WHAT IS GAME MANAGEMENT?

By William K. Shope

PGC Game Biologist

GAME MANAGEMENT consists of manipulating a game population's size or sex ratio to change the number of animals that can be harvested annually. This can be done by manipulating either hunter harvests or habitat. This article will discuss the role of harvests in controlling the size of game populations.

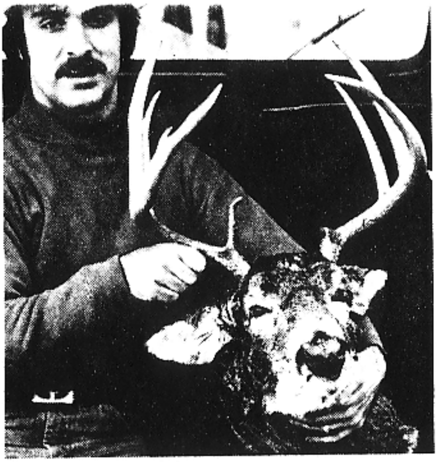
The number of animals that can be harvested on a sustained basis from any game population depends on the number of new animals added to that population between hunting seasons. The number of new animals added depends on both the number born and the number dying between seasons. For example, if we had 500,000 deer left after hunting season and 300,000 fawns were born in June, but 100,000 deer died between hunting seasons, we would end up with a fall population of 700,000. From this population of 700,000 deer we could harvest 200,000 deer. Assuming we want to keep the population at that size, the allowable harvest is the difference between the post-hunt population of 500,000 and the following year's prehunt population of 700,000.

If we were able to harvest 200,000 deer from a fall population of 700,000 deer on a regular basis, we would say that the *sustained yield* value for a population of 700,000 deer is 200,000 deer. Each population of animals has many potential sustained yield levels because of differences in reproduction and survival associated with different population levels. As long as environmental conditions remain fairly stable, the yield associated with a given population level remains fairly constant.

While every game population has many sustained yield values associated with different populations levels, each game population has only one *maximum sustained yield* value associated with the set of environmental conditions in which that population lives. The maximum sustained yield value occurs at the population level which can stand the greatest removal of animals on a regular basis without changing the size of succeeding fall populations. The environmental conditions in terms of food and cover are adequate to provide all the basic needs of the animals at a maximum sustained yield population level.

To illustrate the idea of a maximum sustained yield versus a sustained yield, we prepared a set of population values showing the prehunt and post-hunt population levels, harvest levels, and the adult male and female age structures for a deer population in an area which can support 5,000 animals over winter (Table 1). The adult male harvest rate, reproductive rate, and nonhunting mortality rate from causes other than winter starvation used in developing the population levels and harvest estimates were approximately the same as the current statewide rates for deer in Pennsylvania. The adult male harvest rate used in the model was 70 percent (current statewide rates range between 65 and 73 percent). Reproductive rates used in the model were 0.5 male fawns and 0.5 female fawns per female of age one year or older in June (current statewide rates range between .51 and .53 for either sex of fawns), and the losses between seasons were placed at 20 percent of the post-hunt population (current rates range between 18 and 26 percent).

Winter losses in the model population in Table 1 occurred only when the post-hunt population exceeded 5,000 animals. When winter losses occurred in the model populations, they were deducted evenly from both the male and female fawn segments of the population. Although some older adult fe-



ANN STIMMLER, 12, of Philadelphia, left, and 135-lb. doe taken at long range while hunting with her father in Juniata County. Above, Mike Chesko and a fine trophy buck taken in Lawrence County on opening morning last season.

males die under very harsh winter conditions, the majority of starvation losses in Pennsylvania are fawns.

The examples in Table 1 show that the maximum sustained yield of deer is obtained when the population is kept in line with the winter carrying capacity of 5,000 animals. The largest buck harvests and antlerless harvests occur at the maximum sustained yield (MSY) population level. As you can see from the various sustained yield (SY) values, a population can be stabilized at many different levels by controlling the size of antlerless harvests. It is even stable when there is no antlerless harvest.

Several other points of interest can be shown from the modeled populations in Table 1. Because the adult male age structure is primarily determined by hunting mortality and nonstarvation losses between seasons, both of which were kept the same throughout the model, the percentage of yearlings in the adult male segment of the various stable populations did not change.

The female age structure also remains constant, up to and including the maximum sustained yield level. Above that level, however, the percentage of $1^1/_2$-year-old females at all prehunt population levels changes, reflecting changes in fawn survival from the previous winter.

From reproductive rates obtained by examining road-killed female deer, biologists can estimate the percentage of yearling does which would be in the fall population with no winter fawn losses. By comparing these estimates with the actual percentage of yearling females showing up in the fall harvests, we can estimate winter losses. Deer populations which consistently show low fawn survival are a result of trying to carry too many deer through the critical winter period. Using reproductive rates and the percentage of $1^1/_2$-year-old females in the fall adult female harvests, we can measure the degree of overpopulation in herds with low fawn survival.

Since the discussion above was based on a population model, we thought you might be interested in seeing actual reproductive and age data from the Pennsylvania deer herd since the start of continuous antlerless deer seasons in 1957. This information is shown in Table 2.

A comparison of the current percent yearling females from Table 2 with the MSY population's percent of yearling females shown in Table 1 indicates that we are maintaining the deer herd near the maximum sustained yield level.

The change since 1957 in the percentage of yearling males is not a result of improved survival as is the case in females. As pointed out earlier, the percentage of yearling males is related to the mortality rate in adult males. The increased percentage of yearling males is a result of a higher rate of harvest of adult males.

Although we used deer as an example of sustained yield and maximum sustained yield harvesting, we could have used any animal because the principle is the same for all. Only the reproductive rates and survival rates may differ. Every species of animal that is hunted either commercially or for sport has many potential sustained yield population levels, but only one maximum sustained yield level. The maximum recreational value from a hunted population is obtained when that population is held near the maximum sustained yield level. Establishing regulations to properly control the level of harvest is part of the professional wildlife manager's job.

Table 1. A simulated deer population showing the relationship between the maximum sustained yield and several sustained yield harvests. The winter carrying capacity of this population was set at 5,000 deer. Adult male harvest rates, reproductive rates, and nonwinter between season mortality rates used in the model were the same as the statewide deer herd values. All deer in post-hunt populations which exceeded 5,000 animals were lost to winter starvation. Winter losses were divided evenly between male and female fawns in the post-hunt population.

TYPE YIELD	PREHUNT DEER POPULATION					HARVESTS*		POST-HUNT POPULATION	% YEARLINGS		% WINTER POPULATION LOSSES
	Adults		Fawns					(Before winter losses occur)			
	Male	Female	Male	Female	*Total*	Antlered Males	Antlerless		Adult Males	Adult Females	
SY	865	1917	958	958	4698	605	593 (15.4)	3500	76	34.3	0
SY	988	2190	1094	1094	5367	691	676 (15.4)	4000	76	34.3	0
SY	1112	2465	1232	1232	6041	778	763 (15.4)	4500	76	34.3	0
MSY	1235	2737	1368	1368	6709	864	845 (15.4)	5000	76	34.3	0
SY	1158	2842	1421	1421	6842	810	700 (12.3)	5332	76	31.0	6.7
SY	1093	2906	1453	1453	6905	765	557 (9.6)	5583	76	28.6	10.4
SY	1016	2983	1491	1491	6981	711	392 (6.6)	5878	76	25.9	14.9
SY	932	3067	1533	1533	7065	652	211 (3.4)	6199	76	23.1	19.3
SY	833	3166	1583	1583	7165	588	0 (0)	6583	76	20.0	24.0

****Numbers in parentheses are the antlerless harvest rates required to stabilize the pre- and post-hunt populations at the levels shown.***

Table 2. Age structure changes and reproductive rates for the Pennsylvania deer herd since the start of continuous antlerless deer seasons in 1957.

Year	Percent 1½-year-old deer in fall adult populations		Female reproductive rates (Percent producing)		Average # embryos	
	Males	*Females*	*Age 1*	*Age 2+*	*Age 1*	*Age 2+*
1957	61.0	26.0	—	—	—	—
1958	60.0	28.0	15.0	96.0	1.00	1.60
1959	59.0	30.0	16.0	89.0	1.00	1.60
1960	62.9	34.0	23.3	89.0	1.12	1.64
1961	68.7	27.0	19.5	89.0	1.18	1.65
1962	67.5	30.0	34.2	92.0	1.32	1.75
1963	62.0	32.0	25.0	92.0	1.18	1.72
1964	65.5	32.0	19.4	95.0	1.12	1.66
1965	65.9	35.7	28.3	92.0	1.23	1.70
1966	70.0	35.7	31.7	95.0	1.13	1.76
1967	64.0	34.7	31.3	95.0	1.21	1.74
1968	71.2	34.8	32.1	92.0	1.20	1.71
1969	72.9	29.3	32.1	92.0	1.20	1.76
1970	73.7	30.5	26.3	92.0	1.19	1.72
1971	79.3	34.3	35.1	94.0	1.23	1.71
1972	80.4	36.5	37.0	89.0	1.23	1.76
1973	74.1	32.1	38.0	89.0	1.23	1.70
1974	75.5	35.8	26.4	90.0	1.26	1.72
1975	72.5	34.4	31.7	90.0	1.17	1.67
1976	75.4	35.5	37.0	86.0	1.18	1.72
1977	74.6	36.2	30.0	82.0	1.20	1.76