

HUSBANDRY AND PATHOLOGY OF POLAR BEARS (*THALARCTOS MARITIMUS*) IN SWISS ZOOS

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Summary

Polar bears are kept by the Zoos of Basel and Zurich under conditions which meet the requirements of the current Swiss animal welfare legislation. While the survival of Polar bears purchased as adults or subadults is satisfactory, the rearing success of cubs is unacceptably low, and the keeping is, therefore, not sustainable. Disturbed behaviour, due to the failure of the bears to cope with the captive environment, and to social stress, is considered to be the major problem which leads to stereotypies, infanticide and skin lesions. Consequently, it is concluded that the keeping of Polar bears under the current conditions should be phased out in the medium term, and that new legislation should be developed which should better take into account Polar bear behaviour. The paper describes behavioural disturbances observed, and contains information on the nutrition, longevity and reproductive biology, as well as an overview on the necropsy findings of Polar bears in Swiss zoos.

Zusammenfassung

Die Zoos von Basel und Zürich halten Eisbären unter Bedingungen, die der gegenwärtigen schweizerischen Tierschutzgesetzgebung entsprechen. Währenddem die Lebensdauer der als Erwachsene oder Subadulte erworbenen Eisbären zufriedenstellend ist, ist die Aufzucht der Jungtiere unannehmbar tief. Die Haltung genügt daher dem Grundsatz der Nachhaltigkeit nicht. Als das Hauptproblem werden Verhaltensstörungen angesehen, die durch sozialen Stress und das Unvermögen der Bären, sich der Zooumgebung anzupassen, verursacht werden, und zu Stereotypen, Jungentötung und Hautkrankheiten führen. Unter den gegebenen Bedingungen sollte daher die Eisbärenhaltung mittelfristig eingestellt werden. Die Tierschutzgesetzgebung ist so zu ändern, dass sie dem Verhalten der Art besser Rechnung trägt. Im weiteren enthält der Beitrag Informationen über Fütterung, Lebenserwartung und Fortpflanzungsbiologie, sowie einen Überblick über die Sektionsbefunde bei Eisbären in schweizerischen Zoos.

Résumé

Les zoos de Bâle et de Zurich détiennent des ours polaires dans des conditions correspondant aux exigences de l'actuelle législation suisse sur la protection des animaux. Alors que la durée de vie des ours polaires acquis à l'âge adulte et subadulte est satisfaisante, le taux d'élevage des jeunes, excessivement bas, ne suffit pas au maintien de l'espèce en captivité. Le problème principal réside en des troubles du comportement dus au stress social et à l'incapacité des ours à s'adapter à l'environnement du zoo, ce qui se traduit par des stéréotypies, des infanticides et des dermatoses. En l'occurrence, dans

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les conditions données, la détention des ours polaires devrait disparaître à moyen terme. La législation sur la protection des animaux est à modifier de telle sorte qu'elle tienne mieux compte du comportement typique de l'espèce. Enfin, cet article livre des informations portant sur la nutrition, l'espérance de vie, la biologie de la reproduction, et donne un aperçu des résultats d'autopsie de l'ours polaire dans les zoos suisses.

Key words

Ursidae, *Thalarctos maritimus*, breeding, ethology, husbandry, legislation, mortality, pathology, skin lesions, stereotyped behaviour, stress, *Trichinella*

Introduction

The Polar bear (*Thalarctos maritimus*) is a Red Data Book species which is rated as vulnerable (28). Within Europe, there are approximately 130 Polar bears kept by 39 institutions (4). The species is not included in the Zoo Yearbook's censuses of rare animals in captivity. While there is no Polar bear EEP, a studbook is kept by the curator of mammals of Rostock Zoo.

The Polar bear is of some concern to the EEP Bear Taxonomic Advisory Group. Noting that behavioural problems occur in almost all captive Polar bears, the group discussed, whether the species should be phased out in Western and Central Europe, as is already happening in UK zoos. Under the conditions Polar bears are currently kept, and which are similar in all zoos, disturbed behaviour has to be expected. Consequently, research projects are needed, and alternative captive environments should be tested. For the time being, the group recommends not to increase the population (4).

The present paper aims at giving an overview on the situation of, and on problems faced with Polar bears in Switzerland, where they are currently kept only by the zoos of Basel and Zurich. The other two scientifically directed Swiss zoos never kept the species. A circus and a small private zoo who are known to have formerly owned Polar bears, have not been considered in the context of the present paper.

Legal requirements for the keeping of Polar bears

The Swiss Federal Ordinance on Animal Welfare of May 27, 1981, subjects the keeping of Polar bears to licensing. According to Annex 2 of the ordinance, an enclosure for up to two Polar bears must come up to the following minimum standards: land surface 80 m², pool surface 80 m², average pool depth 1,50 m. For each additional animal, the land and water surfaces have to be enlarged by 20 m², i.e. a total outdoor surface of 240 m² is required for the keeping of four Polar bears. For each bear, an individual den of 6 m² must be available. In the case of holdings which existed already before 1981, the enclosures must meet 90 % of the minimum standards (25).

In a - not yet published - draft amendment to the Swiss Federal Ordinance on Animal Welfare, it is proposed to enlarge by 50 % the minimum measurements for both, land and water surface, i.e. for the keeping of four Polar bears a total outdoor surface of 360 m² would be necessary.

Keeping facilities and group size

At Basel Zoo, Polar bears are kept since the year 1932, when a new bear exhibit was opened. At that time, the enclosure was praised as "the most up to date and most beautiful bear exhibit of all zoos" (3). The outdoor exhibit, designed in the Hagenbeck style, has not been modified since its inauguration. It consists of a pool, situated between the land part and the visitors' path, with a surface of 110 m² and a volume of approximately 180 m³, and a land part of 230 m² at two different levels which are connected by stairs and a concrete slide. Laterally, the exhibit is confined by concrete walls with a naturalistic design, and in the rear by a dry moat. There are two indoor dens measuring 12.8 m² each which are connected by a trap door. In 1977, a third den was insulated against noise, and redesigned as an isolation den for pregnant females. In 1985, three interconnecting dens, measuring between 6.4 m² and 10.4 m², were added. These were connected by trap doors.

At its inauguration, the exhibit at Basel Zoo was occupied by 2.3 (two male and three female) Polar bears. This situation prevailed, with some interruptions, during 17 years. In one year even two males and four females had to share the enclosure. During four years 1.4, during 24 years 1.3, during ten years 1.2, and during eight years 1.1 animals were kept together. The large group size made the cleaning of the enclosure or the isolation of a specific individual extremely difficult. It is reported that fights between the bears were frequent, and that injuries and skin lesions, such as pyogenic dermatitis or alopecia, were frequently observed. In recent years, usually two females are separated in the isolation dens from November to mid-January.

At Zurich Zoo, the Polar bears were originally kept together with three brown bears (15). In the year 1934, the former lion enclosure was converted to accommodate the Polar bears. The outdoor exhibit is made in concrete with some natural rocks. It consists of a pool, situated between the land part and the visitors' path, with a surface of 80 m² and a volume of approximately 160 m³, and a land part of 100 m². About half of the land surface is a plateau, 3.4 m above the water surface of the moat and on level with the visitors' path. It is surrounded by walls on three sides, and by a rather steep descent to the water. There is an open cave in the rear wall, and there are four indoor dens measuring 4.2 m² each, one of which is used to isolate the female before giving birth. The doors to the other dens are open during most of the time. If air moisture is high, the bears prefer to stay indoors, except if there are a lot of visitors who seem to have an entertaining effect on the bears. As is the case in Basel Zoo, the pool is not regularly used during the winter season.

Group size at Zurich Zoo never exceeded three animals. During 42 of the 67 years of the zoo's history, only one male and one female were kept, during 20 years groups of one male and two females (mostly mother and daughter), and during five years one female with her daughter.

With the current group sizes of 1.4 at Basel Zoo and 1.1 at Zurich Zoo, both holdings are in conformity with the existing animal welfare legislation.

Diet

Until the 1970ies, the Polar bears of Basel Zoo were predominantly fed meat and fish. Their diet was qualitatively and quantitatively uniform all year round. As from 1973, the cyclic food intake situation prevailing in the wild was taken into account (1, 26), and bigger rations were offered from spring to autumn, while less or even no food was given during the winter period. This step was followed by a qualitative change in 1974, when the diet was enriched by the addition of salad, carrots, corn, sunflowers and, during summer, grass. Over the years, other ingredients have been added. On an average (weighings carried out in April and October), the daily food intake per animal includes: 8500 g of in-bone beef or horse meat, 850 g of cyprinid fish, 4500 g of vegetables, such as carrots, salad, or fennel, 750 g of apples, 150 g of bread, as well as eggs and dog pellets containing 23 % of crude protein, 4 % of crude fiber, 5 % of crude fat and a.o. 14'000 IU/kg vitamin A. If available, the bears also like to feed on foliage (Heldstab, Curator at Basel Zoo, pers. comm., 1995). During the summer period, the food is distributed across the outdoor exhibit and the two largest dens to which the bears permanently have access. As "entertainment feeds" (22), 20 litre ice cubes containing vegetables, apples and fish are offered, and from time to time live carps are set in the pool. During winter, two female bears don't eat anything, and the food intake of the other two is very much reduced, whereby the animals prefer vegetables and apples to meat.

At Zurich Zoo, the Polar bears receive regularly one side of horse or cow ribs, as well as beef or horse meat cuts with a lot of fat, salad, and carrots. They prefer horse to cow meat, and especially like food which is warm and slippery. Occasionally old layer hens, the large feathers of which have been removed, and which have dipped in hot water, marine fish, and salted and spiced fish preparations are given. Although the latter component seems to be rather unbiological, it is considered a delicacy by the bears. As in Basel Zoo, ice cubes containing food items are offered. From November on, the food intake is very much reduced. The female turns vegetarian during the winter period, while the male still takes a little bit of ribs in addition to carrots and salad, and drinks regularly from a water-hose.

Formerly, the Polar bear diet at Zurich Zoo included also liver and split cow heads of which first the brain was licked out. These components have been given up, the liver for having caused severe diarrhoea, and the cow heads in 1990, to meet the risks due to bovine spongiform encephalopathy.

Breeding and survival

The following information is based on the animal registers. It considers all Polar bears kept by the two zoos, i.e. by Zurich Zoo since the year 1929, and by Basel Zoo since the year 1932, with the exception of a few newborn cubs that died shortly after birth and were not registered. During the entire period of time, the two zoos together purchased a total of 39 Polar bears. Six are still alive and have, at the time of writing (December 1995), been at the zoos for 33 to 289 months (average 159.5 months). Five of them are captive bred, and their age is 60, 132, 157, 181 and 301 months (average 166 months). Twelve bears have been sold, exchanged or donated to zoos abroad, after having lived up to 343 months in Switzerland (average 98 months). The other 21 bears died after having been kept between 0 days and 241 months and 24 days (median 56 months, average 93.5 months). The average weight at death of seven adult males was 313 kg (median 290, range 240 to 413), that of nine adult females 217 kg (median 221, range 180 to 293).

Between 1933 and 1979, 17 litters were registered at Zurich Zoo, and, between 1945 and 1984, 21 litters at Basel Zoo, with a total of at least 60 cubs. 46 cubs died within their first week, five at an age of between 12 and 23 days, and one at an age of six months. At Zurich Zoo, seven cubs were raised, six of which by the same female. Two young females remained in the collection, one of them was sold at the age of 156 months, the other one died by an accident when she was 348 months old. Only one cub was hand-reared at Basel Zoo and was sold at the age of 10 months.

At Basel Zoo, the duration of pregnancy was determined in ten cases. It ranged from 175 to 258 days, with an average of 219 and a median of 216.5 days. In the case of 18 cubs who died within two days after birth, the weight is known. The range was from 0.440 to 0.775 kg, with an average of 0.646 and a median of 0.650 kg. The sex ratio of the 29 cubs in which the sex could be determined was, with 14 males : 15 females, balanced (Basel 10 : 6, Zürich 4 : 9).

Behavioural disturbances

From 1989 to 1992 the stereotypies of three Polar bears living as a group at Zurich Zoo were analysed in detail (29, 30, 31). At that time, the group consisted of a male ("Majno", born at Münster Zoo in 1984), a subadult female ("Malka", wild-born in 1985) and an old female ("Ludmilla", born at Zurich Zoo in 1964, hand-reared). The animals were observed in the outdoor exhibit.

All three Polar bears exhibited stereotyped behaviour (29). The behavioural disturbances were most pronounced in the male which spent 61.3 % of its daily activity in stereotyped walking and 15.2 % in stereotyped swimming. The subadult female showed stereotyped walking (16.0 %) but no stereotyped swimming. The old female performed little stereotyped walking (1.0 %) and swimming (2.8 %). However, during 20.6 % of her daily activity she showed a paw-sucking-scratching stereotypy that consisted of sucking the palm of the right paw and licking the fingers alternating with scratching of the snout, head, or neck.

In all three Polar bears stereotyped walking and swimming bouts were of significantly longer duration than variable walking and swimming bouts (29, 31). The stereotyped walking bouts consisted of regular laps (or to-and-fros), and each individual performed stereotyped behaviour at particular sites in the enclosure. At a given site an equal number of steps was repeated over and over, the paws regularly touched the ground on the same spots, and the duration of a lap varied little. Similarly, stereotyped swimming bouts were composed of laps that were swum at particular sites in the moat. A comparison of data collected in 1989 and 1992 showed that the stereotypies of the three individuals remained stable over 3 years, both in form and with respect to the places where they were performed within the enclosure (31).

The Polar bears regularly interrupted their stereotyped walking bouts to sniff at the ground or to look around (29). It was therefore suggested that stereotyped walking may share a common motivational basis with appetitive behaviour. Based on this assumption it was predicted that the Polar bears' attentiveness to novel stimuli should persist during stereotyped walking. This was experimentally tested by placing marks of unfamiliar odours on the stereotyped paths of the male and the subadult female (30). As expected, both individuals significantly increased their rate of sniffing compared to stereotyped walking bouts without odour marks on the stereotyped paths.

It was also experimentally tested whether the amount of stereotyped behaviour can be reduced by behavioural enrichment (31). On a total of 27 days, 2 to 3 ice blocks filled with pieces of bread and carrots were thrown into the moat at 13:00 h. The percentage of time the Polar bears spent performing stereotyped behaviour was measured both during the time the ice blocks were in the enclosure and during the first hour after the manipulation of the ice blocks. These percentages were compared to data collected at the same time of day on days when no objects had been given to the animals. The

Polar bears were very interested in the ice blocks and performed a variety of natural behaviour patterns while manipulating them. In the male, the amount of stereotyped behaviour was significantly reduced during the time the ice blocks were in the enclosure. However, in the first hour after the manipulation of the ice blocks he performed more stereotyped behaviour than on days without ice blocks. The subadult female never showed stereotyped behaviour during the time the ice blocks were in the enclosure. During the first hour after the manipulation of the ice blocks she spent significantly less time performing stereotyped behaviour compared to days without ice blocks. There was no habituation to the ice blocks over several weeks.

Stereotyped behaviour on land and in the water is also observed at Basel Zoo, but no systematic study has been made.

Clinical histories

At Basel Zoo, the captive bred female "Sira" was purchased in 1982, when she was two years old, and brought together with an adult pair. Three months after her arrival, a 23 years old female was introduced, which died in 1988. In March 1993, the group was again enlarged to 1.3 by the purchase of the 28 months old female "Ballyba". In October 1994, i.e. twelve years after her introduction to the zoo, "Sira" developed a focal hyperkeratosis and a focal perivascular dermatitis with predominantly eosinophilic granulocytes. She showed an intense scratching behaviour which led to a disseminated focal alopecia. Clinical examination and biopsies were not conclusive as to the etiology. Three applications of 6 ml Ivomec® (10 mg ivermectin/ml) at two months intervals (9) resulted in a *restitutio ad integrum*. In October 1995, however, the symptoms appeared again, and, also this time, the dermatopathological examination revealed neither parasites nor fungi. The condition improved after a renewed ivermectin therapy, complemented by the intramuscular application of a corticosteroid depot (Voren®, 8 ml).

At Zurich Zoo, the female "Ludmilla" was born in November 1964. As she was neglected by her mother, she had to be handreared. From April 1965 on, she was kept in the Polar bear enclosure, where she lived with her mother and a young male of her own age. In November 1971 she was brought together with a recently imported one year old pair. The trio lived peacefully together, "Ludmilla" playing the role of the mother of the two youngsters. In 1977, the young female was sent to Basel Zoo. As from September 1984, "Ludmilla" showed a progressive lameness, due to an arthrosis of the right knee-joint. A few months later she fell into the water moat, after having been hit by her foster-son "Ninjan". "Ninjan" died in February 1986, and subsequently a young pair was purchased which could be associated with "Ludmilla" without problems. However, as from November 1986, "Ludmilla" showed an itching irritation in the neck area, started scratching, and mange was suspected. Although she was treated with Ivomec® and corticosteroids, and repeatedly with Alugan® (bromocyclen) her condition did not improve. Biopsies revealed perivascular and - at least partly - eosinophilic dermatitis. Blood samples showed at the beginning an eosinophilia which could not be reconfirmed later on. In 1990, "Ludmilla" was pushed from the platform, obviously without getting injured. Subsequently she often retired in the cave and showed her paw-sucking stereotyped behaviour. In February 1994 she was found dead in the water moat. According to visitors, she had fallen - or had been pushed - from the platform, and had struck her head against the rocks of the descent. Necropsy revealed spondylarthrosis in the neck area, multiple chronic arthroses in the limbs and, as cause of death, a fracture of the fourth vertebra.

In both cases, the other companions of the affected animal didn't show any clinical symptoms of a skin disease.

Parasitological and pathological findings

Routine coprological examination revealed *Capillaria*, *Trichuris* and ascarid eggs at Zurich, and ascarid eggs at Basel Zoo. Formerly, when most of the Polar bears were taken from the wild, also parasites with an indirect cycle, such as *Diphyllbothrium latum* could be observed *intra vitam* (11).

Most frequently, death was caused by behavioural factors. This concerns primarily the perinatal mortality: In most cases, the newborn cubs were either neglected, mutilated or eaten by their mothers. This happened to at least eight litters at Zurich Zoo (5) and to at least five litters at Basel Zoo, in total to 20 cubs or more. In one case, the cub was 24 days old when it died from "cerebral trauma and muscular haemorrhages". In at least two more instances, the female was not separated when giving birth. As a consequence, the other females (at Basel Zoo in 1959) or the male (at Zurich Zoo in 1954) killed the cubs (5). In one case the male, which was separately kept on Zurich Zoo's outdoor

enclosure, demolished the trap door to the den in which the female with her six months old daughter were kept, and killed the youngster (15).

Perinatal deaths include also one case of purulent pneumonia, one case of myocarditis of suspected viral origin, interstitial pneumonia due to a suspected "intrauterine viral infection" in a litter of two, one case of *E. coli* septicaemia, and one case of intestinal volvulus with subsequent septicaemia (*E. coli*, *Klebsiella*, *Streptococcus*). The latter case is of some interest because volvulus - in connection with gastric dilatation - is a relatively common condition in *adult* Polar bears (2, 20).

Infectious diseases played a very minor role in adults. One Polar bear died from tuberculosis, and another one from an exudative pleuritis that pathologically resembled a nocardiosis.

In four necropsies carried out between February 1952 and March 1977, on Polar bears that had been kept for up to 20 years at Basel Zoo, *Trichinella* larvae were found in the striated musculature, especially in the diaphragm, in the intercostal and masseteric muscles, and in the muscles of the extremities (13, 14, 21). Only in one case, trichinellosis was considered to be the cause of death. Also ascarids were found in several animals necropsied at Basel. In the case of a juvenile bear imported in 1952, "helminthiasis" was considered to be the cause of death.

A 86 months old female Polar bear of Basel zoo was euthanised, because she suffered from pyoderma of unknown etiology, and of scratching lesions.

In the case of a 14 months old male Polar bear of Zurich Zoo, a cerebral infarct was diagnosed.

At Zurich Zoo, two deaths were attributed to dietetic factors: In one case an animal showed cirrhosis of the liver, lipid pneumonia, heart edema, ascites and hydrothorax, and mycotoxicosis or a high amount of unsaturated fatty acid in the diet were suspected to be causative. In the other case haemorrhagic enteritis with congested spleen and liver was attributed to contaminated food. Also connected to the digestive tract were one case of mandibular osteomyelitis with subsequent septicaemia due to a broken caninus, and one case of enteritis / colitis.

Diseases of the urinary system were noted in eight animals. Interstitial nephritis was diagnosed in five Polar bears that died or were euthanised at Basel Zoo. In two of them (23 and 25 years old), the nephritis had led to severe uremia. Nephritis was also diagnosed in two animals from Zurich Zoo, in one case the 16 years old bear showed also a hyperplasia of the pancreas. Two female bears of Basel Zoo that clinically had suffered from a urinary incontinence, showed a chronic cystitis at necropsy.

Discussion

While the longevity of the Polar bears purchased, or of the few youngsters raised, is satisfactory, the rearing success is, with 13,3 %, far from reaching an acceptable level. As a consequence, the overall balance (animals purchased minus animals given away or still in the collection) for the species in both zoos together is negative, with a net consumption of 26 Polar bears during the past 66 years, i.e. Swiss zoos do not keep Polar bears on a sustainable basis.

Duration of pregnancy and the average of 1.6 cubs per litter correspond to the information quoted by Kuntze (2) and Uspenski (26), but the range of birthweights is somewhat wider than described elsewhere (20). As it could be observed by video-monitoring at Basel Zoo, how a female Polar bear devoured her newborn cubs while they were still alive, the authors have to contradict the view published by Kohm (18), that Polar bears eat their young only after they have died from other reasons, and go along with Griner (10), who noted that infanticide was the most frequent reason of death of neonate bears at San Diego Zoo.

Skin diseases, as they were observed in both zoos, have been described by various authors, and have been attributed to inadequate nutrition, maintenance in warm climate, hypothyroidism (12, 20), audyoptic mange (7, 8, 23), sarcoptic mange (17), chorioptic or psoroptic mange (quoted in 20), *Candida* mycosis (24), and *Dermatophilus congolensis*, an actinomycete that produces motile spores causing a disease usually referred to as cutaneous streptothrichosis (6). In the case of the skin affections causing problems at Basel Zoo some 40 years ago, trichinellosis which is widely distributed in the wild (26) and often reported from zoos (16, 19, 20), was suspected to be causative (21). It was speculated that the bears either had acquired the trichinellae already as juveniles in the wild, or that they got infected by the consumption of dog meat which was, during a certain period of time, a regular part of their diet. In Switzerland, trichinellosis does not occur in pigs, but is found in wildlife and in

domestic dogs (13, 14). Taking into account that these historical cases occurred at Basel Zoo at a time when five to six individuals of this typically solitary species (1, 26) were kept together under rather cramped conditions, that Basel Zoo's "Sira" has been kept during 12 years, and Zurich Zoo's "Ludmilla" during 22 years without showing symptoms of a skin disease, that both animals were socially low ranked, that "Sira" developed skin disease after the group has been increased to 1.3, and the last introduced female "Ballyba" had become sexually mature (26), and that "Ludmilla" developed the disease shortly after the introduction of a young pair, the authors believe that social stress is an essential factor in the etiology of Polar bear skin disease.

As described from Polar bears in British zoos (1, 22), almost all Polar bears kept in Switzerland exhibit stereotyped behaviour (27). This shows that they fail to cope with the captive environment by performing normal behaviours. Behavioural enrichment programmes may be successful in reducing the amount of stereotyped behaviour (1, 13). However, it is not yet known if such programmes would be effective in preventing the development of stereotyped behaviour in Polar bears raised in captivity.

Although it is not sure whether vegetable food is an essential part of the Polar bears' diet in the wild (26), it is obvious that the addition of plant material to the food, as practised by both zoos, has a positive effect on the wellbeing, because it keeps the animals occupied, and has a stimulative effect on the intestinal activity. Other means to improve husbandry routine and housing conditions of Polar bears in existing enclosures have been recommended by Ames (1).

Conclusions

From an ethological perspective, it is suggested that the keeping of Polar bears should be phased out as the present stock declines. For the currently kept Polar bears, the keeping conditions should be improved as far as possible, e.g. by "entertainment feed" and "behavioural enrichment" of the existing facilities.

Both zoos have already taken certain steps to make the life of their Polar bears less boring. They also came to the conclusion that, in principle, Polar bears should not be kept under the current conditions. As they see no possibility to build large new exhibits which could meet the requirements of the species, they are decided to phase out the keeping of Polar bears in the medium term.

The Federal Veterinary Office has to conclude that the standards contained in the current Animal Welfare Ordinance, as well as those in the proposed draft amendment, are not sufficient to ensure acceptable living conditions for Polar bears. The final draft amendment will, therefore, contain standards which will discourage the keeping of more than one pair. It will especially provide for twin enclosures, as recommended by Ames (1) and Law (22), allowing to completely separate the male and the female whenever appropriate. The recommendations for the keeping of mammals under zoo conditions, issued by the Scientific CITES Authorities of Liechtenstein and Switzerland in 1989 could serve as a guidance. These recommendations (which are not legally binding), suggest that the land part of an enclosure for two Polar bears should not be smaller than 400 m², and that 100 m² be added for each additional adult. The pool should have a surface of 100 m² for the first two animals, and should be enlarged by 50 m² for each additional adult animal. The average water depth should be 2 m.

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