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Indians, the Beaver, and the Bay: The Economics of Depletion in the Lands of the Hudson's Bay Company, 1700–1763

ANN M. CARLOS AND FRANK D. LEWIS

Indians depleted the beaver, yet we do not understand why. We analyzed the pattern and determinants of beaver exploitation in the hinterlands of three Hudson's Bay Company posts. Simulating beaver population, we found declining beaver stock within each hinterland, but overharvesting in only two. Central to this process was the Company reaction to French competition. Managers raised prices in the Albany and York hinterlands, and in response the Indians increased their harvests. Churchill, which did not experience French competition, had more stable fur prices and showed no evidence of overexploitation of the beaver.

Exploration of the geographical area currently called Canada was directly related to the expansion of the fur trade. Under the French regime the search for ever-cheaper furs and for ways to bypass the Indian middleman spurred exploration of the interior, as Europeans traveled up the St. Lawrence, through the Great Lakes, and finally into Lake Winnipeg and the Central Plains. The English trade began in 1670 when the Hudson's Bay Company was formed, and, although Company traders sat at the Bay for over a century, they too eventually moved inland. By the beginning of the nineteenth century, Canada embraced a fur trading network from the St. Lawrence to the Pacific Ocean.

The advent of a commercial fur trade brought with it a change in the relationship between Native Americans and the animal populations they exploited. Now, animals were valued for more than food and clothing; they were a source of European goods. The Indians responded to the

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new opportunities, according to many historians, by overharvesting the furbearers on which they depended, especially the beaver. Our article addresses this issue of depletion. Specifically, we analyze the extent, pattern, and determinants of beaver exploitation within the hinterlands of three Hudson's Bay Company trading posts during the period 1700 to 1763 and ask whether the observed patterns can be explained in terms of beaver population densities and the economic variables facing the Indians. Before agreeing with historians who claim that Indian behavior cannot be described by conventional economic analysis, we want to use that analysis and see how far it takes us in accounting for their actions.

Our estimates of depletion are described by simulations of beaver population in each hinterland. These are based on beaver returns from each trading post, biological evidence on beaver population dynamics, and contemporary estimates of beaver densities. As expected, the introduction of a commercial trade led to a decline in beaver stocks, an outcome that in itself does not imply excessive depletion but rather a move to a lower but stable population level. We do find, however, that in two of the three hinterlands in our study—those served by Fort Albany and York Factory—there were further declines in population caused by overharvesting, particularly in the latter part of the period.

Central to the overexploitation in the Albany and York hinterlands was competition for furs between the English and French. In reaction to a French presence in their areas, the managers of Hudson's Bay Company trading posts raised the prices paid to the Indians for furs. The Indians responded with increased harvests, and ultimately stocks declined. Our sensitivity analysis suggests that the Indians' reaction to price explains much of the fall in the beaver population and casts doubt on the view that as prices rose the Native People reduced effort to maintain a given consumption level. In fact, our results suggest that the Indians clearly responded to higher prices by increasing supply.¹

The contrast between the pattern of returns at the third trading post—Fort Churchill—and the other posts is also revealing. Traders at Fort Churchill did not face serious competition from the French, and our simulation for that hinterland suggests that the interaction between the Hudson's Bay Company and the Native People led to stable beaver stocks that were close to the maximum sustained yield level.² The evidence from Fort Churchill reinforces our view that it was competition between European rivals and the Indians' reaction to the resulting increase in the price they received for furs that led to overharvesting.

¹ The opposite view can be found in Ray, *Indians and the Fur Trade*, p. 68. He argued that the impact of more favorable terms "did not induce them to bring more furs on a per-capita basis. In fact, the reverse was the case."

² This is the population that allows the largest annual harvest on a sustained basis.

DEPLETION AND THE FUR TRADE LITERATURE

That the Indians depleted the beaver is almost universally accepted. But Canadian historians have widely varying interpretations of the causes and extent of the depletion. Harold Innis pointed to sharp declines in the beaver population that occurred very early on: "[by 1635] the beaver was rapidly worked out in the areas adjacent to the St. Lawrence . . . and the supply of beaver was obtained to an increasing extent from more remote areas."³ Indeed, the westerly drift of the trade, according to Innis, was the "result of persistent trapping to meet this demand [for European goods]."⁴ Innis, however, was more interested in the conduct of the European actors than in the Indians and said little more on the matter of depletion. Treating the Indians as bit players is clearly unsatisfactory, given it was they who hunted, trapped, and traded the furs to the Europeans. E. E. Rich and later historians, among them Arthur Ray, who investigated the Indians' role empirically, have appropriately emphasized the importance of the Indians to the fur trade and the impact of that trade on their way of life.⁵ But even Ray, who was interested in the Indian as an economic agent, did not explicitly model the Indians' behavior in relation to the animal stock.

The Indians' role has also been addressed in the ethnohistory literature. One finds complete acceptance of the view that the Indians depleted the resource, but there remains much debate about why this occurred. Calvin Martin, in particular, has argued that "the Indian was everywhere, except in the Rocky Mountain trade, the principal agent in the overhunting of fur-bearing animals. This is undisputed. . . . It is difficult to imagine how an individual whose subsistence economy was underpinned by a reliance upon fish, game . . . could have been so oblivious to wildlife dynamics as not to see that his recent course of hunting was far too exploitive."⁶ Martin rejected a conventional economic interpretation of the depletion and suggested instead that we must look for the answer within the Indians' own cultural view of the trade. According to Martin, the only way the Indians could have exterminated the resource base was "for the mutually courteous relationship between man and animal to disintegrate before the Indian could make war on his animal brethren."⁷ This hypothesis has received much attention in the literature and has been seriously questioned. But even though few ethnohistorians would agree fully with Martin's

³ Innis, *Fur Trade*, p. 28.

⁴ *Ibid.*, p. 109.

⁵ Over the last two decades, the role of the Indian in the fur trade and the impact of that trade on the Native People has received considerable attention. See Rich, "Trade Habits"; Ray, *Indians in the Fur Trade*; and Rea, *A Guide*, topic 6.

⁶ Martin, *Keepers of the Game*, pp. 2–3. A detailed discussion of Martin's position is to be found in Krech, *Indians, Animals and the Fur Trade*.

⁷ *Ibid.*, p. 19.

analysis, generally they have accepted his assertion that the Indians depleted animal stocks. Yet no clearly acceptable reason for the Indians' behavior has been provided. Within this debate, there has been little discussion of beaver population dynamics, the number of animals harvested, the nature of property rights, the course of prices, or the role of the English and French trading companies.

That property rights have a bearing on resource depletion is well known. It is generally agreed, for example, that open access leads to degradation, because it is in no one person's interest to conserve for the future. With open access any individual's effort at conservation will only leave more of the resource to others. It is also generally agreed that this common property rights regime should be changed if the cost of doing so is less than the benefit. Harold Demsetz argued that with the advent of a commercial fur trade such a change occurred among the Montagnais and the Naskapi tribes located in Northeastern Quebec and Labrador. The new structure provided them with the incentive to control their rate of exploitation.⁸ Bruce Trigger, however, has a different view. He claimed that the Montagnais in Quebec exterminated the beaver in an attempt to raise their living standard to the level of their neighbors in the St. Lawrence Valley.⁹

Whether private property regimes are the solution to the problem of overexploitation has been examined by David Feeny and others in a series of papers.¹⁰ They show that many different property rights arrangements can be consistent both with overexploitation and with competent management of a resource. This article takes as given the property rights structure among the Indians and focuses instead on the role played by the Hudson's Bay Company. As an important buyer of furs, the Company was in a position through its pricing policy to prevent overharvesting. Our results show, however, that they failed in two of the three trading districts. Rather, as French competition increased in these areas, the Company raised prices, and the Indians responded by increasing the supply of furs to be traded. It was only in the Fort Churchill hinterland, where the Hudson's Bay Company remained the sole buyer and kept prices down, that beaver stocks remained near maximum sustained yield levels.

A SHORT HISTORY OF THE FUR TRADE

A commercial fur trade grew from the interaction between Indians and European fishermen. Under French rule the trade spread along the

⁸ Demsetz, "Toward a Theory." For a discussion of the role of property rights among these tribes, see McManus, "An Economic Analysis."

⁹ Trigger, "Ontario Native People," p. 28.

¹⁰ Feeney et al., "The Tragedy of the Commons"; and Berkes et al., "The Benefits of the Commons."

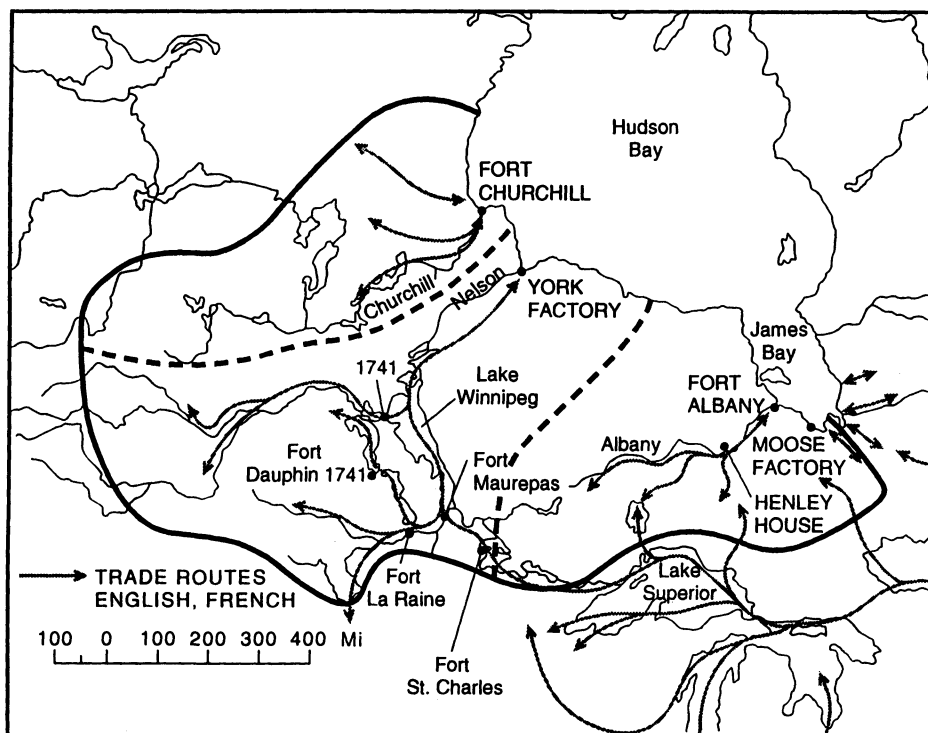


FIGURE 1

HUDSON'S BAY COMPANY TRADING HINTERLANDS:
FORT ALBANY, YORK FACTORY, AND FORT CHURCHILL

Source: These hinterlands have been estimated by Arthur Ray and are described as approximate. See Ray, "Bayside Trade"; and Ray et al., "Rupert's Land."

St. Lawrence and Ottawa Rivers, but with little contact between Europeans and the Indian hunters. Instead, Indian middlemen, in particular the Hurons, dominated the trade and sought to protect their position by hindering French exploration. The French, in turn, tried to bypass these middleman traders with increasing success in the seventeenth century.¹¹ It was in this environment of expanding French trade that the Hudson's Bay Company was formed.¹² On receipt of its charter in 1670, the Company quickly established several posts around James Bay: Rupert's House on the eastern side, in 1671, followed in quick succession by Fort Albany on the Albany River and Moose Factory on the Moose and Abitibi Rivers (see Figure 1).¹³ Both of the latter posts were rudimentary structures; nevertheless, the "newly established

¹¹ For a history of this expansion see Innis, *Fur Trade*, chaps. 4 and 5.

¹² The best history of the Hudson's Bay Company is still Rich, *History*.

¹³ Because of the proximity of Fort Albany and Moose Factory, we have combined the two posts in our analysis under the single heading Fort Albany. Fort Severn has been included with the York Factory returns for the same reason.

Hudson's Bay Company began an immediate and effective competition which was felt'' as far south as the Great Lakes.¹⁴ Indeed, the Governor, Charles Bayly, ''assured the Committee that it [trade] would be 'very extraordinary.'''¹⁵ Bayly, however, had underestimated the speed of the French reaction. In 1686 they captured Fort Albany and Rupert's House, and although both were returned in 1693, fur returns for the Company's first 40 years were modest.¹⁶

Despite the conflict and the uncertainty, the English company continued to expand its trading area around the Bay. In 1684 Port Nelson, later renamed York Factory, was built on the Nelson River. A settlement was built even farther north on the Churchill River in 1689. But even in these areas, the Company was not physically secure.¹⁷ The Treaty of Utrecht in 1713 brought an end to the military conflict between British and French traders; the economic rivalry continued until the end of French rule in 1763. Because of the military nature of the early years of the Company's existence, our analysis focuses on the period from 1700 to the Treaty of Paris in 1763. Company policy in British North America during these years was passive but vigilant.¹⁸ Traders waited for the Indians to come to the Bay rather than actively going out in pursuit of furs, and because each river-mouth fort commanded a different hinterland, a roughly radial trading pattern developed.¹⁹ Such a policy operated to the Company's advantage as long as the French did not intercept the flow of furs. In contrast to the radial pattern of the English trade, the trade from the St. Lawrence was linear, with *voyageurs* continually pushing farther northwest and southwest in search of new sources of supply.

On the surface, the organization of the two trades was similar. The Hudson's Bay Company had a technical monopoly of the trade within the drainage basin of Hudson Bay, and beginning in 1718, the *Compagnie d'Occident* was given a monopoly of the beaver trade farther south. The English trade, however, was organized on strictly hierarchical lines, whereas the French monopoly issued licenses (*congés*) or leased out the use of its posts. The leasing and licensing arrangements gave those involved an incentive to extend the trade, so it is not surprising that during the period after 1720, French traders infiltrated much of the Great Lakes region. Movement farther west was postponed by the

¹⁴ Innis, *Fur Trade*, p. 47.

¹⁵ Rich, *History*, vol. 1, p. 81.

¹⁶ The Hudson's Bay Company's first 40 years are discussed in detail in Rich, *History*, vol. 1, pp. 61–426.

¹⁷ Iberville threatened York Factory in 1690, captured it in 1694, and held it until 1714. Hence, although there was a Hudson's Bay Company presence from 1670 to the Treaty of Utrecht in 1713, the viability of its trading posts depended on the success of its military campaigns.

¹⁸ For the Hudson's Bay Company, these years are often referred to as the period of ''sleep by the frozen sea.''

¹⁹ Harris and Warkentin, *Canada*, p. 12.

Indian Wars of 1727 to 1738, but beginning in the 1740s, new French posts were established on Lake Winnipeg, Lac des Prairies, and Lake Nipigon (see Figure 1). These posts represented a serious threat to the flow of furs to York Factory.²⁰

The Hudson's Bay Company, in contrast to the *Compagnie d'Occident*, attempted to set and maintain uniform rules for the managers of its various forts. Although the head office allowed some divergence in policy, the managers did not have great latitude in the conduct of the trade. The Company dictated the prices managers could charge both for trade goods and for furs. These standards were known as the *Official and Comparative Standards* and were denominated in the Company's unit of account—the Made Beaver.²¹ Because managers needed flexibility over price, however, the head office allowed some differences between its posted schedules and those used in actual trade.²² The difference between the actual revenue at each post (expressed in Made Beaver) and the revenue implied by the Company standard was called the *overplus*, for which the head office demanded a full accounting to ensure that no manager was using the excess for personal gain.²³ It is within this highly centralized structure of the Hudson's Bay Company and the more loosely coordinated French trade that our discussion of depletion takes place.

ESTIMATING THE BEAVER POPULATION IN THE HUDSON BAY DRAINAGE BASIN

Much of the fur trade literature is qualitative. Although data are sometimes collected, they are often presented simply to illustrate a point rather than to provide strong support for a particular hypothesis. In some cases, the absence of quantitative analysis has not been occasioned by a lack of available data. The Hudson's Bay Company preserved its trading post records, and these records allow us to form a good picture of some aspects of the fur trade, including the economic relationship between the Indians and the Company. Arthur Ray and Donald Freeman in their seminal works have already made use of these data.²⁴ We also employ the Company records but do so in order to address the specific issue of depletion.

We analyzed fur returns from three Hudson's Bay Company trading

²⁰ Ibid., chap. 5.

²¹ The best discussion of these standards and of the unit of account is to be found in Ray and Freeman, "Give Us Good Measure," chaps. 6 and 9.

²² Rich has argued that the ceremonial nature of the trade was extremely important. This included giftgiving, which required that traders have commodities and flexibility. Rich, "Trade Habits."

²³ The use of company accounts to monitor its managers is discussed in Carlos and Nicholas, "Agency Problems," pp. 867–72.

²⁴ Ray, *Indians in the Fur Trade*; and Ray and Freeman, "Give Us Good Measure."

posts to determine the trend in the beaver population from 1700 to 1763.²⁵ Although the records show a wide variety of pelts were brought to the posts—marten, wolf, bear, fox, moose, and other species—by far the most important was beaver, which accounted for over 80 percent of the value of furs traded. Each post reported annual returns on three categories of beaver pelts: whole parchment, half parchment, and coat. Both whole parchment and coat pelts sold for the same price, which was also the unit of account, the Made Beaver.²⁶ Half-parchment pelts were from smaller animals or those trapped during the summer, and they sold for one-half a Made Beaver. By summing over the three categories, we obtained an estimate of the number of beaver killed by Indian trappers and traded to the Hudson's Bay Company.²⁷ These numbers provide the basis of our beaver population estimates in each of the hinterlands.

The annual beaver harvest in the Fort Albany hinterland is reported in Figure 2 and Table 1. This hinterland, shown on Figure 1, was roughly 600,000 square kilometers and included an area within about 100 kilometers of the coast where the Company faced no competition, as stipulated by the Treaty of Utrecht. However, the region, consisting of boreal forest, would only support low beaver densities. Farther south, where the environment was more suitable and beaver densities were very much higher, the Company faced substantial competition from French traders, especially after 1720. The increasing French competition seems clearly to have influenced the magnitude of the English trade. From 1700 to 1720, returns averaged 20,000, with wide year-to-year fluctuations: the range was 15,000 to 30,000. After 1720 there was a decline to an average of about 15,000. The returns remained fairly stable until the late 1740s, when there were unusually large harvests, but following these years, the trade fell precipitously to about 6,000 pelts.

²⁵ We define the three trading areas as Fort Albany, York Factory, and Fort Churchill (see Figure 1). Ray points out that the boundaries of the hinterlands are approximate and indeed may have shifted from year to year depending on how aggressive were the managers of different posts. Despite these limitations, we regard the hinterlands outlined by Ray as useful indicators of the plausibility of our estimated beaver populations. See Ray, "Bayside Trade"; and Ray et al., "Rupert's Land."

²⁶ Coat pelts were those worn by the Indians until the guard hairs fell out. They were then more easily fashioned into felt and then hats.

²⁷ The Company reported harvests in terms of its unit of account, the Made Beaver. We converted these into numbers of pelts on the basis of the Company's Official Standard. Accordingly, the harvests of half-parchment beaver in terms of pelts is put at twice the harvest expressed in Made Beaver. Whole parchment and coat beaver are not adjusted, reflecting the fact that they each sold for one Made Beaver. Because coat beaver were worn for a period of time before being sold and we wanted to determine the number of animals harvested each year, we set the harvest of beaver eventually sold as coat beaver equal to the number of coat beaver traded the following year. To illustrate: in 1736 York Factory reported trades of 15,375 whole parchment and 1,825 half parchment beaver. Since these are reported in Made Beaver, the number of skins they represent is set equal (with rounding) to 19,024 ($15,375 + 2 \times 1,825$). In 1737, York Factory received 9,862 coat beaver. These are assumed to have been killed the previous season and worn for a year, therefore the harvest for 1736 in the York factory hinterland is put at 28,886 ($19,024 + 9,862$) beaver.

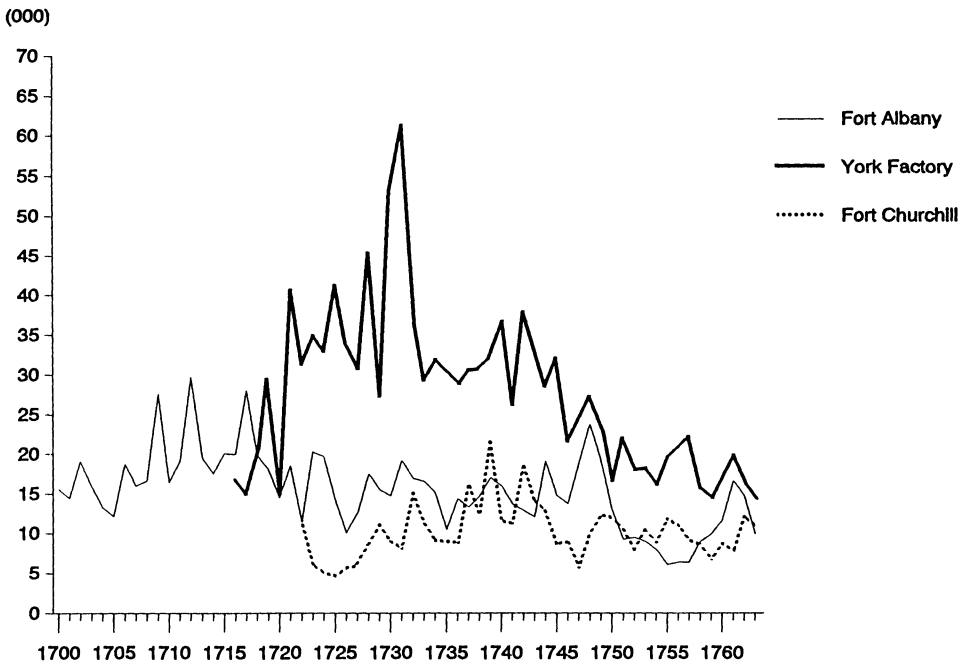


FIGURE 2

BEAVER SKINS TRADED AT FORT ALBANY, YORK FACTORY,
AND FORT CHURCHILL HINTERLANDS, 1701/1716/1722–1763

Source: See Table 1.

Returns were low through the 1760s, despite a modest recovery in the early part of the decade.

The York Factory hinterland, at nearly one million square kilometers, again shown on Figure 1, was roughly two-thirds greater than the area served by Fort Albany, but a larger proportion of this hinterland was boreal forest, again implying somewhat lower beaver densities. At the same time, competition from the French, at least before 1740, was less intense. Not surprisingly, returns at York Factory were much higher (see Figure 2 and Table 1). After some small harvests very early on (from 1717 to 1720), trade increased to nearly 37,000 pelts per year over the decade of the 1720s and remained high during the 1730s when returns averaged 33,000. During the period 1741 to 1749, the trade was smaller by about 5,000 pelts per year, because of the emergence of French competition, and even these smaller harvests could not be sustained. From 1750 to 1763, an average of 18,000 pelts were traded, representing a reduction of 10,000 below the harvests of the 1740s.

Fort Churchill was the post farthest west and north and, therefore, was protected by distance from significant French competition. It served a large hinterland (500,000 square kilometers), but, because of its northerly location, the region consisted mainly of boreal forest with its

TABLE 1
BEAVER SKINS TRADED, SIMULATED BEAVER POPULATION, AND PRICES:
FORT ALBANY, YORK FACTORY, AND FORT CHURCHILL, 1700/1716/1722-1763

Year	Skins Traded	Popula- tion	Price	Year	Skins Traded	Popula- tion	Price	Year	Skins Traded	Popula- tion	Price
FORT ALBANY											
1700	15,604	206	84.0	1722	11,373	173	69.9	1744	19,029	148	83.5
1701	14,426	211	62.5	1723	20,197	169	71.4	1745	14,702	144	83.5
1702	19,083	208	65.9	1724	19,617	165	71.8	1746	13,673	142	97.0
1703	15,894	210	73.1	1725	14,233	168	72.8	1747	18,692	129	89.0
1704	16,302	211	73.6	1726	10,021	179	70.1	1748	23,689	106	82.7
1705	12,121	218	58.9	1727	12,474	185	73.2	1749	19,145	90	85.7
1706	18,792	215	73.8	1728	17,424	182	71.4	1750	12,973	84	87.9
1707	15,979	217	71.4	1729	15,465	182	69.6	1751	9,222	84	92.3
1708	16,758	217	58.8	1730	14,707	184	70.5	1752	9,434	85	102.6
1709	27,583	201	67.6	1731	19,109	177	66.3	1753	8,942	86	95.6
1710	16,395	203	62.6	1732	16,860	174	71.4	1754	7,955	89	106.6
1711	19,016	201	72.6	1733	16,502	171	81.0	1755	6,075	97	115.4
1712	29,644	184	67.2	1734	15,061	169	82.6	1756	6,359	105	128.3
1713	19,419	181	68.3	1735	10,432	176	83.9	1757	6,367	114	122.8
1714	17,477	182	66.9	1736	14,295	176	79.5	1758	8,958	119	110.8
1715	20,017	179	71.9	1737	13,260	176	80.5	1759	9,871	123	103.0
1716	19,935	177	71.8	1738	14,665	174	85.6	1760	11,558	124	100.6
1717	27,959	162	69.3	1739	16,917	167	83.9	1761	16,519	114	87.3
1718	19,781	160	63.7	1740	15,908	160	80.6	1762	14,652	108	80.0
1719	17,976	160	68.6	1741	13,648	159	78.6	1763	9,880	111	105.1
1720	14,473	165	71.6	1742	12,835	159	84.3				
1721	18,468	164	67.0	1743	12,024	160	91.5				
YORK FACTORY											
1716	16,557	277	89.3	1732	36,334	233	73.0	1748	27,085	157	88.4
1717	14,869	296	78.9	1733	29,196	237	69.9	1749	23,272	149	73.1
1718	20,200	307	78.3	1734	31,719	238	68.1	1750	16,685	152	90.9
1719	29,556	309	79.6	1735	30,411	240	67.8	1751	21,868	146	92.6
1720	14,939	324	99.2	1736	28,886	243	68.0	1752	18,301	145	97.5
1721	40,625	313	92.7	1737	30,455	243	66.5	1753	18,088	145	97.2
1722	31,307	312	83.6	1738	30,825	243	68.0	1754	16,100	148	115.1
1723	34,760	307	69.9	1739	31,915	239	75.3	1755	19,615	146	105.6
1724	32,738	306	72.0	1740	36,414	229	76.7	1756	20,928	141	102.7
1725	41,116	295	68.6	1741	26,184	230	74.4	1757	22,277	133	106.7
1726	33,483	294	68.2	1742	37,726	214	78.9	1758	15,503	136	102.9
1727	30,691	295	69.7	1743	33,514	202	79.0	1759	14,357	140	89.8
1728	45,199	282	65.3	1744	28,543	195	86.5	1760	17,218	141	92.9
1729	27,279	288	70.9	1745	32,230	180	83.8	1761	19,676	138	86.1
1730	54,099	266	70.8	1746	21,703	178	85.7	1762	16,402	139	94.6
1731	61,360	236	69.6	1747	24,767	170	87.3	1763	14,396	144	88.6
FORT CHURCHILL											
1722	11,522	84	83.0	1736	8,845	92	99.2	1750	11,900	62	81.4
1723	6,011	83	116.8	1737	16,143	93	80.7	1751	10,501	60	85.5
1724	5,027	87	109.0	1738	12,089	86	91.8	1752	7,858	60	121.2
1725	4,752	92	115.2	1739	21,623	84	80.8	1753	10,381	62	88.0
1726	5,703	96	121.6	1740	11,508	72	86.8	1754	8,807	62	101.2
1727	6,061	100	118.2	1741	11,315	71	81.8	1755	11,733	64	90.5
1728	9,052	102	85.9	1742	18,581	70	82.3	1756	10,982	62	97.2
1729	11,016	101	72.4	1743	14,089	62	84.9	1757	9,033	62	101.1

TABLE 1—continued

Year	Skins Traded	Population	Price	Year	Skins Traded	Population	Price	Year	Skins Traded	Population	Price
FORT CHURCHILL—continued											
1730	8,845	99	75.8	1744	12,820	59	94.6	1758	8,550	63	115.7
1731	8,178	99	76.3	1745	8,655	56	113.9	1759	6,776	65	96.8
1732	15,147	99	80.2	1746	8,891	57	113.9	1760	8,776	69	101.7
1733	11,214	93	83.1	1747	5,960	59	85.8	1761	7,738	70	93.5
1734	9,076	91	98.9	1748	9,948	63	85.9	1762	12,027	73	89.6
1735	8,943	91	96.6	1749	12,239	63	85.1	1763	10,848	72	93.1

Notes: Simulated population is expressed in thousands of animals. Price is expressed as an index of one Made Beaver equals 100.

Source: MG20B Hudson's Bay Company Archives (microfilm copy). For a more complete discussion of the derivation of each series, see text and footnote 27.

consequent low beaver densities. Trade volume in the early years was very low, about 5,000 pelts from 1723 to 1727, but as the Fort became established, trade expanded (see Figure 2 and Table 1). During the 1730s, returns averaged 11,000 per year. There was a modest decline in harvests to about 9,000 in the 1750s, but in the 1760s volume returned to the earlier levels. What distinguishes Fort Churchill from the other posts is the comparative long-run stability of fur returns. The lack of French trading in the region almost certainly accounts for part of the difference in harvest patterns, but as we argue later, the absence of competition may also have influenced Hudson's Bay Company strategy in exploiting the beaver stocks.

The pattern of trade at any of the Company posts can, in principle, be explained by a falling beaver population, a change in the intensity of trapping by the Indians, a diversion of furs to the French, or some combination of these changes. The problem is to disentangle the effects. Consider the period 1740 to 1763 (see Figure 2). After averaging about 15,000 furs during the 1740s, the trade at Fort Albany in 1751 fell to under 10,000, only the second time that had happened in 50 years. By 1755 the trade had declined a further 35 percent to about 6,000 furs. This reduction in the Fort Albany harvest could presumably have been due to any of the three causes we have mentioned; nevertheless, even the limited evidence provides compelling support for the historical consensus that depletion did occur.

There were major epidemics among Indian tribes in the seventeenth century, but none are reported for the eighteenth century. So despite the lack of reliable population estimates, we have little reason to believe that the number of trappers was falling dramatically during this period.²⁸ The decline in the Fort Albany harvest therefore resulted from either a shrinking beaver population or some combination of reduced trapping

²⁸ Ray, *Indians in the Fur Trade*.

effort and the diversion of furs to the French. Quantitative information on French harvests are scarce. In fact, Gratien Allaire has argued that “il est impossible de constituer une série statistique complète du volume des entrées et des sorties du port de Québec.”²⁹ Although a complete series cannot be generated, some data on French harvests are available. It has been estimated, for example, that in 1755 the French received about 6,000 beaver pelts from the Fort Albany hinterland, roughly the same number as the Hudson’s Bay Company.³⁰ Even if the French in 1755 were receiving twice the average number of furs as in the 1740s, the increase in French harvests would still account for only a small fraction of the overall decline in the Hudson’s Bay Company’s returns.

If increased French harvests did not bring about the fall in returns at Fort Albany, could decreased trapping effort by the Indians have been the cause? Again, we cannot answer this issue directly, but the indirect evidence clearly points to a declining beaver stock rather than declining Indian effort. The Indians traded a wide variety of skins to the Hudson’s Bay Company: white and red fox, wolverine, wolf, bear, cat, and muskrat. Other than beaver, however, by far the most important animal traded was marten, whose price was held fixed at one-third Made Beaver. Because the price was constant in terms of beaver, harvests of marten and beaver should have moved together unless one of the species was being depleted. In Table 2, we present the number of beaver and marten brought to Fort Albany from 1740 to 1763. The correlation coefficient of the two series is just .16, which suggests fluctuating harvests were due to factors other than variable hunting effort.

The period from 1750 to 1755 is especially revealing. In 1751, the trade in beaver declined sharply, and for the next two years harvests remained at historically low levels. During the same period, the marten harvest jumped to historic highs. In fact, the marten trade in 1753 was more than double the 1740 to 1750 average. It seems apparent that during the early 1750s, hunting effort was diverted from beaver to marten, and because the relative prices of the two types of fur were unchanged, a decline in the beaver stock seems clearly to have been the cause. After 1753, the marten harvest also shrank to very low levels providing further evidence of depletion. What emerges from the Fort Albany data is a pattern where overharvesting of one species (the beaver) in the late 1740s led to depletion in the early 1750s, which in turn induced overharvesting of marten and the decline of that species as well.

The year-to-year fluctuations in the returns at all three trading posts

²⁹ Allaire, “Le Commerce,” p. 95. The quantitative problems in generating a volume series are discussed in detail in Wien, “Castor, Peaux, et Pelleteries.”

³⁰ In their plate for the *Historical Atlas*, Heidenreich and Noël estimated the number of “packs” of furs traded at Fort Albany and Moose Factory to be 200 (each pack is 80–100 lbs). Their estimate of the French trade from the same region is 210 packs. French returns include Kaministiquia, Nipigon, and Michipicton. Heidenreich and Noël, “France Secures the Interior.”

TABLE 2
BEAVER AND MARTEN TRADE: FORT ALBANY, 1740–1763

Year	Beaver Skins	Marten Skins
1740	15,908	8,814
1741	13,648	6,050
1742	12,835	3,942
1743	12,024	5,400
1744	19,029	8,250
1745	14,702	11,265
1746	13,637	4,850
1747	18,692	3,600
1748	23,689	6,742
1749	19,145	9,255
1750	12,973	6,592
1751	9,222	9,723
1752	9,434	12,623
1753	8,942	13,902
1754	7,955	4,650
1755	6,075	3,620
1756	6,359	2,850
1757	6,367	1,850
1758	8,958	4,515
1759	9,871	9,453
1760	11,558	9,722
1761	16,519	6,350
1762	14,652	5,119
1763	9,880	2,233

Source: MG20B Hudson's Bay Company Archives (microfilm copy).

are also suggestive of a declining beaver population. During the early years, returns exhibit a pronounced sawtoothed pattern, but later on the short-run variation is noticeably dampened (see Figure 2). This difference in harvest pattern has also been observed in Ontario during the twentieth century, when estimates of beaver stocks are available. In Ontario, it was only in the 1960s that the beaver population fully recovered from the serious depletion of the 1930s. Throughout the years of decline and recovery the harvests exhibit very small year-to-year fluctuations, but beginning in the 1960s, there is a pronounced change in the pattern. It becomes sawtoothed and very reminiscent of the Hudson's Bay Company experience during the early eighteenth century.³¹

The fur returns from Fort Albany are strongly suggestive of depletion, but depletion was a force operating on the underlying population from which these harvests were drawn. In order to describe more fully trends in the beaver population, we have combined the harvest data with a model of biological resource extraction to simulate the stock of beaver in the Fort Albany hinterland. Our simulations turn out to be very

³¹ Miles Novak attributed the sawtoothed pattern after the early 1960s partly to climatic factors that affected trappers. See Novak, "Beaver," p. 291.

sensitive to the parameter values that we select and must, therefore, be regarded as suggestive of only one possible scenario. They do, however, have the feature of being generally consistent with the qualitative evidence on the trade, the beaver ecology literature, recent surveys of beaver populations, and the number of furs received at Fort Albany during the eighteenth century.

The relationship between annual harvest and population was based on the standard Lotka-Volterra logistic, which relates the natural growth of a biomass to the animal population:

$$F(X) = aX - bX^2, \quad a, b > 0 \quad (1)$$

where X is the animal population, a is the maximum proportional growth rate of the population, and $b = a/\bar{X}$, where \bar{X} is the upper limit to population size or the maximum population size. The population dynamics of the species exploited will depend on the harvest each period:

$$\dot{X} = aX - bX^2 - H \quad (2)$$

where H is the harvest and \dot{X} is the annual change in population. The choice of parameter a and maximum population \bar{X} is central to the population estimates. They have been based largely on estimates from the beaver ecology literature and recent Canadian provincial field reports on beaver densities.

We have set parameter a , the maximum proportional growth rate, at 0.3. This figure is roughly consistent with Payne's beaver life tables and estimates of rapidly growing beaver populations.³² It also seems to reflect beaver population growth in one small area of the region in the twentieth century, where the beaver recovered from virtual extinction.³³ As is evident from the preceding discussion, French competition was an important element and must be incorporated. According to Ray, French traders after 1740 were trading in much of the Fort Albany hinterland, and the 1755 estimate implies that the English and French harvests in the region were about the same. We allowed for increased French competition by assuming the Hudson's Bay Company was harvesting a

³² Henry and Bookhout analyzed a rapidly growing beaver population in Ohio during the mid-1960s. They estimated that, exclusive of adult mortality, the population was increasing at 49 percent per year. Since the adult population was 60 percent of the total, allowing a 30 percent mortality rate among adults gives a net annual rate of population growth of about 30 percent. See Henry and Bookhout, "Productivity," pp. 931–32; and Payne, "Mortality Rates," pp. 119, 124. Beaver populations have also been analyzed by Bergerud and Miller, "Population Dynamics"; Boyce, "Beaver Life-History Responses"; Jenkins and Busher, "Castor Canadensis"; and Navakowski, "Population Dynamics."

³³ Novak reports that in an area of southern Ontario where the beaver recovered from virtual extinction, the number of beaver families increased from zero in 1937 to 18 in 1948 to 254 in 1959. Assuming a value of one rather than zero in 1937, the implied annual rates of growth are 30 percent from 1937 to 1948, and 27.2 percent from 1948 to 1959. See Novak, "Beaver," p. 291.

hinterland that gradually shrank in size from 70 percent of the total available area in 1720 to 50 percent in 1740.³⁴

Having incorporated the French harvests in this manner, we then selected a value of \bar{X} and simulated the beaver population using equation 2 and observed Hudson's Bay Company harvests. Values of \bar{X} that are too low imply an extinction path and so were rejected. Values of \bar{X} that are too high lead to unreasonably large beaver populations in the 1750s and 1760s when, as we have noted, the evidence for depletion is compelling. As a further check that our procedure was generating reasonable results, we compared the beaver densities implied by our simulations to recent Ontario Ministry estimates of beaver densities in the region.³⁵

Figure 3 and Table 1 present the population simulations in the Fort Albany hinterland where \bar{X} , the maximum population, has been set at 344,000.³⁶ The maximum density implied by this estimate is about 0.6 beaver per square kilometer. The Ontario Ministry of Natural Resources surveyed the Fort Albany hinterland and, as part of its land use plan, included estimates of the potential beaver harvest, which was set at 30 percent of the stock. The implied population density of 0.5 beaver per square kilometer that emerged from that study is consistent with the maximum density assumed in our simulation.³⁷

From 1700 to 1717 according to our simulation, the population declined, which is the expected pattern for a resource that has not yet been fully exploited, but by 1717 the beaver population appeared to have reached an equilibrium. For the next 20 years the stock remained at levels roughly consistent with maximum sustained yield management³⁸

³⁴ We assume that the Hudson's Bay Company harvested a hinterland of 70 percent of the total area available in 1720. This area declined from 1720 to the 1740s and then remained constant at 50 percent. These assumptions are based on the historical evidence that some French competition existed prior to 1720, that it increased from 1720 to the 1740s, and that it remained relatively unchanged thereafter.

³⁵ Their estimates are based largely on aerial surveys of beaver colonies and reports from trap lines.

³⁶ The choice of 344,000 is based, in part, on the simulation results. Even a slightly lower value gives rise to an extinction path, whereas a slightly higher value implies no depletion in the 1750s, when the evidence for depletion is compelling. The starting point for the simulations is somewhat arbitrarily put at 60 percent of maximum population, but results are not sensitive to this assumption.

³⁷ See Ontario Ministry of Natural Resources, *Land Use Guidelines*. According to the land use plans for districts within the Fort Albany hinterland, excluding the district of Moosonee, the average beaver density in the early 1980s was 0.67 beaver/km². In the Moosonee district, however, the density was only 0.10 beaver/km² according to information supplied to us by the Ontario Ministry of Natural Resources. The relevant area of Moosonee comprises about 30 percent of what was the Fort Albany hinterland, implying that the average beaver density in that hinterland during the early 1980s was about 0.5 beaver/km². Given that the beaver had not been heavily exploited during previous periods, an observed density roughly 80 percent of the maximum seems plausible.

³⁸ Obtaining a maximum sustained yield may not necessarily have been the optimal policy for the Hudson's Bay Company, but it provides a useful benchmark with which to compare the actual

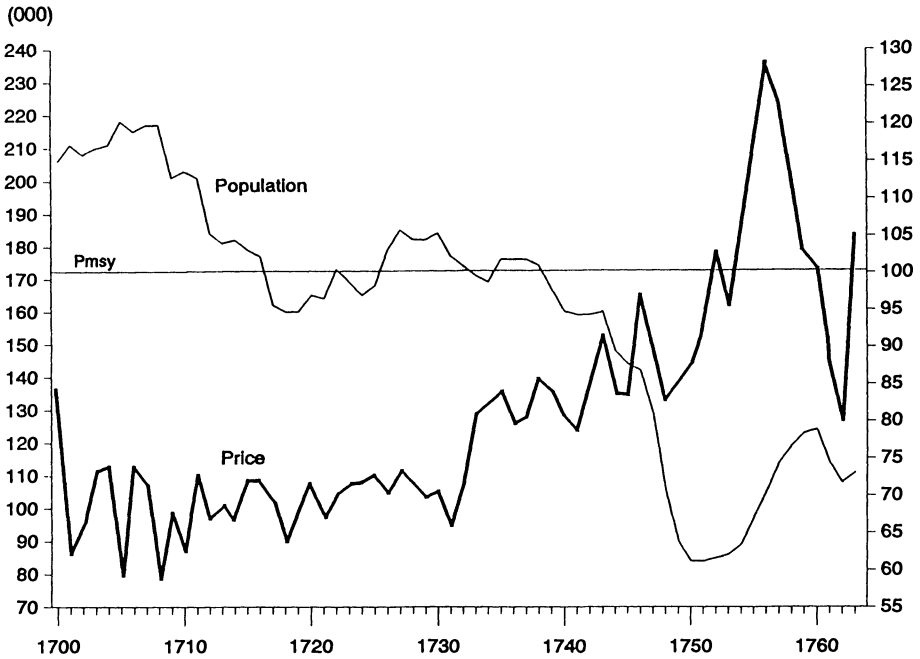


FIGURE 3
FUR PRICES AND SIMULATED BEAVER POPULATION:
FORT ALBANY, 1700–1763

Note: Pmsy is the population consistent with maximum sustained yield. For the assumed natural growth function of beaver, this equals one-half the maximum population. The population scale runs from 20 to 70 percent of the maximum population.

Source: See Table 1.

(see Figure 3). In the 1740s, however, a combination of greater French competition and unabated trading by the Hudson's Bay Company began to deplete the stock. This pattern of depletion was especially apparent during the period from 1747 to 1749, when Fort Albany received an average of 20,500 pelts, a larger harvest than in any of the preceding 20 years. According to our simulation, it was these harvests in particular that devastated the beaver colonies, reducing the stock to about half of maximum sustained yield levels. This decline led not only to meager fur returns throughout the 1750s but to modest harvests in the 1760s as well.

Unlike Fort Albany, which faced competition early in the eighteenth century, York Factory was protected by distance until the 1730s. In 1732 the French established Fort St. Charles on Lake of the Woods and in 1734 built Fort Maurepas at the mouth of the Red River (see Figure 1). These posts, both located near the southeastern limit of the York Factory hinterland, provided some competition, but it was not until the 1740s and the building of four additional trading posts that large

harvests. The extent to which the Hudson's Bay Company did indeed pursue a profit-maximizing strategy is examined in Carlos and Lewis, "Optimal Beaver Harvests."

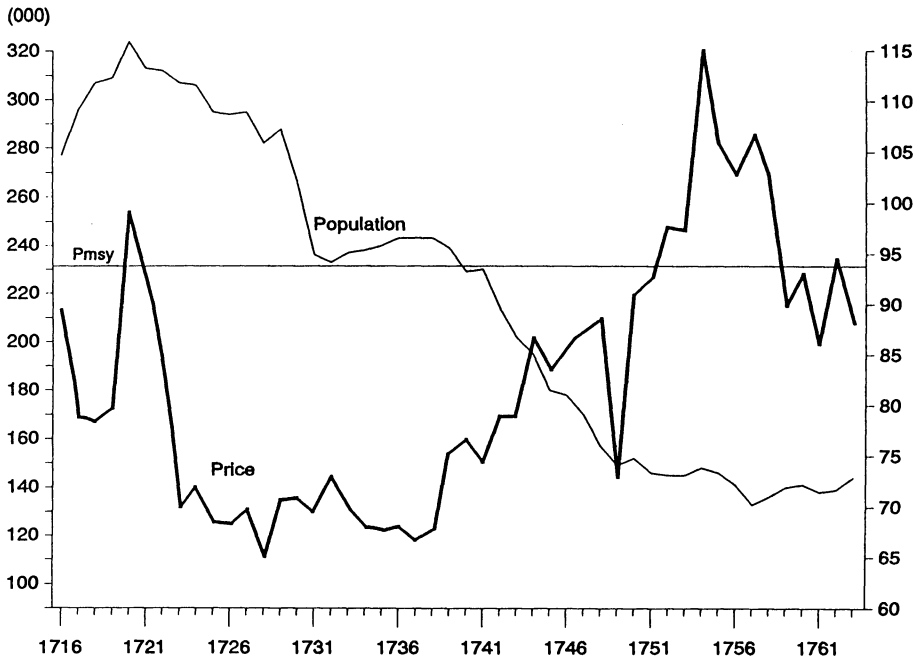


FIGURE 4

FUR PRICES AND SIMULATED BEAVER POPULATION:
YORK FACTORY, 1716-1763

Note: See Figure 3.

Source: See Table 1.

numbers of furs were diverted to Montreal. By 1755, the French accounted for 40 percent of the region's trade.³⁹

The pattern of returns at York Factory from 1717 to 1763 not only reflected the increasing French competition, but was also strongly indicative of depletion. In the early years, from 1717 to 1730, returns were increasing but highly variable, consistent with an emerging trade. Then in the 1730s, the trade stabilized at about 30,000 furs annually, a harvest that approximated the maximum sustained yield of the region (see Figure 4). The first break in the pattern came in the early 1740s. The French built Fort La Raine in 1738 and three years later established two more posts, both in the heart of the York Factory hinterland. Surprisingly, given the greater competition, trade at York Factory increased markedly, to an average of 34,000 furs over the period from 1740 to 1743. Indeed, the 1742 return of 37,727 was the largest since the French had established any trade in the region.

The changes in the underlying beaver population in the York Factory region are presented in Figure 4 and Table 1, where we report the results

³⁹ Innis, *Fur Trade*, pp. 91-94. Heidenreich and Noël estimated the York Factory trade at 550 packs and the French trade from the same region (*Mer de l'ouest*) at 350 packs. See Heidenreich and Noël, "France Secures the Interior."

of a simulation that uses the same methodology applied to Fort Albany. The York Factory hinterland was considerably larger, close to one million square kilometers, but beaver densities were almost certainly less. Our simulation is based on a maximum beaver population in the region of 462,000, or just under 0.5 beaver per square kilometer. This density is somewhat lower than the value assumed for the Fort Albany hinterland, but is consistent with the type of vegetation—boreal forest—that dominates the region.

We somewhat arbitrarily have put the beaver population in 1716 at 60 percent of the unexploited level of 462,000.⁴⁰ From this level, according to our simulation, the population declined to about 240,000 in the 1730s, which is roughly equal to the population consistent with maximum sustained yield management. The falling population during this period, although partly a consequence of some very large harvests, did not indicate overharvesting of the stock. It simply represented the usual pattern observed when a resource has been previously underexploited. With the increase in French competition starting in 1738, however, the beaver population became severely depleted. Depletion occurred not simply because the French were taking more furs from the region, but more importantly, because harvesting by the Hudson's Bay Company also increased. According to our simulation, the beaver population during the 1740s declined to just above 60 percent of the level consistent with a maximum sustained yield, and these low levels persisted through the 1750s, although there was a modest recovery in the early 1760s (see Figure 4).

Unlike Fort Albany and York Factory, the third post—Fort Churchill—was too far west and north to face significant competition from the French. The fur returns at Fort Churchill show a markedly different pattern from the two more central trading posts (see Figure 2 and Table 1). During the 1720s the returns were very low, which is indicative of a post that had yet to become fully established, although the inexperience of post factor Richard Norton almost certainly played some role.⁴¹ After 1727, when Norton was replaced, returns increased sharply, and although highly variable, they exhibited only a slight downward trend for the remaining years to 1763. In fact, if we remove the years up to 1744, a period when the beaver population had not yet been fully exploited, the harvest hardly declined at all.

Applying our earlier methodology, we have simulated the beaver

⁴⁰ Our simulations turn out not to be sensitive to the assumed initial population. For example, assuming the starting point is 80 percent rather than 60 percent of the maximum population and assuming a slightly smaller maximum population (456,000 rather than 462,000), we derive, after ten years, an almost identical population stream.

⁴¹ In its letter removing Norton from his position as chief trader, the London Committee stressed that the low returns were due not to any opportunism on his part but rather to lack of experience. Norton was then demoted and sent to York Factory, although he later returned to Churchill as chief trader. See Carlos and Nicholas, "Agency Problems," p. 871.

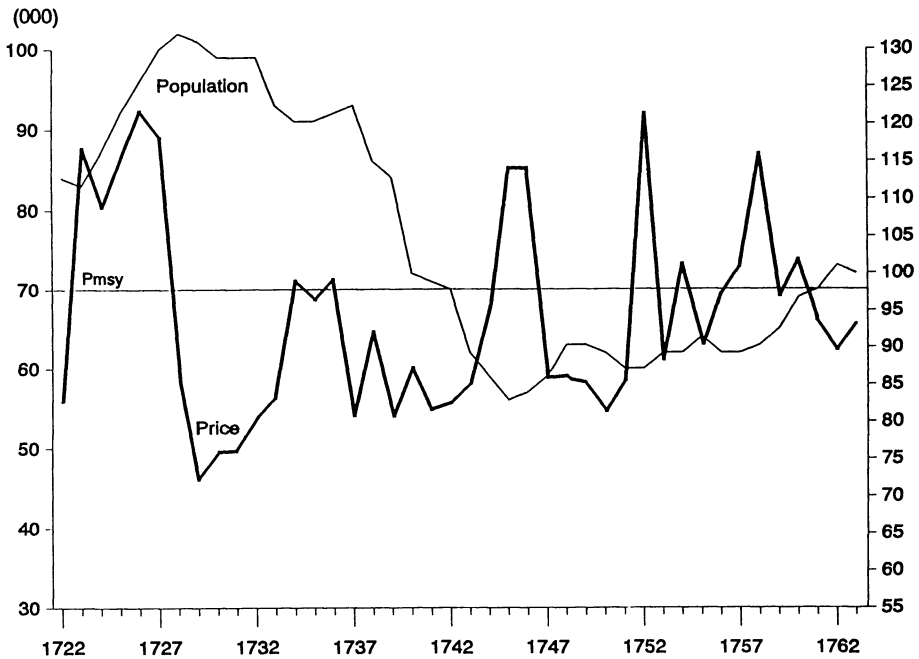


FIGURE 5

FUR PRICES AND SIMULATED BEAVER POPULATION:
FORT CHURCHILL, 1722–1763

Note: See Figure 3.

Source: See Table 1.

population in the Fort Churchill hinterland. The area, at 500,000 square kilometers, was just 15 percent smaller than the region served by Fort Albany, but it almost certainly supported a much smaller beaver population. At 0.3 beaver per square kilometer, the density is assumed 50 percent lower than our Fort Albany estimate, which is entirely consistent with the nature of the terrain—tundra and boreal forest, neither of which can sustain a large beaver population.⁴² Our estimate of the maximum stock is 140,000. Despite the low population density, we simulate much more stable beaver stocks than at the other trading posts (see Figure 5 and Table 1). From 1722 to 1742, population fell from an assumed 60 percent of the unexploited size to the maximum sustained yield level of 70,000. Although the population fell briefly below that level, it soon climbed back. The pattern at Fort Churchill is thus in direct contrast to the behavior of population in the Fort Albany and York Factory hinterlands. The lack of French competition was almost certainly a direct factor in explaining the stability, but in addition, the fact that the Hudson's Bay Company had a monopoly in the region may have led to a strategy that discouraged depletion.

⁴² The lower population density is due primarily to the high latitude of Fort Churchill.

HUDSON'S BAY COMPANY PRICING POLICY

The analysis so far has assumed that the Hudson's Bay Company could control the number of furs traded at each post, but given the nature of its relationship with the Indians, it could do so only indirectly. After all, Indians did the actual trapping. The Company, however, could set fur prices through its post managers, and it was pricing policy, we argue, that ultimately determined, or at least strongly affected, the size of the beaver harvest. We have estimated prices at the three posts in order to study their influence on the beaver population. Throughout the period from 1700 to 1763, posted prices were based on the Company's *Official Standard*, which remained constant over time and was the same across posts. The actual prices received by the Indians, however, rarely equaled that standard because, as mentioned earlier, post managers were permitted to offer lower prices to the Indians, in which case the managers recorded an overplus in the accounts. At the same time, the trading process required that managers incur expenses in addition to the value of goods traded directly for furs. These expenses represented the cost of gifts given to the Indians that were a very important ceremonial feature of the trade. When the overplus exceeded expenses, the Indians received less than the official standard for their furs, and when the reverse was true they received more. Because both the overplus and the expenses are reported in the annual accounts of each post, it is possible to derive a price series for each area (see Table 1).

There appears to be a connection between the prices the Indians received for their furs and the size of the beaver stocks (see Figures 3 through 5). In the Fort Albany region, we estimate that from 1717 to 1730, when there was almost no change in fur prices, the beaver population was stable or rising; whereas from the 1730s to the early 1750s, when fur prices rose by 40 percent, the (simulated) beaver population declined by 50 percent. This negative relationship between fur prices and beaver stocks is also observed in the York Factory data. In that region, the simulated population fell from an average of 242,000 in the 1730s to 146,000 in the period 1751 to 1755, whereas fur prices at the trading post went from 0.69 to 1.02 Made Beaver. Equally suggestive is the evidence from Fort Churchill. In that region, we estimate that the beaver population remained fairly stable after the early 1740s, and the slight upward trend in the price series is consistent with that stability.

We formalize the relationship between prices and beaver stocks by appealing, as in the previous section, to the fisheries literature. (For a presentation of the model that uses specific functional forms, see the Appendix.) According to that literature, the per period harvest (H) will depend positively on the level of harvesting effort (E) and the size of the resource stock (X).

$$H = H(E, X), \quad H_1, H_2 > 0 \quad (3)$$

The Indians' trapping effort is assumed to be positively affected by the return to that effort:

$$E = E(r), \quad E' > 0 \quad (4)$$

where r is the return per unit of trapping effort. Return increases with the price of furs (p) and the stock of beavers:

$$r = r(p, X), \quad r_1, r_2 > 0 \quad (5)$$

Equilibrium is achieved where the harvest just equals natural replacement:

$$H = aX - bX^2 \quad (6)$$

The effect of price on the equilibrium beaver population can be derived from equations 3 through 6. An increase in price raises the return to harvesting effort, which induces more harvesting effort and gives rise to a larger harvest. In the longer run, however, the larger harvest reduces the beaver population and this feeds back into the system. A smaller population would reduce harvests even if effort remained constant, as described in equation 3; but, in fact, the level of effort declines because the return to effort is lowered (see equations 4 and 5). Thus, both effects contribute to lower harvests, which in turn moderate the decline in population. Ultimately a new equilibrium is reached where the harvest and the stock of beaver are again in balance.

The effect of fur prices on the beaver population, as predicted by the model, is illustrated in the Fort Albany hinterland from 1717/21 to 1750/54 (see Table 3). Within each five-year interval the beaver population was stable, but between periods it fell by 47 percent, from an average of 162,000 to an average of 86,000. Our adjustment model supports the suggestion made earlier that Hudson's Bay Company pricing policy was an important element in the depletion of beaver stocks. According to the model, the increase in price, from 0.68 MB (Made Beaver) in the earlier period to 0.97 MB in the later one, reduced the stock of beavers to between 87,000 and 139,000 and therefore accounts for between 30 and 100 percent of the estimated decline in population.⁴³

The York Factory hinterland also experienced a drop in beaver stocks. From 1735/39 to 1751/55, the population fell from an average of 242,000 to an average of 146,000, or by about 40 percent. Here again the price the Indians received for furs, which rose from 0.69 MB to 1.02 MB, appears crucial. According to our adjustment model, the increase

⁴³ The wide range of estimates is based on elasticities of supply of effort that vary from 0.25 to 2.0. Assuming the intermediate and, possibly, more plausible values of 0.5 and 1.0 gives rise to estimates of the contribution of price to the population decline that lie between 55 and 86 percent.

TABLE 3
THE EFFECT OF FUR PRICES ON THE SIMULATED BEAVER POPULATION

Fort Albany			York Factory		
Years	Population	Price	Years	Population	Price
1717/21	162	68.0	1735/39	242	69.1
1750/54	86	97.0	1751/55	146	101.6
CASE	Predicted Population 1750/54			Predicted Population 1751/55	
A	139			217	
B	120			197	
C	97			170	
D	87			146	

Notes: Simulated population is expressed in thousands of animals and price as an index of one Made Beaver equals 100. Both are averaged over the indicated periods. Cases are based on equation 12, with $\alpha = .5$, $\beta = .67$, and δ taking a value of .25, .5, 1, and 2 respectively for A, B, C, and D. Estimates based on other parameter values are available from the authors.
Source: See the text.

in price should have reduced population to between 146,000 and 217,000 and therefore explains 26 to 100 percent of the estimated population decline.⁴⁴

DEPLETION, OVEREXPLOITATION, AND THE HUDSON'S BAY
COMPANY'S REACTION

The preceding analysis highlights the role played by price in the overexploitation of the beaver population. But ultimately, it was the fact of the French presence and the Company's reaction to that presence that determined the extent of harvesting and the resulting stock of the resource. Indeed, the fact of a French presence is commonly cited in the correspondence between the managers and the head office as the reason for the declining returns at Hudson's Bay Company trading posts.⁴⁵ The effect of French competition on the trade at Fort Albany is well documented in the letters sent from that post to the head office in London, which provide a good description of the actions and reactions of the Hudson's Bay Company managers.

In 1716, which was part of a period in which we estimate that the beaver population was close to maximum sustained yield levels (see Figure 3), Thomas Macklish, the chief trader, wrote:

I have told all the Indians not to bring any summer beaver, neither in coat nor parchment. I likewise burnt 150 coat and parchment before their faces, telling

⁴⁴ The range is narrowed considerably if we use the intermediate supply elasticities, 0.5 and 1.0. The contribution of price to the population decline now falls between 47 and 75 percent.

⁴⁵ The initial response of the Governor and Committee to French competition was a political one. They tried, but failed, to get the French to honor the preliminaries to the Treaty of Utrecht by leaving their posts in the area.

them at the same time that it is of no value with us; upon which all the Indians in general has promised to bring no more summer beaver. I likewise told all the Indians not to make any cub skin coats, which is somewhat impossible for the Indians to perform, unless they were to make coats of summer beaver, for as soon as the winter sets in they are obliged to make use of the first beaver they catch to keep them from freezing.⁴⁶

But in the same letter, Macklish told the Committee that “it is certain the French began their new settlement up this river last summer and have built two houses in the centre of those Indians that have used this place ever since it was settled by the English.”⁴⁷ Macklish knew this not just because the Indians told him, but also because they came carrying French goods. However, he felt that the French would not be much of a problem because “They all in general told me that the French trades hard with them, and that I give twice the value from beaver and all other furs, cats excepted”—upon which he raised the rate for cats, “which has given good satisfaction to the Indians and they have promised to come here next summer to trade and bring what cats they kill with them.”⁴⁸ Interestingly, at the same time that Macklish was saying that the French would not be a problem, he responded to the French presence by increasing the price of at least one fur.

In 1722 Joseph Myatt, who was then chief factor, wrote that the Albany returns had declined because “we have not had any of the leading Indians down with us to trade that were here last year.”⁴⁹ He hoped that they had gone to York Factory, although he knew that the Moose River Indians and the Tibithebe Indians had gone to the French.⁵⁰ His response was to “make some presents to the two leading Indians of Moose River . . . being in great hopes that will induce them to come here again.”⁵¹ In his 1726 letter, Myatt, who was once again chief trader, replacing Richard Staunton, told the Committee that “Mr Staunton tells me, to encourage the native, he promised them to trade them martens at two per beaver the next year, therefore hopes you honours will not take it amiss if I should trade them so.”⁵² Thus from a position in 1716 when the Company’s traders were burning furs to discourage trapping of inferior skins, the traders in the mid-1720s slowly eroded that position by increasing the standard on particular furs. By the 1730s the policy of raising price was extended to the most important fur, beaver, and as a result we see a marked increase in the overall price

⁴⁶ Davies, *Letters from Hudson Bay*, p. 41.

⁴⁷ *Ibid.*, p. 42.

⁴⁸ *Ibid.*, p. 43.

⁴⁹ *Ibid.*, p. 82.

⁵⁰ It has been argued that the Hudson’s Bay Company posts competed among themselves for the Indian trade. We find little evidence of this in the harvest numbers.

⁵¹ Davies, p. 82.

⁵² *Ibid.*, p. 114.

index. As we show in Table 2, the increases in price had significant long-run repercussions on the beaver stock.

A second policy response to French competition, used far more occasionally, was to send out individuals to persuade the Indians to come to the Bay posts to trade. The policy was pursued at Albany to the unusual point that the Company set up an inland post, Henley House. It was not considered a trading post, but rather an interception point from which the traders could entice and direct Indians down to the Bay.⁵³ York Factory's manager, James Isham, built Flamborough House up river from the coast in 1750, again to intercept the Indians. But once the level of competition declined, Isham closed the post. The head office wrote to Isham in 1753 noting that "as you are of opinion that if a proper Person were sent a great way up into the Country with *presents* to the Indians it May be a means of drawing down many of the Natives to Trade We approve therof."⁵⁴ In terms of the issue of depletion, these policies—setting up interception posts and sending people inland—were structured to increase the flow of furs to the Bay, but this strategy also included the use of presents, which increased the prices paid to the Indians.

It seems clear that the responses to French competition were damaging to the underlying resource stock, but these actions cannot be seen in isolation from other Company objectives. A primary feature of Company policy throughout the eighteenth and nineteenth century was the desire of the head office to maintain control of the trade. This desire manifested itself in two ways. The first was in the attempt of the Company to maintain close trading relationships with the various Indian tribes. Managers, for example, were willing to burn furs during periods when there was no competition, but they were unwilling "to disgust the Indians" by such policies or by refusing to purchase poorer quality skins once the French became a threat. The second was in the imposition of controls on Company managers, who, nevertheless, were given enough flexibility to respond to the French presence.

One of the most important devices used by the Company in its efforts to monitor managerial effort was the post account books. The head office combined the information given in the accounts with data on the quantity of trade goods sent out to the posts and furs shipped from those posts to England. These were then used to create terms-of-trade indices, or measures of managerial performance. Whenever the index fell below a given level, the head office would write and complain about the returns and often would recall, demote, or even fire the trader.⁵⁵ The

⁵³ This post represents one of the few instances in the pre-1770 period when the Company moved away from the Bay. Henley House was closed in 1754 when the Indians destroyed it and killed all the personnel. Rich, *History*, vol. 1, chap. 42.

⁵⁴ Rich, *James Isham's Observations*, p. 323, emphasis added.

⁵⁵ See Carlos and Nicholas, "Agency Problems."

objectives of the Company were laid out to Joseph Isbister when he took over command of Fort Churchill: “we have nothing more at Heart than the Preservation of our Factorys, the Security of our People and the Encrease of our Trade.”⁵⁶ Although maintenance of the resource base should have been important, the operation of this policy made it difficult for individual managers to react to depletion. During a period of competition, an individual manager who refused to trade for small or summer furs would find that his returns were falling, as the Indians now had alternative opportunities. Such a strategy would be risky for a manager because, in the face of such falling returns, the head office would find it very difficult to distinguish between a manager operating in the long-term interest of the Company and one who was just incompetent or behaving opportunistically.

We must also ask just how apparent the decline in the resource base would have been during this period. In one sense, the evidence available to the Company was the same as that available to us. We used the actual numbers of furs traded at each of the three posts. But it is clear from Figure 2 that there was a large variability in the returns. The downward trend is evident only retrospectively. In addition to these returns, we also used modern ecology literature on the beaver to generate estimates of the underlying population. This information would not have been available to the Company. However, two other sources of information were available: the Indians and the traders. James Isham, chief trader at York and at Churchill, was also a well-respected British naturalist. He wrote of the beaver in the early 1740s, that “I’tts a Little strange the Breed of these beaver Does not Diminish greatly considereing the many thousands that is Killd.of a Year.”⁵⁷ Later, in his description of the number of young born, he reported “some having five and six at a time.”⁵⁸ We know from the ecology literature that only in an irrupting population will a beaver bear that number of young. In a stable environment, the number is around three. Isham’s intuition that the beaver stock should have been declining at York is correct and is borne out by our simulations, but the precipitous decline in population occurred only after Isham made these comments.

The Indians were also a potential source of information on the state of the underlying animal population. Here the situation is clouded by the fact that beaver was not the only fur traded. Although beaver was the most important, and the head office kept the accounts in terms of Made Beaver, a manager could keep his total Made Beaver return up by ensuring an increasing (or at least not decreasing) supply of other furs. As pointed out earlier, what is commonly seen is that as the number of beaver traded declined, the number of martens traded increased. Thus,

⁵⁶ Rich, *James Isham’s Observations*, p. xxx.

⁵⁷ *Ibid.*, p. 143.

⁵⁸ *Ibid.*, p. 147.

the Indians could substitute one fur for another in the trading process, which reduced their incentive to conserve any one resource.

Yet even if the Indians told Company managers about the true state of the underlying population, that information was likely to be downplayed if not completely ignored. The problem was one of the role of information in the bargaining process. As Isham wrote in his *Observations*,

The worst property that attends these Natives is their false information, for if you put a Question to them, as I have Done oft's, they will anser to what I Desir's, at the same time neither her'd see, or new any thing of the matter, so by severall other casses, by which they are not to be Really's on unless all points upon the same Subject, as the proverb is, what all say's is true, but I found the Contrary by these Natives.⁵⁹

All of the forces discussed above made it difficult for the Hudson's Bay Company to realize the serious nature of the problem and thus to devise a response to it. In fact, it was not until 1821 when the resource base was almost exterminated, that the Company was able to merge with its main rival and begin to put in place policies to deal with the problem of overexploitation.⁶⁰ After 1821 the Hudson's Bay Company returned once again to a policy of refusing to purchase small or young skins and even to burning such skins to show the Indians that they were serious.

CONCLUSION

The theme of competition and depletion of biological resources has been played out in other contexts, and the plots have a familiar ring. A previously unexploited or underexploited resource is suddenly opened to a new harvesting technology or to new markets. As long as the exploiter can control access, the harvesting is at an appropriate level. Once this control is lost, however, the resource becomes degraded. This is our story of the beaver during the early years of the Hudson's Bay Company. Where the Company had a monopoly, it pursued a maximum sustained yield strategy in regard to the animal stock; but once sole access was lost, as happened when the French infiltrated its trading areas, the strategy changed. To meet the competition, the Company raised the prices they paid to the Indians, and the Indians responded in the short run with larger harvests. But these harvests were not sustainable, and ultimately the beaver population declined. Only in the area protected by distance from French competition was the animal stock maintained at close to optimal levels.

Our results suggest that both the Hudson's Bay Company and the Indians on whom they relied were victims of the same market forces

⁵⁹ Ibid., p. 92.

⁶⁰ Carlos and Hoffman, "North American Fur Trade."

that continue to afflict other “fisheries.” The unhappy outcome in two of the trading areas in our study thus represents not a failure by either party to respond to the changing market, but rather their success in confronting a competitor in an industry where private rationality meant lower returns for all.

Appendix: The Effect of Price on the Equilibrium Beaver Population

We assume specific functional forms in equations 3 and 4 to derive empirical estimates of the effect of price on the (simulated) beaver population. The harvest function is assumed constant-elasticity, with nonincreasing returns to effort and population:

$$H = E^\beta X^\alpha, \quad 0 < \alpha, \beta \leq 1 \quad (7)$$

The effort function is also a constant-elasticity relationship:

$$E = er^\delta, \quad \delta > 0 \quad (8)$$

where δ is the elasticity of supply of effort. Noting that $r = pH/E$, it follows from equation 7 that

$$r = pE^{(\beta-1)}X^\alpha \quad (9)$$

Substituting equation 9 into equation 8 and rearranging terms gives the following:

$$E = (ep^\delta X^{\alpha\delta})^{1/[1+\delta(1-\beta)]} \quad (10)$$

Substituting equation 10 into equation 7 gives us a relationship between the harvest, the price of furs, and the stock of animals:

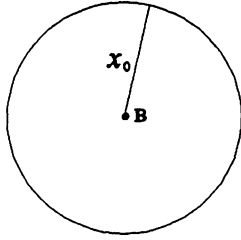
$$H = [e^\beta p^{\beta\delta} X^{\alpha(1+\delta)}]^{1/[1+\delta(1-\beta)]} \quad (11)$$

For a given population, X , the elasticity of the harvest with respect to the price of furs is $\beta\delta/[1+\delta(1-\beta)]$, which for $\beta = 1$ is the same as the elasticity of supply of effort. Over the longer run, however, fur prices will also influence the harvest indirectly because the beaver population will change. The long-run equilibrium effect of a change in price from period 0 to period 1 is derived by substituting equation 11 into equation 6:

$$\left(\frac{p_0}{p_1}\right)^{\beta\delta} = \left(\frac{X_1}{X_0}\right)^{\alpha(1+\delta)} \left(\frac{aX_0 - bX_0^2}{aX_1 - bX_1^2}\right)^{[1+\delta(1-\beta)]} \quad (12)$$

Equation 12 provides the basis for our estimates of the effect of price on the beaver population. Central to these estimates are the values of the elasticity parameters, α and β . Here we suggest the likely orders of magnitude by deriving a harvest function specifically for beaver.

It appears that harvesting beaver involved three costs: the cost of finding them, which was not very difficult because beaver are territorial; the cost of killing them and preparing them for market, which was reasonably difficult in that the lodges had to be broken into; and the cost of entering the trade. The first cost depends on distance and thus is related both to the size of the harvest and the density of the beaver population. Suppose the hunter is based at location B in the following diagram.



The larger the harvest, the greater the distance, x_0 . Thus the (travel) cost of beaver trapping rises with the size of the harvest. The number of beaver harvested at any distance, x , from B is proportional to the circumference of a circle of that radius.

$$h(x) = 2\pi kx \tag{13}$$

where $h(x)$ equals harvest at distance x , and k is a factor that depends on beaver density. The total harvest of a hunter who travels a maximum distance, x_0 , from B is given by

$$H(x_0) = \int_0^{x_0} 2\pi kx \, dx = \pi kx_0^2 \tag{14}$$

Treating the travel cost per beaver as proportional to distance walked,

$$c(x) = wx \tag{15}$$

where w is the travel cost per beaver per unit distance walked, we derive the total travel cost of harvesting beaver within radius, x_0 , of B as

$$C(x_0) = \int_0^{x_0} wxh(x)dx = \frac{2}{3} \pi wkx_0^3 \tag{16}$$

Substituting equation 14 into equation 16 and rearranging terms, we have

$$H(x_0) = \left(\frac{3}{2w}\right)^{2/3} \pi^{1/3} [C(x_0)]^{2/3} k^{1/3} \tag{17}$$

Noting that density, k , is proportional to the beaver population and cost, $C(x_0)$, is proportional to effort, we can write the harvest function as

$$H = K \cdot E^{2/3} X^{1/3} \tag{18}$$

Including the cost of killing and preparing beaver for market and the cost of entering the trade will tend to reduce the population elasticity α , and increase the effort elasticity β .

Although we have no empirical estimates of α and β for beaver, Henderson and Tugwell have estimated a harvest function for lobster, another nonmigratory species. Their estimates are $\alpha = .44$ and $\beta = .48$.⁶¹

⁶¹ Henderson and Tugwell, "Exploitation of the Lobster Fishery," p. 292.

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