Section 1

Breeding, Reproduction and Care of the Normal Animal

1 Care of the Juvenile, Genetics and Planning of Breeding

Puppies are most commonly weaned from their dam at approximately 6 weeks of age and will then be placed into a new home.

- the exact time of homing will depend upon the opinion of the breeder and the availability of a new home; early placement at 6 weeks has many advantages relating to behavioural development of the pup, but attention needs to be paid to health care and preventative treatments
- whilst pups may arrive in a new home 'fully weaned', there are substantial physiological changes in the gastrointestinal tract which are not complete until several months of age; these put the pup at risk of gastrointestinal upset following minor dietary change

1.1 BEHAVIOURAL DEVELOPMENT

- there are several important phases of behavioural development, including (1) the neonatal period, (2) the transitional period, and (3) the socialization period (Figure 1.1)
- on arrival at a new home, pups will have passed through the neonatal and transitional periods (these are discussed later in 15.2) and will be within the socialization period which is probably one of the most important phases of its life

Socialization period

- this period classically starts at 3–4 weeks of age and is complete at approximately 12 weeks
- during this time pups should be learning to live as part of the pack (or household)
- the period starts with a general acceptance by the pup that anything experienced is not harmful, therefore the pup will not be frightened by exposure to

Dog Breeding, Whelping and Puppy Care, First Edition. Gary C.W. England.

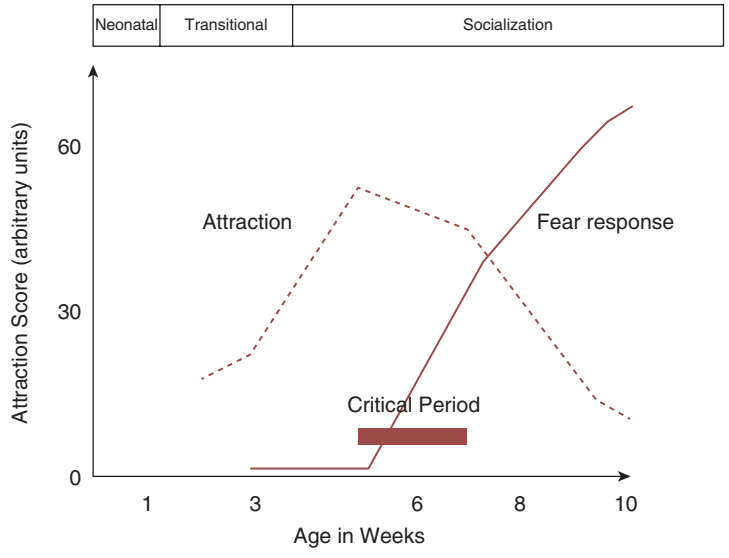

Figure 1.1 Schematic representation of attraction and fear scores for pups demonstrating the 'critical period' in relation to the neonatal, transitional and socialization periods.

something new; in the wild exposure to new things at an early age would be regulated by the dam and therefore can be considered safe

- the period ends with the pup responding to new stimuli with a fear response; in the wild as the pup roams from the nest it is more likely to meet hostile situations and these things should first be treated as dangerous
- as the pup moves through the socialization period it starts to learn what is safe, what is dangerous and how to interact with others in the social hierarchy
- a 'critical period' between 5 and 7 weeks of age has been identified and this is the time when the pup should be exposed to as many stimuli as possible so that the pup will accept these as normal and will not be fearful of them
- for appropriate socialization of the pup into the human household it is imperative that the new owner recognizes the importance of the socialization period and provides a rich, stimulating and social environment:
  (a) early exposure of pups to new environments, people, noises, stimuli etc will be accepted as non-threatening and will normally result in a life-long benefit. As examples pups who have their ears cleaned and examined at 4 weeks of age are likely to accept this as a normal event; pups that are exposed to a vacuum cleaner will accept it as not threatening
  (b) late exposure will result in a fear response that may take multiple exposures in a very controlled environment to overcome. As examples, pups exposed to a vacuum cleaner at 14 weeks of age may be fearful and it may take many months to overcome the fear

- for appropriate socialization owners should:
  (a) make sure that pups are used to being touched all over including opening the mouth and ears
  (b) establish that it is normal for a human to remove the pups' food
  (c) establish basic training commands
  (d) expose the pups to all manner of different environments (cars, buses, shopping centres, crowds etc)
  (e) expose the pups to as many different noises as possible (fireworks, vacuum cleaners, washing machines, gunshots etc); specific tape recordings are useful for this task
  (f) ensure the pup is exposed to people of different ages, sexes and to those wearing different types of clothing, uniforms (e.g. postmen) and hats
  (g) expose the pup in a controlled environment to other animal species (e.g. cats, sheep) so that a chase response does not develop
  (h) correct all inappropriate behaviours quickly

1.2 HEALTH CARE

There is substantial alignment of the socialization period with the immune system of the pup; early in the socialization period the pup has acceptance of new stimuli (at this time the pup will have protective immunity from the dam's colostrum) whilst later new stimuli are met with a fear response (maternally derived antibodies will be waning and the pup may not be protected).

- a variety of routine preventative health care measures should be implemented and due consideration should be given to dietary requirements

Dietary requirements

- it initially appears complex to understand the dietary requirements of a developing pup, however much research has been undertaken and the use of commercially available preparations is scientifically sensible and safe in terms of nutrient requirement and bacterial contamination (many home-prepared diets do not meet the same standards for nutrients or bacteriological safety)
- the nutrient requirement will be based upon the size of the pup, the likely size at maturity (the expected growth rate) and the stage of development
- the volume of food to be fed relates to the density of the food and its nutritional value
- owners normally feed to an expected volume of food in the feeding bowl and forget that total weight of food fed is important
- overfeeding of pups is common and may result in increased tendency to obesity throughout life because of setting an expectation of a particular appetite as well as the nature of fatty tissue that is developed

- the balance between energy intake, protein and calcium is important and will differ between breeds and body size of the dog and varies at the different stages of development; it is important either to recognize the variable amounts required if feeding home-prepared diets or to use commercially available preparations appropriate for the stage of development (age) of the pup
- it is important to recognize that commercially available complete diets for pups should never be supplemented with additional minerals as this will result in dietary imbalance and can result in skeletal deformity

Vaccinations

- vaccination regimes are designed to stimulate the body to produce an immune reaction to particular organisms
- pups will have received some antibodies from their dam (these are called maternally derived antibodies)
- maternal antibodies are not permanent but generally persist in the pup until 6 or 8 weeks of age but this varies from one infectious disease to another
- if vaccination is performed when there are high levels of maternal antibodies it is possible that vaccination will not be as successful as expected and therefore the timing of vaccination is important
- vaccinations are normally given for distemper, infectious hepatitis, parvovirus, parainfluenza, leptospirosis and Bordetella
- most primary vaccination courses include two doses at approximately 10 and 12 weeks of age although an early vaccination may be given at 6 weeks in some cases
- a later last vaccine dose may be required for canine parvovirus (e.g. at 14 or 16 weeks) because maternal derived antibody persists in the pups
- local veterinary surgeons are best placed to advise on suitable regimes since the prevalence of disease varies from one location to another

Deworming

- many breeders will have either treated a bitch for endoparasites during pregnancy, and/or treated the pups when they were in the nest
- establishing what regimes have been followed can be important and this will influence which preventative treatments are given during puppy development
- treatment is required for many different forms of internal parasites

Roundworms

- Toxocara is a roundworm that is most commonly seen in young pups and may cause respiratory disease (because of larvae passing through the lungs) or gastrointestinal disease

- if bitches have been infected before pregnancy larvae may remain dormant but become re-activated in the last third of pregnancy and then pass to the pups; pups are born infected and may produce many eggs themselves within a few weeks of birth
- Toxocara is a potential zoonotic disease and regular de-worming is therefore imperative and should be combined with careful hygiene measures to ensure that human contamination with faecal material does not occur
- pups should be treated approximately every 4 weeks according to the instruction for the medicine supplied

Hookworms and tapeworms

- Uncinaria and Ancyclostoma are hookworms which are not uncommon in hunt and greyhound kennels
- Taenia are tapeworms, of which the most commonly seen has the flea as an intermediate host; pups with fleas invariably harbour tapeworm and should be appropriately treated
- common treatments are given at the same time as treatment for roundworm

Heartworm

- Dirofilaria is common in warmer climates since it is transmitted by mosquito
- where the condition is endemic regular prophylactic treatment is required

1.3 PHYSIOLOGICAL DEVELOPMENT

Body size

- pups grow at a rapid rate over the first 10 months of life; small and medium-sized dogs will reach adult body size at approximately 11 months of age, whereas giant breeds may not reach adult bodyweight until 20 months of age (Figure 1.2)
- there is substantial increase in bone mass and increasing length of the long bones
- normal bone and joint development can be adversely impacted by inadequate diet (both composition and volume fed)
- the period of growth is limited ultimately by the closure of bone growth plates, but there is considerable variation between these for different bones and locations (for example proximal humeral epiphysis closes at an average of 375 days whilst the medial and lateral humeral condyles close at an average of 187 days)

Body conformation

- juvenile pups normally appear relatively long-legged in appearance and this is normal

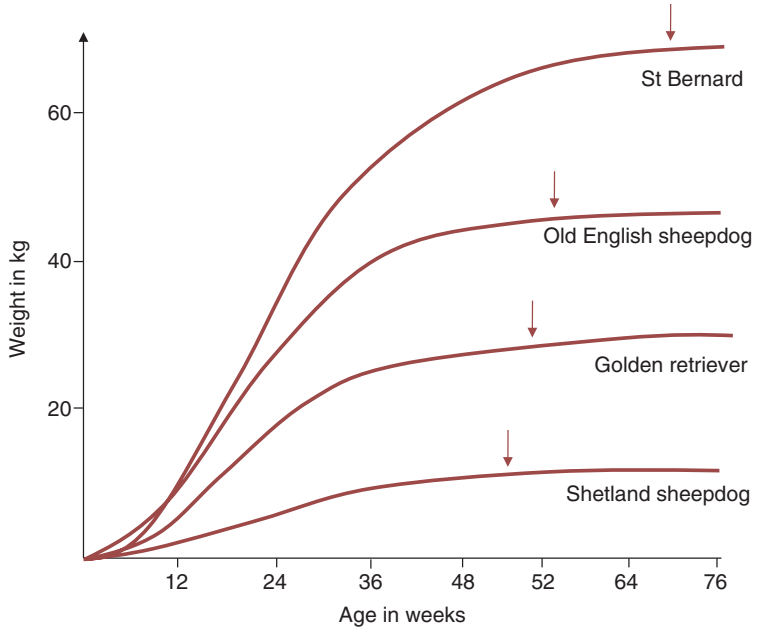

Figure 1.2 Representation of typical growth curves for a variety of different breeds of dog (arrow demonstrates achievement of adult bodyweight).

- unfortunately there has been a societal drift into acceptance of 'chunky' puppies being normal whereas 'chunky' puppies are actually overweight or obese
- accurate evaluation of pups' body conformation is best performed using an assessment of body condition score
- body condition scoring requires palpation of the dog and examining its outline, either a 5- or a 9-point scale are used for simplicity. Here a 5-point scale is described:

Score 1 **Emaciated**
Ribs, spine and bony protrusions are easily seen.
These animals have little muscle mass and there is no observable body fat.
May be described as bony, and starved in appearance.

Score 2 **Thin**
Ribs, spine and other bones are easily felt.
These animals have an obvious waist when viewed from above and have an abdominal tuck.
May be described as lean or skinny in appearance.

Score 3 **Normal**
Ribs and spine are easily felt but not necessarily seen.
These animals have a waist when viewed from above and the abdomen is raised and not sagging when viewed from the side.
May be described as ideal and often have a muscular appearance.

Score 4 **Overweight**
Ribs and spine are hard to feel or count underneath fat deposits.
These animals have no waist which is distended or pear-shaped when viewed from above and the abdomen sags when seen from the side.
There are usually fat deposits on the hips, base of tail and chest.
May be described as heavy or stout.

Score 5 **Obese**
Large fat deposits over the chest, back, tail base and hindquarters.
These animals have a sagging abdomen and there is no waist when viewed from above.
The chest and abdomen often appear distended or swollen.
May be described as rounded or bloated.

Physical appearance and sexual behaviour

- there are no significant differences between male and female pups in their appearance at an early age
- as puberty approaches in the male the production of male hormones (testosterone) results in some specific changes including increased body size, heavier appearance of bones, lengthening of the penis and enlargement of the sheath, substantial increase in size of the testes and epididymides, increased dominance play and mounting behaviour
- in females several months before the first (pubertal) oestrus there are elevated concentrations of female hormones (oestrogens) which result in development and enlargement of the vulva (which previously may have been small and recessed) and slightly increased size of the mammary glands and teats

1.4 ONSET OF PUBERTY

Puberty is a term used to describe the transition (physiologically, morphologically, behaviourally and functionally) from a juvenile to an adult.

- usually growth of the dog or bitch has reached a plateau and changes to the physical appearance mentioned above commence and progress
- the onset of puberty is thought to be produced primarily by a change in the hormonal output from a part of the brain called the hypothalamus; in the

juvenile period there is little activity within the hypothalamus (earlier in growth it was active), but this juvenile quiescence is followed by pulses of gonadotrophin-releasing hormone (GnRH) being produced
- the onset of puberty appears to be linked to attaining a critical body weight and to maturation of nervous tissue within the hypothalamus
- the GnRH is conducted to the anterior pituitary gland where is stimulates the release of two further hormones termed follicle-stimulating hormone (FSH) and luteinizing hormone (LH) which stimulate development of the testes and ovaries
- the gonadotrophins (FSH and LH) are the same in the male and female although it would appear strange terminology to have a follicle-stimulating hormone in a male dog which has no follicles to stimulate
- stimulation of the testis results in the production of male hormone testosterone
- stimulation of the ovaries results in the production of the female hormone oestrogen
- testosterone and oestrogen are called reproductive sex steroids
- the reproductive sex steroids are important in regulating sexual function but they also have important effects on other tissues which result in changes in their appearance and function
- the effects of the reproductive sex steroids are therefore said to influence secondary sexual characteristics; in females this results in changes in size of the genitalia and mammary glands as noted above

Puberty in the bitch (see also 3.2)

- normally reached approximately 2–3 months after achieving adult bodyweight; between 6 and 24 months of age
- small breeds reach puberty earlier than large breeds
- influenced by diet, genetic/line factors and cross-breeding
- often the bitch demonstrates some temperamental changes in the few weeks before the first oestrus including more being restless or excitable and often an increased urination (sometimes involving urine marking with one hind leg raised)
- it is important to consider appropriate housing and management to ensure that the bitch is held in a secure manner and does not escape

Puberty in the dog

- testes are normally present within the scrotum at birth
- spermatogonal activity is first detected at 5–6 months of age and first ejaculations can be collected at approximately 8 months of age
- a longer transition to adult sexual performance is noted rather than the abrupt occurrence of pubertal oestrus as in the bitch and mature semen quality is often not present until 12–15 months of age

- dogs become more boisterous as they approach puberty and there is increased size of the testes but no other overt clinical signs

1.5 SELECTION OF ANIMALS FOR BREEDING

- as dogs mature many will be considered as potential breeding stock, and decisions are often made in relation to the appearance of the animal or the particular attributes that can be observed in him or her; this is described as the 'phenotype'
- it is important to recognize that the phenotype is a combined effect of the genes that an animal carries (the 'genotype') and the effect of environmental conditions
- selection of an animal for breeding therefore requires consideration of the qualities of the animal itself as well as its parents and grandparents and its brothers and sisters (siblings)
- overall the aim of any breeder is to produce pups that are sound in terms of temperament and health; the challenge is to select for a particular trait or suite of phenotypes without development of unwanted traits as a consequence of selection
- nowadays there are many sources of information available to help with selection of animals for breeding including specific health scoring schemes (such as hip, eye, elbow schemes) and temperamental tests (such as response of the animals to particular challenge circumstances)
- for some characteristics statistical predictors of the relative genetic value of an individual within a programme or breed are available; these are called estimated breeding values (EBVs)
- EBVs are based upon genetic liability and do not account for environmental influences
- guidance relating to the particular phenotypes for individual breeds are published as the Breed Standards and EBVs can be useful for estimating the impact that a particular mating might have in terms of shifting the phenotype in any particular direction
- for some breeds where there are especial problems guidance notes may be published (including International Breeding Guidelines) to help control specific diseases
- currently much attention is paid to selection of animals based upon health criteria and much more attention needs to be paid to selecting for temperamental soundness
- in future more information will become available about the specific gene regions that are associated with the desirable or undesirable criteria that breeders wish to select for or against; this will enable development of genomic breeding values (geBVs)
- geBVs will therefore be available for animals at a very early age and as such could be useful for selecting animals into a breeding programme before particular phenotypes are demonstrated

- interestingly, in our laboratory we have documented heritability values for semen quality in dogs and proposed that it is possible that breeding selection may improve semen quality [1]; no other studies have investigated this in dogs and it is important to consider heritability of fertility when planning a breeding programme

1.6 BASIC GENETICS

- dogs have 78 chromosomes grouped in 39 pairs (39 from the father are paired with 39 from the mother – these are called homologous chromosomes)
- all cells contain these 78 chromosomes except sperm and oocytes where the number is halved (they contain only one set and not a pair of chromosomes)
- when sperm and eggs combine together at fertilization the chromosomes reform into pairs so the developing embryo contains 39 pairs
- chromosomes carry genes which are made of deoxyribonucleic acid (DNA)
- each gene is always found within the same chromosome and in the same place (locus) within that chromosome
- coding within each gene is governed by the order in which nucleotide bases are present; these bases are abbreviated to A,C,G,T (adenine, cytosine, guanine, thymine)
- since chromosomes are paired there will be two genes – one on each chromosome
- genes can be either dominant or recessive and the different forms of the gene are called different alleles; when describing these forms it is convention to denote dominant the dominant allele with a capital letter and the recessive with a lower case letter
- a dog with either a single or both alleles that are dominant will display that phenotype whereas for the recessive phenotype to be displayed both alleles need to be recessive
- when the two alleles are the same it is described as a homozygous state, whereas when the alleles differ it is described as a heterozygous state

Example of dominants and recessives

- consider a simple dominant recessive relationship which is coat colour in some breeds of dog (note in some breeds a more complex mode of inheritance occurs for coat colour and this is described later)
- two alleles are present black and brown; black is dominant (termed ‘B’) and brown is recessive (termed ‘b’)
- the possible combinations for an individual dog are BB, Bb or bb, where
  (a) BB = black phenotype (homozygous dominant)
  (b) Bb = black phenotype (heterozygous)
  (c) bb = brown phenotype (homozygous recessive)
- the outcome from mating depends on which alleles are present in the germ cells (sperm or eggs); an animal that is homozygous dominant (BB) can only have B alleles in germ cells, an animal that is heterozygous (Bb) will have some germ cells that are B and others that are b

- mating (a) homozygous dominant to homozygous dominant and (b) homozygous dominant to heterozygous

	Black (BB)	B	B
Black (BB)	B	BB = Black	BB = Black
	B	BB = Black	BB = Black

(a) 100% offspring are homozygous black

	Black (BB)	B	B
Black (Bb)	B	BB = Black	BB = Black
	b	Bb = Black	Bb = Black

(b) 50% offspring are homozygous black
50% offspring are heterozygous black

- mating (a) heterozygous to heterozygous and (b) homozygous recessive to homozygous recessive

	Black (Bb)	B	b
Black (bb)	B	Bb = Black	Bb = Black
	b	Bb = Black	bb = Brown

(a) 25% offspring are homozygous black
50% offspring are heterozygous black
25% offspring are homozygous brown

	Brown (bb)	b	b
Brown (bb)	b	bb = Brown	bb = Brown
	b	bb = Brown	bb = Brown

(b) 100% offspring are homozygous brown

- mating (a) homozygous dominant to homozygous recessive and (b) heterozygous to homozygous recessive

	Black (BB)	B	B
Brown (bb)	b	Bb = Black	Bb = Black
	b	Bb = Black	Bb = Black

(a) 100% offspring are heterozygous black

	Black (Bb)	B	b
Brown (bb)	b	Bb = Black	bb = Brown
	b	Bb = Black	bb = Brown

(b) 50% offspring are heterozygous black
50% offspring are homozygous brown

Polymorphism

- some genes have more than two types of alleles
- an example are the genes that cause the spotting of colour in the coat in some breeds; here four different alleles exist but of course an individual can only have two of the four. The versions are
  - (a) S = solid colour
  - (b) s^i = Irish spotting
  - (c) s^p = Piebald spotting
  - (d) s^w = Extreme white

Epistasis

- some genes are influenced by other genes that are present at another position in the DNA
- the gene that influences the other is called an epistatic gene
- this is nicely illustrated by the control of coat colour in Labradors where either black, brown (called chocolate) or yellow colours occur (the yellow dogs may have a dark- or a light-coloured nose)
- colour is determined by the black (B) or brown (b) allele as previously described, but also by a further allele that can be present in dominant or recessive form ('E' or 'e' respectively)
- the phenotypes and genotypes can be seen below:

Coat colour phenotype	Possible genotype
Black	BBEE BbEE BBEe BbEe
Chocolate	bbEE bbEe
Yellow (black nose)	BBee Bbee
Yellow (liver nose)	bbee

- the only genotype that can be identified from the phenotype is yellow with a liver nose that can only be bbee
- it can be seen that something as simple as mating together two black dogs is actually genetically very complicated since a black dog can be any of BBEE, BbEE, BBEe, BbEe
- one example of this would be mating a BbEe stud to a BbEe bitch:

Brood = BbEe \ Stud = BbEe	BE	Be	bE	be
BE	BBEE Black	BBEe Black	BbEE Black	BbEe Black
Be	BBEe Black	BBee Yellow (black nose)	BbEe Black	Bbee Yellow (black nose)
bE	BbEE Black	BbEe Black	bbEE Chocolate	bbEe Chocolate
be	BbEe Black	Bbee Yellow (black nose)	bbEe Chocolate	bbee Yellow (liver nose)

56% offpring are black (with various genotypes)
25% offspring are yellow (of these 75% have black noses and 25% liver noses)
19% offspring are chocolate (with various genotypes)

Sex determination

- male and female dogs both have 39 pairs of chromosomes but there are differences in the appearance of one of these pairs between the sexes

- in females all pairs are similar in size; but in males, in one pair, one chromosome is larger than the other – the large one is the same size as seen in the same pair in females
- these chromosome pairs are called the sex chromosomes and the larger one is designated 'X' and the smaller one is designated 'Y'; in this manner females are XX and males are XY
- when germ cells are produced by a bitch she can only have X chromosomes in her eggs, whilst for the dog he will have sperm that contain either an X or a Y chromosome
- the sex of the fertilized egg will then depend upon which type of sperm fertilizes the egg:

		Male (XY) X	Male (XY) Y
Female (XX)	X	XX = Female	XY = Male
	X	XX = Female	XY = Male

50% offspring will be male (XY)
50% offspring will be female (XX)

Sex linkage

- some genes are carried on the sex chromosomes; in fact very few are carried on the Y chromosome but some are carried on the X chromosome, including for example those that are responsible for the disease haemophilia
- the haemophilia gene is present in two alleles; the normal allele is dominant (H) whilst the other abnormal allele is recessive (h)
- in the female (who has 2 X chromosomes) the full gamut of normal (X^HX^H), carrier (X^HX^h) and affected (X^hX^h) will be seen
- in the male (who has XY chromomes) there is only normal (X^HY) and affected (X^hY)
- results of breeding of affected and carriers can be estimated as before, for example mating (a) affected male with normal female and (b) affected male with carrier female

		Male (X^hY) X^h	Male (X^hY) Y
Female (X^HX^H)	X^H	X^HX^h = Carrier Female	X^HY = Normal Male
	X^H	X^HX^h = Carrier Female	X^HY = Normal Male

(a) 50% offspring are normal males
50% offspring are carrier females

		Male (X^hY) X^h	Male (X^hY) Y
Female (X^HX^h)	X^H	X^HX^h = Carrier Female	X^HY = Normal Male
	X^h	X^hX^h = Haem Female	X^hY = Haem Male

(b) 25% offspring are normal male
25% offspring are carrier females
25% offspring are affected males
25% offspring are affected females

1.7 BREEDING SCHEMES

- breeders who wish to develop or exclude particular characteristics need to understand the mode of inheritance of the condition; this may be an autosomal recessive trait or a polygenic inheritance as previously described
- for autosomal recessive traits it is imperative to understand whether an animal is normal, carrier or affected; this may be established (a) with information from the sire, dam, siblings and offspring especially by observing which litters contain affected animals, or (b) from genetic tests (for example a blood sample can be taken and gene mapping undertaken to establish if the dog is normal, carrier or affected with progressive retinal atrophy)
- for polygenetic inheritance it is possible to calculate the heritability of the trait which is the degree of variation that is caused by the genetic makeup of the animal; using this it is possible to estimate how much a population can be shifted by breeding from animals above or below a threshold of the phenotype (Figure 1.3)
- in some cases there are clear numerical data assigned to the condition that is to be selected for or against (e.g. hip score, elbow score, some trainability scores), in others the breeder subjectively assesses appearance of the individual; the aim is to breed for the wanted characteristics and against the defects
- commonly this involves breeding animals that are to some degree related (inbreeding and line breeding) but can also involve selection of animals that have appropriate characteristics from another pedigree (outcrossing)

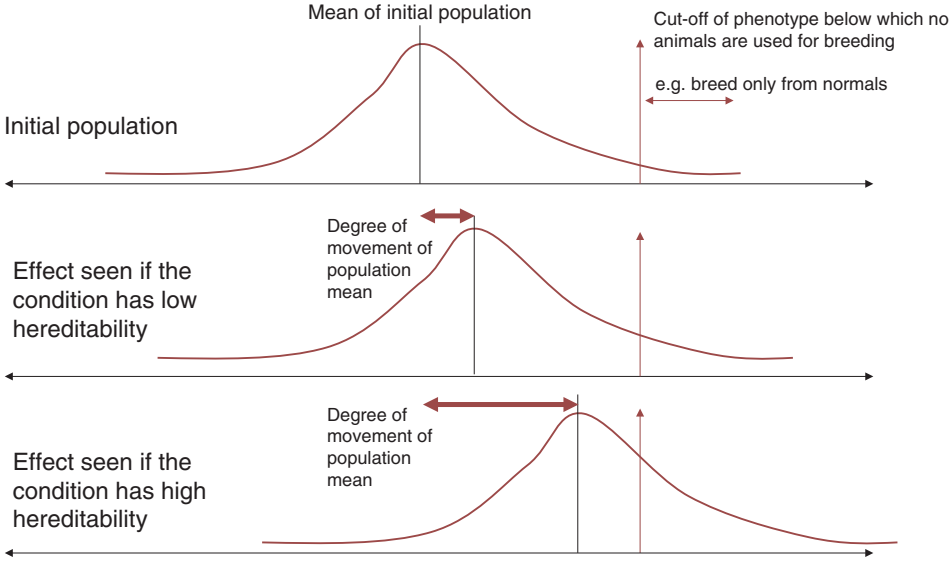

Figure 1.3 Shifting of population mean by selecting normal animals where the condition has either low or high heritability.

Inbreeding and line breeding

- mating two genetically related animals tends to result in increased homozygosity in the programme and this is used to produce specific desired characteristics
- in fact within a country most breeds of dog have a relatively small gene pool and most animals have some degree of relation to each other
- the differences between inbreeding and line breeding relate to how closely related are animals that are bred together
- strictly speaking inbreeding is defined as breeding animals that are more closely related than the average of the population; however inbreeding it often taken to mean breeding animals that are very closely related (e.g. parent to offspring, or two siblings), whereas line breeding is taken to mean breeding less closely related animals (e.g. first cousin mating)
- the degree of inbreeding in a pedigree can be calculated using the 'inbreeding coefficient' (measured on a scale of 0–1); mating two different breeds of dog together would have an inbreeding coefficient of 0, whilst mating a brother to sister for many generations would finally result in an inbreeding coefficient of 1
- breeding from animals that have some relatives in common can be used to select for a particular phenotype, generally has rapid results (within a few generations) and can help to establish a phenotype, however it also risks establishing the unwanted genes and is essentially a genetic 'dead-end'
- there is some data to show inbreeding is associated with production of increased stillbirths and decreased litter size

Outcrossing

- here animals that do not have shared ancestors are mated
- the aim is to introduce a particular characteristic that is present in one line to the other line
- the breeder needs to be clear that within the offspring, whilst some animals will have the desired phenotype, this is likely to be a small proportion and the remainder of animals are not suitable for future breeding
- the selected animal whilst having the appropriate phenotype will in general have a heterozygous genotype and may not have the effect within a breeding programme that would be expected, or would be seen from a traditional animal that comes from a typical line-breeding programme

1.8 FIT TO BREED

- finally the potential stud dog and potential brood bitch have been selected; each must have passed the threshold criteria for health and temperament established by the breeder

- performance of a breeding soundness examination can be useful to assess whether the individual is likely to have normal fertility (see Chapters 5 and 10); in the dog this should include collection of semen and full semen evaluation
- for the bitch there is also a question of whether she is fit to breed; in particular this decision is based upon the physical maturity of the bitch, her temperamental maturity, and her current state of health and body condition score
- nutritional factors influencing fertility are often overlooked but inadequate nutrition in both the male and female can have a significant impact

1.9 BREEDING AT THE FIRST (PUBERTAL) OESTRUS

- in a particular breeding programme there may be a desire to breed a bitch at the first oestrus so that the interval to the next generation is as short as possible
- the bitch's reproductive tract is clearly capable of sustaining a pregnancy at the first oestrus

However

- physiologically the bitch is not fully mature at the first oestrus (growth plate closure for the entire skeleton is not completed)
- many bitches are not behaviourally mature at the first oestrus
- some hereditary diseases have a late onset and may not be detectable by the time of the first oestrus
- there is a lower pregnancy rate and litter size when breeding at the first oestrus
- there is a slightly increased risk of problems at whelping when bitches are bred at the first oestrus
- overall it might be argued that breeding at the pubertal oestrus should be avoided, however, some breeds reach puberty at a much later age than others, and some individual bitches reach puberty at an age greater than the average – in these, at least, breeding at the first oestrus is entirely reasonable

REFERENCE

1 England, G.C.W., Phillips, L. and Freeman, S.L. (2010) Heritability of semen characteristics in dogs. *Theriogenology* **15**, 1136–1140.