ESTIMATING MORPHOLOGICAL PARAMETERS OF *TAMARIX* BY DIGITAL HEMISPHERICAL IMAGE IN THE LOWER REACHES OF HEIHE RIVER, NORTHWEST CHINA

Huanhua Peng[1], Chuanyan Zhao[2], Zhaodong Feng[1], Zhonglin Xu[1]

([1]Key Laboratory of Western China's Environmental Systems, Lanzhou University, Lanzhou China 730000;[2]Key Laboratory of Arid and Grassland Ecology, Lanzhou University, Lanzhou China 730000)

1. INTRODUCTION

Tamarix is one kind of shrub which is widespread species in sand and saline land in arid and semi-arid regions. *Tamarix* has been paid more attentions for its unique physiological and ecological features, and important socioeconomic effects. In order to study the biomass and growth status of *Tamarix*, we need to measure the morphological parameters (e.g. height, perimeter of canopy). However, there has been a lack of effective methods for quantitative estimation of the parameters.

It is usual to measure the morphological parameters of *Tamarix* using tapes and other ancillary tools. But the traditional methods are low in efficiency and accuracy, and acquire less parameters. The hemispherical image method has thus been used [1]. The method is widely accepted with the development of the digital camera and a large number of image processing softwares. The photogrammetry can easily obtain the surface features of shrub. And instruments are convenient to operate in field survey. Therefore we used the photogrammetry to obtain the morphological parameters of *Tamarix*. The aim of this study is to establish a convenient, fast and high accuracy method for estimating morphological parameters of *Tamarix* with digital hemispherical images.

2. MATERIALS AND METHODS

2.1. Study area

The lower reaches of Heihe River covers the area from 41°48′ N - 42°42′ N and 100°10′ E -101°30′ E with the average altitude of 920 m. The mean annual precipitation and mean annual evaporation is 37.9 mm and 3700 mm, respectively. With little precipitation, high evaporation and long duration of sunlight, the climate is characterized by continental arid. Our study area is located in the downstream area of Heihe River, where dominant species is *Tamarix*. The distribution area of *Tamarix* accounts for 60.84% of the total riparian area.

2.2. Methods

In this study, Nikon D80 digital camera with a fisheye lens (Nikon AF Fisheye 10.5mm) was used to get the digital hemispherical images. The images of *Tamarix* in horizontal and vertical directions were taken under fixed

camera parameters in the field survey. At the same time, the distance from digital camera to base or top of *Tamarix* was measured. Then these images were processed and classified to acquire morphological features of *Tamarix*.

We computed the optical centre of the digital camera (Fig. 1). A series of images about the mosaic wall were taken with the fixed focus lens under different distance to establish the projection function of the hemispherical camera (Fig. 2) [2]. The projection function is expressed as follows:

$$A=0.0454*P \quad (R^2=0.9998;\ RMSE=0.2153(°)) \tag{1}$$

where A is the view angle (degree) of the fisheye lens, P is the radius (pixels) from the optical centre.

We can obtain the layer of the view angle about each hemispherical image by the projection function in ArcGIS 9.2. And this layer is used to create angle gradient of each pixel layer.

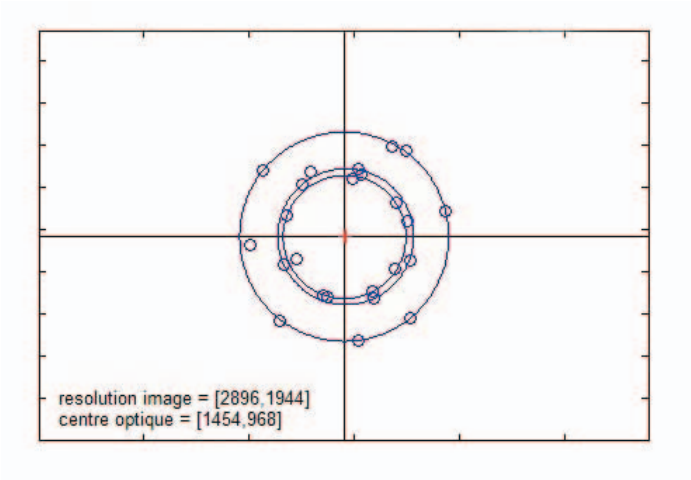

Fig. 1 Computed optical centre of hemispherical camera

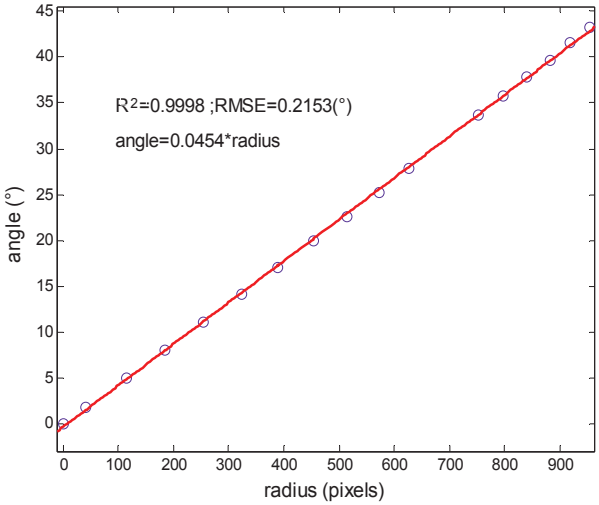

Fig. 2 Illustration of the projection function of hemispherical camera

The digital hemispherical images of *Tamarix* were processed and classified in ENVI 4.6, and then the morphological contours of Tamarix were created in Arcgis9.2 (Fig. 3 and Fig. 4).

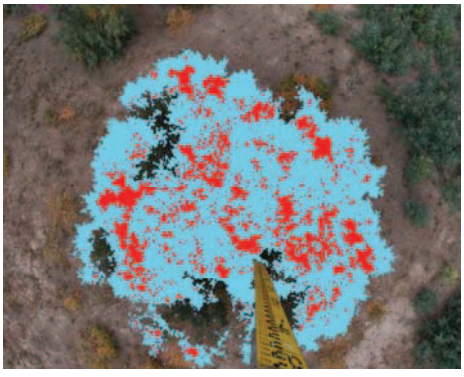

Fig. 3 Classification of the digital hemispherical image taken in vertical direction

Fig. 4 Illustration of the morphological contour of *Tamarix*

In order to get a layer of actual resolution of morphological features about *Tamarix*, angle gradient of each pixel layer multiplied the distance of digital camera to the maximum section of *Tamarix* (the distance was calculated from the above measured distance). And then overlay this actual resolution layer to the morphological contour layer of *Tamarix* to extract the morphological parameters.

3. RESULTS AND DISCUSSION

As shows in Fig. 3, the maximum and minimum crown diameters are 5.65m and 5.13m, while the area of the crown is 23.5682 m^2.

4. REFERENCES

[1] P.L. Brown, D. Doley, and R.J. Keenan, "Estimating tree crown dimensions using digital analysis of vertical photography", *Agricultural and Forest Meteorology*, 199-212, 2000.

[2] F. Baret. A simple method to calibrate hemispherical photographs. http://w3.avignon.inra.fr/valeri/methodology/hemis_calib1.pdf.2004.