

This version of the report has been edited by Simone Runyan (March 2007).

I included a clearer definition of “major” and “minor” food items according to my understanding. I also noted that this diet analysis focused on mammalian guard hairs.

A list of the voucher specimens available to Song should be included (black bear, raccoon, black-tailed deer, elk?, wolf, cougar?, river otter, mink, sea otter, California sea lion, Steller’s sea lion etc.). Check this list against the set of the voucher specimens that Song used gave to Bob Hansen.

The original data (e.g. Excel spreadsheet) should be re-examined to confirm the understanding that “In this analysis, each scat contained only one major food item.”, as well as Song’s definition of “major” and “minor” food items.

# **Diet of Carnivores in Pacific Rim National Park of Canada**

## **Final Report**

Pacific Rim National Park Reserve, BC

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**August 30, 2005**

## **Introduction**

Pacific Rim National Park Reserve of Canada has an interest in learning more about the ecology of wolves and cougars in the region. In recent years, there has been an increase in carnivore – human interaction. The park has concerns regarding carnivore conservation while at the same time wanting to ensure public safety. A key knowledge gap is the lack of local carnivore ecological information. Scat analysis provides the opportunity to learn more about the diet composition of carnivores living within the region.

In this analysis, 93 large carnivore scats were analysed, with a focus on mammalian guard hair content. The results of this analysis are presented below. Fifty scats were also sent away for DNA extraction and fingerprinting using microsatellite analysis.

## **Methods**

From 2000 to 2005, large carnivore (i.e. wolf or cougar) scats were collected opportunistically throughout Pacific Rim National Park Reserve and southern Clayoquot Sound. One hundred and ten scats were frozen for diet analysis. Of those 110 samples collected, 93 samples were considered usable for diet analysis and were categorized into three groups: wolf (n = 64), cougar (n = 8) and unknown (n = 21). The samples in the unknown carnivore group could not be classified into either the wolf or cougar category.

Scats were then autoclaved to kill paracites, bacteria and viruses, which may be dangerous to humans. The autoclaved scats were washed using a sieve to remove small particles. After washing, the remains of the scats were collected in paper lunch bags; the bags were then hung up to air dry for at least a week.

Once dried, the remains of each scat were examined in order to determine the prey species. Each scat was placed in a clean tray with an x-y grid on the bottom for examination. Teeth, bones, claws or talons were collected in Ziploc bags for further identification. The remains of the scat, in this case mostly hair, were spread out evenly in the tray. For the photographs of the primary processing steps, please see Appendix 1.

At least three independent and random sub-samples of hairs were selected from the x-y grid on the tray using a random-numbers table. Each sub-sample was first examined with bare eyes and then under a microscope to identify prey species' hairs. In order to assist in identifying the hairs, a set of voucher specimens along with keys of the potential prey species were used. When several species had been identified, the relative proportion of each species was then estimated. Remains of fish and birds were noted as either present or absent. Major (> 40% of the scat contents) and minor (1% to 40% of the scat contents) food items were recorded for each scat. The percentage of scats containing a major and minor portion of each food item was calculated.

## **Diet**

Major food items for each scat were defined as comprising more than 40% of the scat, where as minor food items were defined as comprising less than 40% of the scat. In this analysis, each scat contained only one major food item. (However, it using this approach to categorization, it would be possible for a single scat to have two or no major food items. For example a scat composed of 50% deer hair and 50% harbour seal hair would have two major food items, and no minor food items. Alternatively, a scat composed of 30% deer hair, 30% seal hair and 30% river otter hair would have three minor food items, and no major food items.) Scat composition of wolf scats, cougar scats and unidentified large carnivore scats are summarized in Tables 1 to 3. The “occurrence percentage” rate of food items is the percentage of examined scats which contained the food items as major or minor food. Claws were found in 12 samples and were used to confirm the prey species of each sample.

### **Wolf**

Five prey species were found in the 64 wolf scats, including deer (*Odocoileus hemionus hemionus*), river otter (*Lutra canadensis*), raccoon (*Procyon lotor*), harbour seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*). Two samples had only bird feathers, and two had only vegetation.

Major prey items of 29 samples were found to be deer, which made up 45.3% of all the major prey items. River otters and raccoons were the second and third major prey items. For a list of major and minor food items found in the wolf scats of Pacific Rim National Park Reserve, see Table 1. Furthermore, there were 43 samples with only one kind of food item, 15 samples with two food items and 3 samples with three food items. There was one sample with fish bones.

### **Cougar**

There were only three prey species found in the eight cougar scats: black-tailed deer, raccoons, and river otters. Black-tailed deer was the main food item in cougar scat, present in four samples. A list of major foods of cougars in Pacific Rim National Park Reserve is present in Table 2. Each cougar scat contained only one type of prey item, so there were no minor prey items to list. The sample size of eight may not adequately capture the regional diet of cougars.

### **Unknown Carnivore**

In the unknown carnivore group, six prey species were found in the 21 samples. Raccoons, black-tailed deer and river otters were three main species in the major food item category. Minks (*Mustela vison*) and black bears (*Ursus americanus*) were also present in this unknown carnivore group, but not in the previous wolf and cougar groups. A list of major and minor foods of unknown carnivores in Pacific Rim National Park Reserve of Canada was shown in Table 3.

Table 1. Major and minor foods of wolves (n = 64) in Pacific Rim National Park Reserve of Canada.

<b>Category</b>	<b>Scientific name</b>	<b>Common name</b>	<b>Number of samples</b>	<b>Percent occurrence</b>
<b>Major (&gt;40%)</b>	<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	29	45.3%
	<i>Lutra Canadensis</i>	River otter	13	20.3%
	<i>Procyon lotor</i>	Raccoon	11	17.2%
	<i>Phoca vitulina</i>	Harbour seal	5	7.8%
	<i>Zalophus californianus</i>	California sea lion	2	3.1%
	--	Bird species	2	3.1%
	--	Vegetation	2	3.1%
	<b>Total</b>		<b>64</b>	<b>100%</b>
<b>Minor (1% to 40%)</b>	<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	7	10.9%
	<i>Phoca vitulina</i>	Harbour seal	6	9.4%
	<i>Procyon lotor</i>	Raccoon	4	6.3%
	<i>Lutra Canadensis</i>	River otter	3	4.7%
	<i>Zalophus californianus</i>	California sea lion	1	1.6%
	<b>Total</b>		<b>21</b>	<b>100%</b>

Table 2. Major foods of cougars (n = 8) in Pacific Rim National Park Reserve of Canada.

<b>Category</b>	<b>Scientific name</b>	<b>Common name</b>	<b>Number of samples</b>	<b>Percent occurrence</b>
<b>Major (&gt;40%)</b>	<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	4	50.0%
	<i>Procyon lotor</i>	Raccoon	3	37.5%
	<i>Lutra Canadensis</i>	River otter	1	12.5%
	<b>Total</b>		<b>8</b>	<b>100%</b>

Table 3. Major and minor foods of unknown carnivores (n = 21) in Pacific Rim National Park Reserve of Canada.

Category	Scientific name	Common name	Number of samples	Percent occurrence
<b>Major (&gt;40%)</b>	<i>Procyon lotor</i>	Raccoon	5	23.8%
	<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	4	19.1%
	<i>Lutra Canadensis</i>	River otter	4	19.1%
	<i>Phoca vitulina</i>	Harbour seal	3	14.3%
	<i>Ursus americanus</i>	Black Bear	3	14.3%
	<i>Mustela vison</i>	Mink	1	4.8%
	--	Vegetation	1	4.8%
		<b>Total</b>	<b>21</b>	<b>100%</b>
<b>Minor (1% to 40%)</b>	<i>Odocoileus hemionus hemionus</i>	black-tailed deer	2	33.3%
	<i>Phoca vitulina</i>	Harbour seal	1	16.7%
	<i>Procyon lotor</i>	Raccoon	2	33.3%
	<i>Lutra Canadensis</i>	River otter	1	16.7%
		<b>Total</b>	<b>6</b>	<b>100%</b>

## Location

Carnivores in different areas may consume different prey species according to the availability of a particular animal. In the Pacific Rim Park Reserve of Canada, carnivores consumed five species of prey in the Long Beach area, with raccoons ranking the highest and deer second (Table 4). However, remains of deer within the scat were the highest in the Barkley Sound area; while raccoons were absent in the scat remains coming from that area. Samples from the West Coast Trail (n=9) and Clayoquat Sound (n=5) were determined to be too few to represent the real number of prey species consumed by carnivores in those areas.

An interesting note was that those scats with raccoon remains occurred in large numbers only in the Long Beach area. This might be due to the fact that raccoons feed on human waste and the Long Beach area is more accessible to human activities than the other regions. Besides that, remains of black bears were also found only from carnivore scat coming from the Long Beach area.

Table 4. Prey species consumed by carnivores in Pacific Rim National Park Reserve of Canada.

Scientific name	Common name	Number of samples	Percent occurrence
<b>Clayoquat Sound</b>			
<i>Lutra canadensis</i>	River otter	3	60.0%
<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	1	20.0%
<i>Zalophus californianus</i>	California sea lion	1	20.0%
	<b>Total</b>	<b>5</b>	<b>100%</b>
<b>Long Beach</b>			
<i>Procyon lotor</i>	Raccoon	16	42.1%
<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	10	26.3%
<i>Phoca vitulina</i>	Harbour seal	4	10.5%
<i>Lutra canadensis</i>	River otter	3	7.9%
<i>Ursus americanus</i>	Black Bear	3	7.9%
--	Vegetation	2	5.3%
	<b>Total</b>	<b>38</b>	<b>100%</b>
<b>Barkley Sound</b>			
<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	21	60.0%
<i>Lutra canadensis</i>	River otter	8	22.9%
<i>Phoca vitulina</i>	Harbour seal	2	5.7%
--	Bird	2	5.7%
<i>Zalophus californianus</i>	California sea lion	1	2.9%
--	Vegetation	1	2.9%
	<b>Total</b>	<b>35</b>	<b>100%</b>
<b>West Coast Trail</b>			
<i>Odocoileus hemionus hemionus</i>	Black-tailed deer	5	55.6%
<i>Lutra canadensis</i>	River otter	2	22.2%
<i>Mustela vison</i>	Mink	1	11.1%
<i>Procyon lotor</i>	Raccoon	1	11.1%
	<b>Total</b>	<b>9</b>	<b>100%</b>

## Conclusions and Recommendations

Wolves in PRNPR eat a wide range of prey species, while cougars' samples were too few to determine their overall prey species. Black-tailed deer was a main food source for both wolves and cougars in PRNPR. River otters were the second most common prey item consumed by wolves. Although raccoons were the second highest prey item consumed by cougars in the study, the numbers of cougars' scats were likely too few to represent the overall food habits of cougars in PRNPR.

Deer and river otters, which appeared in the scats from four categorized locations, were two of the most common prey species available in the Pacific Rim Reserve. Raccoons and black bears remains were found mainly in the scats from the Long Beach area.

Recommendations for further study of food habits of wolves and cougars in PRNPR:

- In future scat collection efforts, an unified protocol should be set up for gathering information on other sources that might determine the age of scats, such as canopy cover, the presence or absence of fungus, insects and smell (for a list of subjects to be recorded, please contact Simone Runyan or Bob Hansen).
- The ages of the scats analyzed in this paper were difficult to determine, thus affecting the ability to analyze the seasonal food habit of cougars and wolves. It is recommended that the warden collect all the scats from each location during each season so that in the following season, all the scats would fresh, or at least not older than couples of months.
- Ensure an equal sample effort in different locations from season to season in order to obtain more accurate seasonal data of food habits for each location.
- Samples should be collected in 95% ethanol in order to preserve the DNA material for further DNA analysis.
- Wardens should be trained on how to determine whether a scat belongs to a cougar or a wolf, other than the visual sighting of the animal.

## Appendix 2. Samples selected for DNA extraction

1. 3792	18. 7931	35. 8463
2. 3795	19. 7999	36. 8464
3. 6805	20. 8430	37. 8465
4. 7000	21. 8431	38. 9596
5. 7001	22. 8432	39. 9597
6. 7002	23. 8433	40. 9598
7. 7003	24. 8435	41. 9599
8. 7004	25. 8436	42. 9631
9. 7005	26. 8437	43. 9645
10. 7006	27. 8439	44. 9647
11. 7007	28. 8440	45. 9695
12. 7008	29. 8441	46. 9696
13. 7009	30. 8442	47. 9697
14. 7514	31. 8454	48. 9698
15. 7705	32. 8457	49. 9699
16. 7721	33. 8458	50. 9704
17. 7747	34. 8459	

## Appendix 1. Primary processing steps of diet analysis.

Step 1. Scats were first autoclaved to kill bacteria and viruses, which may be potentially dangerous to humans.



Step 2. The autoclaved scats were washed using a sieve to remove small particles.



Step 3. After washing, the remains of the scats were collected in paper lunch bags. The bags were then hung up to air dry for at least a week.



Step 4. After drying for at least one week, the remains of each scat were examined in order to determine the prey species.



Step 5. Each scat was placed in a clean tray with x-y grid on the bottom for examination.



Step 6. Tooth, bones, claws or talons were collected in a Ziploc bag for further identification.



Step 7. The rest of the scat remain, in this case mostly hair, were spread evenly in tray.



Step 8. Each sub-sample was first examined with bare eyes and then under a microscope to identify any prey species' hairs.

