Population Dynamics of Deer

study of deer herd reveals internal parasites and starvation are most important factors contributing to mortality of deer

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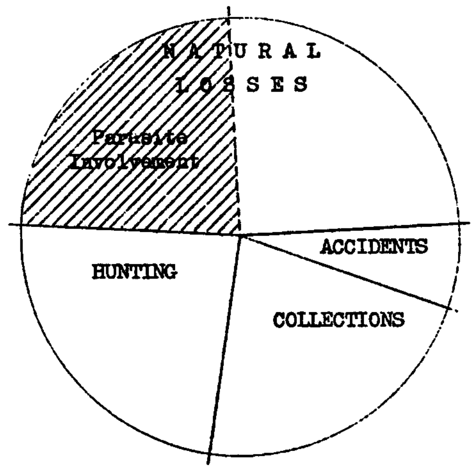

Proportions of all losses.

Natural causes—starvation, accidents, internal parasites, diseases, and predation—accounted for 47% of the losses observed in a population of Columbian black-tailed deer, studied on the Hopland Field Station of the University of California.

Accidents of various sorts—such as deer being caught in trees or stock fences—accounted for 6% of the losses. Hunting—bucks only—took an additional 23%.

Subsequent surveys have indicated that the carcasses found on the range of deer dying from natural causes probably represented between 30% and 50% of the total number that actually perished.

The collection of deer of both sexes and various ages for autopsy amounted to 24% of the total drain on the herd. These deer had to be considered as a category of loss even though such a situation did not exist in other comparable herds. Very likely had these animals not been collected, a nearly equal portion could have been added to the natural loss category. It is also possible that the added competition for forage—which would have resulted had these deer not been removed by collecting—would actually have pushed the total losses higher than they were.

The Hopland Field Station—devoted primarily to the study of experimental sheep range management and allied problems—covers nearly 5,000 acres of hill range land in southeastern Mendocino County. Elevations range from 500′ to 3,000′. Cover—characteristic of the inner coast ranges—is a mixture of grassland, oak-woodland association interspersed with patches of chaparral. The climate is essentially Mediterranean with cool moist winters and hot dry summers. Long-term records of annual rainfall average 35″ and the temperature average is 50°F.

Observations were begun in the fall of 1951 and continued through April 1955. Information was gathered principally from carcasses of deer found dead on the range because of natural causes or accidents, from records of bucks taken during the hunting season, from deer collected for autopsy, and from herd composition counts.

Whenever possible, deer were aged by means of dental criteria, and their sex and time of death recorded. Deer could be aged with fair accuracy through their seventh year, but without known age specimens for reference it was difficult to separate older classes and they were therefore lumped in an eight-years-old-and-older category. Does were likewise examined for reproductive status and their ovaries saved for corpora lutea counts. Fetuses were sexed when possible to determine the sex ratio at birth.

The borders of the field station do not constitute natural barriers to deer movement, so the samples obtained from this study area did not reflect what hap-

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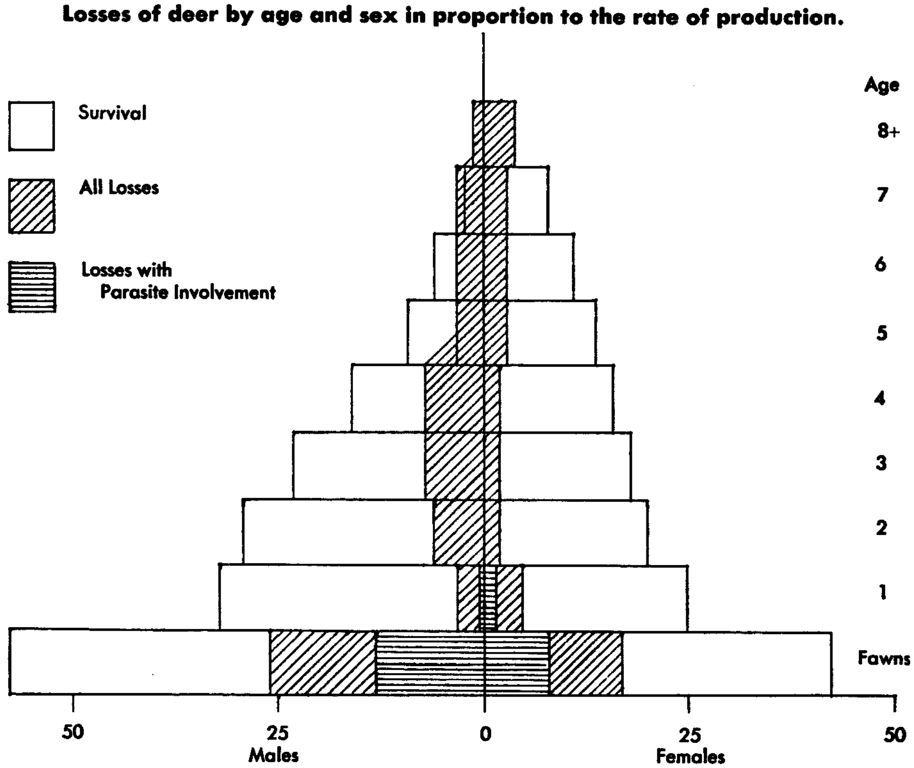
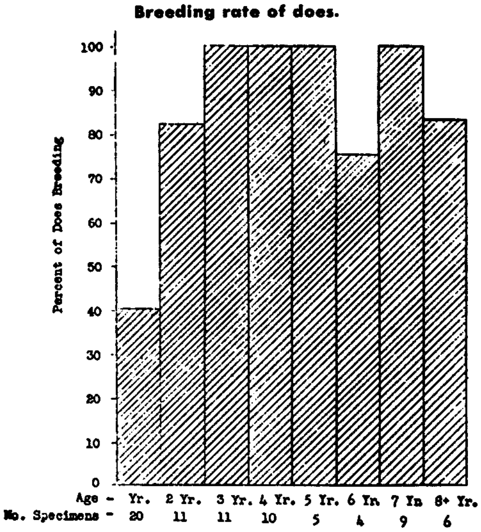
Losses of deer by age and sex in proportion to the rate of production.



Note: Fetus count—137.5 males:100 females. All losses—136.8 males:100 females.

Breeding rate of does.



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pened to the animals moving beyond the boundary fences. In fact, there is regular seasonal movement of an estimated two thirds to three fourths of the population off the station to the chaparral-covered slopes higher on the mountains. This movement takes place about mid-April and the deer do not return until early August.

Good estimates of total deer numbers were not available until the fall of 1954 when sufficiently complete kill and herd composition data could be applied to an area of nearly 12,000 acres including the field station. The population density—after the 1954 hunting season—was about one deer to nine acres. Prorated to the area of the field station, that ratio indicated a fall population of around 550 deer. At this time there were 1,000 head of sheep on the station.

Field observations and records make it evident that deer numbers have fluctuated considerably since the fall of 1951 when there were possibly close to 1,000 deer on the station.

A heavy deer loss during the severe winter of 1951–52 was followed by poor fawn survival the succeeding summer and winter. Numbers reached a low of probably between 400 and 500 head by the spring of 1953 but started upward with the good fawn crop of that year and increased in 1954 despite the heavy fawn loss during that summer and a heavy buck kill by hunters in August and September of that year.

Though the number of does autopsied was not large enough to reflect differences in fawn production from year to year accurately, the over-all sample does give some indication of average production over the period of study.

Productivity for the various age classes of does was calculated by multiplying the number of fetuses or corpora luteal scars by the average percentage of pregnancy for the various age classes of does. On this basis, considering the percentage of the herd in the various age classes, gross production was 107 fawns born per 100 does.

Compared with other areas where deer often produce 160–180 fawns per 100 does, this rate of production is low. It appears largely to be a response to substandard nutrition with a resultant lack of ovulation among the younger and older age classes of does with only the four-year-olds approaching the maximum potential.

Of the 40 species of parasites which have been found to affect deer in this area, nematodes—worms—inhabiting the fourth stomach, intestinal tract, and the lungs are probably the most important in their effects on the host.

All of these worms have a direct life cycle in that the adult females living in the lungs, stomach, or intestines of the deer lay numerous eggs—up to an estimated 10,000 per day per female in some species—which pass out of the animal with the feces. After a few days under proper conditions of moisture and temperature, the eggs hatch. The minute larvae develop to the infective stage and crawl up on the vegetation ready to be ingested by the next deer or sheep grazing in the area.

If the soil is moist, the vegetation green, and the temperature not too low, the infective larvae can survive for several weeks or months depending on the species. Thus it is that on California coastal ranges the wet winter season is the period of greatest infection. Apparently most fawns born in this area in late April and May do not eat sufficient green grass or herbaceous vegetation to become infected before the ranges dry up in June. Moreover, at this season the majority of

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Chronology of Deer Losses

Dates	Natural	Accidents	Hunting	Collections	Total
1951–52					
May–Oct	18	1	19		38
Nov–Apr	113	3		29	145
1952–53					
May–Oct	22	5	16	42	85
Nov–Apr	26	7		14	47
1953–54					
May–Oct	24	1	32	18	75
Nov–Apr	18	5		13	36
1954–55					
May–Oct	34	10	74	12	130
Nov–Apr	29	5		14	48
Total	284	37	141	142	604
Per cent ..	47	6	23	24	

Reproductive Rate

Age	No. Specimens	Av. % Pregnant	Av. No. Fetuses or Scars of Corpora Lutea/Doe	Av. % Does in Age Class/100 Does	Fawns/100 Does
1	10	40	1.00	22	9
2	11	82	1.00	17	14
3	11	100	1.43	16	23
4	10	100	1.80	14	25
5	5	100	1.60	12	19
6	4	75	1.00	9	7
7	9	100	1.11	6	7
8+	6	83	1.00	4	3
Aver.	64	85	1.242	100	107

Aver. Gross Productivity:
107 Fawns born/100 Does

Seasonal Losses of Deer from Natural Causes

Age	Summer (May–Oct) M	F	Sex Unknown	Subtotal	%	Winter (Nov–Apr) M	F	Sex Unknown	Subtotal	%	Total	%
Fawn	15	9	37	61	21	76	47	1	124	44	185	65
1	2	5	0	7	2	4	4	0	8	3	15	5
2	1	2	0	3	1	1	2	0	3	1	6	2
3	0	2	0	2	1	5	3	0	8	3	10	4
4	0	5	0	5	2	2	3	0	5	2	10	4
5	0	2	0	2	1	0	6	0	6	2	8	3
6	0	6	0	6	2	1	6	0	7	2	13	4
7	0	3	0	3	1	1	8	0	9	3	12	4
8+	0	4	0	4	1	2	14	0	16	6	20	7
Unknown	0	5	0	5	2	0	0	0	0	0	5	2
Total	18	43	37	98		92	93	1	186		284	
%	6	15	13	34		33	33	0	66		100	

Herd Composition Counts

Date	No. Deer Classified	No. Does	No. Fawns	No. Bucks	No. Adults	Fawns/100 Does	Bucks/100 Does	Fawns/100 Adults
				Hunting				
1951 Nov.	 177	95	60	22	117	63	23	51
Dec.	 300	171	86	43	214	50	25	40
1952 Jan.	 145		39		106			37
Feb.	 241		47		194			24
Mar.	 239		37		202			18
Apr.	 187		24		163			15
				Fawning				
July	 227	117	60	50	167	51	43	36
				Hunting				
Oct.	 222	118	63	41	159	53	35	40
1953 Apr.	 221		49		172			28
				Fawning				
July	 216	104	78	34	138	75	33	57
				Hunting				
Oct.	 235	123	83	29	152	67	24	55
1954 Apr.	 200	104	54	42	146	52	40	37
				Fawning				
July	 251	124	84	43	167	68	35	50
				Hunting				
Oct.	 160	102	38	20	122	37	20	31
1955 Apr.	 206	135	44	27	162	33	20	27

FLY NUISANCE

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If all of the major avenues of departure of flies from the labeling site were known, the sum of the percentage values—the fly population at the labeling site which migrates daily to a particular sampling site—for all sampling sites should be equal to the daily renewal rate for the labeling site. For example, if it is assumed that the fly populations for the horse barn, the artificial insemination barn, and the steer shed were equal at the time of this experiment, then the 14% influx of flies at the horse barn and the 7% influx of flies at the artificial insemination barn would represent a 21% daily loss of the steer shed fly population. Since the daily renewal rate was calculated at 30% per day, this does not account for all of the fly loss from the steer shed. If it is further assumed that the mean life span of flies at the steer shed is two weeks, then a 7% daily loss of the fly population could be attributed to death. Thus 28/30—essentially all—of the flies leaving the steer shed daily would have been detected. This assumption further implies that flies leaving the steer shed are proportionately of all ages.

The results obtained in this test are not subject to general interpretation since in different areas, or in the same area under different weather conditions, they might have been considerably different. This variability of a fly population's migratory tendencies, which is not predictable by standard entomological information, indicates the need for a field test such as this, which can be used when necessary.

The health hazard resulting from the random distribution of the radioactive flies is negligible. If it is assumed that the average labeled fly caused 400 counts per minute on a Geiger counter with 20% efficiency—20% of the total disintegrations are detected—then one microcurie of radioactive phosphorus would be contained by 1,100 labeled flies or by 15,700 flies of the total population if 7% are hot. The human body tolerance for radioactive phosphate—the quantity of the radioisotope which can be borne indefinitely with no ill effect—has been estimated by the National Bureau of Standards to be 10 microcuries. Thus individuals would have to ingest and retain all of the radioactive phosphorus from at least 157,000 of the flies at the labeling site to contain this permissible dose. The relatively short half-life of the isotope used and the fairly rapid mortality of flies also serve to reduce the radiation hazard.

A field test—in the evolution of a fly control program—using this method would depend on the availability of radioactive material, radiation detecting equipment, and technically trained personnel.

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deer are shifting to a summer diet that is primarily browse. Browse plants do not generally provide a suitable habitat for the worm larvae which at most only travel a short distance above the ground level.

When winter rains, which usually start in November, bring up the new growth of grass and herbaceous plants, deer eagerly turn to this protein-rich source of food. With favorable conditions again present, the pastures are soon seeded with worm larvae and the cycle of infection is re-established. Infections of worms produce deleterious effects either by causing direct anemia through their blood-sucking activities or such severe irritation to the walls of the fourth stomach and intestines that cases of scours result. Toxins may also be secreted that further add to the debility of the host and, in the case of lungworms, fatal lobar pneumonia often follows.

Another factor complicating this problem is the transference of many of these species of worms between domestic livestock and deer. On the station alone, twenty species of worms which are common to both sheep and deer have been found.

If a deer survives a worm infection, it builds up an immunity to further infection even though larvae are ingested. Thus older animals usually carry relative few worms. Also there is a direct correlation between the plane of nutrition of the host animal and the effect of the parasites. Well-fed animals can withstand infections much better than those competing for forage on overstocked ranges. In addition, the greater the density of livestock or deer on a range, the greater is the chance for reinfection and the rapid build-up of worm numbers.

Under these conditions, fawns born in the spring usually pick up infections in early winter and with the energy-deficient diet of grass and herbs which they obtain at this season, they often suffer considerable loss. The progressive pattern of fawn losses through the winter of 1951–52 was revealed by herd composition counts. A small proportion of fawns barely survived their first winter but were so weakened that they succumbed as yearlings the following summer.

Because of the fundamental differences in the nutritional basis for malnutrition during the summer—protein shortage—and winter—energy shortage in the forage—records were divided into a summer period of from May through October and into a winter period of from November through April. In certain instances, parasites were very likely the primary mortality factor, but in most cases the underlying cause was probably poor nutrition. Most older deer dying from natural causes were judged to have succumbed either directly to uncompli-

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All Losses of Deer May, 1951–April, 1955

Age	Natural Deaths			Accidents			Hunting		Collections		Subtotal		Subtotal		Subtotal		Total	
	M	F	Sex Unknown	M	F	Sex Unknown	M	F	M	F	M	%	F	%	Sex Unknown	%	No.	%
Fawn	91	56	38	7	11	7	0	0	36	21	134	22	88	15	45	8	267	44
1	6	9	0	3	3	0	1	0	8	19	18	3	31	5	0	0	49	8
2	2	4	0	0	0	0	25	0	6	7	33	5	11	2	0	0	44	7
3	5	5	0	0	0	0	34	0	3	6	42	7	11	2	0	0	53	9
4	2	8	0	0	0	0	35	0	1	6	38	7	14	2	0	0	52	9
5	0	8	0	0	2	0	18	0	1	6	19	3	16	3	0	0	35	6
6	1	12	0	0	0	0	16	0	1	4	18	3	16	3	0	0	34	5
7	1	11	0	3	0	0	7	0	1	5	12	2	16	3	0	0	28	5
8+	2	18	0	0	1	0	5	0	0	5	7	1	24	4	0	0	31	5
Unknown	0	5	0	0	0	0	0	0	2	4	2	0	9	0	0	0	11	2
Total	110	136	38	13	17	7	141	0	59	83	323		236		45		604	
Per cent	18	23	6	2	3	1	23	0	10	14	53		39		8		100	