R.B.

This makes it clear that the Calif. brood stock selection plan has nothing to do with trout strains and survival in the wild.

The Resources Agency of California
DEPARTMENT OF FISH AND GAME

RAINBOW TROUT BROODSTOCK SELECTION[1/]

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SUMMARY

The four primary broodstocks maintained by the Department are descendents of wild trout trapped and artificially spawned many years ago. These fish have undergone an undetermined amount of selection since that time. Although significant gains have been achieved in the past, any future gains seem dependent on the development of an efficient mating system and a systematic selection program.

The objective of this selection program is to supply quality broodfish and at the same time to improve the economics of the production of fingerling, subcatchable- and catchable-sized trout through genetic means. This program is limited to the following five traits: size of eggs, number of eggs, percent egg mortality, size of fingerling and percent fingerling mortality. The net merit of an individual family is determined by a selection index. The index is derived by scoring each family for each trait on the basis of its performance and weighing the score by the relative economic value assigned to that trait.

The present selection program includes individual selection, sibling selection and family selection. The reproductive value is evaluated on the basis of both individual performance and the performance of a sample of full sisters. Fingerling growth and survival are evaluated on the average performance of full sib families.

Detailed information regarding data collection procedures, scoring of the traits, marking fish and terminology used are appended to this report.

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1/ Submitted March 1971.
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2/ Prepared by Dr. Gall, in consultation with the Trout Broodstock Committee. October, 1970. Detailed broodstock selection program in use at State Department of Fish and Game broodstock hatcheries.

INTRODUCTION

Virtually all of the rainbow trout planted by the Department of Fish and Game are obtained from brood fish maintained by the Department at four broodstock hatcheries: Mt. Shasta, Hot Creek, Mt. Whitney and San Joaquin. All the brood fish are the domesticated descendents of wild trout trapped and artificially spawned many years ago.

Down through the years, as the domesticated fish were spawned, enough eggs were put aside to provide a continuing source of broodstock. However, rather than taking fish at random for this purpose, they were selected for certain characteristics such as size, conformity, egg size, number of eggs, and so forth. Through this selection process, fish culturists were able to produce fall spawning rainbows, fish which produced more eggs of larger size than ever before, and in general, a fish which fit the needs of an ever expanding hatchery program.

Although the gains have been significant in the past, it became evident to the Trout Broodstock Committee and to consulting geneticists that future improvements were dependent on the development of a systematic selection procedure and on efficient system of mating. To be effective the selection procedure had to include only those characters of importance to overall production efficiency and necessary for the production of quality trout. The mating system required was one which maximized the effects of selection but at the same time minimized rate of inbreeding. The program described below attempts to achieve these objectives and is based on our present knowledge of the genetic nature of the characteristics considered important.

strictly of hatchery significance

THE PROGRAM

The objective of the program is to supply quality brood fish and at the same time to improve the economics of the production of fingerling, subcatchable- and catchable-sized fish through genetic means. In the program's present form each broodstock population will be selected for five traits considered necessary for improvement of the net merit of the stock. The traits and their relative economic values are:

how would this be defined?

Trait	Relative Value
Size of eggs	0.4
Number of eggs	0.9
Percent egg mortality	0.4
Size of fingerlings	0.9
Percent fingerling mortality	1.0
survival, growth and return in the wild - - - -	0.0

Information on size of eggs and number of eggs is obtained equally from data on the female producing the eggs and from data on 10 of her full-sisters sampled at random (Appendix B).

The traits, percent fingerling mortality, size of fingerlings, and number of eggs spawned are given the highest relative values; the expense of raising fingerlings is high, thus losses should be kept as low as possible; the cost of producing fingerlings is greatly affected by growth rate, so rapid fingerling growth is desirable; and the expense of maintaining broodstock can best be minimized by obtaining the largest possible number of eggs per female retained as a brood fish. Size of eggs and percent egg mortality are given values of only 0.4 each; it is felt that large egg size is important only to the extent of maintaining egg quality and further improvement in lowering the percent of egg mortality would be difficult because of environmental effects. This attitude relative to the latter traits will prevail unless future information suggests otherwise.

The net merit of an individual family of fish is determined by a selection index. The index is derived by scoring each family for each trait on the basis of its performance and weighing the score by the relative economic values assigned to that trait. A score for the spawning performance of full-sisters of the dam of the family is included in the index. The heritability of each trait and any possible complicating correlations between traits have not been considered in constructing the index because of a lack of information on these parameters.

The generation interval will be held at two years. Consequently, two sublines will develop for each broodstock. These will be maintained and no effort will be made to cross mate between the two sublines.

The effect of maintaining two sublines will be to develop a greater degree of diversity in the total broodstock population since different alleles, for some traits, may be retained in the two sublines. It can be anticipated that the two sublines will become dissimilar in genetic constitution after a time if sufficient genetic variation presently exists in the population. Should response to improvement through selection plateau in one or both sublines, the possibility of making further improvement then exists from crossing the two sublines. In addition to the above genetic considerations, the two sublines can be considered as two replications of the main effort-improvement through selection. In this way each line will provide a base of comparison for the other line in lieu of a proper control population.

Each year each of the broodstock hatcheries will spawn 60 two-year-old females with 60 two-year-old males, keeping the 60 lots of eggs separate. Additional lots of eggs may be taken as a safeguard against the loss of some lots. These lots will be used to replace lots which fail to survive. Failure to survive is to be taken as meaning a loss to the fingerling stage of 85% or greater.

For those strains of fish in which it is desirable to select time of spawning toward the beginning of the spawning season, broodstock spawning will begin prior to the peak of the season and be concluded in as few subsequent spawnings as possible. For those strains in which it is desirable to select time of spawning toward the end of the season, the 60 lots of eggs will be taken after the peak spawning day and concluded in as few subsequent spawnings as possible. For those strains in which it is desirable to select time of spawning to widen the peak, a group of lots will be taken on each side of the peak spawning day.

The type and extent of selection for spawning time will be determined for each broodstock by the Trout Broodstock Committee. Care must be taken in executing selection to widen the peak spawning time. The effect of selection in the two directions will be directly proportional to the number of lots selected in each direction. If it is desirable to effect a change of equal magnitude in each direction, equal numbers of lots must be spawned in each time group and equal numbers of lots must be selected from each time group. The later means that selection must be practiced within time groups.

When the fish are sorted prior to broodstock spawning, it will be the policy to discard only those fish which are not healthy, vigorous, and free from obvious physical defects. To further remove personal biases of the spawner, any selection for size will be carried out only for the purpose of eliminating exceptionally small fish (runts). When spawning females for potential broodstock matings selection for number of eggs from each female should be carried out only for the purpose of eliminating those females which spawn an exceptionally low number of eggs. No female will be rejected on the basis of egg size unless the egg size is below 650/oz (RTV excluded from egg size restriction).

The elimination of small fish and females spawning a low number of eggs is not intended as part of the selection program of broodstock improvement, but is intended for the removal of individuals which are abnormal in their behavior. Such eliminations should be classified under "obvious physical defects" as listed above but are enumerated here simply for the purpose of clarification.

After the data have been collected as outlined under "Broodfish Data Collection Procedures" (Appendix A) and the index of each lot has been determined (see Scoring Procedure, Appendix C), 10 lots are to be selected as brood fish on the basis of their index values. If there is a danger of lots being lost prior to marking the families, additional lots in order of rank may be retained. These will be discarded if not needed to fill the 10 lots required. Two exceptions to this policy are appropriate.

1. If sufficient numbers of fish cannot be obtained from the best 10 lots (due to low hatch, low egg number or a high requirement for brood fish) the next highest ranking lots must be selected until sufficient numbers are obtained.

2. An effort must be made to control rate of inbreeding. It is conceivable that of the top 10 families (lots) selected in any one year, 6 could be from females which were full sisters. Consequently, a limit of 3 lots from any one full-sib female group will be included in the 10 lots selected. When this limit must be imposed, lots which rank below 10th on the index score will need to be selected.

The 10 lots finally selected will be marked with a distinctive family mark (Appendix D) combined into one group and reared as brood fish. When the fish are two years of age they will be spawned in the usual manner. It would be desirable to take advantage of family marks to prevent brother-

sister spawning of production fish. If desirable, they may be carried to three years of age for production purposes but they will not normally be used for broodstock-selection spawning.

When it becomes time to make broodstock-selection spawnings, the eggs from each 2-year-old female will be fertilized with sperm from a 2-year-old male from any family (as determined by family marks) other than the family to which the female belongs. This procedure will assure that no brother-sister matings occur.

In the ideal situation the 60 lots of eggs (a lot consisting of the eggs from a one-female-one-male mating), being taken to produce prospective brood fish, will be made up by spawning 6 females and 6 males from each of the 10 families selected the previous generation. The 6 females from each such full-sib family will each be mated to males from different families. Since achievement of the ideal may not always be possible, the following limitations are to be adhered to:

1. If less than 6 females or males can be obtained from a family, then more than 6 but not more than 10 (unless absolutely necessary) must be taken from the remaining families in order to make up the total of 60 lots. It is desirable that the additional females or males (above 6) be taken from the family or families which had the highest index. If possible all 60 lots are to be completed in two spawnings. Hopefully this situation will not occur to any large extent because for every family eliminated, the gene pool will have been reduced considerably.

2. In cases where more than 10 families were selected the previous generation to obtain sufficient numbers of fish, the same procedures are to be followed except that the numbers of females and males taken per family will be scaled down in proportion to the number of families available. For example, if 12 families were available, 5 females and 5 males would be taken from each family. When the number of families available is not a multiple of 60, the 60 individuals of each sex will be made up by taking more fish from the high ranking families. For example, if 13 families were available, 5 females and 5 males would be taken from each of the 8 highest ranking families and 4 from each of the remaining 5 families.

3. The mating of full sisters to unrelated full brothers results in the offspring being double first cousins. To keep such matings to a minimum and thus reduce the rate of inbreeding, not more than 2 full sisters shall be mated with males which are full brothers. For example, if 3 females were obtained from family two (left ventral clip) and 3 males from family seven (right ventral-anal clip) only 2 of the females from family two could be mated to males from family seven.

A reliable source of information concerning female characteristics can be obtained by studying the performance of a random sample of females from each family. It would be desirable to collect the same data on this random sample as is obtained for the broodstock spawnings. Unfortunately, inadequate hatchery facilities and excessive manpower requirements would prohibit such a program. However, a volume measurement and a size count of water hardened green eggs for a random sample of 10 females from each family could and should be made. It is not necessary, nor particularly desirable, to spawn all 10 females from any one family on the same date. If possible, a few females from all 10 families should be spawned at several consecutive spawning dates and the data collected and recorded. For example, if a broodstock spawned over a 10-week period a good distribution of random sample data would be obtained if 2 females from each family were spawned during the second week, 3 during the fourth and sixth weeks, and last 2 during the eighth week. The procedure for this operation is outlined in Appendix B.

It is imperative that the data on each lot be complete. Hatchery personnel will not discard a lot because of low hatch or low survival or a high level of deformities. One purpose of the scoring system is to allow comparisons from year to year and possibly from hatchery to hatchery. This comparison cannot be done simply on the basis of the 10 lots finally selected as future broodstock. It must be done on the basis of the average of all lots which survive, preferably all 60. A comparison based on only the 10 lots selected in any one year would not consider the range in level of performance which could and will vary from year to year. Basically, the 60 lots spawned in any one year represent a sample of the broodstock being used in that year and thus yield unbiased and consistent estimates of the level of performance in that year.

A scoring system has been developed over the past two years as an aid to making the final selection of fingerlings for future broodstock. The system involved assigning an arbitrary numerical value for degree of excellence for each of the traits considered. This system will allow a comparison to be made between each lot of fish for any one year as well as serving as an index of how the broodstock population is progressing from one year to the next. The scoring system is described in detail in Appendix A.

Finally, Form FG 732 (Select Broodstock Spawning Record) has been revised and two new forms, FG 732A and FG 732B, have been created to accommodate the new scoring system. These forms (and these forms only) will be used at all broodstock hatcheries in the interest of statewide uniformity of data collection.

APPENDIX

APPENDIX A

BROODSTOCK DATA COLLECTION PROCEDURE

Broodstock selection shall be carried out in two consecutive spawnings whenever possible. These spawnings should not be from the very beginning or end of the season because of the possibility of getting inferior eggs.

A. Spawning procedure for broodstock

1. Sorting ripe males and females for potential broodstock matings:

   Discard only those fish which are not vigorous, healthy, and free from obvious physical defects. Any selection for size should be carried out only for the purpose of eliminating exceptionally small fish (runts).

2. Sorting females for potential broodstock matings:

   Selection for number of eggs from each female should be carried out only for the purpose of eliminating those females which have an exceptionally low number of eggs. No females will be rejected on the basis of egg size unless egg size is below 650/oz. (RTV excluded from egg size restriction).

3. Egg taking procedure:

   Spawn one female and one male (The male to be from a different family than the female) into a suitable container and designate as a lot. Each lot will be held separately until the resulting fingerlings are selected for broodstock and marked.

B. Hatching procedure for broodstock

1. Determine egg size in each lot by counting one 2-ounce sample of green eggs. Record on Form FG 732.

2. Using a volumetric cylinder, determine the total volume of green eggs in each lot. Record on Form FG 732.

3. Determine the number of eggs in each lot as the product of volume of eggs (B2) and number of eggs per ounce (B1). Record on Form FG 732.

4. Using a volumetric cylinder retain from each lot for hatching, as many eggs as required to provide adequate numbers of brood fish or a minimum of 1,500, whichever is larger.

5. Count the number of dead eggs in each lot. Record both the number of dead eggs and the date hatching was complete on Form FG 732.

6. Determine the number of eggs hatched in each lot by subtracting the number of dead eggs (B5) from the total number of eggs (B4). Record on Form FG 732.

7. Determine percentage of egg mortality by dividing the number of dead eggs (B5) by the total number of eggs in the lot (B4).

C. Procedure for broodstock fingerlings

When the fingerlings in any lot reach a size of about 25 per ounce, fingerling size and mortality will be determined. The data must be taken at the same age for each lot. If all lots were spawned on the same date, data on all lots must be taken on the same day. If some lots were spawned later than the lot first to reach 25/oz, the data on these lots must be taken at a time when they will be the same age as the lot which reached 25/oz. If a lot from a second spawning date reaches 25/oz before a lot from the first spawning date, it will be necessary to immediately obtain the data for the lots from the first spawning and then wait the period of time between spawnings before taking the data for lots from subsequent spawnings.

1. Determine the exact number per ounce by taking a weight count. Record both the size and date data when taken on Form FG 732.

2. Weigh each lot - record total weight on Form FG 732.

3. Determine the total number of fish in each lot as a product of number of fish per ounce (C1) and total number of ounces per lot (C2). Record on Form FG 732.

4. Determine the percent of fingerling mortality for each lot by subtracting the total number of fingerlings (C3) from the total number hatched (B6) and dividing the result by total number hatched (B6). Record on Form FG 732.

5. Visually inspect each lot for deformed fish. Discard any lot with 25% or more deformed fish. For questionable lots, count a random sample of 200 fish.

APPENDIX B

PROCEDURE FOR SPAWNING RANDOM SAMPLES OF FEMALES

Each of the 60 lots of fish will be evaluated for potential performance in number of eggs and egg size by spawning a random sample of 10 of their aunts, that is, full sisters of the female spawning the eggs. Since only 10 families are involved in supplying the females for the 60 lots, the data on a random sample will be used for more than one lot. In the ideal case, each random sample will apply to 6 of the 60 lots.

1. Spawn 10 females from each family (females with the same mark) each into a separate container. Fertilize with a male from any family. The 10 females from each family should be obtained from spawn dates representative of the entire spawning season.

2. Allow eggs to water harden.

3. Using a volumetric cylinder, determine the total volume of eggs from each female. Record on Form FG 732B.

4. Count a 2-ounce sample of eggs from each female. Record on Form FG 732B.

5. Determine the number of eggs from each female as a product of volume of eggs (3) and number of eggs per ounce (4). Record on Form FG 732B.

6. Average the egg size and egg number of the 10 females from each family and record on Form FG 732A.

7. Combine all of the eggs taken for random sample spawning data with regular production eggs.

APPENDIX C

SCORING PROCEDURE

Each lot will be evaluated by assigning a score for degree of excellence for each characteristic to be considered. The scores are to be assigned according to the following schedule of grades.

1. Size of eggs - 20 points maximum

   Divide Score by 2 and record on Form FG 732A.

No./oz.	Points	No./oz.	Points
225 and larger	20	476-500	9
226-250	19	501-525	8
251-275	18	526-550	7
276-300	17	551-575	6
301-325	16	576-600	5
326-350	15	601-625	4
351-375	14	626-650	3
376-400	13	651-675	2
401-425	12	676-700	1
426-450	11	701 and less	0
451-475	10		

2. Number of eggs - 45 points maximum

   Divide score by 2 and record on Form FG 732A.

Eggs/Lot	Points	Eggs/Lot	Points
5161-5320 or more	45	3241-3400	21
5001-5160	43	3081-3240	19
4841-5000	41	2921-3080	17
4681-4840	39	2761-2920	15
4521-4680	37	2601-2760	13
4361-4520	35	2441-2600	11
4201-4360	33	2281-2440	9
4041-4200	31	2121-2280	7
3881-4040	29	1961-2120	5
3721-3880	27	1801-1960	3
3561-3720	25	1641-1800	1
3401-3560	23	1640 and less	0

3. Percent egg mortality - 20 points maximum

0- 5%	20 points	31-35%	8 points
6-10%	18 "	36-40%	6 "
11-15%	16 "	41-45%	4 "
16-20%	14 "	46-50%	2 "
21-25%	12 "	51% and over	0 "
26-30%	10 "		

4. Size of fingerlings (fish per oz) - 45 points maximum

The lot (of the entire group) which contains the largest fish will arbitrarily be rated at 100%. All other lots will be rated as a percentage of this lot.

95-100%	45 points	65- 69%	15 points
90- 94%	40 "	60- 64%	10 "
85- 89%	35 "	55- 59%	5 "
80- 84%	30 "	Less than 55%	0 "
75- 79%	25 "		
70- 74%	20 "		

Due to method used in determining fingerling size (fish per ounce), the lot with the largest fish is given the lowest numerical value. Consequently, percentages of the largest lot must be calculated as the reciprocal of the usual percentage calculation, that is, by dividing the size of the largest lot by the size of each of the other lots. An example using four hypothetical lots is given below:

Lot	Size	Calculation	Percent
1	25/oz	-	100
2	27/oz	$\frac{25}{27}$ x 100	93
3	30/oz	$\frac{25}{30}$ x 100	83
4	50/oz	$\frac{25}{50}$ x 100	50

5. Percent fingerling mortality - 50 points maximum

0- 2%	50 points	18-20%	20 points
3- 5%	45 "	21-23%	15 "
6- 8%	40 "	24-26%	10 "
9-11%	35 "	27-29%	5 "
12-14%	30 "	30% and over	0 "
15-17%	25 "		

6. Random sample spawning of sisters.

   a. Egg size: Average the egg size of the 10 random sampled females from each family and score as in (1). Record family score (divided by 2 as stated in 1) on Form FG 732A for all females from the same family.

   b. Egg number: Average the number of eggs of the 10 random sampled females from each family and score as in (2). Record family score (divided by 2 as stated in 2) on Form FG 732A for all females from the same family.

APPENDIX D

MARKING PROCEDURE

All fingerlings in each of the 10 selected lots (families) will be marked with a distinctive fin clip. These marks will identify the families at spawning time. The 10 marks listed below will be standard for all broodstock. Additional marks (numbered 11-20) may be obtained by adding adipose (Ad) to the 10 listed.

Lot	Mark*	Lot	Mark*
1	An	6	LV An
2	LV	7	RV-An
3	RV	8	LV-LM
4	LM	9	RV LM
5	RM	10	RV-RM

*An=anal; V=ventral; M=maxillary; L=left; R=right.

APPENDIX E

DEFINITIONS OF TERMS

Allele - Each gene has one or more partner genes (alleles). The alleles are each located in the same relative position on paired chromosomes. In many instances one gene is said to be dominant to its allele; or contrarywise, the second gene is recessive to its dominant allele.

Autosomes - All chromosomes except the sex-chromosomes.

Backcross - The mating of an individual to a mate of the same type or breed as one of the individual's parents.

Broodstock spawning - a group of eggs destined to become future brood fish.

Cell - Basic unit concerned with the formation of all body tissues and fluids. The two main types are somatic sells and germinal cells.

Character - A term referring to a feature (often a body form or function) which is frequently used to describe inherited factors.

Coefficient of Inbreeding - The degree to which an individual, or group of individuals has been inbred. Usually reported in terms of percentage. Theoretically, it is the percentage of gene-pairs which have become fixed in a homozygous state.

Combining Ability - Good combining ability is the ability of a stock to cross with another stock, or stocks, and produce superior offspring. Crosses of a stock with poor combining ability would produce progeny which were not superior to the parent stocks.

Complementary Genes - Genes which result in a different effect when together than when acting independently.

Correlation - the degree to which performance in two characters is related. The observed or actual association is referred to as the phenotypic correlation. The degree of association caused by genetic linkage of the two characters is called the genetic correlation. Performance in two characters can also be related due to effects of the environment. This is referred to as the environmental correlation.

Crossbreds - Individuals resulting from the mating of one pure line to a different pure line.

Diploid - Double number of chromosomes. The chromosomes are paired. Cells or individuals with the diploid number have two sets of haploids.

Dominance - A condition which permits the appearance of a character, even if there is only one dominant gene present. Used in reference to alleles.

Epistasis - The ability of a gene to behave as a dominant towards another gene, or genes which are not alleles. It masks the appearance which would have resulted from other genes or complements the other gene in a multiplicative manner.

Family - collectively all progeny produced by a single pair of parents. It is analogous to a lot as used in accompanying write-up.

Fix - Herein used to represent the establishment of a true breeding or homosygous type.

Gamete - The reproductive cell. It contains the haploid number of chromosomes.

Gene - The basic unit of inheritance. Genes are linearly located on chromosomes. Each gene occupies a specific locus on the chromosome and influences or controls a specific phenotypic character.

Genetic Variability - That portion of the total observed variation which is due to the effects of genes.

Genotype The diploid gene complement which an individual possesses.

Haploid - Single set of chromosomes which is normally found in each sperm and unfertilized egg.

Heritability - Degree to which a trait is inherited. The fraction of the total variation that is accounted for by genetic differences. (The factors with high heritability are more easily established in a stock by breeding methods than are those of low heritability).

Heterosis - Hybrid vigor found in the offspring.

Heterozygote - A zygote, or individual, containing two unlike genes (two unlike alleles). The heterozygote cannot "breed true" for the character for which it is heterozygous.

Heterozygous - Containing two unlike alleles.

Homologous - Each somatic cell has diploid chromosomes; that is, the chromosomes are present in pairs. The members of a pair of diploid chromosomes are said to be homologous to each other.

Homozygote - A zygote containing two like alleles for a given trait. It will breed true for the character when mated to similar homozygotes.

Homozyous - Containing two like alleles.

Hybrid - The offspring of two unlike and usually unrelated parents. In animal breeding the term has become associated more specifically with offspring from parental stocks that have been inbred or with offspring from crosses of two parental breeds.

Hybrid Vigor - A desired vigor often observed in the offspring of two unlike parents wherein the progeny performance exceeds that of both parents.

Random Mating - A mating in which there is no preferential mating exercised by the breeder. Any individual has equal probability of mating with any other individual in the population.

Random Sample - A sample taken from a larger group in such a way that each individual in the group has an equal opportunity to be included in the sample.

Recessive - The term applied to a gene which is not expressed in the phenotype unless it is homozygous. A recessive gene has a dominant allele.

Reciprocal Cross - A breed or variety cross involving mates of the opposite sex. For example, when Red males are mated to Leghorn females, the reciprocal cross would be Leghorn males mated to Red females.

Recurrent Selection - The selection of breeder stock on the basis of the performance of crossbred progeny produced by testing against a tester stock. The breeder stock and tester stock are maintained independently, with testing continued each year.

Score - The numerical value assigned to any lot for each characteristic on the basis of the lots performance in that characteristic.

Selection - The retention of individuals or families as breeding stock with the elimination of all other individuals or families.

Sex-Linked Trait - A character carried on the sex chromosome.

Sex-Linked Cross - A cross between individuals carrying different sex-linked alleles in such a way that the character shown by one sex appears in the offspring of the opposite sex only. An example of this type cross is the mating of barred females with non-barred males; the male offspring are barred, the females are non-barred. This type of inheritance is sometimes referred to as cross-cross inheritance.

Sibs - Sisters and brothers.

Sib Mating - Mating of sister with brother. Preferred mating typed used in inbreed-programs.

Sib-Test - A test which evaluates the breeding worth of an individual by the performance of its brothers and sisters.

Somatic Cells - Body cells, as contrasted to germinal cells. Body tissues (i.e. muscle, bone, glands) are composed of somatic cells.

Viability - The ability to live.

Zygote - The new individual formed when the gametes, or reproductive cells, unite at fertilization.

Inbred Line - A group of individuals which has been subjected to an inbreeding program for a number of generations.

Inbreed - To mate individuals related more closely than the average of the population. The most intense methods for inbreeding involve mating; (1) brothers with sisters and (2) parents with offspring.

Incomplete Dominance - A condition which exists when the appearance of the heterozygote is less than the homozygotes, but greater than mid parent value.

Incross - Progeny from crosses of inbred lines within a given breed.

Incrossbred - Progeny from crosses of inbred lines of different breeds or varieties.

Index - The sum for each lot of all scores for characteristics being included in the selection program. This is the item on which the final family selection of future broodstock is based.

Lethal - A condition causing death.

Locus - A position on a chromosome where a given gene is located.

Lot - Any set of eggs handled as a separate item.

Maternal - Pertaining to the dam, or mother.

Multifactorial - Controlled by multiple factors.

Multiple Factors - A trait is controlled by multiple factors when there are several pairs of genes responsible for the expression of the trait.

Mutation - An abnormal condition resulting from some genetic change.

Nick - A term used to express good combining ability.

Paternal - Pertaining to the sire, or father.

Pedigree Record - A continuous record of the ancestors.

Phenotype - Type of appearance. What the individual looks like. Phenotype is normally controlled by an interaction of the genotype and the environment.

Progeny - Offspring. Sons and daughters.

Progeny Test - Evaluation of the breeding value of parental stock or an individual by the performance of its offspring.

Purebred - A recognized breed which has presumably not been crossed with a different breed.