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保护生物学研究

吴诗宝 马广智 廖庆祥 卢开和 著

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吴诗宝简介

曾就读于安徽师范大学、西华师范大学、兰州大学，分别获学士、硕士和博士学位，现师从孙儒泳院士从事博士后研究。在《Mammalia》、《生态学报》、《应用生态学报》、《应用与环境生物学报》、《兽类学报》等学术期刊发表论文40余篇，主持中国博士后科学基金会、中国野生动物保护协会、中国中药现代化课题组、广东省林业局等部门资助的科研课题9项。现任IUCN/SSC穿山甲专家组成员、广东省动物学会理事、广东省野生动物保护协会理事、广东省陆生野生动物驯养繁殖技术科学论证专家委员会委员。

序

中国穿山甲（*Manis pentadactyla*）是极其珍贵的经济动物，具有重大的生物多样性保护价值，由于乱捕滥猎和栖息地的破坏，已濒临灭绝的边缘，已列入 IUCN 红色名录、CITES 附录 II 和国家重点保护野生动物名录。其生存状况历来未受到重视，它的生物学、生态学、保护生物学研究资料也十分欠缺，以致该物种的保护工作长期缺乏科学理论支持而难以取得显著成效。

这部专著比较系统地对中国穿山甲的起源、地理分布、洞穴特征及生境选择、食性等进行了研究，并在资源调查的基础上，对其保护对策和受危状况进行了充分的讨论和定量性的评估，这在目前国内尚属首次，系穿山甲保护生物学研究仅见的系统结果，它为我国政府制定更为有效的保护对策提供了依据。

这部专著反映出作者具有良好的探索和求是的科学精神。例如，尝试建立穿山甲的进化谱系；主张将现存穿山甲所在的穿山甲属（*Manis*）一分为二，建立亚洲穿山甲属（*Manis*）和非洲穿山甲属（*Phataginus*）；对 Emry R. J.（1970）的穿山甲“北美起源说”提出质疑，确立穿山甲“欧洲起源说”；首次发现在中国有马来穿山甲（*Manis javanica*）的分布；认为洞穴在穿山甲的生活史中具有极其重要的作用；阐述了穿山甲的觅食行为谱、食谱和食物选择指数，还发现黄翅大白蚁（*Macrotermes barneyi*）、台湾乳白蚁(*Coptotermes formosanus*)是中国穿山甲食谱中的关键食物，它们的分布决定着中国穿山甲的分布；尝试建立受危指数（T_i）法对该物种的受危程度进行了评估。

我非常乐意将这部专著推荐给广大读者，相信它的出版对该物种的保护一定会起推动作用。

孙儒泳　院士

2005 年 3 月

前　言

这是一部关于中国穿山甲（*Manis pentadactyla*）保护生物学研究的专著，由 10 个部分组成。第 1 部分，穿山甲生态学研究概况；第 2 部分，穿山甲的起源、分类、进化及地理分布；第 3 部分，中国穿山甲的洞穴特征及生境选择；第 4 部分，大雾岭自然保护区穿山甲冬季生境选择；第 5 部分，中国穿山甲的食性；第 6 部分，中国穿山甲和马来穿山甲形态学特征比较；第 7 部分，中国穿山甲资源现状及保护对策；第 8 部分，中国穿山甲受危状况评估；第 9 部分，中国兽类新记录——马来穿山甲；第 10 部分，马来穿山甲年龄组划分及寄生虫观察。

第一部分，综述了全球现存 7 种穿山甲生态学研究概况，目前的研究主要是通过访问法对中国穿山甲的栖息地、活动习性、食性、繁殖习性、打洞习性进行一般性的描述。南非穿山甲（*M. temminckii*）的研究主要集中在家域、活动和运动、食谱和觅食行为生态上，繁殖生态学、种群生态学及栖息地的研究未涉及。树穿山甲（*M. tricuspis*）仅见其家域研究的报道。其他 4 种穿山甲生态学研究未见任何报道。7 种穿山甲的习性相似。今后应当强调从生命的各个层次对其生态学进行比较研究，以揭示其存在的生态差异。重点应当是洞穴生态、觅食生态、行为生态（如家域与活动）、进化生态、繁殖生态和种群生态。

第二部分，讨论了现存 7 种穿山甲（*Manis* spp）的系统位置。根据穿山甲的化石资料，结合有关古地质、古气候和古生物的知识，探讨了穿山甲的起源、进化、历史地理分布及现代分布格局的成因，认为：（1）穿山甲与贫齿类的关系是平行的，共同起源于古食虫类，古贫齿兽类不可能是它的祖先。（2）主张将现存的穿山甲属（*Manis*）一分为二，建立亚洲穿山甲属（*Manis*）和非洲穿山甲属(*Phataginus*)。（3）现代穿山甲主要分布在亚洲和非洲的热带和亚热带地区，历史上曾在第三纪的始新世到中新世分布于欧洲和北美。（4）穿山甲的起源地在欧洲，北美起源说难以成立，北美、非洲和亚洲的穿山甲由欧洲迁入。（5）在第四纪冰期到来前，更可能是在中新世末之前，北美、欧洲的穿山甲就全部灭绝，保留下来的欧洲 *Manis* 属全部迁移到非洲和亚洲的热带和亚热带地区，并形成现今分布格局，现存穿山甲可能由欧洲 *Manis*

属分化而来。（6）穿山甲在欧洲和北美灭绝及向亚洲和非洲迁移的重要原因是新第三纪和更新世北方大陆气温剧烈下降和反复到来的冰期，和由此造成的广布北方大陆的白蚁和蚂蚁大量灭绝，使穿山甲食物严重短缺。

第三部分，描述了大雾岭保护区中国穿山甲的洞穴结构、功能、利用及生境选择，发现穿山甲的洞均为盲洞，没有分支；洞口径大小一般为：长径 14.20 ± 2.79cm（n=61），短径 12.50 ± 2.83 cm（n=61）；洞穴可分为冬洞和夏洞，冬洞在冬春季节打造，洞穴较深(1.44 ± 0.73 m, n=28)；夏洞在夏秋季节打造，洞穴较浅（0.32±0.11m, n=12）。多在冬春季打洞，夏季打洞少，并且主要选择在土质松软湿润、土层厚、地表有机质丰富的黄壤土中打洞，主要是为了获得食物白蚁，然后再利用它越冬、卧息、繁殖、隐藏和逃避敌害。新洞的平均利用时间为 12.25±2.25d，旧洞的再次利用率极低（1/12=8.33%）。穿山甲喜爱将洞穴设置在干扰程度小（干扰源距离> 1000m）、坡度较陡（30°～60°）、坡向为半阴半阳坡、针阔混交林、中低海拔（760～1500m）、洞口隐蔽程度好（全隐蔽或半隐蔽）、中坡或下坡位、离水源距离近（<500 m）的生境内；不喜爱将洞穴设置在阴坡、洞口隐蔽程度差（裸露）、极陡坡（>60°）或缓坡（<30°）、高海拔（>1500m）、针叶林的生境内；洞口多朝南，避免朝北。

第四部分，对大雾岭保护区穿山甲冬季栖息地的选择进行了研究，结果表明：大雾岭保护区的穿山甲在冬季对林型的选择次序为：针阔混交林>灌木丛>常绿阔叶林>针叶林；最偏爱针阔混交林，最不喜爱针叶林。穿山甲喜爱阳坡、中低坡位、坡度大（30°~60°）；干扰源距离在 1000m 以上（85.37%），干扰程度小；地被物的盖度大（81%～100%），隐蔽程度好；海拔在 760m~1500m 之间（78.05%）；乔木郁闭度适宜(31%～70%)的生境。乔木下茂密的灌草层对穿山甲可能特别重要。

第五部分，通过野外观察及粪便和胃内容物分析，对中国穿山甲的食性进行了调查。结果表明，中国穿山甲的觅食行为可分为 6 个类别，即行走、搜寻、行走/搜寻、挖掘、取食、暂停；取食地点主要发生在杂草、乔木、灌木的基部，落叶层下，倒木/枯枝、死树桩附近，及白蚁巢内；对蚁类有明显的选择和偏爱，被拒食的蚂蚁和白蚁种数分别占 83.87%（26/31）和 53.85%（7/13），最喜爱的蚁类是台湾乳白蚁（*Coptotermes formosanus*）、黄翅大白蚁（*Macrotermes barneyi*）、双齿多刺蚁(*Polyrhachis dives*)；食谱由 11 种蚁类构成，占保护区蚁类组成 25%，其中蚂蚁 5 属 5 种，白蚁 4 属 6 种，夏季食谱主要由蚂蚁构成，冬季食谱主要由白蚁构成，台湾乳白蚁、黄翅大白蚁很

可能是穿山甲食谱中的关键食物。

第六部分，涉及中国穿山甲（*Manis pentadactyla*）和马来穿山甲（*M. javanica*）一些形态学指标测定。被测定的变量主要有头骨（颅全长、基底长、腭长、眶间宽、后头宽、鼻骨长、鼻骨宽、脑颅高、听泡长和下颌长）、体重、体全长、头体长、尾长、耳长、后足长、前后中爪长、体中部鳞片最大列数、尾缘鳞单侧个数，并且在这两个物种之间进行了比较。结果表明（1）这两个物种头骨形态十分相似，但马来穿山甲头骨细长，听泡长小于 10 mm (n=12)，鼻骨狭长，前后部宽窄相似，两鼻骨外侧缘内凹或平行，鼻骨宽长之比值小于 0.3（0.2025～0.2811, n=12）；而中国穿山甲头骨较粗短，听泡长大于 11mm (n=46)，鼻骨宽短，后部较前端宽，外侧缘外凸，鼻骨宽长之比值大于 0.3 (0.3154～0.5325, n=33)。这些异同之处，可以作为区分这两个物种的依据。（2）中国穿山甲华南亚种与海南亚种头骨各变量之间差异不显著(P >0.05)，用颅全长是否大于 83mm 来区分这两个亚种不能成立，但海南亚种头骨上颌骨的颧突和鳞骨的颧突通常越过眶颞窝完全相接触，如果不是这样，则在它们之间有一个小的骨质棒状结构将它们连接起来。（3）这两个物种的体重和后足长差异不显著，其他变量均显著。（4）中国穿山甲的后足中爪长与前足中爪长之比小于 1/2 (n =48)，而马来穿山甲大于 1/2 (n=15)；中国穿山甲的外耳长大于 10mm (n=38)，而马来穿山甲小于 10 mm (n=13)；中国穿山甲的尾缘鳞单侧数目少于 21 枚(n=65)，而马来穿山甲多于 21 枚(n=14)。因此可以把前后足中爪长之比值、外耳的长度、尾缘鳞单侧数目作为这两个物种的鉴别特征和分类指标。（5）这两个物种的体重（Y）与其总体长、头体长、尾长(X)呈正相关关系，并且符合方程 $Y= aX^b$。

第七部分，简要介绍了我国穿山甲的资源种类与分布、资源价值与利用、市场价格、走私与贸易、人工养殖，重点论述了我国穿山甲的资源数量及其变化、资源濒危原因及应采取的保护对策。穿山甲是穿山甲属（*Manis*）的动物总称，全球现存 7 种，我国 3 种，它们是中国穿山甲（*Manis pentadactyla*）、印度穿山甲（*M. crassicaudata*）和马来穿山甲（*M. javanica*）。其中中国穿山甲是分布最广、数量最大的一种，主要分布在我国长江以南地区，河南南部为其分布的最北界；马来穿山甲是本次调查新发现的我国兽类新纪录，与印度穿山甲同分布于云南局部地区，是分布最狭窄，数量最少的两种穿山甲。尽管中国穿山甲地理分布最广，但其生态分布范围已大大退缩，分布面积大大下降，种群被分割成小种群，呈岛屿状。估计当前我国穿山甲资源量在 50 000~100 000 头，似乎数量很大，显然是其分布广的缘故，若与 20 世纪 60

年代相比，其种群数量已严重下降，至少下降了 88.88%~94.12%，生态密度仅为 0.001134~0.61 头/km^2，雌雄已很难有交配机会，在野外已几乎见不到新鲜的痕迹，处于较高的受危状态，潜在的灭绝危险大。在我国，穿山甲主要是食用和药用，若最大限度地满足市场需求，估计年需求量在 28.5 万头左右，其中药用 13.5 万头，食用 15 万头，供求矛盾、保护与利用矛盾已到了十分尖锐化的程度。造成我国穿山甲资源濒危的主要原因是利用过度、栖息地破坏、穿山甲遗传性能衰竭。建议积极开展穿山甲生态生物学研究，依靠科学保护穿山甲；采取以就地保护为主的对策，建立穿山甲自然保护区；应当鼓励并支持开展穿山甲人工驯养研究，实现变野生为家养，以满足市场需求，解决保护和利用的矛盾，为迁地保护做前期准备；加强药用穿山甲代用品的研究，以减轻对野生资源的捕捉压力；积极创造条件开展穿山甲离体保护技术的研究；将我国 3 种穿山甲列为国家一级保护动物。

第八部分，分析了中国穿山甲的各种致危因素共 19 种，并以此评估了它的受危状况。结果表明，中国穿山甲属易受危物种，潜在的绝灭危险较大。较高的受危指数（T_i= 0.6947）表明它处于高度受危状态，已成为濒危物种（En）。最关键的外在致危因素是过度狩猎、利用和走私，其次是栖息地的丧失、改变、岛屿化和种群分布格局的片断化。20 世纪 60 年代至今，中国穿山甲种群数量已下降了 88.88%～94.12%，栖息地内的种群密度已低至 0.001134～0.056 头/km^2，较高的狩猎压力以及栖息地的丧失、改变、岛屿化和走私还将持续，受危程度将进一步加重，潜在的绝灭危险继续上升。要缓解中国穿山甲当前的受危状况，减轻狩猎压力，保护好现有栖息地，打击走私是当务之急。依据 IUCN 红色名录（Red List，version 3.1）和我国濒危动物红皮书对受危物种等级标准的定义，以及 CITES 附录物种等级标准、我国重点保护野生动物等级标准，中国穿山甲应当从我国濒危动物红皮书中的易危级（Vu）和 IUCN 红色名录里的低危接近易危(LR/nt)上调为濒危级（En），由 CITES 附录 II 上升为附录 I，由国家 II 级保护野生动物上升为 I 级保护。

第九部分，记述了我国兽类新记录，来自云南的马来穿山甲，标本收藏于中国科学院昆明动物研究所标本馆。

第十部分，根据鳞甲、毛发、爪的磨损程度以及母幼行为关系和体重大小，将马来穿山甲划分成 4 个年龄组：幼年组、亚成体组、成体组和老年组。记述了马来穿山甲 1 种体外寄生虫——爪哇花蜱（*Amblyomma javanese* Supino, 1897）。

这部专著是我们近十多年来对中国穿山甲保护生物学研究成果的系统总

结，其中一些内容已在相关刊物发表。

撰写过程中得到了兰州大学刘迺发教授、张迎梅教授、王子仁教授、王刚教授、杜国祯教授、王根轩教授，中国科学院动物研究所魏辅文研究员、宋延龄研究员，中国科学院昆明动物研究所王应祥研究员，浙江大学刘季科教授，中国科学院西北高原生物研究所苏建平研究员，西华师范大学珍稀动物研究所胡锦矗教授的指导，以及 Martha E. Heath 博士(Biodiversity Research & Application Association, USA)、Renee A. Richer 博士（Biological Laboratories # 49 of Harvard University, USA）、杨翕雯博士（台北市立动物园）、赵荣台博士［SSC/IUCN 穿山甲专家组（PSG）主席，台湾］、温晋林博士（兰州大学资源与环境学院）、黄族豪博士（兰州大学生命科学院）、阮禄章博士（兰州大学生命科学院）、刘付轶博士（the University of Utah, USA）的帮助。

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吴诗宝

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ABSTRACT

This monograph, Studies of Conservation Biology on Chinese pangolin (*Manis pentadactyla*), is composed of 10 sections, **section 1**, A Current Situation of Ecology Study on Pangolins; **section 2**, Origin, Classification, Evolution and Geographic Distribution of Pholidota; **section 3**, Burrows and Habitat Selection of Chinese Pangolin; **section 4**, Habitat Selection by Chinese Chinese Pangolin in Winter in Dawuling Natural Reserve; **section 5**, Food Habits in Chinese pangolin; **section 6**, Comparison of Morphological Feature in Chinese Pangolin and Malayan Pangolin; **section 7**, Status and Conversation Strategy of Pangolin Resource in China; **section 8**, Assessment of Threatened Status on Chinese Pangolin; **section 9**, A New Record of Mammalia in China: Malayan Pangolin; **section 10**, Age Group Dividing and Parasite Observation on Malayan Pangolin.

Section 1, summarized the current situation of ecology studies on 7 living species of pangolins in the world, indicating very few studies done. The habitat of Chinese pangolin and its habits of activity, foraging, breeding and burrowing were described in general only depending on data from interviewing hunters, and few monographic studies were carried out. The ecology studies in Cape pangolin (*M. temminckii*) were mainly focused on its home range, activities, mobility, diet and foraging behavior, and these studies were intensive. However, the studies on Cape pangolin's breeding ecology, population ecology and habitat are still not involved. The known tree pangolin's ecology study was only on its home range. There is no report on ecology study of the other 4 species. The 7 species are similar in habits, to reveal their difference in ecology, in future it should be stressed to make comparing study to their ecology on the different organism level. The study's focal point should be placed on burrowing ecology, foraging ecology, behavior ecology (such as home range and activity), evolution ecology, breeding ecology and population ecology.

In section 2, the systematic position of the seven species of extant pangolins (*Manis*. spp) was discussed in this paper. On the base of pangolin fossils, linking related knowledges of palaeo-geology, palaeo- climatology and palaeobiology, we analysed the Pholidota's origin, evolution and geographic distribution in history,

and the cause of formation of current distribution pattern. The following conclusion have been reached: **a**. Pholidota and Edentata derive together from ancient Insectivora with parallel relationships. It's impossible that the ancestor of Pholidota is the Palaeanodonta; **b**. it's suggested to split the extant genus *Manis* into two genera, *Manis* for Asia pangolins, *Phataginus* for Africa pangolins; **c**. the living pangolins are confined to the tropical and subtropical area in Asia and Africa, the Pholidota ever inhabited Europe and North America in history; **d**. the original home of the Pholidota is considered to be Europe, we don't accept the view of North America origin; **e**. pangolins of Europe and North America died all out before or among ice age of Quaternary, even by the end of Miocene. The remaining genus *manis* of Europe, from which the remaining extant pangolins probably differentiate, migrated all into tropical subtropical area of Asia and Africa, and formed current distribution parttern; **f**. the causes of the extinction and migrating to Asia and Africa for pangolins of Europe and North America should be air temperature extremely declining and frequent occurrences of ice age, which resulted in die of abundant ants and termites, among the late-Tertiary and Pleistocene of the North Word, and the serious short of pangolins' food, ants and termites.

Section 3, described the structure, function, utilization, and habitat selection of Chinese pangolin's burrow at Dawuling natural reserve. We found that all the burrows are blind without branch. The long diameter of entrance is 14.20 ± 2.79 cm (n = 61), and the short one is 12.50 ± 2.83 cm (n = 61).We divided them into two types: winter burrows and summer burrows. Winter burrows are deeper (1.44 ± 0.73 m , n = 28) with more numbers, dug in winter. Summer burrows are shallower (0.32 ± 0.11 m, n = 12) with less numbers, dug in summer. Soil at burrows usually is soft, damp and thick with a thick surface layer of organic matter; Digging burrows by pangolins is mainly to prey on termites living underground termites nests, then to use them to hibernate, rest, breed, hide and defense. Mean duration of pangolin residing in a burrow is 12.25 ± 2.25 d. However, pangolins rarely use used burrows, the reusing rate of old burrows is 8.33% only. Surroundings factors of 61 burrows were recorded, which were divided into 9 categories and 27 subcategories. According to the occurrence frequencies of each factor and the results of the Cluster analysis of 61 burrows,

we discussed habitat selection of burrows of pangolin, and considered that pangolins prefer creating burrows at such sites with weak human disturbance degree (distance from disturbance source beyond 1000 m), steep slop (30° ~ 60°), half sunny and half shady slope, mixed coniferous and broadleaf forest , moderate elevation (760 ~1500 m), good hiding conditions at entrance (full cover or partial cover), middle slope location or lower slope location, easily accessing to water source (distance from water source within 500 m); pangolins are averse to establish burrows at such habitats with shady slop, poor hiding condition at entrance (bare), sharp steeper slop (>60°) or gentle (<30°), higher elevation (over 1500 m), coniferous forest. Pangolins prefer entrances facing south, and strongly avoided ones exposing north.

Section 4, studied habitat selection by Chinese pangolin (*Manis pentadactyla*) in winter in Dawuling Natural Reserve. The results showed that the ranking of vegetation types selected by pangolins in winter was MCBF > SF > EBF > CF. The environmental factors preferred by pangolins in winter were 30°~ 60°steep slopes, middle and bottom of slopes, sunny slopes, > 1 000 m from human disturbance, heavy (81%~100%) undergrowth with good shelter conditions, moderate (760~1500 m) elevation, and medium (31% ~ 70%) closure of arbor canopy. The thick layer of shrub and herbs growing under the tree canopy appeared to be especially important to pangolins during winter.

Section 5, the food habits of Chinese pangolin (*Manis pentadactyla*) were surveyed by using the methods of field observation and the analysis of droppings and stomach contents. The foraging behavior was classified into 6 categories, which were walking, searching, walking/searching, digging, feeding, pause. The feeding sites occurred at the base of grass, tree, and shrub, under leaf litter, near fallen log, fallen limb and dead stump, and in termite nests. Chinese pangolin showed obviously selection and preference to ants and termites, the refused ants and termites species accounted for 83.87%(26/31) and 53.85%(7/13) respectively, favorite species of ant and termite were *Coptotermes formosanus*, *Macrotermes barneyi*, *Polyrhachis dive*. The diet was composed of 11 species of ant and termite, including 5 genera and 5 species of ants, and 4 genera and 6 species of termites. Ants constituted the major component of the summer diet, while termites formed that of the winter diet. *Coptotermes formosanus* and

Macrotermes barneyi were probably key species in Chinese pangolin's diet.

Section 6, dealts with the measurement of some morphology indices in *Manis petadactyla* and *Manis javanica*. Measured variables included skull (the greatest length of skull, the basilar length, the palatilar length, the greatest cranial breadth, the inter orbital breadth, the length of auditory bulla, the height of brain case, the nasal bone length, the greatest breadth of nasal bone, and the mandibula length), the body mass, the total body length, the length of head and body, the length of tail, the length of protruding rim of external ear, the length of hind feet, the length of middle claws of fore feet, the length of middle claws of hind feet, the number of rows of scales round mid-body, the number of scales along one edge of tail. All variables measured were compared respectively between this 2 species. The results indicated that: (1) Skulls of these 2 species were very similar in shape, an elongated cone, but *Manis javanica* was thinner and longer, the length of auditory bulla was no more than 10 mm (n = 12); nasal bone was narrower and longer, nearly the same width throughout or a slight concave at the middle both sides; the width length ratio was less than 0.3000 (0.2025 ~ 0.2811, n = 12). Compared with skull of *Manis javanica*, *Manis pentadactyla* was thicker and shorter; the length of auditory bulla was longer than 11 mm (n = 46); nasal bone was wider and shorter; and wider at the posterior than at front part; both sides was convex; the width length ratio was more than 0.3000 (0.3154 ~ 0.5325, n = 33). These differences between these 2 species might be regarded as basis of identifying them. (2) The skull difference between *Manis pentadactyla aurita* and *M. p. pusilla* was not significant ($P > 0.05$), so it is untenable to identify these 2 subspecies on the basis of whether their skull length is longer than 83 mm or not. But, at all events, the maxillary bone and the squamosal process of skull of *M. p. pusilla* are usually completely bridged the orbito-temporsal fossa, their tips touching, or, if they don't quite touch, a small bony element between them completes the bridge. (3) There were no significant differences in body mass and length of hind feet between this 2 species, but differences in the other variables were extremely significant. (4) The ratio of the length of middle claws of hind feet and fore feet in *Manis pentadactyla* was less than 1/2 (n=48), while *Manis javanica* was more than 1/2 (n=15); the length of protruding rim of external ear in *Manis pentadactyla* was over 10 mm (n=38), whereas *Manis javanica* was under

10 mm (n=13); the number of scales along one edge of tail in *Manis pentadactyla* was not beyond 21 (n=65), and *Manis javanica* exceeded 21 (n=14). So the ratio of the length of middle claws of hind feet and fore feet, the length of protruding rim of external ear, and the number of scales along one edge of tail should be regard as distinctive feature and taxonomic indices between this 2 species. (5) The relationships between body mass (Y) and the total body length, the length of head and body, the length of tail (X) were positive correlation, and satisfied relation formula $Y = a X^{b}$.

Section 7, a brief introduction was given to the resource types, geographic distribution, resource value and utilization, market price, smuggle and trade, domestic rearing of pangolin in China, with the focus on the analysis on the resource amount and change, the cause for its decline, and the protective measures that should be taken. Pangolins are general call to all animal under pangolin genus (Manis), with 7 living species in the world, 3 species of these in China: *Manis pentadactyla*, *M. crassicaudata*, *M. javanica*. *Manis pentadactyla* mainly distributed the south area of Yangzi river in China, even go beyond Yangzi river, and extend northward to southern Henan province, with wider distribute range and larger population number; *Manis javanica* is a new mammalian record in China from this survey, occurs in narrow area of Yunnan province together with *Manis crassicaudata*, with little number like *Manis crassicaudata*. In despite of *Manis pentadactyla* distribute widely, its ecological range has dramatically shrunk, habitat area has greatly reduced, the population has been segmented into many meta-populations. At present the number of wild pangolins in China is estimated to be between 50 000 and 100 000 individuals. Compared with that of 1960s, the number has dramatically declined, at least 88.88% ~ 94.12%. The eco-density is only 0.001134 ~ 0.61 ind./km^2. Their fresh activity trails were hardly observed in field. Little mating opportunities will occur between male and female. These indicate that Chinese pangolin is in high threatened status and high risk of extinction-susceptibility. In China pangolins are mainly used as food and raw material of Chinese medicine. The annual domestic maximum demand reach about 285 000 individuals, of these 135 000 individuals for medical use, 150 000 individuals for food use. The contradiction between supply and demand, conservation and utilization are very sharp. The decline of pangolin resource is

mostly due to overexploitation, habitat destruction, and genetic deterioration. It were suggested to carry out research on eco-biology for pangolin, protecting pangolin depend on science and technology; to take on-site conservation measures, establishing natural reserve for pangolin; to carry out study on domesticating techniques, realizing artificial rearing; to strengthen research on the substitute for pangolin in medical uses, reliving the hunting press; to create conditions to study the technology for the protection of pangolin in vitro.

Section 8, some information of threatened status on Chinese pangolin was given. Nineteen factors threatening this species survival were used to assess its threatened status, the attributes of these factors were known from published information and the findings of this study. Each of factors was given a score on the basis of the potential to cause this species risk in survival, ranging from a maximum of 5 (risk is highest) to 0 (no impact). The overall threatening index ($\bar{T}i$) is the summed scores of all factors divided by the total possible scores. The results showed that Chinese pangolin belongs to susceptible species due to its taxonomic uniqueness (monotypic order, family and genus), food specialization and stenophagy (only feeding on several species of ants and termites), very low reproductive rate (usually one cub per litter, one litter per year), strict requirement in habitat and very poor in defense (moving slowly, shy, curling up into a ball when threatened). The potential extinction risk for this animal is very high. The high threatening index (T_i = 0.6947) suggested that this species is in higher threatened degree, and has become an endangered species. The most key external threatening factors of this species is over hunting, utilization and rampant smuggling occurring at the border of China and Viet Nam, owing to its rare value in medicine and food. The second is the loss, alteration and insularity of its habitat, and fragmented population distribution pattern. Now Chinese pangolin is very rare whether in China or out the boundary of China. The estimated population number has decreased 88.88% ~ 94.12 % since the end of 1960s last Century. The population density in habitat has declined to 0.001134 ~ 0.056 individual per square kilometer. The high hunting press, habitat loss/ alteration/ insularity and rampant smuggling will continue keeping, so the threatened status of this species will become more serious, the potential extinction risk will also rise increasingly. To prevent the increasing threatened situation of Chinese

pangolin, a task of top priority of the moment is to relieve hunting press, protect available habitat, and strike smuggling pangolins. According to the threatened species categories and criteria used in IUCN red list (version 3.1), China Red Data Book of Endangered Animals, CITES Appendix Species and National Importance Protected Animals List in China, Chinese pangolin should be moved up to Endangered categories from Vulnerable categories in China Red Data Book of Endangered Animals and from Lower Risk, near threatened categories in IUCN Red List, and also should be shifted to Appendix I from CITES Appendix II, and to the List of Rank I from the List of the Rank II National Importance Protected Animals in China.

Section 9, described Malayan pangolins (*Manis javanica*), from Yunnan of China, which are a new record of mammals in China. The specimens are collected in the Museum of Kunming Institute of Zoology, Chinese Academy of Siences.

Section 10, according to the wear degree of their claws, scales, hair and the behavior relationships between mother and baby, divided *Manis javanica* into 4 age groups, cub, sub-adult, adult and senior; reported 1 species of tick parasite beneath scales of the animal, *Amblyomma Javanese* Supino, 1897.