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Black bear (<u>Ursus americanus</u>) autumnal use of foothills riparian habitats.
Final Report to: City of Boulder, Open Space Dept. & Div. of Mountain Parks.

Abstract:

Black bears near Boulder, Colorado utilize foothills riparian habitats as fall foraging areas. In this study I surveyed 30 drainage segments for bear scat, examined scat contents, and recorded presence or absence and rough abundance of woody shrub and tree species. I located 302 scats in 30 segments, the great majority of which (300/302) contained fruit remains. I used Spearman rank correlation to examine associations between variables. The abundance of two abundant fruit-bearing shrubs, hawthorn (Crataegus sp.; Rho = -0.65, $p < 0.001$) and wild plum (Prunus americana; Rho = -0.59, $p < 0.005$), and a summary fruit abundance index (Rho = -0.62, $p < 0.001$) decreased with increasing elevation. The number of bear scats per kilometer was significantly negatively correlated with elevational mid-point of drainage segments and significantly positively correlated with abundance rank of hawthorn (Rho = 0.51, $p < 0.01$), wild plum (Rho = 0.59, $p < 0.005$), wayfaring-tree (Viburnum lantana; Rho = 0.41, $p < 0.05$), and fruit abundance index (Rho = 0.63, $p < 0.001$). Lower elevation foothills riparian areas apparently represent important fall foraging habitats for black bears.

Introduction:

Black bears (Ursus americanus) are opportunistic omnivores, feeding on a variety of plant and animal materials. Food consumption peaks during the period prior to hibernation, when bears typically seek carbohydrate-rich foods that enable them to build fat stores for the winter (Pelton, 1982). Productivity of fall foraging habitats appears to be important to bear reproductive output (Beecham, 1983; Eiler et al, 1989; Elowe & Dodge, 1989; Pelton, 1982; Rogers, 1976). Mast and berry production failures may increase age to first reproduction while reducing litter size and frequency (Beck, 1991; Beecham & Rohlman, 1994). Reduction in reproductive success during years of low mast production strongly suggests that food obtained during fall foraging is critical to bear populations.

Black bears in western Colorado forage in oakbrush (Quercus gambelii) habitats during the autumn, consuming both acorns and soft fruits. Individual bears may migrate 15 to 40 km to fall foraging areas (Beck, 1991). Travel to fall foraging areas has been noted in many parts of the black bear's range (Beecham & Rohlman, 1994; Pelton, 1982). In Boulder County, bears are commonly observed in lower elevation foothills drainages in the autumn, feeding on the abundant fruit of hawthorn (Crataegus sp.), wild plum (Prunus americana), and chokecherry (Prunus virginiana; Cushman, et al., 1993). The Colorado Division of Wildlife's Black Bear Management Plan emphasizes the importance of protecting patches of shrubs with high fruit production (Gill & Beck, 1990).

Foothills drainages near Boulder vary considerably in the species composition of their vegetation, and therefore presumably vary in their value to bears as foraging areas. Species composition also varies markedly with elevation. Although bears are secretive and difficult to census, bear scat is easily observed and distinctive from that of other mammalian species in the area. Surveys for bear scat can provide evidence of bear habitat use, as well as information on food habits. Areas with abundant fruit bearing shrubs and trees would be expected to contain more bear scat than drainages lacking fruit resources.

Although the black bear is a highly adaptable species that has shown itself to be tolerant of a high degree of human disturbance, it does tend to avoid humans (Beecham & Rohlman, 1994; Gill & Beck, 1990; Pelton, 1982). Many of the smaller drainages in the foothills west of Boulder contain recreational hiking trails, some of which receive extremely high levels of use. A high intensity of human visitation may reduce bear use of these areas.

Study Area:

I conducted this study in foothills drainages west of Boulder, limited to the north by Boulder Creek, and to the south by South Boulder Creek. Only drainages which exit the foothills to the east were included. Drainages with significant amounts of foothills shrub/riparian vegetation were surveyed from their upper end or approximately 2,195 m elev. (whichever is highest) down to the point where they completely leave a forested habitat context and enter the grasslands. (Figure 1) The lowest elevation of a segment end was 1744 m. The total length of drainages surveyed is approximately 20.8 km, as estimated from a 1:24,000 scale USGS topographic map.

Methods:

I walked each drainage once between 9 October and 2 November 1996, and divided drainages into segments based on hydrology (confluences with tributaries) or major landmarks that could be unambiguously recognized on a map. (Figure 1) I recorded the total amount of time spent in each segment, and later estimated the segment length from a 1:24,000 scale USGS topographic map. I determined upper and lower elevations from the topographic map, and calculated the elevational midpoint of each segment. I recorded the presence of recreational trails, and ranked segments as no trail nearby (0), trail parallel to drainage within 100 m or intersecting drainage (1), or trail within riparian zone (2).

I noted shrub and tree species observed in each segment, and ranked each species as abundant (4), common (3), uncommon (2), or rare (1). Species with abundant fall fruit were included in an index of fruit abundance calculated for each segment as the sum of the ranks of the following species: hawthorn (Crataegus sp.), chokecherry (Prunus virginiana), wild plum (Prunus americana), wayfaring-tree (Viburnum lantana), apple (Pyrus malus), mountain ash (Sorbus scopulina), and buckthorn (Rhamnus cathartica).

While traveling each segment, I searched for bear scat. I described each scat observed with crude determinations of scat age (fresh, moist, dry) and content (seeds, fruit, hair, insect parts). I identified fruit and seeds to species when possible.

As an index to bear use of drainages, I used each segment to calculate the number of scats per kilometer. I used Spearman rank correlation to examine associations between elevational mid-point and scats per kilometer, fruit abundance index, and abundance rank of each species listed in Table 1. I also used Spearman rank correlation to examine associations between scats per kilometer and fruit abundance index, abundance rank of each species above, and trail presence rank. To determine effects of fruit abundance independent of elevation, I repeated Spearman rank correlations for fruit abundance index and abundance rank of each species within only those segments with an elevational mid-point of less than 1900 m (n = 14).

Results:

The most common fruit bearing large shrubs or trees in the study area were chokecherry, hawthorn, and wild plum (Table 1). The largest distinction in vegetation in the study area is between low and high elevation segments. Segment elevational mid-point was significantly negatively associated with abundance rank of hawthorn (Rho = -0.65, $p < 0.001$), wild plum (Rho = -0.59, $p < 0.005$), skunkbrush (Rhus aromatica; Rho = -0/54, $p < 0.005$) and fruit abundance index (Rho = -0.62, $p < 0.001$). Elevational mid-point was significantly positively associated with abundance rank of mountain maple (Acer glabra; Rho = 0.43, $p < 0.05$), waxflower (Jamesia americana; Rho = 0.63, $p < 0.001$), water birch (Betula fontinalis; Rho = .57, $p < 0.005$) and aspen (Populus tremuloides; Rho = .56, $p < 0.005$).

I found a total of 302 bear scats in 30 segments. The number of scats per kilometer ranged from zero to 113.9 (15.6 ± 5.2). Scat density was highest in lower Bluebell Canyon and in lower Skunk Canyon, and was typically low in higher elevation segments. Scat density was significantly negatively correlated with segment elevational midpoint (Rho = -0.62, $p < 0.001$) and waxflower (Rho = -0.45, $p < 0.05$), and significantly positively correlated with hawthorn (Rho = 0.51, $p < 0.01$), wild plum (Rho = 0.59, $p < 0.005$), wayfaring-tree (Rho = 0.41, $p < 0.05$), and fruit abundance index (Rho = 0.63, $p < 0.001$). Scat density showed no significant relationship to trail presence rank (Rho = 0.15, $p = 0.41$). Within low elevation segments, scat density was positively correlated with abundance rank of wild plum (Rho = 0.57, $p < 0.05$), buckthorn (Rho = 0.05, $p < 0.05$), apple (Rho = 0.71; $p < 0.05$), and fruit abundance index (Rho = 0.86, $p < 0.005$).

Scats varied from dry and crumbled, with many seeds predated by insects, to moist and fresh. I found fresh scats in lower Gregory Canyon on 30 October 1996, one of the last days of surveying. The great majority of scats observed (300/302) contained fruit remains (Table 2). Hawthorn remains were abundant, occurring in 182 scats. Fruits of two exotic species (apple and wayfaring-tree) were common in scats. Vegetation (grass, leaves) was observed in 44 scats, insect remains in only 7 scats, and hair in only 5.

Discussion:

Lower elevation portions of drainages supported a greater abundance of fruit-bearing shrubs, especially hawthorn and wild plum. These lower elevation areas also had a high density of bear scats.

Based on comparison with the decomposition of a few scats of known age from August 1996, I am confident that all scats observed were from this year. If scat decomposition rates vary between habitats, or bear seasonal use of habitats is varied, comparisons based on observed scat densities do not perfectly reflect utilization of habitats. However, due to the range of scat ages observed, the relatively short period of sampling, and the magnitude of variation in scat density, I believe that the patterns I observed do accurately represent habitat utilization. It is not possible to estimate the number of bears using the study area from observed scat densities, but it seems reasonable to conclude that at least a few bears are spending a significant amount of time foraging in lower elevation foothills riparian areas.

Although crude scat content determinations can not provide detailed analysis of the dietary importance of various food items, remains found in scat are positive evidence of utilization. Fruits of native species, especially hawthorn, chokecherry, and plum, were abundant in scats, and areas in the foothills with these species are presumably historical bear fall foraging habitat. Although mountain ash fruits were not recognized in any scats, almost all large mountain ash trees observed had either old or fresh claw marks from bear climbing, presumably to obtain fruit. Interestingly, two exotic species were also abundant in bear scats: apple and wayfaring-tree. Apple trees are now widely distributed through the foothills, especially in riparian areas. Wayfaring-tree is less common, but occurs in many drainages and can be locally abundant. The addition of these two species to foothills riparian areas may have increased their value as bear foraging areas.

Bears did not appear to show any response to the level of recreational trail use in the study area. While this appears to indicate that recreational trail use is not having a negative impact on bears, it is possible that the lack of response is due to the general pervasiveness of trails, especially in fruit-rich lower elevation areas. Trails may also alter bear behavior without changing distributions. Beecham and Rohlman (1994) found bears in natural habitats to be largely diurnal, while those in areas with heavy human visitation were more nocturnal. They also suggest that human activity may reduce bear use of areas with limited cover.

Black bears appear to be able to coexist with humans in habitats directly adjacent to developed land. The importation of exotic fruit-bearing trees and shrubs may even have had a positive influence on bear populations. However, the habitat type with the highest level of bear utilization, low elevation fruit-rich riparian areas, previously extended out of the foothills into the grasslands. These areas were probably utilized by bears, but have now been largely destroyed and converted into housing. This habitat loss may be balanced to some extent by the availability of human garbage and produce as food sources.

All areas included in this study are protected as either City of Boulder Mountain Parks or Open Space, and therefore closed to hunting, eliminating one major cause of statewide bear mortality (Gill & Beck, 1990). If bears travel large distances to utilize these areas, the drainages may provide a refuge from hunting for bears which spend the spring and summer in areas open to hunting. Capturing bears foraging in the autumn and using radiotelemetry to track them to den sites and summer habitats would allow determination of the regional importance of autumnal foraging areas, and might help to identify important corridors for bear movements. The variability of fruit production in low elevation foothills riparian areas in the Front Range of Colorado, and its importance to black bear population dynamics, are also worthy of study.

The number of bear scats found in a relatively small sampling area, and particularly the high densities in the lower portions of Bluebell and Skunk Canyons, strongly suggest that these areas are of importance to bears. The positive correlation between fruit abundance and bear scat density, even within low elevation segments, suggests that fall fruit resources are a substantial determinant of bear habitat use.

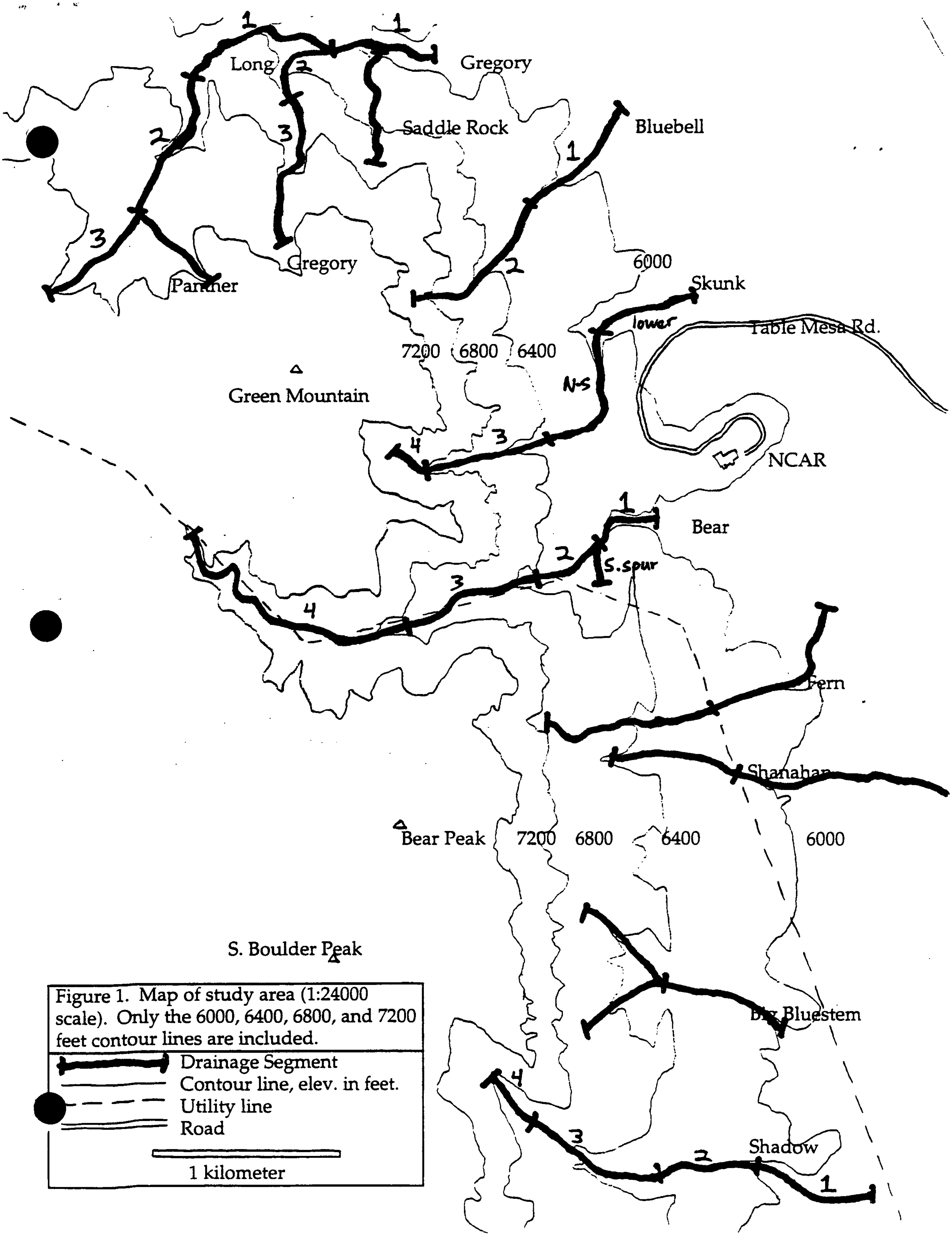

Figure 1. Map of study area (1:24000 scale). Only the 6000, 6400, 6800, and 7200 feet contour lines are included.

Table 1. Common large woody shrubs or riparian trees observed on a minimum of 5 segments of foothills riparian drainages. Mean abundance is calculated as total abundance rank divided by total segments (n = 30). Abundance ranks: 4 = abundant, 3 = common, 2 = uncommon, 1 = rare.

Species:	Number of Segments	Mean Abundance
Mountain maple (Acer glabra)	28	2.6
Hazelnut (Corylus cornuta)	23	2.3
Chokecherry (Prunus virginiana)	29	2.1
Willow (Salix sp.)	26	1.8
Hawthorn (Crataegus sp.)	21	1.7
Box elder (Acer negundo)	21	1.7
Water birch (Betula fontinalis)	15	1.4
Waxflower (Jamesia americana)	18	1.3
Skunkbrush (Rhus aromatica)	18	1.2
Wild plum (Prunus americana)	18	1.2
Cottonwood (Populus sp.)	21	1.1
Aspen (Populus tremuloides)	20	1.1
Apple (Pyrus malus)	17	0.9
Wayfaring-tree (Viburnum lantana)	12	0.9
Mountain ash (Sorbus scopulina)	9	0.4
Buckthorn (Rhamnus cathartica)	6	0.3
Alder (Alnus tenuifolia)	5	0.2

Table 2. Food remains observed in field inspection of 302 black bear scats in foothills riparian drainages.

Fruit of:	# of scats	Food remains:	# of scats
Hawthorn	182	Vegetation	44
Apple	110	Insect remains	7
Chokecherry	91	Hair	5
Plum	26	Snail shell	1
Wayfaring-tree	26	Unknown seeds	25

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Segment	# of scats	scats/km	Length(m)
Shadow, #1	1	1.45	690
Shadow, #2	4	7.55	530
Shadow, #3	0	0.00	760
Shadow, #4	0	0.00	300
Big Bluestem, lowe	22	31.43	700
Big Bluestem, S. fk	2	4.00	500
Big Bluestem, N. fk	0	0.00	580
Shanahan, lower	6	4.69	1280
Shanahan, upper	6	9.84	610
Fern, lower	17	18.48	920
Fern, upper	1	1.00	1000
Bear Creek, #1	13	33.33	390
Bear Creek, #2	8	18.60	430
Bear Creek, #3	0	0.00	800
Bear Creek, #4	1	0.63	1580
Bear, S. spur	0	0.00	290
Skunk, lower	60	101.69	590
Skunk, N-S	29	38.67	750
Skunk #3	0	0.00	720
Skunk #4	0	0.00	280
Bluebell, #1	82	113.89	720
Bluebell, #2	0	0.00	780
Gregory, #1	31	56.36	550
Saddle Rock	4	6.56	610
Gregory, #2	2	4.35	460
Gregory, #3	4	4.65	860
Long, #1	6	6.74	890
Long, #2	1	1.22	820
Long, #3	0	0.00	630
Panther	2	3.57	560
TOTAL	302		20580
MEAN	10.0667	15.6234	686