HABITAT USE OF THE PINE MARTEN *MARTES MARTES* IN SMALL-SCALE WOODLANDS OF MECKLENBURG (GERMANY)

by

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ABSTRACT

This study examines whether small-scale forest structures in the south-west of Mecklenburg (Germany) are colonized by pine marten, and how in those forests the spatial-temporal utilization takes place by a species normally requiring a comparatively large space, and whether there exist differences in the behaviour of the animals when compared with other European investigations.

During our investigation which lasted for 27 months, six pine martens (four males, two females) inhabiting two separated, small-scale forest areas in the south-west of Mecklenburg Western Pomerania were tracked by telemetry. From the results conclusions could be drawn about habitat utilization in a landscape with small-scale forest structures.

The animals exclusively stayed in the forest with the exception of a male marten who regularly crossed treeless areas located between the two forest parts. In general, the pine martens moved through their home range in search for food after having left their hides and looked for a new hide late in their activity period, each at the locality to where they had strayed. In most cases there was no deliberate return to a particular known day hide. Female martens appeared to utilize their home range more regularly than males. With the exception of plantations up to two meters tall, forest structures of all age classes were used. A clear preference to spruce stands was obvious both during the activity and resting phases. Stands consisting of other tree species were used differently, depending upon the individual. The proportion of fixings obtained in coniferous stands providing a high degree of shelter even increased during wintertime, whereas areas with deciduous broad-leaved trees were less often visited in the winter season. In the majority of the fixings the animals were on the ground. In contrast to some of the earier studies, they used the crowns of the trees for foraging and crossed from tree to tree.

Regarding habitat utilization parallels can be drawn to other European investigations, suggesting that the spatial utilization by pine martens that colonize small-scale forest areas hardly differs from that of pine martens living in other areas. In accordance with the small-scale forest structures in south-west Mecklenburg, small-scale forest structures in south-west Mecklenburg also small home ranges were selected.

Key words: pine marten, *Martes martes*, habitat use, habitat preference.

1. Introduction

Pine martens have been described as a strictly forest inhabiting predatory mammal with large spatial demands (Storch, 1988; Schröpfer et al., 1989; Stubbe 1989b). All previous investigations were conducted in coherent woodlands, which were essentially larger than the home ranges of pine martens known up to then. In contrast to this, the present investigation refers to an agrarian landscape in Mecklenburg, comprising scattered, small-area forest regions.

Habitat utilization by pine martens in two small forest areas was investigated; data on home ranges (Stier, 1998) and day hides (Stier, 2000) are reported elsewhere. Since the few available telemetric studies of habitat utilization were usually conducted without taking into consideration the supply of the respective vegetation structure, particular emphasis has been placed on these issues. The results permit preliminary conclusions of habitat utilization by pine martens in a biotope that until now has been generally regarded as atypical of this species.

2. Material and methods

2.1. Area of investigation

The study was concucted in the landscape of south-west Mecklenburg (Germany) that has been created by the Glacial Period. The two areas of investigation are located at the southern foothills of the gently rolling end-moraine. Following the melting of the glaciers small water bodies had emerged in the numerous depressions. The scenic pattern is determined by agriculture. Interspersed in the arable land we find plenty of small woods and field-woods ranging between 10 to 100 ha in size, which are supplemented by a few larger, coherent forest areas (max. 500 ha). In some places one still encounters remnants from the structure of small fields including the typical hedgerows.

Two small forest areas typical of the agrarian landscape in south-west Mecklenburg, which are located near Zarrentin (53° 33' N, 10° 55' E) were selected for the investigations. They are surrounded by arable land and distinctly delimited against other forests. The shortest distance between the two forests is 1.85 km (fig. 1).

Forest area 'Wifo'

This woodland is immediately contiguous to the south-east corner of the settlement Zarrentin and covers 136 ha. The rivulet Schaale runs through it, the course of which, including the adjoining alder-birch marshland, has been designated as a nature reserve. The vegetation growing in the north-western part of the investigation area is influenced by the Schaale and the lake Schaalsee. Fen forests and ponds, reed and

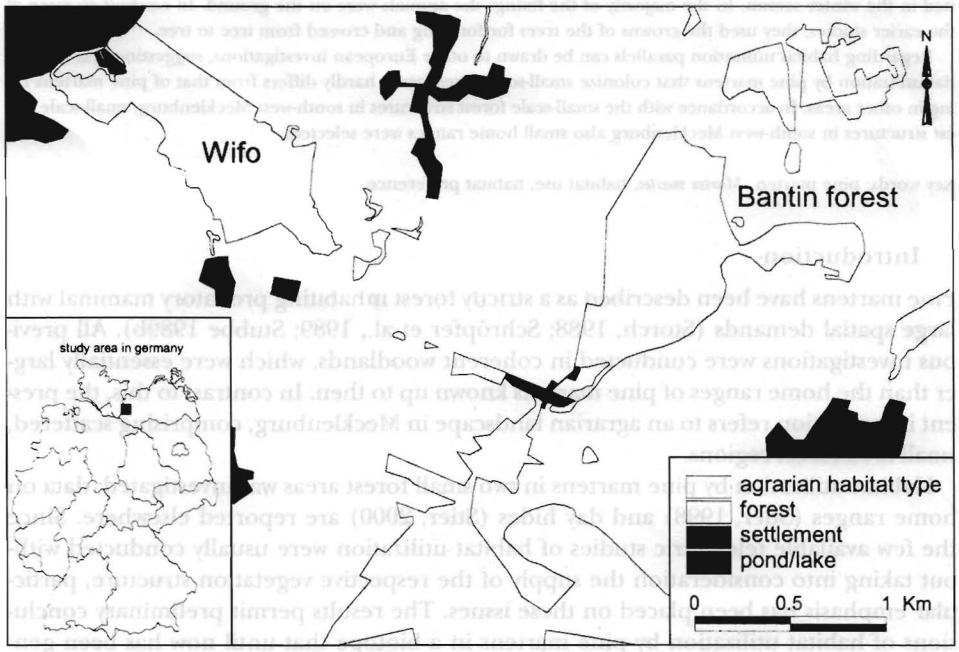

Fig. 1. The situation of the forests 'Wifo' and 'Bantin Forest' near Zarrentin in Mecklenburg (Germany).

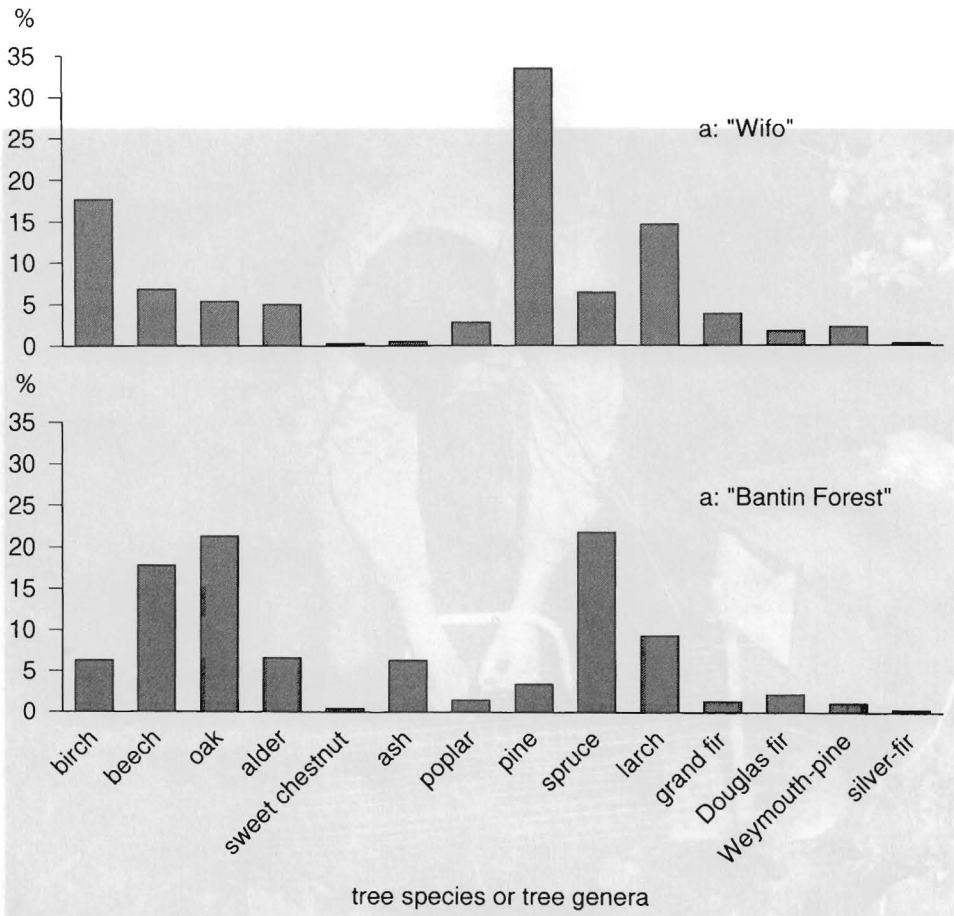

Fig. 2. Tree species distribution in the forest areas 'Wifo' (above) and 'Bantin Forest' (below).

sedge plots prevail here. Otherwise, mesotrophic to oligotrophic sites are encountered, eutrophic sites only occasionally. This part of the investigation area consists of a great number of even-aged pure forest stands and is subject to intensive management. Only a few stands only have a second tree storey. All age classes from young growth to mature timber and almost all commercial tree species are represented (fig. 2a).

'Bantin Forest'

The second investigation area, Bantin Forest, comprises a total of 201 ha. It consists of a main part and a complex of fields and satelite woodland located to the north, separated from the main part by pastureland. A hedge forms the sole wooded connection. Here too we encounter wetlands in terms of alder groves. With respect to site characteristics, management intensity and diversity of tree species Wifo and Bantin Forest are quite similar (fig. 2b). However, special features of Bantin Forest are the more vertically

Normen Stier, anaesthetizing a caught pine marten. The marten has been moved from the wooden trap into a wire netting treatment cage with a loos`e second bottom. This second bottom is lifted by the rope over Norman's neck, to fix the marten against the upper side of the cage. Photograph: Gerard Müskens.

Normen Stier, bezig een gevangen boommarter te verdoven. De marter is uit de houten vangkooi overgezet in een gazen behandelkooitje met een dubbele bodem. Met het touw om zijn nek trekt Norman de losse tweede bodem naar boven om zo de marter tegen de bovenkant te fixeren. Foto: Gerard Müskens.

structured forest stands, a luxurious shrub and herbaceous layer as well as broad-leaved and broad-leaved/coniferous mixed stands comprising up to six tree species. The stands of deciduous trees are interspersed with small- to medium-size clusters of spruce, which results in a high extent of shelter during the winter period, or also with isolated spruces and Douglas firs. In some parts of the investigation area we encounter isolated, very old oaks or oak clusters. The age classes most often found here comprise medium-age and more mature trees. The entire forest area is free of clear-cuttings and includes only three young-growth plantations.

2.2. Material and telemetry

In the period from February 1993 to May 1995 six pine martens were telemetrically recorded, two in Wifo and four in Bantin Forest. As a whole, the evaluation of five animals was based on 8683 fixings, of which 3474 (40%) were values obtained during their activity periods.

It was not possible to observe all animals over the whole period of investigation. The pine martens were caught using wooden-box traps, and anaesthetized with 'Hellabrunn chemical mixture' (Wiesener & v. Hegel, 1989) and marked using radiocollars (company Fa. Wagener, Köln). A TRX-1000S (Wildlife Materials, USA) served as receiver, which was combined with a 6-element-Yagi-aerial or a H-aerial (HB9CV).

Single fixings as well as coherent series of fixings (partly during the whole night) were made. The activity condition of the animals (active or resting) could be concluded from a fluctuating or a uniformly strong signal strength, respectively. With the distance to the animal known, its place of stay (on the forest floor or in tree crowns) could be determined via the signal strength, since the reception was markedly better when the animal was in the canopy region. The fixing distance ranged between 10 and maximally 200 m owing to the dense network of forest roads and the low susceptibility to interference of the tracked pine martens. The telemetric measurements were made usually from distances of 50 to 80 metres.

In Wifo, a female marten (F3), aged approximately 11 month when caught for the first time, was tracked over the whole period with few interruptions. In May of 1993 an old male marten (R5) could be caught, that, however, had slipped off the radiocollar already after two days. Since this animal could not be caught again before the period of investigation was over, it was not involved in data analysis because of the low quantity of data.

In Bantin Forest, three male martens (R4, R7, R9) and one female marten (F6) were provided with radiocollars. R4, a 6- to 9-year-old male marten, was caught in May 1993 and found dead during the rutting time in late July.

In late August of 1993 two approximately 5-month-old martens, the female F6, and the male R7 who had just entered maturity, were caught on the same day at a distance from each other of just 200 m. Both presumably were the offspring from a litter of a female marten in Bantin Forest in May/June 1993, which, however, could not be caught. R7 was found shot-killed in mid-August of 1994 in the margin of a cornfield adjacent toward south.

In early October 1994 a male marten (R9) was caught, which was born the year before and telemetrically registered until end of May 1995.

2.3. Habitat preference

Topographic maps on a scale of 1:10.000, as well as a map collection from forest management planning and aerial photographs, formed the cartographic basis. A mapping of habitat structure by tree species composition, age, crown closure and other criteria was carried out, allowing a subtle subdivision of the forest into relatively homogenous plots (as small as 0.1 ha). Related tree species and those with structural resemblance can be listed as follows:

maple: sycamore maple (*Acer pseudoplatanus*), plane maple (*A. platanoides*);
birch: white birch (*Betula pendula*), pubescent birch (*B. pubescens*);
beech: European beech (*Fagus sylvatica*);
oak: pedunculate oak (*Quercus robur*), sessile oak (*Q. patraea*), northern red oak (*Q. rubra*);
ash (*Fraxinus excelsior*);
sweet chestnut (*Castanea sativa*);
alder: common alder (*Alnus glutinosa*);
spruce: Sitka spruce (*Picea sitchensis*), blue spruce (*P. pungens*), Serbian spruce (*P. omorika*), Norway spruce (*P. abies*);
pine: Scotch pine (*Pinus sylvestris*);
larch: European larch (*Larix decidua*), Japanese larch (*L. kaempferi*);
poplar: all poplar species;
fir: silver fir (*Abies alba*), grand fir (*A. grandis*), Douglas fir (*Pseudotsuga menziesii*); Weymouth pine (*Pinus strobus*).

In order to be able to assess the preference to or avoidance of plots or tree species in connection with the selection of hides, a preference index (Pi) was calculated (Broekhuizen, 1983; Skirnisson, 1986; Trube, 1994) as the ratio of the forest stand types or tree species used and their availability. The index is an indicator of the extent of possible preference.

In most papers dealing with habitat use of pine martens and beech martens the availability of habitat elements was restricted to the home range, taken as the minimum convex polygon (MCP) around the fixes involved of the animal investigated (e.g. Broekhuizen, 1983, Skirnisson, 1986; Herrmann, 1987; Lachat Feller, 1993; Trube, 1994). As in our investigations the pine martens exclusively use the forested areas, it seemed illogical to use the MCP-method which would include parts of unforested land. The entire forest colonized by the respective animal was appraised in terms of supply. This procedure applies only to such special cases where, as in the case of these forest-inhabiting pine martens, only one male and one female marten each is present in a relatively small forest.

To evaluate the results of habitat selection during the resting phase, only each first fixing (relative to the time of rest in the day hide) has been considered.

The period April-September were categorized as summer half-year and October-March as winter half-year. The seasons were classified as spring: March, April, May; summer: June, July, August; autumn: September, October, November; winter: December, January, February.

3. Results

3.1. Use of the home range

3.1.1 Open areas

All pine martens with the exception of the male R9 were exclusively tracked within the forest. They selected their home ranges so that they almost fully utilized the area available to them by respective forestland (fig. 3). In addition to the areas covered with trees, F3 also visited the reed stretches occurring in Wifo and the partly treeless patches of a former depot inside the forest. It was only R9 which had to leave the forest in order to reach the northern field woods of Bantin Forest. For traversing the two forest parts this marten used an almost coherent hedge in the eastern part of his home range, bridging the two areas (fig. 4). Only occasionally he used the shortest distance from the northernmost tip of the forest main part to the opposite largest of the field woods – a path along which, however, poorly stocked pastureland had to be overcome. On one occasion the crossing of the meadow in winter time when vegetation cover was missing could also be tracked even during daytime. Passing between the forest parts took always place at a higher speed compared with normal locomotion.

R9 moved between the two parts of his home range at a regular scale, so that he

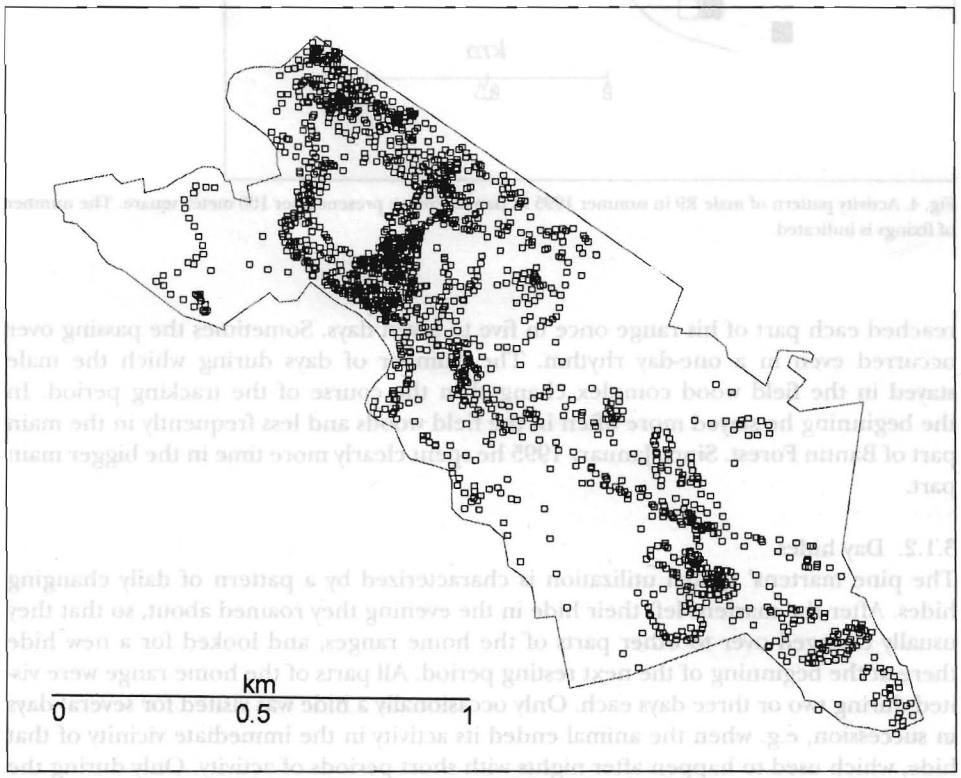

Fig. 3. Presentation of all fixings of female F3 (n=3947) in Wifo (line indicates forest border).

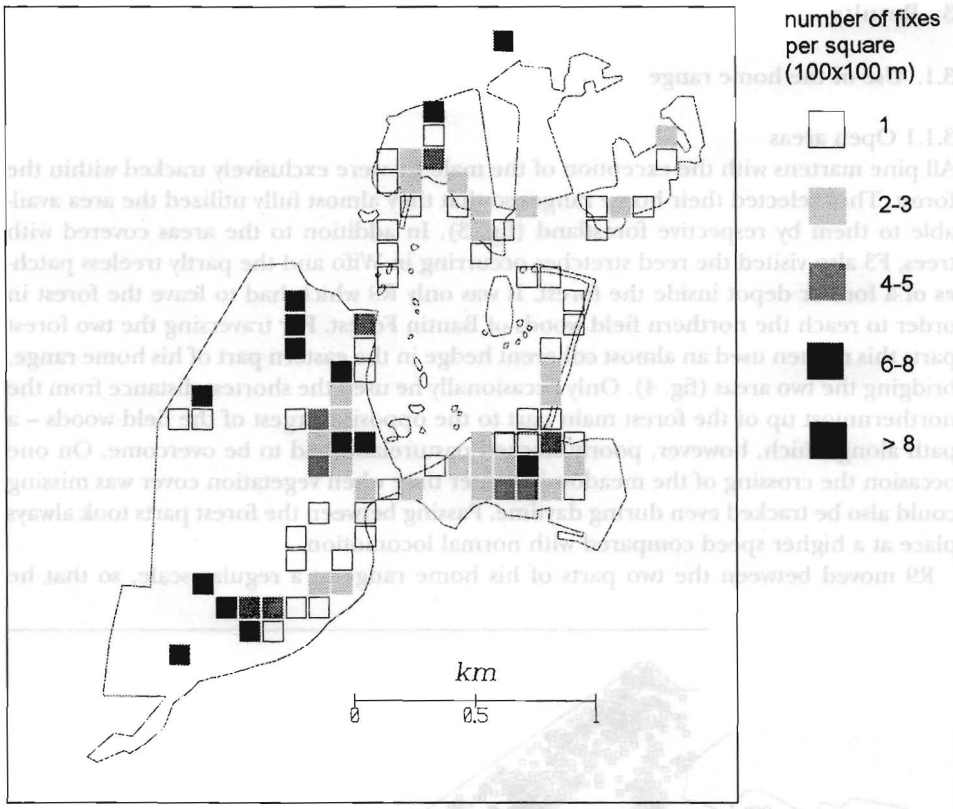

Fig. 4. Activity pattern of male R9 in summer 1995 in Bantin Forest: presence per 100 meter square. The number of fixings is indicated.

reached each part of his range once in five to seven days. Sometimes the passing over occurred even in a one-day rhythm. The number of days during which the male stayed in the field wood complex changed in the course of the tracking period. In the beginning he stayed more often in the field woods and less frequently in the main part of Bantin Forest. Since January 1995 he spent clearly more time in the bigger main part.

3.1.2. Day hides

The pine martens' spatial utilization is characterized by a pattern of daily changing hides. After the martens left their hide in the evening they roamed about, so that they usually changed over to other parts of the home ranges, and looked for a new hide there at the beginning of the next resting period. All parts of the home range were visited during two or three days each. Only occasionally a hide was visited for several days in succession, e.g. when the animal ended its activity in the immediate vicinity of that hide, which used to happen after nights with short periods of activity. Only during the period of cub rearing female F3, following her activity periods, returned to the known

hides where her cubs were staying. After the birth of the cubs that female marten F3 used almost the entire home range. At an age of the cubs of 6 to 10 weeks she distinctly reduced her home range and used merely the environment of the cub hide. Lateron the whole home range was frequented again.

After leaving the sleeping places in the tree crowns the search for food usually started in neighbouring trees. For this purpose the animals systematically searched the crown of a tree and thereafter jumped or climbed to the next one, in order to continue their search there. This period usually lasted for 10 or 20 minutes before the pine martens started to look for food on the forest floor.

In general, the pine martens spent their resting periods in trees. Hence, the forest stand structure is of particularly importance during this period.

When looking for day hides pine martens frequented the plots in the forest differently from the rest of their activity. Over the observational period of two years female marten F3 selected only 30 of the 57 plots (53%) of Wifo for resting. The distribution of the daily hides and also the intensity with which they were used were very irregular for this particular female. In Bantin Forest, F6 selected only 36 of the 97 plots (37%) for sleeping.

The preference indices of these stands used for resting were essentially higher than those regarding activity. The maximal value of the index was calculated for male marten R9 and accounted for Pi= 65.7. However, the number of the clearly preferred plots with an index greater than three corresponded approximately to the number determined for the activity phase.

Specific differences in habitat preferences was also found for seasonal relationships. For instance, male marten R7 preferred 14 plots in the summer half-year and 10 plots in the winter half-year with an index greater than three; of these, however, only four were preferred both in summer and winter seasons.

A proportion of 51 % of the plots in Bantin Forest that were preferred to a greater extent by all animals consisted of spruce stands. The other preferred plots were usually likewise coniferous stands. Broad-leaved deciduous stands played almost no role as resting places. In the case of using broad-leaved deciduous stands, the hides, generally, were in single admixed spruces.

The preference indices for spruce stands, ranging between 2.4 and 5.9 in these animals, were markedly higher than with other tree species, except for fir stands which also played a considerable role for F3 and R9. During the winter of 1994/95 (reduced home range) female marten F3 exclusively preferred spruce and fir stands, other tree species were avoided.

Coniferous stands, especially spruce-clad plots, were more important for the sleeping periods in the winter season than in the summer season. The preference indices for plots stocked with broad-leaved deciduous trees were higher in summer than in winter.

The hides were located both inside the stands and along stand margins. Some of the hides, in particular those of F3 were immediately adjacent to highly frequented forest roads, so that on some days hikers and vehicles walked or drove directly below the sleeping animals. Some daily hides of F3 were situated in the immediate vicinity of the regularly frequented road. Female marten F3 was twice encountered in a squirrel drey located at a distance of 20 m from an operating concrete shattering plant in the depot area, and despite the noise she did not change her hide.

3.2. Habitat preference

For determination of habitat preference the use of habitat structures was considered relative to the supply. Fiftyseven plots were designated in the Wifo and 103 plots in Bantin Forest, which were largely similar regarding tree species composition, age, canopy closure and other criteria. In Bantin Forest 98 plots were located in the main part. The field woods were subdivided into five plots.

3.2.1. Forest types

When categorizing the plots according to forest types, clear distinctions can be made in view of the intensity of utilization. For the case of coniferous trees, spruce and fir stands were favoured by all five pine martens examined, whereas pine and larch stands were generally utilized below average (table 1). A relish for Weymouth-pine plots could be observed in F3, R4, and R9. In contrast to this, however, these stands were avoided by F6 and R7 (Pi=0.3 and 0.3). Regarding the deciduous broad-leaved tree species, consistent trends were not apparent. Beech plots were favoured by R4 (Pi=1.9) and R7 (Pi=1.4), birch plots by F6 (Pi=1.6) and R4 (Pi=3.2), and alder stands were particularly strongly preferred by R9 (Pi=3.2). R4 also used the mixed stands above average. Female marten F3 distinctly preferred the extensive plots of birch-alder fen forests which exclusively occur in Wifo. The average preference indices of all animals with respect to stand types are illustrated in figure 5.

During their activity periods, 28% to 35% of the available plots were preferentially used by the five pine martens (Pi>1). The highest preference index (Pi=18.8) was determined for R9, concerning a pole-sized spruce stand in Bantin Forest. This plot appeared to be visited almost 19 times as much as would be equivalent to its area pro-

Table 1. Preference indices referring to the available stand types of five pine martens investigated.

stand type	preference indices				
		Bantin forest			
	Wifo F3	F6	R4	R7	R9
birch	0.3	1.6	3.2	0.7	0.0
beech	0.5	0.6	1.9	1.4	0.2
oak	0.4	0.7	0.0	0.8	0.3
alder	0.1	0.0	0.0	0.0	3.2
ash	–	0.2	0.0	0.4	0.3
sweet chestnut	–	0.0	0.0	0.0	0.0
poplar	0.1	0.0	0.0	0.0	0.0
spruce	3.2	2.5	1.2	1.6	2.6
pine	0.8	0.8	0.6	0.3	1.0
larch	0.5	0.7	0.5	0.9	0.4
fir	2.0	1.5	1.2	1.1	1.2
Weymouth pine	1.6	0.3	2.0	0.3	1.7
deciduous mixed stand	–	0.6	1.1	0.8	0.8
mixed stand	–	0.5	1.6	0.7	0.3
fen forest	1.8	–	–	–	–

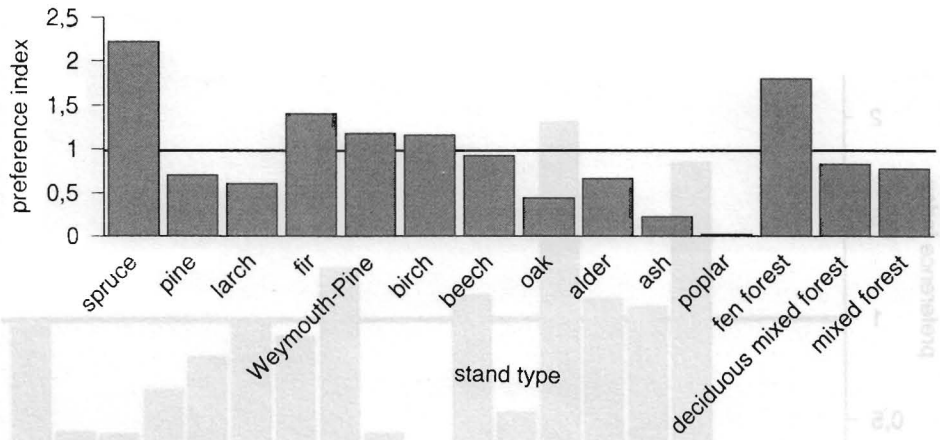

Fig. 5. Average preference to stand types by five investigated pine martens during their activity periods.

portion. Normally, the preference indices of the preferred plots ranged between one and five. The plots the index of which were equivalent to or greater than three were regarded as unambiguously preferred. Concerning F6, in the main part of Bantin forest this category comprised 11 plots; for R4 the number was 13, for R7 five and in R9 it was 12 plots.

The more preferred plots, mostly stocked with younger coniferous stands (in particular pole-sized spruce stands), were distributed relative to all investigated animals over the entire forest in such a way, that this type of plot was selected in each section of their home range. Concerning F3 in Wifo, these were located inside or along her core areas.

When during the winter of 1994/95 the female marten F3 had temporarily drastically reduced her home range, a shifting in preference for individual plots in Wifo took place. During that time even plots which had been clearly favoured in previous winter seasons were less or no longer visited at all. Instead, a considerable increase of preference indices for some plots of her northern core area was detected. The indices of the five plots distinguished by higher preference ranged between 3.4 and 16.2 and accounted for 7.3 on average. The highest preference index determined for that winter season was 16.2, concerning a dense pole-sized spruce stand.

3.2.3. Stand heights

During the activity phase forest stands of all height classes were used. Treeless areas and stands below 4 metres in height were frequented only occasionally (fig. 6). Male R9 could never be detected in such sections of his home range. F3 avoided a poplar plantation two metres in height located in the margin of the core area in the northern part of Wifo, although shelter was possible in a very dense herbaceous layer, and the adjoining plots were among those most preferred (fig. 3). The preference index of all animals was generally below 0.5 for such low-height stands.

Pole-sized stands were especially used by all animals. R7 particularly often stayed in 6 m high and R9 in 8-12 m high stands. F3 favoured 12 m high, and F6 6 and 16 m high timber stands. Figure 6 illustrates the preference of stands according to height classes,

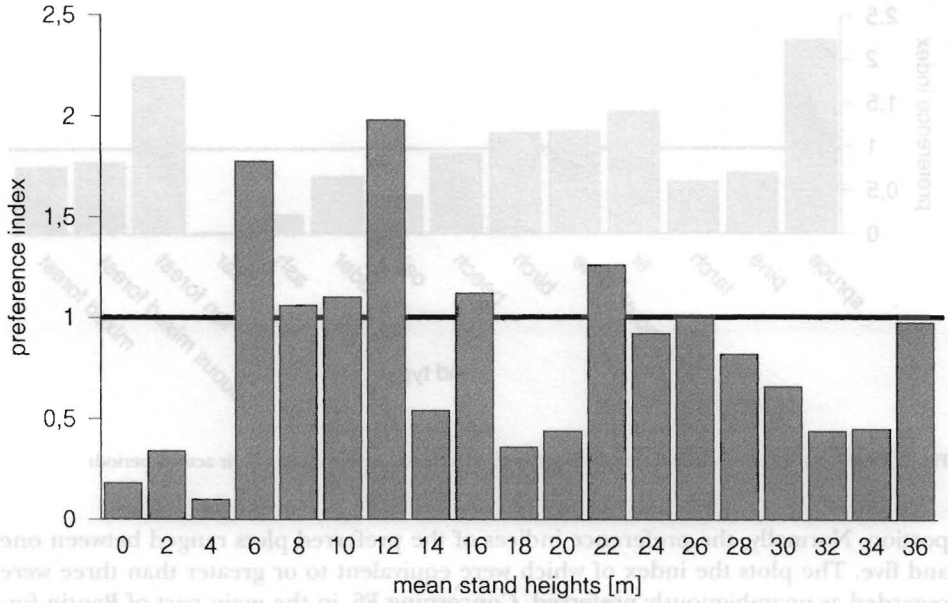

Fig. 6. Height preferences, average of all animals (n=5).

averaged for all animals, with the index clearly found above the average only in the stands of 6 and 12 m in height.

3.2.4. Seasonal differences

Differences in stand selection between summer and winter half-years were obvious in most of the animals during their activity phase. In the case of F6 only 2 of the 13 plots preferred during the summer (Pi>3) formed part of the 12 plots preferred during wintertime (fig. 7). A similar situation holds true for R9: in both half-years three plots were more preferred, while 13 were exclusively preferred during the summer and 9 during the winter season. Concerning R9, the preference to spruce, pine and Weymouth-pine increased during the winter season, and the preference to fir, larch and alder enhanced during the summer season.

In the case of F3, the index for spruce and fir stands markedly increased from summer to winter season from 0.9 to 4.1 and from 0.8 to 2.4, respectively. The index of the fen forest plots decreased. The other indices changed only slightly. During the winter of 1994/95 when she reduced her home range to a greater extent, there were clear differences in indices as compared with the winter average. The preference index for spruce was with 6.9 still markedly above the average with 4.1 of the three investigated winter seasons. Likewise, the index for fir was higher in that winter season compared with the winter average. The index for Weymouth pine, being with 2.0 almost equal in summer and winter, diminished to 0.4. Concerning the rest of the tree species, the values were found to fluctuate only slightly.

In view of R7, there were only minor differences between the summer and winter sea-

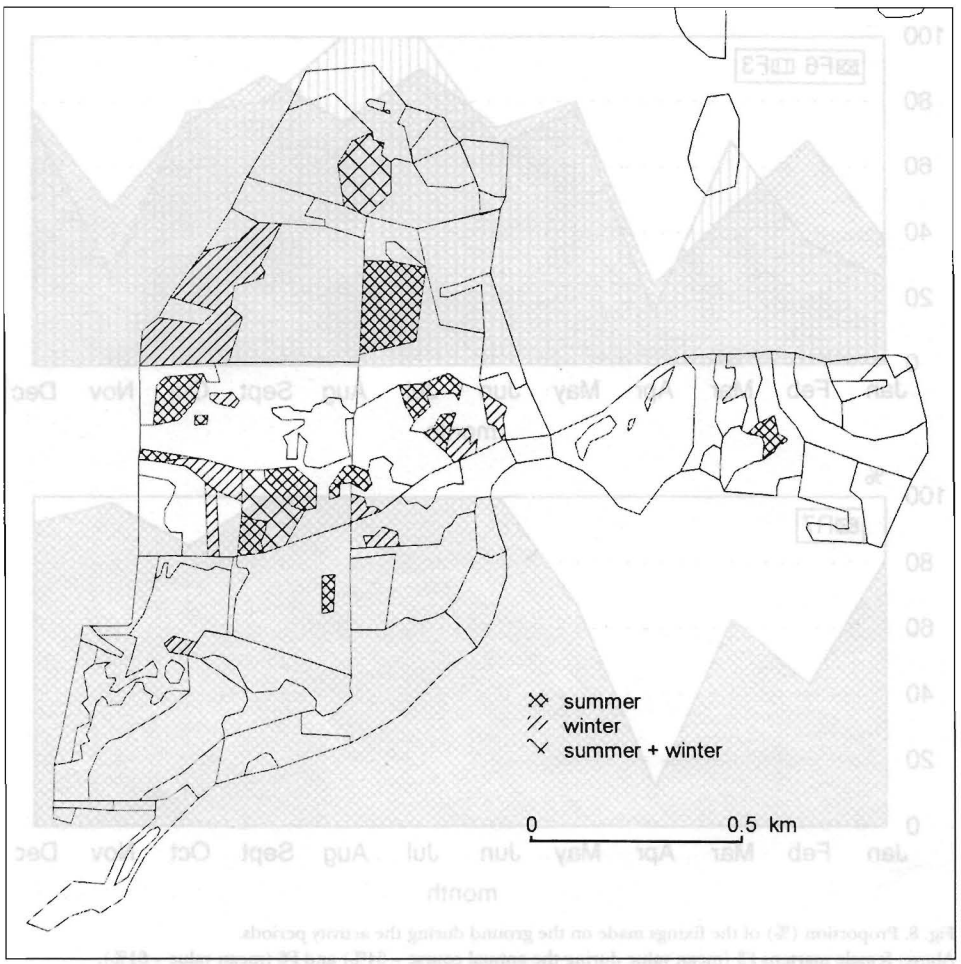

Fig. 7. Plots in the main part of Bantin Forest, which were highly preferred by female marten F6 exclusively during the wintertime, the summertime or during both in summer and winter periods (Pi>3).

sons. Similarly, the differences between these half-year periods were low in female marten F6, apart from a more intensive use of the birch plots during the summer season. In general, the mixed stands (10 to 20% in both areas investigated, were slightly avoided. Pure broad-leaved stands were used by the animals F3, R4, and R7 in an adequate ratio to the supply, which in Wifo accounted for 35% and in Bantin Forest for 45%. The percentages of fixings of the animals F6 and R9 in these plots, however, were even below half of the supply. The pine martens F3, R4 and R7 tended to a slight preference of coniferous stands. The sparse supply of coniferous tree stands (accounting for only 35%) showed a clear preferential utilization by female marten F6 and male marten R9 of approximately 65%.

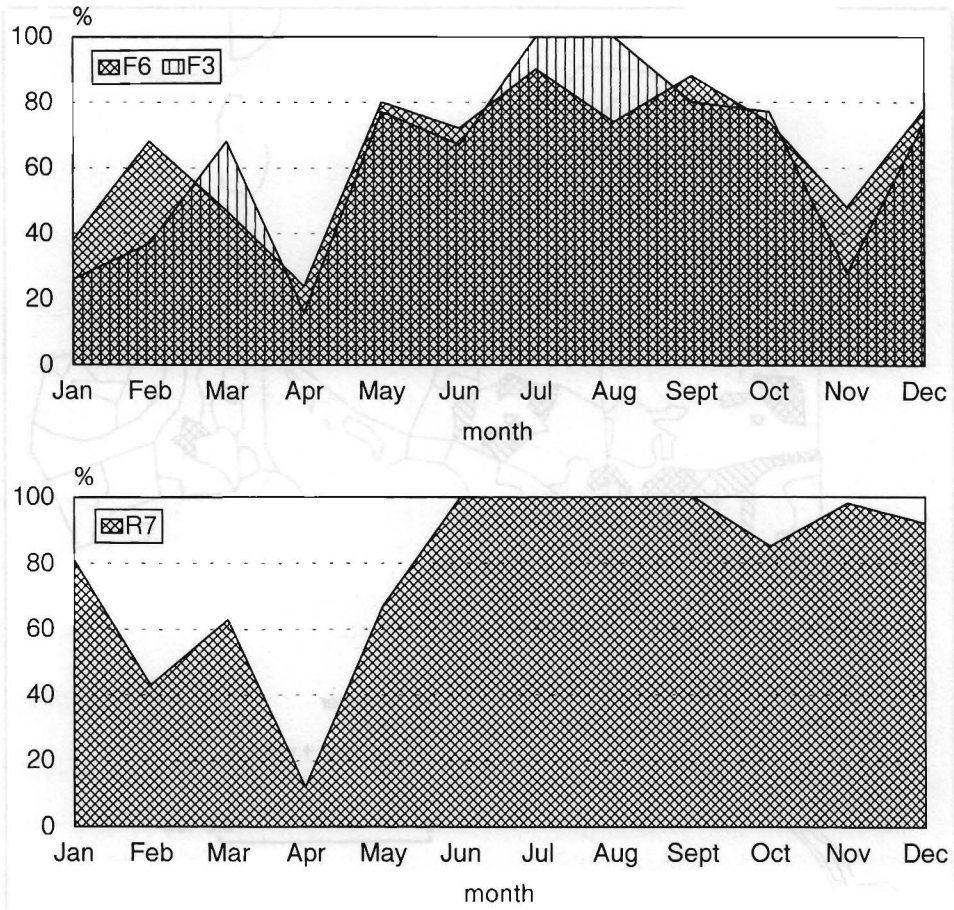

Fig. 8. Proportion (%) of the fixings made on the ground during the activity periods.
Above: female martens F3 (mean value during the annual course = 64%) and F6 (mean value = 61%).
Below: male marten R7 (mean value = 78%).

3.3. Activity on the forest floor

More than 90% of all fixings allowed to assess whether the animal moved along the forest floor or within tree crowns. The major part of these fixings referred to the ground surface. In female marten F3 the proportion of the fixings on the ground accounted for 64% on a monthly average, while in female F6 it was 61%. The male R7 stayed even more often on the forest floor (78%) than the females, and used the tree crowns in his activity periods not so often.

The annual course of the ground fixings revealed very similar tendencies in the two female martens F3 and F6 (fig. 8). During the summer and early autumn months they used the ground at an enhanced rate. The proportion of crown usage increased over the first months of the year. The stay on the forest floor was least in the months January, April, and November, when they were found primarily moving in tree crowns.

4. Discussion

4.1. Use of the home range

4.1.1. Open areas

Marchesi (1989), Schröpfer et al. (1989) and Ebersbach et al. (1995) describe the strong affiliation of pine martens to the forest. Also in the agrarian landscape of Mecklenburg they nearly exclusively live in the forest. However, they obviously do not shrink back from crossing treeless areas, as is substantiated by the repeated changing of home range subdivisions by male R9, with the restriction that - if possible - pine martens for this purpose use vegetation structures that provide shelter such as hedges, rows of trees or avenues. Such crossing between forest parts along hedges and stony escarpments was also described by Marchesi (1989). Treeless sections within the forest, e.g. open areas in the depot and appreciable stretches of reed in Wifo were likewise used in this investigation, whereas plots with stands not exceeding two metres in height, for instance a poplar plantation and Douglas fir and pine young growths, were avoided. Storch (1988) also observed that early successions of plant communities consecutively occupying the same area of ground were avoided. Balharry (1993) and Clevenger (1993) report on the use of scrub. The results of this investigation as well as those obtained by other authors suggest that pine martens need a high degree of safety, since they hardly left the forest which provides sufficient shelter. This suggestion is reinforced by the preference to hides situated in lofty tree crowns. Stubbe (1989) also pointed out that pine martens after having been chased by hunting dogs fled on trees and stayed there for a while.

4.1.2. Day hides

Regarding all animals, the fixings made during their resting phases were distributed over their entire home ranges, and the sizes of the home range calculated based on these values were only slightly smaller than the areas computed on the basis of all fixings. Thus, the assertion by Ebersbach et al. (1995) and Schröpfer et al. (1989) that home ranges were characterized by the distribution of the fixings obtained during the resting phases can be corroborated.

Pine martens hunt for food when roaming about their home range, i.e., preying takes place during locomotion. Females tended to utilize the home ranges more uniformly than the males, a fact which was also reported by Storch (1988). The core areas remained stable in both sexes over longer time periods (in F3 over two years). During the period of colonizing the territory, exploitation of the home range by R9 was particularly irregular. Similar statements were made by Skirnisson (1986) concerning beech martens. Other information on observations about pine martens in such stages is absent. The use of the home range during the period when F3 was apparently exposed to social pressure (winter season 1994/95) was likewise very irregular. Skirnisson (1986) succeeded in observing beech martens also under this aspect. Female F3 as well as the observed beech marten retreated into a very small section of their home range, probably because they evaded a competitor, and used that part with increased intensity.

Regarding the rearing of cubs the results for female F3 were similar to those of

Storch (1988). During the period when the cubs still stayed in the tree cavity, being nursed exclusively there, the female marten moved a far distance from the cavity, apparently because she felt the hide being very safe. During the period following her moving together with the cubs to the surface of the ground and feeding the young with prey, she stayed, in contrast, only in a very small area around the locations where the cubs spent the day. This was obviously because of the continuous need for foraging, while in addition compared to the tree cavity the safety of the cubs had decreased in regard to bad weather and enemies like fox and dog.

4.2. Habitat preferences

The investigations made by Ebersbach et al. (1995) and Zalewski et al. (1995) took place in pure deciduous forest areas, so that a comparison of the results in view of habitat utilization would be hardly reasonable. In the investigations conducted by Schröpfer et al. (1989) and Trube (1994) in areas comprising deciduous and coniferous forests, a clear preference to spruce stands during the periods of activity as well as resting was established just as in the present paper. Stands of deciduous forest including single spruces were selected for sleeping and so were pure spruce stands. As a whole, during the activity period coniferous stands were most frequented - a fact which was also stressed by Schröpfer et al. (1989). The fact that coniferous areas were even more preferred during the winter season is probably attributable to various reasons. In contrast to the glabrous broad-leaved stands, during wintertime coniferous stands provide sufficient shelter for pine martens. In addition, considerable flocks of thrushes and small birds use the coniferous stands as sleeping places in winter. Since, according to Nitze (1989), birds up to the size of thrushes belong to the main food categories, their proportion in the food composition increases in the winter period. In the summer season these spruce stands are preferred breeding sites of open-air breeders such as finches and doves, the eggs and fledglings of which are an easy prey for pine martens.

In contrast, Gautschi (1981) attached the highest importance to mature oak and beech stands. He assessed the environments of 53 pine martens that were shot or knocked down in Switzerland. However, his data are too sparse for an universal statement referring to the overall pine marten population living in Switzerland.

The individual attitude resulting in preference to or avoidance of certain tree species seems to be very important in habitat selection, with the exception of spruce. In the region of Central Europe detailed data about habitat utilization (in particular when taking into account the supply) are missing, so that additional research into these issues, e.g. in pure pine or deciduous forests, is needed.

4.3. Activity on the forest floor

The assertion of Trube (1994) that pine martens moved in tree crowns only on rare occasions and that jumping from tree to tree was mainly confined to situations of danger, cannot be confirmed at all by our studies. H. Ebersbach (oral statement) likewise made contrary observations concerning pine martens tracked by telemetry. The statements of Storch (1988) which were quoted by Trube (1994) for corroborating his

results (describing that the investigated pine martens only rarely jumped from tree to tree in Sweden) might be attributable to the slimmer habit of crowns and the larger distances between trees in Scandinavia. Also in Pulliainen (1984), who studied the even more open forests of North Finland, the pine martens tended to climb on trees only very rarely and usually left them soon afterwards.

In the Mecklenburg investigation locomotion took likewise place on the ground over larger distances. However, the pine martens foraged in tree crowns sometimes for periods of up to two hours. In contrast with Trube's statement (1994) this jumping was not performed reluctantly and assumed a high degree of unerring precision. Approximately one third of all fixings relate to tree crowns. The leaving and approaching of daily hides in the trees took usually place via several tree crowns. H. Ebersbach (pers. comm.) made similar observations. Once I observed the exceptional case of a pine marten (F3) in an attempt to prey on a squirrel. During this chase via the thin branches of a pole-sized larch stand the pine marten seemed equal to the chased squirrel in speed and unerring precision. It is suggested that the most important main nutrition category "small mammals" (Nitze, 1998) is in the main preyed upon on the ground. The birds, however, are often suddenly attacked while sleeping or nesting in tree crowns.

When the results of this investigation, conducted in an area where small-scale forest structures dominate, are compared with the utilization of more extended woodlands (Marchesi, 1989; Pulliainen, 1981; Schröpfer et al., 1989; Storch, 1988; Trube, 1994), both common characteristics and differences are becoming apparent. Pine martens succeeded in colonizing small-scale forest areas and developing intact populations. For the number of pine martens living there as well as their spatial utilization of the forest the size and the distance of forest areas is more crucial than their habitat structure.

ACKNOWLEDGEMENTS

The author acknowledges his gratitude to numerous persons and institutions without their support and cooperation the present paper would have been impossible. In particular, he wishes to express his sincere thanks to Prof. Dr. W. Bassus, Prof. Dr. M. Roth, I. and M. Stier, K. Beindorf, Dr. H. Eichstädt, J. Kießling, M. Nitze and two referees of the journal Lutra.

ZUSAMMENFASSUNG

Als Hauptziel der Untersuchung stand die Beantwortung der Fragen, ob die kleinräumigen Waldstrukturen in Südwest-Mecklenburg (Deutschland) durch den Baummarder besiedelt werden, wie die Raum-Zeit-Nutzung einer Art mit relativ großem Raumbedarf in solchen Wäldern erfolgt, und ob es Unterschiede im Verhalten der Tiere zu anderen europäischen Untersuchungen gibt. In der 27monatigen Untersuchung wurden sechs Baummarder (vier Rüden, zwei Fähen) aus zwei voneinander getrennten, kleinflächigen Waldgebieten im Südwesten Mecklenburg-Vorpommerns mittels Telemetrie beobachtet. Die Ergebnisse lassen Aussagen zur Habitatnutzung in einer Landschaft mit kleinräumigen Waldstrukturen zu.

Die Tiere hielten sich nur im Wald auf. Nur bei einem Rüden konnte eine regelmäßige Überquerung von waldfreien Flächen zwischen zwei Waldteilen beobachtet werden. In der Regel bewegten sich die Baummarder nach dem Verlassen des Verstecks nahrungssuchend durch den Aktionsraum und suchten sich am Ende der Aktivphase im zuletzt genutzten Bereich ein neues Versteck. Es erfolgte meist kein gezieltes Zurückkehren zu einem bestimmten, bekannten Tagesversteck. Fähen nutzten ihren Aktionsraum gleichmäßiger als Rüden aus.

Mit Ausnahme von Kulturen bis zwei Meter Höhe wurden Waldstrukturen aller Altersklassen genutzt. Eine deutliche Bevorzugung von Fichtenbeständen konnte in Aktiv- und Ruhephasen nachgewiesen werden. Die Nutzung von Beständen anderer Baumarten erfolgte individuell verschieden. Der Anteil der Peilungen in deckungsreichen Nadelholzbeständen stieg im Winter noch an, während Laubholzflächen im Winter seltener aufgesucht wurden.

Es konnten in Bezug auf die Habitatnutzung des Baummarders Parallelen zu anderen europäischen Untersuchungen festgestellt werden, so daß man davon ausgehen kann, daß es in der Raum-Nutzung der Baummarder, die kleine Waldgebiete besiedeln, kaum Unterschiede zu Baummardern in anderen Gebieten gibt. Als Anpassung an kleinräumige Waldstrukturen in Südwest-Mecklenburg wurden auch kleine Aktionsräume gewählt.

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SAMENVATTING

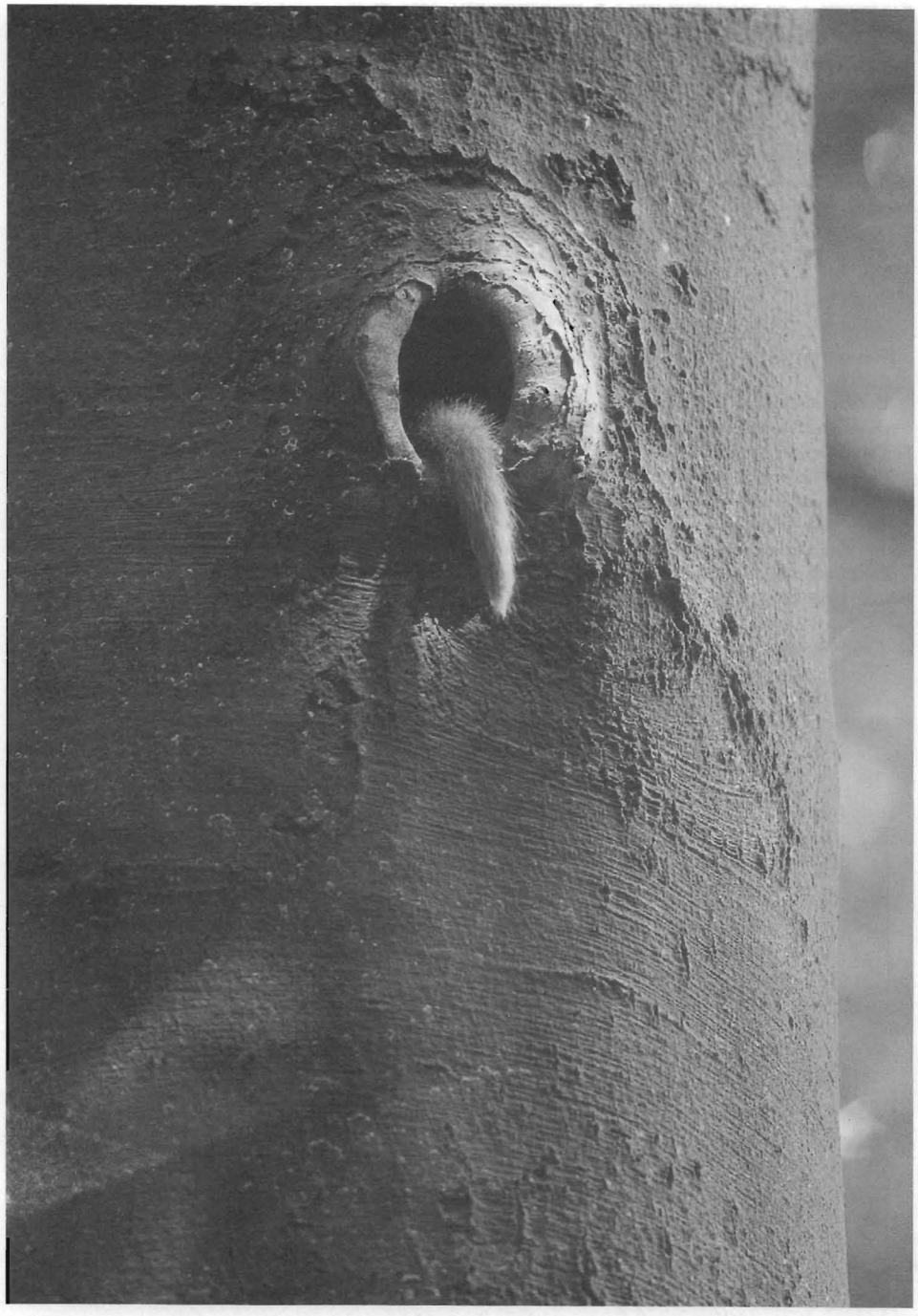
Biotoopgebruik van de boommarter *Martes martes* in kleinschalige bosgebieden in Mecklenburg (Duitsland)

Onderzocht zijn kleine bossen (135-200 ha) in Mecklenburg waarin boommarters voorkomen waarvoor het territorium samenvalt met het gehele bos. In twee bossen zijn zes boommarters gevolgd met behulp van teleletrie. Eén mannetje bezocht regelmatig een satelietbos van kleine omvang waar hij langs een heg heen liep.

De omvang van het gebied waar een bepaalde boommarter te peilen viel, viel samen met die van het gebied waarbinnen de dagrustplaatsen van hetzelfde dier lagen. Bospercelen van alle hoogtes werden bezocht door de marters, maar onder de diverse boomsoorten was er een duidelijke voorkeur voor spar, in het bijzonder in de winter. Enige boommarters hielden zich daarnaast vaker op in bepaalde boomsoorten.

De boommarters hielden zich in 60-80% van de actieve periode op de grond op; zij foerageerden echter uitgebreid in de kronen van de bomen, iets wat deze studie onderscheidt van enige eerdere.

(H.J.W. Wijsman)



Een staart verraadt de aanwezigheid van een nest jonge boommarters. Foto: Chris Achterberg.
A tail gives away the presence of a nest of pine marten kittens. Photograph: Chris Achterberg.