. Glycogenolysis and gluconeogenesis are slower than in adults (Root Kustritz, 2002; Howe LM, 1999).

### Implications:

- Paediatric patients are predisposed to hypoglycemia and should not be starved for longer than a few hours prior to anaesthesia.
- Paediatric patients anaesthetised for longer than one hour should receive 5% dextrose in a balanced electrolyte solution.
- Paediatric patients should be offered food or glucose syrup within two hours of recovery.

3. Glomerular filtration rate is not mature until 2 to 3 weeks of age and tubular function is not mature until 4 to 8 weeks of age (Grandy JL, Dunlop CI, 1991). Root Kustritz, 2002 states that renal function is not mature until 12 to 14 weeks of age.

## Thermoregulation

(Root Kustritz, 2002; Grandy JL, Dunlop CI, 1991)

1. Young animals have

- An immature thermoregulatory system
- A larger surface area to volume ratio
- A reduced ability to shiver
- Little subcutaneous fat.

2. Anaesthesia depresses thermoregulation and reduces metabolic heat production.

3. Paediatric patients are therefore susceptible to hypothermia. This can cause:

- Bradycardia
- Reduced cardiac output and hypotension.
- Delayed metabolism of drugs and delayed return to consciousness.

### Implications:

- These patients must be insulated from cold surfaces and should be kept dry.
- They should be placed on a heating pad. Infrared lamps may also be used.
- Intravenous fluids and lavage fluids should be warmed.
- The use of alcohol preparatory solutions should be avoided or minimised.

## Pharmacokinetics

(Grandy JL, Dunlop CI, 1991).

Low plasma albumin concentrations result in an increased sensitivity to highly protein bound drugs (eg thiopentone).

Non-protein-bound drugs may have a larger volume of distribution, which is seen as an apparent resistance to the initial intravenous bolus of the drug.

The undeveloped muscle mass and the reduced fat deposits in paediatric patients decrease the sites available for drug redistribution. This may result in a delayed recovery where repeated doses of a drug are administered when recovery from the drug relies on redistribution.

## Anaesthesia of Paediatric Patients

(Root Kustritz MV, 2002; Howe LM, 1999; Grandy JL, Dunlop CI, 1991)

### Premedication

- An anticholinergic (atropine or glycopyrrolate) should always be administered.
- Phenothiazine tranquilisers (eg acepromazine) should be avoided or administered at reduced dose rates. Acepromazine relies extensively on hepatic metabolism, is hypotensive and disrupts thermoregulation. It is not an analgesic. A dose rate of 0.025 – 0.05 mg/kg SC can be given to 10 - 16 week old animals. It is best avoided in those less than 10 weeks old.
- Benzodiazepines (diazepam, midazolam) result in minimal sedation when used alone. However, when added to an opiate they may have a synergistic sedative effect and, when added to ketamine, will improve muscle relaxation.
- Alpha-2 agents (xylazine, medetomidine) slow the heart rate and decrease contractility. Combining these drugs with ketamine or atropine may counteract the bradycardia. However, this does not improve peripheral perfusion, and in the case of atropine, is contraindicated. The major haemodynamic disturbance created by alpha-2 agents is intense peripheral vasoconstriction. Elevation of the heart rate cannot reverse this. Increasing the heart rate will increase the myocardial workload when there is probably decreased myocardial perfusion (due to coronary artery constriction). I prefer not to use these drugs in pups and kittens less than 12 weeks old.

- Opioids provide analgesia and thus decrease anaesthetic requirements. They do not decrease contractility. However, opioids cause a sinus bradycardia, which is contraindicated in young animals. Fortunately this can easily be treated with anticholinergics such as atropine or glycopyrrolate. The duration of action of atropine is only thirty minutes and as the durations of action of all of the opioids are much longer than this, multiple doses of atropine may be required. Alternatively glycopyrrolate may be used. It has a longer duration of action (2-3 hours). The adult dose rates of opioids should be halved as high doses of opioids may cause respiratory depression, particularly when combined with tranquilisers or other anaesthetic drugs. If this occurs, oxygen should be administered by mask, ventilation should be assisted if intubated, and consideration given to reversal of the opiate. Butorphanol, an antagonist-agonist, can be used to reverse the pure mu agonists such as morphine, pethidine and buprenorphine. The respiratory depressant effect of butorphanol is less than that of the pure mu agonists and some analgesia is retained. Naloxone may also be administered to reverse the opioid. However, practices are unlikely to stock this drug.

- Acepromazine can be combined with opioids in patients greater than 10 weeks of age. These combinations provide greater sedation at lower dose rates than when either drug is used alone and are particularly useful in frightened, excited or aggressive animals.

### General Anaesthesia

- Pentobarbitone ("Nembutal") depends entirely on hepatic metabolism for termination of its effects and is therefore contraindicated in pups and kittens less than 12 weeks old.
- Thiopentone relies on redistribution to muscle for termination of its effect and a carefully administered single dose may be administered for induction in those greater than 10 weeks of age. Doses should be titrated carefully as low albumin concentrations result in increased sensitivity to highly protein bound drugs. Using a 1.25 to 2.5 % solution can facilitate this. Additional doses should not be administered. This would result in a prolonged action, as recovery depends upon hepatic metabolism once the limited muscle and fat deposits are saturated.
- Propofol is a short-acting general anaesthetic agent. Recovery from a single dose occurs due to rapid redistribution, followed by rapid metabolism. Its rapid metabolism enables it to be non-cumulative despite repeated dosing. Young animals with



immature hepatic function may have prolonged recoveries from multiple doses. However, single induction doses are safe. In order to avoid profound respiratory depression, it should be administered slowly intravenously over one minute.

- Alphaxalone (Alfaxan-CD) is another short-acting general anaesthetic agent, similar in effect to propofol. Recovery from a single dose is largely due to rapid redistribution. Therefore, it is an acceptable induction agent in paediatrics, but as with propofol, it is probably not ideal for maintenance. Recent evidence suggests that alphaxalone is much less depressant on the cardiovascular system than is thiopentone or propofol.
- Recovery from diazepam/ketamine and zolazepam/tiletamine depends on hepatic metabolism and therefore these combinations are not advisable for pups and kittens less than 8 weeks old. For those greater than 8 weeks of age, zolazepam/tiletamine IV/SC produces anaesthesia of 15-40 minutes duration, dependent on dose rate. Animals should be intubated as the presence of laryngeal reflexes does not prevent aspiration. Recovery is longer than for techniques utilising intravenous inductions and inhalant maintenance.
- Isoflurane is the inhalant of choice for maintenance of anaesthesia. However, halothane has been used successfully in several studies.

## Intubation

The soft cartilages of young pups and kittens make them more susceptible to airway obstruction. Thus intubation is indicated for all but the most brief of anaesthetics (eg cat castration).

Intubation is no more difficult than in adults. However, the cartilages are fragile so the larynx should be visualised. A curved laryngoscope blade greatly facilitates intubation.

Un-cuffed endotracheal tubes allow the maximum diameter tube to be inserted. All kittens and the majority of puppy breeds will take greater than a 3mm un-cuffed ET tube. Tubes smaller than this are susceptible to obstruction by secretions and should be suctioned every 20 minutes.

If intubation cannot be performed, a close fitting facemask may be used, providing that it does not obstruct the nares. A mask does not protect against aspiration. A mask that is too large will introduce a large volume of dead space and result in rebreathing of carbon dioxide.

## Monitoring

Basic monitoring should include heart rate (oesophageal stethoscope etc), respiratory rate, movement of the rebreathing (or nonrebreathing) bag, mucus membrane colour, depth of anaesthesia, and temperature. Where size permits, pulse oximetry and indirect blood pressure monitoring should be utilised.

## Suggested Protocols for Anaesthesia - PUPPIES

### Premedication of puppies less than ten weeks old:

\*butorphanol 0.1 – 0.2 mg/kg SC

**plus** \*atropine 0.04 mg/kg SC

**or** \*glycopyrrolate 0.01 mg/kg SC

\*buprenorphine 0.005 mg/kg SC may be used as an alternative to butorphanol.

### Premedication of puppies greater than 10 weeks old:

butorphanol or buprenorphine as above \*

**plus** atropine or glycopyrrolate as above \*

**plus** acepromazine 0.025 – 0.05 mg/kg SC

### Anaesthesia of all puppies may be induced with:

Propofol 2 – 6 mg/kg IV

**or** Alphaxalone 0.5 – 2 mg/kg IV

**or** Thiopentone 5-15 mg/kg IV

**or** an inhalational agent (this is less desirable due to the stress and pollution often associated with this technique).

### Maintenance with isoflurane:

Endotracheal intubation is desirable. A non-rebreathing circuit should be used in those < 7 - 10 kg. (A paediatric circle circuit may be used for 5 - 10 kg patients).



## Suggested protocols for anaesthesia – KITTENS

### Premedication of kittens less than ten weeks old:

\*butorphanol: 0.1 – 0.2 mg/kg SC

**plus** \*atropine: 0.04 mg/kg SC

**or** \*glycopyrrolate: 0.01 mg/kg SC

\*buprenorphine 0.005 mg/kg SC may be used as an alternative to butorphanol

### Premedication of kittens greater than 10 weeks old:

acepromazine: 0.05 – 0.1 mg/kg SC

**plus** butorphanol or buprenorphine as above \*

**plus** atropine or glycopyrrolate as above \*

**plus** ketamine: 4 – 6 mg/kg SC if greater sedation is desired.

### Anaesthesia of all kittens may be induced with:

Propofol 2 – 6 mg/kg IV

**or** Alphaxolone 0.5 – 2 mg/kg IV

**or** Thiopentone 5 – 15 mg/kg IV

**or** an inhalational agent (this is less desirable due to the stress and pollution often associated with this technique).

### Maintenance with isoflurane

Endotracheal intubation is desirable, except for very quick procedures (eg kitten castration). Here, a tight fitting face-mask may be used. A non-rebreathing circuit should be used in those <7 - 10kg. (A paediatric circle circuit may be used for 5 - 10kg patients).

## References:

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