Effects of forest health tourism on human health

Pingge He[1, a], Xiping Cheng[2, b], Leichao Yu[1, c] and Rumin Zheng[1, d]

[1]Faculty of Ecotourism, Southwest Forestry University, Kunming 650224, China

[2] Southwest Forestry University, Kunming 650224, China

[a]hepingge0420@126.com, [b]xipingcheng@yahoo.co.jp, [c]leichaoyu@126.com, [d]ruminzheng@163.com

Abstract

Based on the relevant conceptions of forest health tourism, this paper introduces the impacted factors on human health and emphatically describes the domestic scholars'work for evaluation and research progress of forest health effects. It also lists several applications of forest health effects in practice and sums up the defects in development of domestic forest health tourism. In the end, some suggestions are put forward for the study and development of forest health tourism.

Keywords

forest health tourism, green shower, evaluation of forest health effect.

1. Introduction

With the development of modern society, working pressure and lacking of exercise result in more and more people suffering from "civilized disease", together with the air pollution, noise pollution, heat island effect and greenhouse effect.A series of health problems have lead urban residents to the forest and look forward to meeting their physical and mental requirements from the forest which is superior in ecological environment, rich in natural resources, and has appropriate climate conditions so that can bring them health care attribute. Above all lead to the birth of forest health tourism.

2. The Relative Conception

Health tourism is different from the general types of tourism. It is not only the integration of health and tourism, but also the application related to health care ideas and activities in tourist behavior [1]. It is a kind of new tourism whose objective is maintaining sound in body and mind.This type of tourism is based on the natural forest environment and aims to create "Forest Health Spa". As the theme to carry out various forms of health activities, forest health tourism is supplemented by a variety of tourism resources and facilities with the aid of traditional health care culture.

Green shower is the most important form of forest health tourism. Originated from the "Climatotherapy" in Germany, green shower was put forward by Japanese scholar in 2003 after "Pythoncidere Science"of former Soviet Union and "Areoanion Bath" of French. The discipline researched on the effects of forest health to human body is known as the "Forest Medicine" which studies the effects of treatment, rehabilitation, health care that forest acting on human bodies in the view of medicine. And the green shower is the application of "Forest Medicine" in practice [2].

3. The Embodiment of the Forest Health Effects

3.1 Areoanion

The areoanion is negatively charged oxygen molecules in the air and the service life of areoanion is usually from a few seconds to several minutes [3]. In a large population like the factory populated cities or industrial areas, the service life of areoanion will be very short, only a few seconds. Around the forest, beach and waterfalls, the service life of areoanion will be slightly longer, but only about 20 minutes [4].

Foreign medical research has been proved the areoanion has a lot of health effects such as cure disease, dust-removing or sterilization. The experimental research also proves that areoanions can accelerate the movement of respiratory epithelium cilium and make them shake more frequency, increase the oxygen content in the blood, so that inhibit the serotonin in the blood; After entering blood through the alveoli, areoanions release charge, then effect on blood cells and collagen protein, pass through the blood brain barrier so that into the cerebrospinal fluid and directly affect the central nervous system[5-6]; However, the areoanion can only have health effects on human body at the time the concentration reaches more than 700 per cubic centimeter, when more than 10000 per cubic centimeter, it will have a therapeutic effect.

3.2 Phytoncidere

Phytoncidere is found by Professor Paul Durkin through repeatedly observing the metabolism of plant process at university of Leningrad in 1930. The oil gland cells of plants' organizations such as flowers, leaves and roots continuously secrete a kind of aroma volatile organic substances. It can not only kill bacterium and fungi but also prevent the harm of diseases and pests, suppress weeds in the tree.The gas is phytoncidere, also called plant essence or phytoncid [7].

Domestic scholar Zhangwen Wu studied the phytoncidere different plants released and found that the main beneficial composition is terpene. Japanese scholars also suggest that terpene chemicals have the effects of analgesia, insecticide, antibacterial, anti-rheumatism, anti-tumor, expectorant and sedation, furthermore, the single terpene compounds impact most of all terpene class materials through medical research [8].

3.3 The Forest Climate

The forest is the main body of terrestrial ecosystem, it is also the foundation of humans and a variety of biological survival. Since forest is a special kind of underlying surface, its physical properties is different from soil and surface, so the special kind of microclimate "Forest Climate" is formed.

The influence of climate on the human body is mainly composed of forest solar radiation, forest sunshine, temperature, humidity and wind speed. According to the function of forest canopy and the surface of the earth, the most of the solar radiation is absorbed, so average sunshine is not strong in the forest, temperature is comfortable, humidity is high and wind speed is low. This comfortable forest climate can adjust people nervous system, improve the system functions such as respiratory,circulation, digestion.It can also promote metabolism and enhance the immunity to make the person full of energy,then improve the work efficiency [9].

4. Domestic scholars' research on forest health tourism effects

At present, the domestic scholars mostly focus on the factors, evaluation and monitor of forest health effects [10].

4.1 Evaluation and Monitor of Areoanion

Table 1 Areoanions grading Evaluation Criteria[11]

Assessed on a sliding scale according to the concentration of areoaions Units:/cm^3	I	II	III	IV	V	VI
	＞3000	3000-2000	2000-1500	1500-1000	1000-400	＜400
	Beneficial to humans, concentration range with health effect				Allowable concentration	Pollution
	Remark: 400 for the critical concentration; 400-1000 to allow the concentration range, that is useless and harmless to human body; More than 1,000 is the concentration of a health effect					

The earliest research of forest health tourism effects' evaluation is mainly on testing areoanions. The existing evaluation indexes research includs air cleanliness, concentration of areoanions standards.

Shi Jiang develops a forest grading evaluation criterion and the concentration of areoanions is divided into six levels:

Zhifu Ma then set out the areoanions' concentration parameters as resort air quality standards [12]:

Table 2 Areoaions' Concentration Parameter Assessment of Air Cleanliness Standards

Standard Grade	Areoanions' concentration range (/cm^3)	Remark
Fresh air	1000-1500	When the concentration reaches 10,000, it is beneficial to human health with increasing endurance
Good air	4000	
International level	10000-15000	

Qingshan Zhang develops a forest microclimate environment of areoanions concentration classification standard which appropriate grade refers to the suitability for development of forest bath and forest health tourism [13]:

Table 3 Areoanions' Concentration Rank

Level	Appropriate grade	Areoanions' concentration (/cm^3)
A	Very suitable	> 3000
B	Suitable	3000-2200
C	More appropriate	2200-1100
D	Unfit	1100-600

Linsheng Zhong says the mostly indexes to evaluate the air cleanliness of forest through areoanions' concentration are single factor and amperometric air ions assessment index [14].

Single factor:

$$q = n^+ / n^- \tag{1}$$

Type: n^+ for cations, n^- for areoanions, some scholars think the q should be equal to or less than 1, which gives people comfort.

Amperometric air ions assessment index:

$$CI = n^- / 1000q \tag{2}$$

Type: CI to be greater than or equal to 0.29, the air cleanness.

Jiang Shi points out that even though amperometric air ions assessment index CI considers the human biology effect coefficient, the single factor q of CI is not suitable for areoanions' evaluation of the forest area which has the ecological health effects, based on this, he advances the forest areoanions' evaluation model [15]:

$$FCI = p \times n^- / 1000 \tag{3}$$

Type: p as the coefficient of areoanions, $p = n^- / \left(n^- + n^+\right)$, n^- as the concentration of areoanions, the n^+ for positive ions' concentration, 1000 is the minimum concentration of areoanions to human biological effect.

4.2 Appraisal Index for Urban Forest Health Care Function

By 2012, Mingchen Han builded a comprehensive evaluation index system on the basis of what domestic scholars had studied on the urban forest health effect evaluation, he choosed specific climate factors and air quality as the appraisal index. Mainly relative to the monitoring factors including oxygen concentration, concentration of areoanions, air temperature, air relative humidity, wind speed and other microclimate and air quality indexes [16].

The comprehensive evaluation index of the urban forest health effect:

$$UFHI: 0.5S_i + 0.08C_i + 0.42CL_i (i = 1,2,3\ldots n) \quad (4)$$

Type: S_i , C_i , CL_i respectively for the i th observation sites of the human body comfort, oxygen-enriched air, air cleanliness normalized values.

4.2.1 Oxygen-enriched Air Index

Calculation formula is:

$$Ci = Ci + ati/100 \times 0.16 \quad (5)$$

Oxygen-enriched air index can be divided into five grades, the higher the concentration of oxygen in the air, the higher level of oxygen enrichment degree.

Table 4 Oxygen-enriched air index evaluation standard [16]

Level	Oxygen concentration	Degree
1	$O_2 \geq 22\%$	Higher
2	$22\% > O_2 \geq 20.8\%$	High
3	$20.8\% > O_2 \geq 20\%$	Medium
4	$20\% > O_2 \geq 19.5\%$	Low
5	$O_2 < 19.5\%$	Lower

4.2.2 Air Cleaness Index

Mingchen Han used amperometric air ions assessment index method (Formula 2) to grade the measured areoanions level, and constructed evaluation rating standard air cleanliness level 5 with reference to the evaluation of air cleanliness standards promulgated by Linsheng Zhong [14].

Table 5 Air cleanliness grade evaluation criteria

Level	CI	Air cleanliness
A	CI ≥1.00	High clean
B	1.0＞CI ≥0.7	General clean
C	0.69＞CI ≥0.5	Medium clean
D	0.49＞CI ≥0.3	Allowed
E	CI＜0.29	Cleanness

The higher the CI value, the greater the air cleanliness level.

4.2.3 Human Body Comfort Index

Human body comfort index involves temperature, relative humidity and wind speed these 3 meteorological index, specific calculation formula is [17]:

$$S = 0.6(|T - 24|) + 0.07(|RH - 70|) + 0.5(|V - 2|) \quad (6)$$

Table 6 Human climate comfort index evaluation standard [18]

Level	Numerical arrange	Feel
1	S ≤ 4.55	More comfortable
2	4.55 ＜ S ≤ 5.75	Comfortable
3	5.75 ＜ S ≤ 6.95	Less comfortable
4	6.95 ＜ S ≤ 9.00	Uncomfortable
5	S ＞ 9.00	More uncomfortable

Type: S for human comfort index, T for temperature, RH for relative humidity, V for wind speed.

And with the reference to Dinghuang Lu's comprehensive comfort level classification method, the human body comfort index is divided into five grades.

Comfort index is smaller, the human body comfort level is higher, lower instead.

4.2.4 Urban Forest Health Effect Index Evaluation

According to the formula (4) and above three critical value of one-way index hierarchy, Han concluded the evaluation index of urban forest health effect of rating standard finally.

Table 7 Urban Forest Health Effect Index Rating Standard

Level	Iindex range	Degree	Expression
1	UFHI ≥ 0.8	Very good	Too beneficial to human health
2	0.8＞UFHI ≥ 0.6	Good	Beneficial to human health
3	0.6＞UFHI ≥ 0.4	Medium good	Slightly beneficial to human health
4	0.4＞UFHI ≥ 0.2	Bad	Bad to human health
5	UFHI＜0.2	Too bad	Harmful to human health

5. The application of forest health tourism effect

After many achievements made by domestic scholars, it has a lot of agencies and departments to take the forest health tourism into practice. E'mei sanitarium of Chengdu military area command and Beidaihe sanatorium of Beijing military region have made full use of its effects, they took green shower as an important mean of medical care. Because of the fatigue training, a series activities of forest health have been carried out to keep officers in good health [19-20].At the same time, Xingcheng nursing homes of Shenyang military area command conducted the green shower sleep intervention method to find the forest bath using the areoanion to improve the sleep quality of pilots greatly[21].Researchers at the university of Zhejiang applied green shower to the training of the athletes. They put parts of athletes to train in forest environment and finally confirmed that forest improves more for athletes both from physiology and psychology, so as to make athletes to get superior performance in the game [22].

6. Conclusions

At present, the research of forest health tourism effect on human health has gradually developed from theory into practice in China, however, the forest health effects' evaluation system is still not form a unified standard. Since different scholars have different opinions on the choice of evaluation indexes, how to uniform standard, and how to build a perfect forest effect evaluation system will become the question which the domestic scholars must face at present, only in this way, we could apply theory to practice better and make the efficacy of forest health tourism to the maximum.

Acknowledge

This study was supported by the scientific and technological innovation project of southwest forestry university, and the project of Kunming science and technology bureau (2014-02-03-A-A-04-1064).

References

[1] Zhou Bo, Fang Wei. Domestic health tourism research. Tourism BBS, 1, pp, 40 ~ 45, 2012. (In Chinese)

[2] Chucai Wu, Qunming Zheng. Forest medicine:human well-being. Forest with the Human, 3, pp.11.2010. (In Chinese)

[3] Zhipan Zhang, Yiwu Yu, Minghao Meng,etc.The research progress of tourism environment of areoanions. Journal of Zhejiang Forestry College,23(1),pp.103- 108,2006. (In Chinese)

[4] Hairong Shao, Qingtang He. Forest and air anion. World Forestry Research, 13(5), pp. 19 -23, 2000. (In Chinese)
[5] Zhongning Lin.The role of areoanions in health care. Ecological Science, 19 (2),pp.87-90,1999.
[6] Xia Lian. Human biometeorology, Meteorological Press: Beijing, 1986. (In Chinese)
[7] Huating Liu. Forest bath-green aerobics. Taiwan Exhibition Press: Taipei, 1984. (In Chinese)
[8] Zhangwen Wu. The depth of the forest recreation area health tourism resources development. Journal of Beijing Forestry University, 3, pp.63-67, 2003. (In Chinese)
[9] Xue Jing.Forest and health. Foreign Medical Geography Pathol, 9, pp.109-112, 2004.
[10] Jun y. Urban forestry in challenging environments. UrbanForestry & Urban Greening,11 (2),pp.103-104,2012.
[11] Jiang Shi, Linsheng Zhong, Chucai Wu. The forest environment of areoanions concentration classification standard. China Environmental Science, 4,pp. 30-34,2002. (In Chinese)
[12] Ma Zhifu, Tan Fang, Juan Yun. Air areoanions concentration parameters play an important role in the planning of tourist resort. Chinese Science,3,pp.73-78,2003. (In Chinese)
[13] Qingsha Zhang, Yanmei He, Jianmin Zhao, Sihu Li. Forest park microclimate concentration of areoanions care grading evaluation. Journal of Northwest Forestry College,3,pp.43-49,2003. (In Chinese)
[14] Linsheng Zhong, Chucai Wu, Duning Xiao. Areoanions in the evaluation of forest tourism resources research. Ecology Journal, 6,pp.52-57,1998.
[15] Jiang Shi, Shuhui Fang, Linsheng Zhong, Chucai Wu. Forest recreation area air anion evaluation studies. Journal of Forestry Science, 1,pp.37-41,2004.
[16] Mingchen Han. North Palace National Forest Park health care function index evaluation studies. Journal of Guangdong Agricultural Science,24,pp.185-194,2012. (In Chinese)
[17] Mei Liu, Bo Yu, Kemin Yao. The human body comfort research status and development prospect. Journal of Meteorological Science and Technology,1,pp.11-14,2002. (In Chinese)
[18] Dinghuang Lu. Beijing urban greening summer microclimate condition the comfort of human body. Meteorological Press:Beijing,1999. (In Chinese)
[19] LiYing Gan, Hui Liu, Na Li. Forest bath in the application of health and rehabilitation care. Journal of Rehabilitation Medicine in China,2,pp.20-21,2005.
[20] Jing Zhao,Yali Hu, Ji Qi. The role of forest bath in health care. Journal of Massage and Rehabilitation Medicine,8,pp.101-102,2012. (In Chinese)
[21] Bo Li, Xin Nie. To recuperate the forest bath on the investigation and analysis of military pilot sleep quality influence. Journal of Rehabilitation Medicine in China, 23(1),pp.75-76,2014.
[22] Lei Jin. Forest bath training method in university athletes' track and field before the state regulation application case study. Journal of Zhejiang Sports Science,8,pp.72-73,2006. (In Chinese)