

CAUSES OF LOSS OF AFRICA'S RHINOS

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N. Leader-Williams, Planning and Assessment for Wildlife Management, Department of
Wildlife, PO Box 63150, Dar es Salaam, Tanzania.

INTRODUCTION

Until the mid 19th century, black rhinos (*Diceros bicornis*) had a fairly continuous distribution through 29 present-day countries of sub-Saharan Africa, with the exception of the Congo Basin. The black rhino is a browser and its primary habitat is woodland savannah, but it has also colonised other habitats ranging from deserts in the southwest (and formerly northwest) to montane forest in the northeast of Africa. By contrast, white rhinos (*Ceratotherium simum*) are grazers and in recent times have had a disjunct distribution at the north and at the south of the black rhino's range (Sidney 1965). Africa's two species of rhinos are amongst the world's most endangered large mammals. One sub-species (northern white) teeters on the edge of extinction. Over the past two decades, the formerly numerous black rhino has plummeted from an estimated 65000 in 1970 to 2500 in 1992 and has become locally extinct over large areas. In fact, black rhinos have the dubious distinction of showing the fastest known rate of decline of any species of large land mammal. By contrast, the southern white rhino is currently well conserved in limited areas of its range in southern Africa. However, with a total world population in only the low thousands, the continued survival of southern white is by no means guaranteed (Cumming, du Toit & Stuart 1990). This review aims to discuss reasons for the loss of Africa's rhinos, in the context of both historical and recent losses. The purpose of this review is to set in context the problem, in order to be better able to find a solution, for successes in rhino conservation there have been (reviewed in Leader-Williams 1991).

HISTORICAL LOSSES OF AFRICAN RHINOS

Rhino numbers have declined for two main reasons. First, loss of rhino habitat has been especially serious in certain areas. Second, rhino horns are used in medicines and as dagger handles, and other rhino products such as skin and blood are used to a lesser extent. As a result of high demand for rhino horns, unprotected populations of rhinos have been exploited unsustainably and the trade in their products has largely been responsible for reducing rhinos to their presently endangered status.

Loss in habitat. Human population densities in much of Africa are generally not very high, and habitat loss has not been as much of a problem for African rhinos as for their Asian cousins. However, it is clear that habitat loss and conflicts with human interests has led to the loss of many rhinos in historical times. For example, the near elimination of southern white rhinos early this century was as a result of direct conflicts with settlers (Owen-Smith 1981). For

many years now there have been very few rhinos remaining in West Africa as a result of the high human population density in that area (Happold 1987). However, even in East Africa, it is clear that human expansion has caused a major contraction of the range of the black rhino. A map of areas of high human population density in 1949 is the almost exact reverse of a map of the distribution of the black rhino, and there has been a progressive loss in its range since 1925 (Figure 1). The most quoted example of conflict between man and rhino is the case of John Hunter who shot around 1000 black rhinos in three dry seasons of 1944-46 to clear land for an agricultural scheme to the south of Nairobi (Hunter 1952). Rhinos so killed have also played a major part in contributing to the other main problem for rhinos, that of the trade in horn.

The uses and history of the rhino horn trade. The rhino horn trade has a long history, but there is little evidence of domestic consumption of rhino horn produced in Africa (Martin & Ryan 1990). One of the earliest records of use of rhino horn as a medicine was by the Chinese during 200 B.C.-200 A.D. (But, Lung & Tam 1990; Martin & Martin 1982). During the Ming and Ching dynasties, the Chinese carved rhino horns into beautiful cups, plates, bowls and figurines. Rhino horn drinking vessels had the added advantage of being able to detect alkaloid poisons, in an age when such poisons were a major means of treachery. However, westerners long believed that rhino horn was used primarily as an aphrodisiac, but this myth was exploded in the early 1980s (Martin & Martin 1982; Parker & Martin 1979). Some rhino horn is indeed consumed as an aphrodisiac, but this is limited to use by the Gujaratis in India. Rhino horn has had two far more important uses in terms of volume traded in recent times (Figure 2). First, horn and other rhino products such as blood, skin and urine, are an important constituent in traditional medicines and potions used to reduce fevers, headaches and other illnesses in the Far East. Such medicines are used primarily by the Chinese, but also by Burmese, Thais and Nepalis. In contrast, the Japanese and Koreans also learned to use rhino horn in medicines through early cultural links with the Chinese, but do not use other rhino products. Rhino horn is generally sold in the Far East in one of two forms, first as "raw" horn by traditional pharmacists who make up the medicine for individual customers from horn held in their shops, and second as a constituent in manufactured medicines. An important point is that "Fire" (Asian) horn is believed more efficacious than "Water" (African) horn and that Asian horn is considerably more expensive (Martin & Martin 1982; Nowell, Chyi & Pei 1992). Thus both African and Asian rhino horn is used widely throughout the Far East both by indigenous people but particularly by the resident Chinese communities found in most Far Eastern countries (Martin 1983). In addition, confiscations in Los Angeles, San Francisco and Brussels attest to the use of rhino horn by Chinese communities in Western countries. Second, Yemenis have used African rhino horn since at least the 8th century to make handles for traditional daggers (jambias). Daggers are important status symbols in the cultural life of Yemeni men. In contrast to other materials used for dagger handles such as water buffalo

horn, rhino horn handles improve in appearance and lustre with age. Therefore, it is the quality of rhino horn that interests the makers of daggers rather than any fascination with rhinos per se (Varisco 1989).

The beauty of carved rhino horn, whether as cups or dagger handles, cannot be disputed. The pharmacological efficacy of rhino horn as an aphrodisiac can, as with all other types of aphrodisiac, only be guessed at. However, its psychocological value may well be all important and has some basis both in the shape of rhino horns and in the long courtship and staying power of copulating rhinoceroses, which take upwards of 1 hour from intromission to ejaculation (Goddard 1966; Laurie 1982). An early study suggested, too, that rhino horn had no pharmacological efficacy as an anti-pyretic, using doses of 100-300 mg kg⁻¹ administered orally in rats (Hoffmann-La Roche 1980), and that its use must therefore rest on traditional belief. However, a more recent study shows that African rhino horn has an anti-pyretic effect at much higher doses of 4000-20,000 mg kg⁻¹ administered intra-peritoneally, also in rats (Figure 3). The latter represents a dose some one hundred times higher than would be taken by a human, and experimental protocols between the studies differed, not only with respect to the route of administration, but also with respect to the experimental means used to induce the initial pyrexia (But, Lung & Tam 1990). However, the recent study shows that traditional Chinese beliefs may have some pharmacological basis, but this conclusion needs further substantiation (But, Lung & Tam 1990).

Whatever the situation with pharmacology versus traditional beliefs, trade in rhino horn has occurred along well established routes for centuries. An early record of rhino horn leaving Azania (ancient East Africa), together with ivory and tortoise-shell, for southern Arabia dates from 50 A.D. (Sutton 1990). However, historical and contemporary information on actual volumes and prices of rhino horn in world trade are generally lacking. One of the best runs of data come from East Africa where the declared exports of rhino horn were compiled from customs statistics from 1926-76, three years before Kenya became a party to CITES in 1979 (Parker & Martin 1979). The relationship between the average price and the total volume of rhino horn sold from the East African auction rooms is shown in Figure 4. This data set, acquired from one consistent source, can be combined with some more anecdotal information for earlier years (Martin & Martin 1982). From these figures, it was estimated that East Africa as a whole may have traded 11,000kg/yr from 1849-1895 (Figure 5). This represents the death of around 170,000 black rhinos over this period. In later years declared exports from East Africa declined to average 1600kg/yr (or the death of 555 black rhinos/yr) during the 1930s, dropped to 500kg/yr (174 rhinos/yr) during World War II, rose to 2500kg/yr (or 868 rhinos/yr) immediately after the war, dropped to 1800kg/yr and 1300kg/yr (625 and 451 rhinos/yr) during the 1950s and 1960s, before rising to 3400kg/yr (1180 rhinos/yr) in the

1970s. During this period average prices increased steadily until the early 1970s when they showed a more rapid increase (Figure 4).

RECENT LOSSES IN AFRICAN RHINOS

Conservationists and governments responded to this double dilemma, namely loss of wildlife habitat and unsustainable levels of trade in wildlife products, with a two-pronged approach, not only for rhinos but for all other species. On the one hand, an increasing number of protected areas were established in Africa from the early part of this century and onwards. Africa is very well endowed with many such areas that are now world famous and were home to many rhinos. Names like Tsavo, Selous, Luangwa, Wankie and Kruger come to mind immediately, and at the beginning of the 1970s Africa was estimated to hold a continental total of 65,000 black rhinos. On the other hand, attempts were made to regulate international trade in wildlife products from endangered species through the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), which entered into force in 1975. Rhinos and their products were among the first species to be placed on the CITES appendices. In July 1975, three species (Sumatran, Javan and Indian) and one sub-species (northern white) were placed on Appendix I, while one species (black) was placed on Appendix II. In February 1977, both the black and southern white rhino were placed on Appendix I, therefore banning international trade in the whole family of rhinos and their products.

Since CITES was formulated and all species of rhinos were placed on Appendix I, it has been hoped that successful conservation of rhinos would be achieved most cost-effectively by halting the trade in horn. While being afforded the supposed benefit of an international trade ban, many populations of the most widely distributed species, the black rhino, have continued to be over-exploited for their horns, as already noted at a rate faster than any recorded for any other large land mammal. What has gone wrong? The levels of illegal exploitation arise from a number of complex social and economic factors, such as the external demand for trophies, the poverty of rural people and their disenfranchisement from protected areas, from corrupt officials and the ready availability of weapons (Douglas-Hamilton 1987; Milner-Gulland & Leader-Williams 1992; Western 1987).

Resources available for protected areas. In theory large reserves or parks reduce the risks of extinctions arising from genetic isolation because they contain sizeable populations, and a minimum viable population may survive for several hundred years (Soulé 1986a; Soulé 1986b). In practice, however, most African countries have lacked the resources during the past two decades to protect large populations of rhinos from illegal exploitation within protected areas. Surveys both during the 1980's show that numbers of black rhinos declined in 14 countries and remained the same or increased in only three (Cumming, du Toit & Stuart 1990;

Cumming & Jackson 1984; Western & Vigne 1985). The declines of rhinos within different countries appears to be linked to their prevailing socio-economic conditions. There was a wide variation in the budgets allocated by central governments to national conservation agencies in 1980 and in their staffing levels, both absolutely and in relative terms when compared to the total areas under protection. A detailed study of differences in patrol effort devoted to the various areas of Luangwa Valley, Zambia, in 1979-85 showed that the resources put into conservation played a role in determining the success of protecting rhinos (Leader-Williams, Albon & Berry 1990). Likewise, across different countries in the 1980s, there was a direct relationship between estimated declines of total numbers of both black and white rhinos combined and spending, corrected for total area (Figure 6). To have achieved a zero decline of rhinos the relationship predicts that 1980 spending levels should have been \$US 220 per km² per year (Leader-Williams & Albon 1988).

Furthermore in poor African countries, large conservation areas and sizeable populations of valuable species like rhinos have not been maintained because socio-economic problems faced by those living around conservation areas have not been rectified (Abel & Blaikie 1986; Bell 1987). This is very important when coupled with the lack of investment in park infrastructure and policing. In order to understand the mechanism underlying the success of protection, it is necessary to turn to the theory of economics, and to consider the incentives to undertake any form of illegal activity, whether this be robbing a bank or poaching a rhino (Milner-Gulland & Leader-Williams 1992). Rhinos are poached because their horn has a high economic value (see Figure 4). There are considerable incentives to poach a rhino, for three main reasons. Firstly, there is little chance to earn wages from some form of legitimate activity in deprived rural areas and because of the depressed national economic climate. That is to say the crime has a low opportunity cost. Secondly, the probability or severity of punishment is low. Thirdly, the actual profit from the crime is high. Law enforcement can affect incentives in both these last two ways. Studies of various crimes, including of incentives to poach rhinos in Luangwa and Lower Zambezi vallies in Zambia and Zimbabwe show that a high penalty is less of a deterrent than improving the rates of detection and capture (Leader-Williams & Milner-Gulland 1993; Martin 1991; Milner-Gulland & Leader-Williams 1992). This message is important too for traders in horn, few of whom are captured and prosecuted.

Control of trade in rhino horn. Since 1977, CITES has prohibited commercial international trade in all rhinoceros parts, derivatives or products. However, actual demand for horn, as evidenced by continued loss of rhinos in the wild, is a function both of the degree to which speculators are stockpiling horn and consumers are using horn. Control of domestic possession and sale of rhino parts and products is beyond the specific mandate of CITES and still remains unregulated in most consuming nations in Asia. Since the 1980s, therefore, the

main approach by conservationists wishing to halt the serious declines seen in unprotected populations of endangered rhinos has been to attempt to halt the trade and encourage the use of substitutes within individual consuming nations. This option was seen as a more cost-effective approach than providing protection for rhinos throughout their range (Cumming & Jackson 1984; Martin 1980; Western 1987).

It has been argued from survey data collected on the illegal rhino horn trade in the Far and Middle East that demand for rhino horn has decreased (Martin & Martin 1987), and that the battle to control the trade is being gradually won, using the following reasoning. First, only 3 tonnes/yr of horn came onto world markets from 1980-85, in contrast to the 8 tonnes/yr during the 1970s. Second, even with this reduced supply, wholesale prices have remained the same since 1979, and retail prices actually fell from 1980 to 1986 in several cities. Third, had the demand for horn remained constant, the prices would have soared because less horn was available (Martin & Martin 1987). Demand was believed to have fallen due to acceptance of substitutes such as water buffalo and saiga horn in traditional medicines (indeed recent findings suggest that substitutes like water buffalo horn are as efficacious as anti-pyretics in traditional medicines (But, Lung & Tam 1990). Yet results from South Korea and Taiwan caution against accepting results from such surveys as evidence of reduced demand (Nowell, Chyi & Pei 1992; Song & Milliken 1990). By the mid 1980s there was evidence of reduced consumption only in Japan, India and North Yemen. In the case of Japan, this appeared due to the voluntary acceptance of substitutes (Martin 1983) but, as noted above, the use of rhino horn medicines by the Japanese was learned from the Chinese and may not be as firmly ingrained a traditional belief. In the case of India, it was because it is more economically viable to export horns to lucrative markets (Martin 1983; Martin, Martin & Vigne 1987). In the Yemen the reduced use of rhino horn can be attributed to the fact that substitutes and synthetic materials of suitable quality are acceptable for dagger handles, especially in times of economic stringency, in contrast to medicines (Vigne & Martin 1991). This makes the point quite clearly that it is easier to halt the trade in animal products in luxury than in consumer goods.

Since the earlier optimism that demand for horn was slowing, the retail prices of horn have again risen in the data collected from 1988 and onwards. A further look at the survey data on the illegal trade in rhino horn is merited because the retail prices charged in pharmacies had not previously been corrected for inflation, and have therefore not reflected real prices. It is unfortunate that only average retail prices are available from Martin's work for correction, rather than the full range of prices, because the few data points give little chance for statistically significant trends in changes of price to be detected. That aside, such correction appears to provide a slightly clearer picture of the success of efforts of a sample of consuming nations to control their trade in rhino horn (Leader-Williams 1992). In Hong Kong, a significantly and

consistently lower proportion of pharmacies have stocked rhino horn during 1979-90 and the real average retail price of rhino horn has shown no trend of increase, and possibly even decreased (Figure 7). By contrast, in South Korea (1980-88) and Taiwan (1979-90) the proportion of pharmacies stocking horn varied significantly but showed no consistent decline, and in Singapore (1979-88) there was no significant change in the proportion of pharmacies stocking horn. However, even with the limited price data, there was a close to significant increase in the real price of Asian rhino horn in Taiwan and weaker trends of increase in the real price of African rhino horn in South Korea, Taiwan and Singapore (Figure 8).

Demand, in terms of stocking frequency and real price, for horn has declined, as far as an analysis of limited data permitted, in only Hong Kong, Peninsula Malaysia and Brunei (plus North Yemen and India for reasons discussed above). In the remaining points of sale surveyed over the past decade or so, there is suggestive evidence that demand, in terms of real price has increased. Thus it appears clear that CITES, other national bans and most other efforts may have succeeded in slowing, but not in halting, the rhino horn trade for medicines in the Far East. Control of domestic possession and sale of rhino parts and products, however, is beyond the specific mandate of CITES and still remains unregulated in most consuming nations in Asia. The regulatory model developed in Hong Kong has involved successive steps, of acquiring the broad legal scope to deal with all rhinoceros commodities, of registration of stocks and issuance of possession licences, of import and export/re-export bans, of total bans on domestic trade and of instituting penalties for offenders (Milliken 1991). This regulatory model is being adopted in Taiwan and could be promoted as the way forward in other flourishing markets like South Korea and Thailand. However, after two decades of unsustainable exploitation of the black rhino and its local extinction in many of Africa's protected areas, it is being increasingly questioned whether the policy of attempting to halt the trade in rhino horn, followed for the last 15 years or so, should be reversed. Therefore, proposals were made to the March 1992 Conference to the Parties of CITES in Kyoto, Japan to downlist their rhino populations by Zimbabwe (black and white rhinos) and South Africa (white rhinos), to Appendix II, thereby allowing a limited trade in rhino horn, but these proposals were not even discussed. When revisited again at the next Conference to the Parties of CITES, such proposals will further divide conservationists of different persuasions, and perhaps to a greater degree than the elephant issue. The stance of these countries will differ very markedly from those of most others, who will wish to promote further attempts to control the illegal trade.

CONCLUSION

While the above may all sound rather gloomy, successes in rhino conservation have been achieved or consolidated. When funding for conservation of large areas and large populations

has not been available, then concentrating resources at appropriate levels upon selected areas has provided a pragmatic option for rhino conservation. The recovery of the southern white rhino from near extinction earlier this century and its continued increase in numbers is the best example of success. Other efforts have begun to show signs of success, for example, the initial recovery of two of the four sub-species of black rhinos in Kenyan and in South African and Namibian sanctuaries, respectively and of northern white rhinos in Zaire (Brett 1991; Hillman-Smith, Smith & Atalia 1991; Owen-Smith 1981). The recipe for success of these endeavours has involved the rounding up of stragglers, concentrating resources in small areas, and once the population has built up sufficiently, making translocations to unoccupied habitats in areas of former range (reviewed in Leader-Williams 1991). These efforts must be accompanied by attempts to correct the socio-economic problems outside protected areas, through the involvement of local people in conservation, both in its planning and its benefits (Bell 1987).

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FIGURE LEGENDS

Figure 1. Loss in the range of the black rhino in East Africa from 1925-1975, shown with areas of high human population density (based on Parker and Graham 1989).

Figure 2. Rhino horn is used for medicines in the Far East and dagger handles in the Middle East (photographs by E Bradley Martin).

Figure 3. The anti-pyretic effect of two intra-peritoneal injections (marked with arrows) of rhino horn at doses of 2.5g/ml in rats (after But et al. 1990).

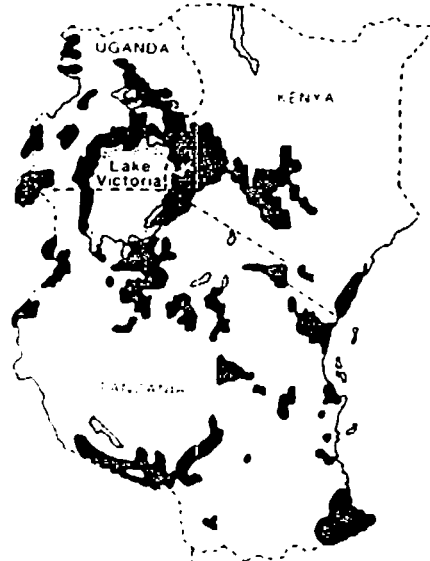
Figure 4. The volume (solid line) and price (dashed line) of East Africa's declared exports from 1929-1976 (data from Parker and Martin 1979).

Figure 5. Volumes of horn traded and numbers of black rhino killed annually in East Africa (based on data from Parker and Martin 1979; Martin and Martin 1982).

Fig. 6. Relationship between change in black rhino numbers during 1980-87 and conservation spending in various African countries in 1980 (from Leader-Williams & Albon 1988)

Figure 7. Change in numbers of pharmacies selling rhino horn and in retail price, corrected for inflation, of African horn (except where indicated), in four Far Eastern countries (from Leader-Williams 1992).

HUMAN DENSITIES > 25 per sq km



1949

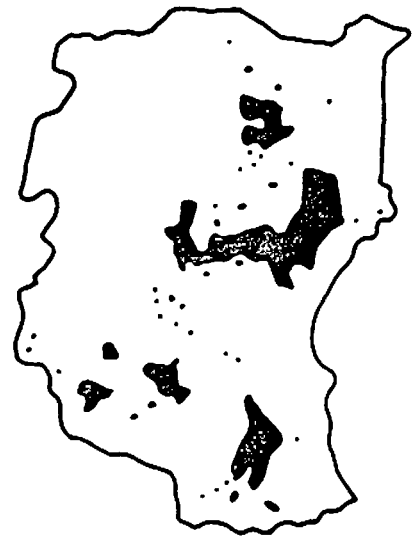
BLACK RHINO DISTRIBUTION



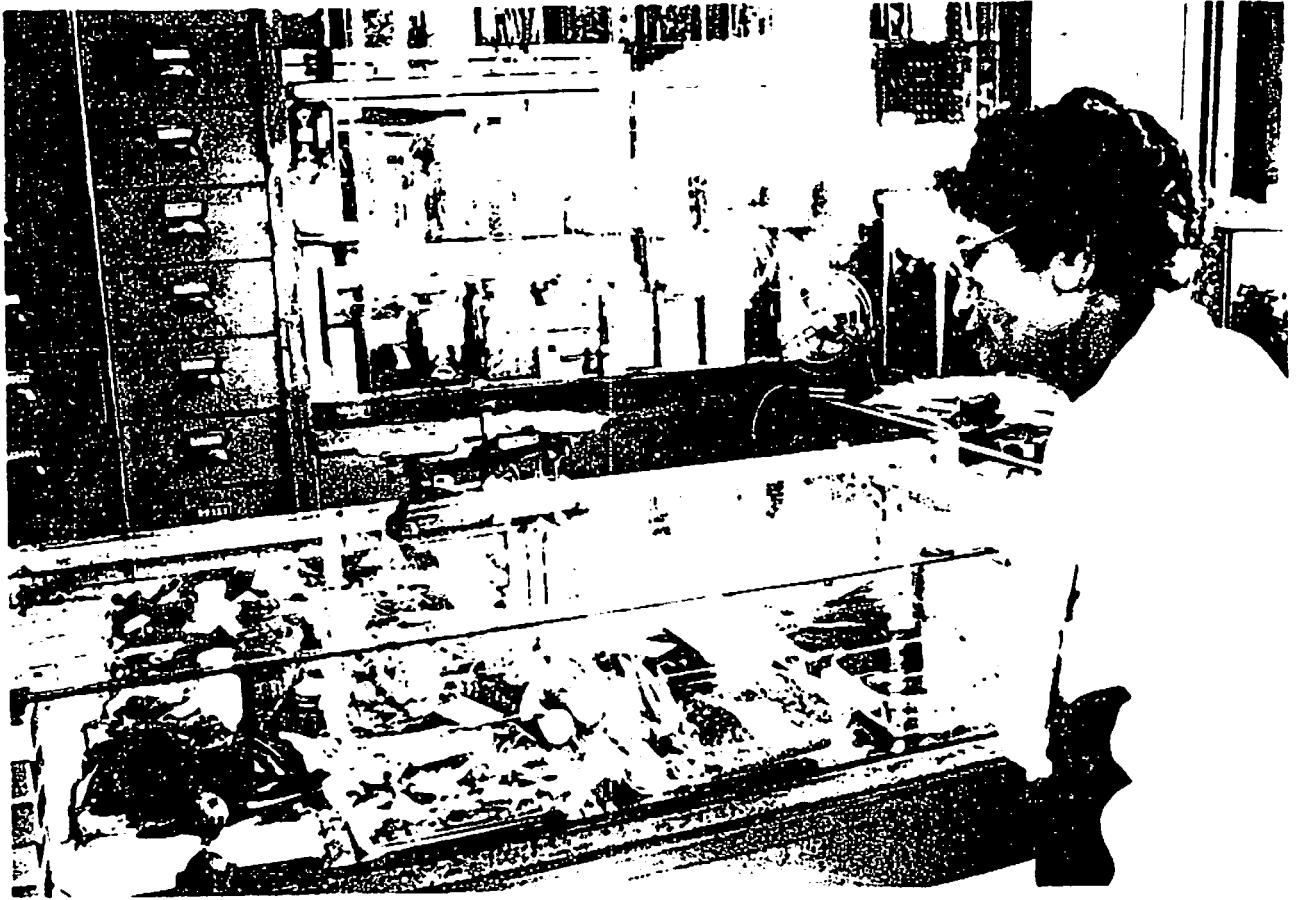
1925

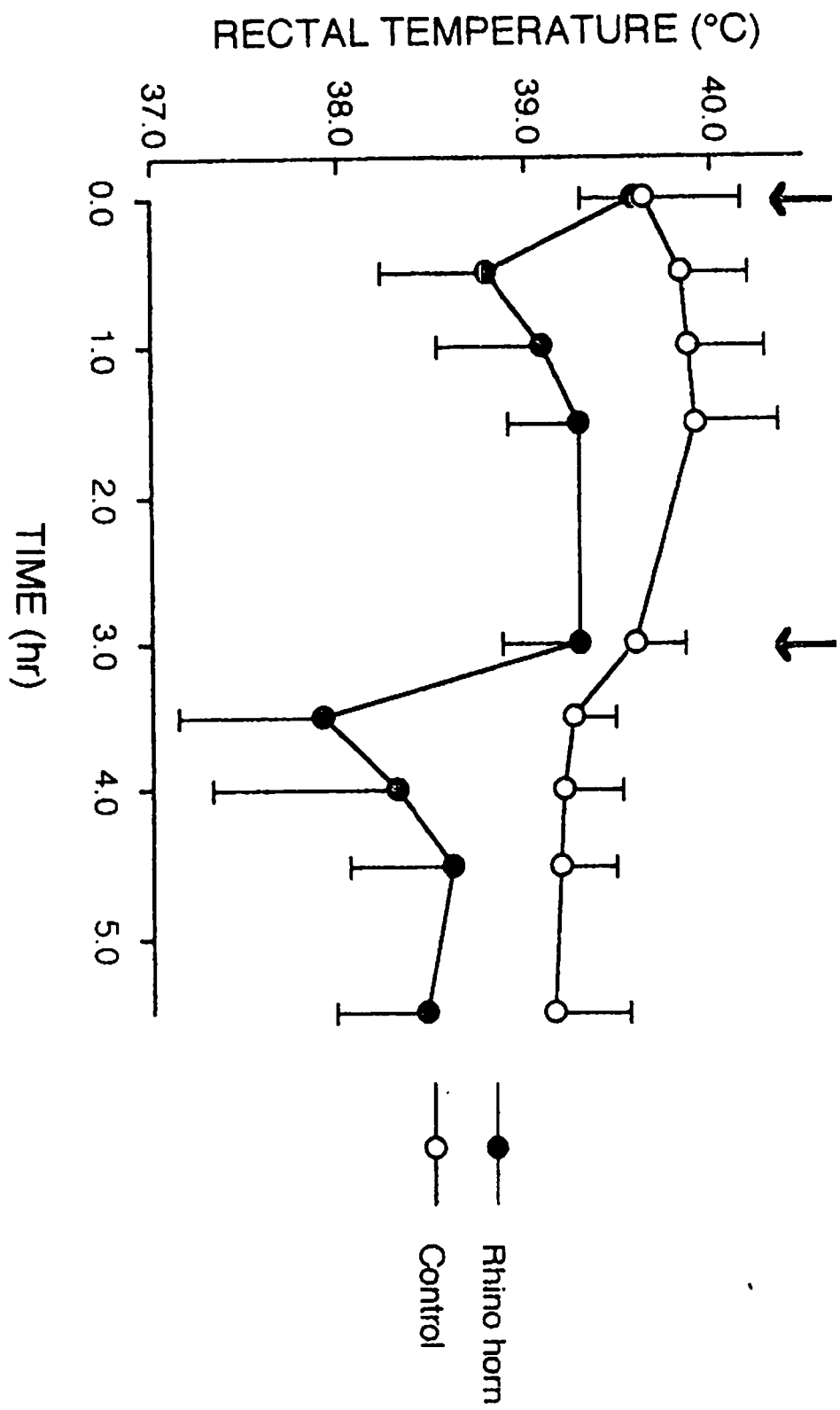


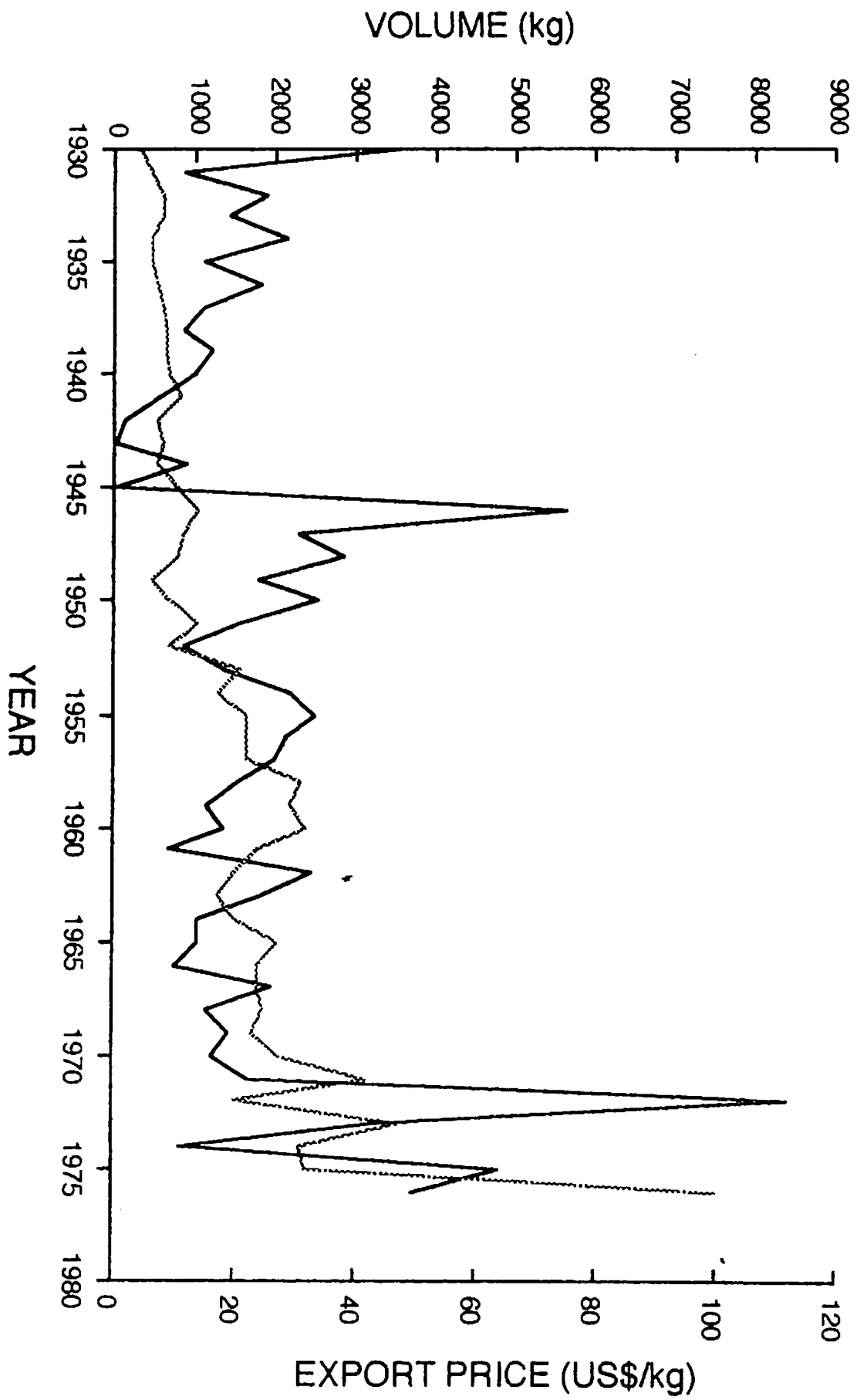
1950



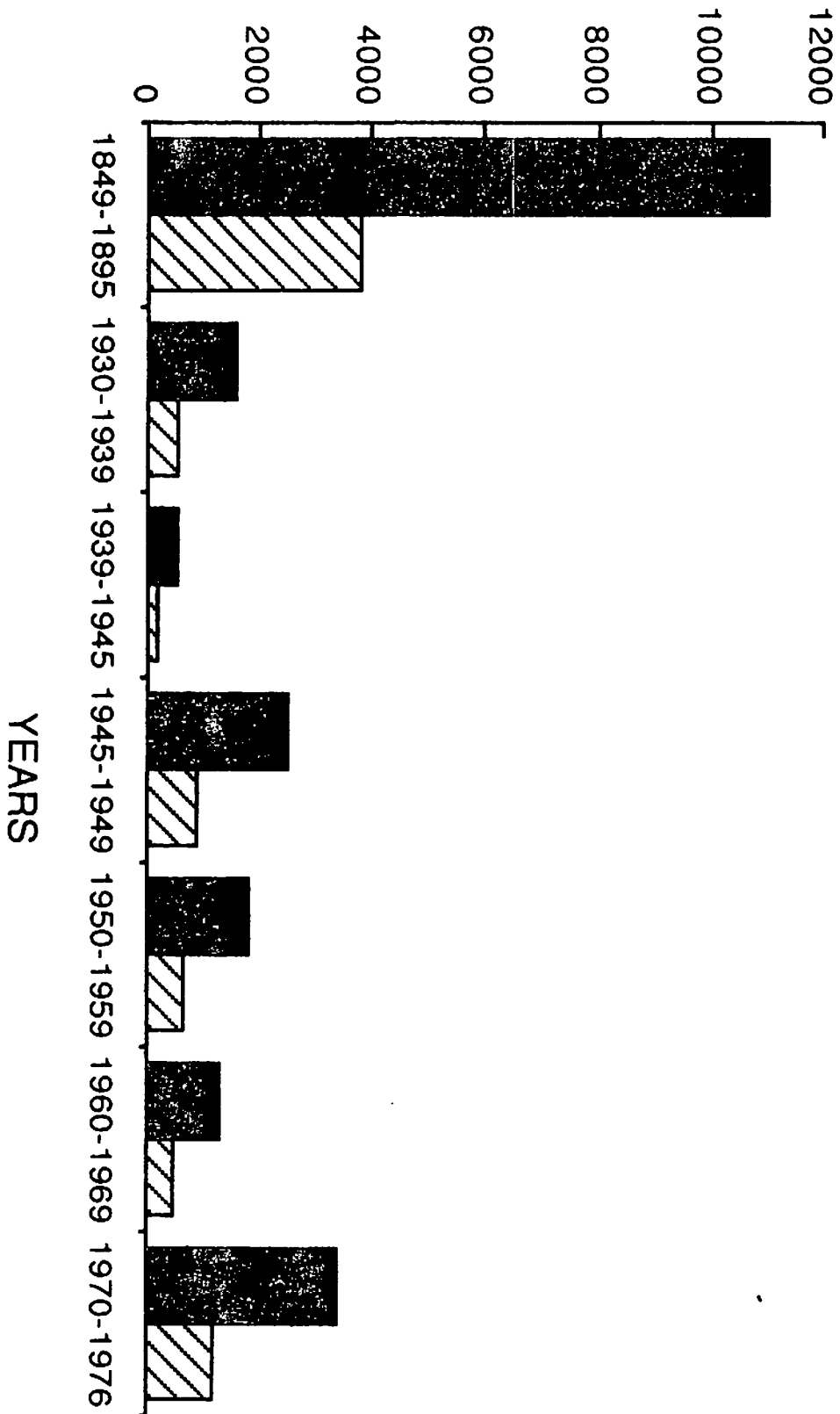
1975

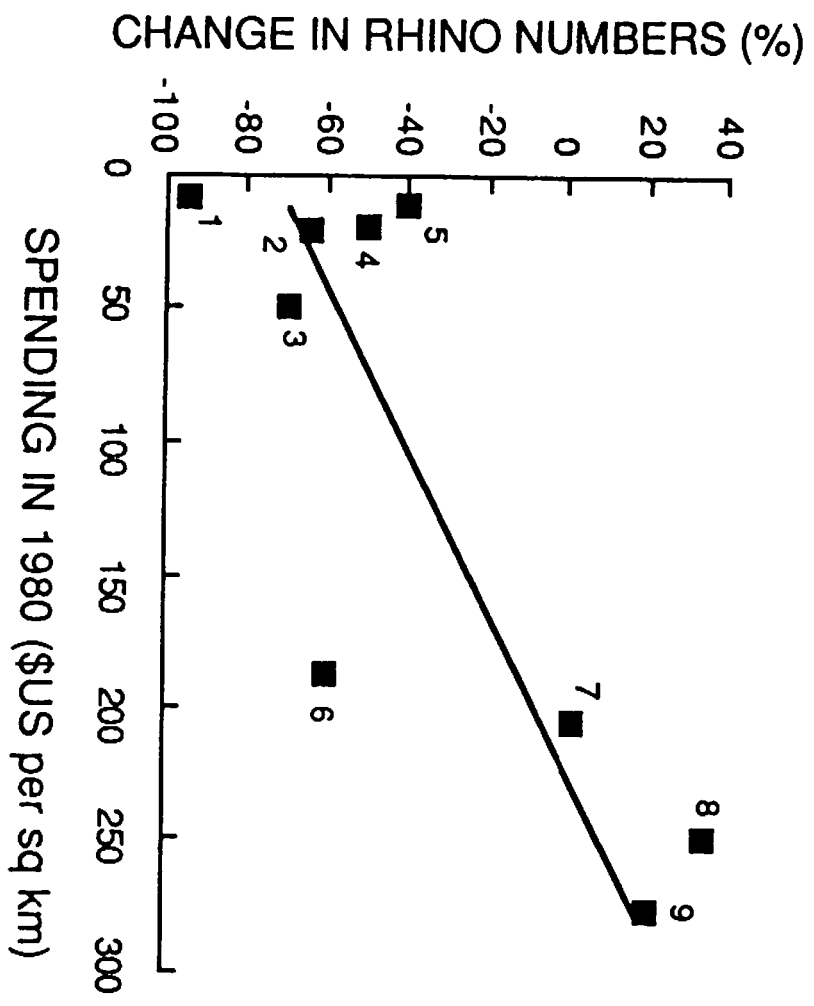




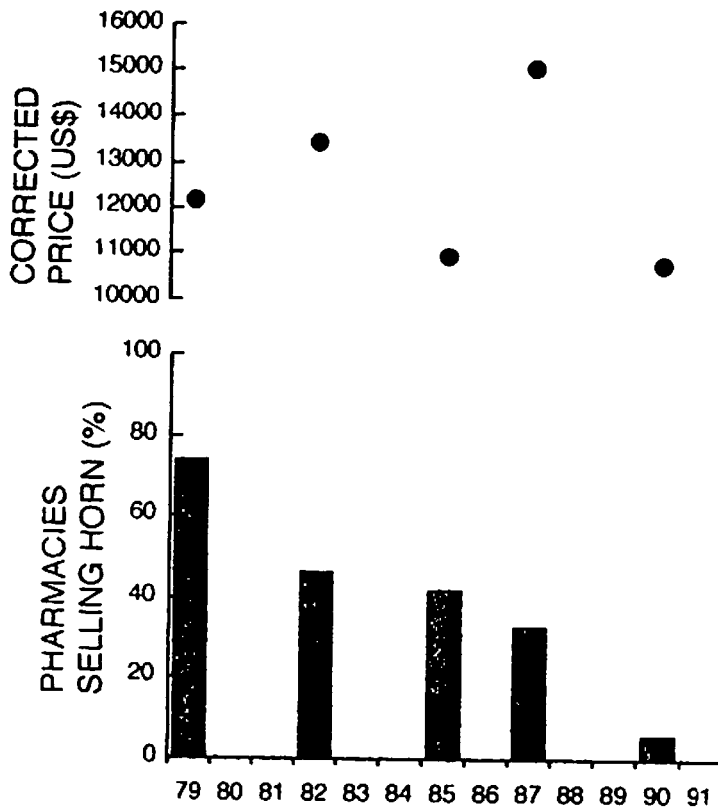


VOLUME OF HORN (kg) AND NUMBERS OF RHINOS PER YEAR

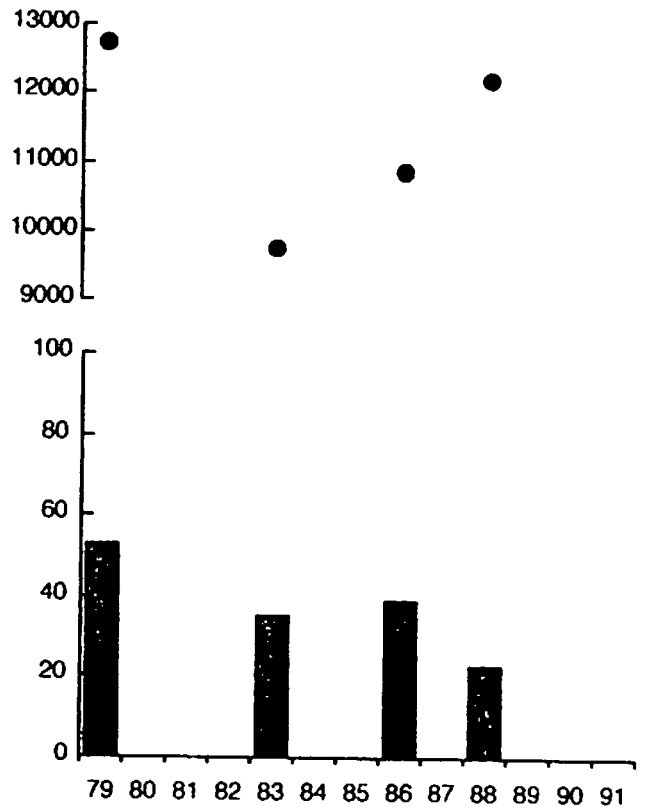




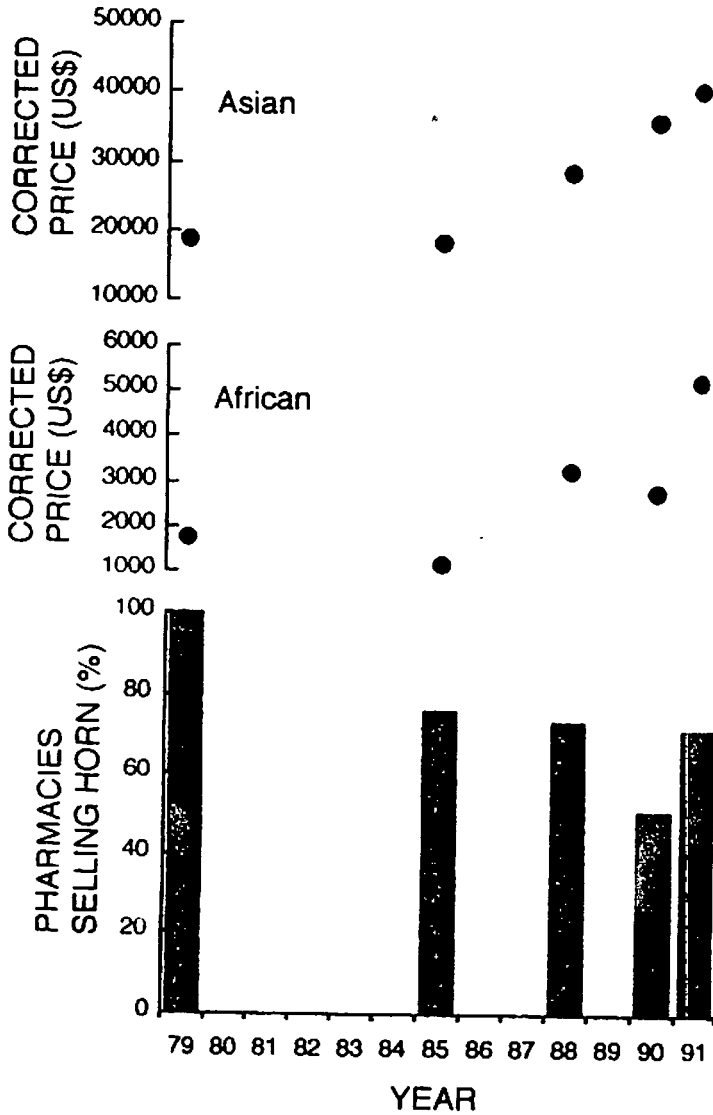
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