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Determination of biometric parameters of fish by image analysis

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Abstract

Fisheries management and research often require the use of biometric relationships in order to transform data collected in the field into appropriate indices. Currently in Iran, researchers have to measure the fish biometry parameters one by one manually by using measurement tools. In addition, this method is very time consuming and increases the risk of disease and sudden death. Then the Image processing technology was used to determine the biometric parameters of fish (length, weight). Results show that the biometry parameters measured by using image processing technique were highly correlated with the actual values ($R^2 \geq 0.95$).

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Introduction

Among various biometric relations in fishes, the weight–length relationships are greatly presented by authors as functional tools with several applications in the fields of fisheries research, ecology, population dynamics, and stock assessment (Ghazvini and Kateb, 2014; Sakar *et al.,* 2013; Ferreira *et al.*, 2008; Chu *et al.*, 2012; Oscoz *et al.*, 2005). Fish length is very important to the fishery research to identify fish population. The fish length sample is a main parameter to identify fish reproduction, recruitment, growth and mortality (Abdullah *et al.*, 2012, Saha *et al.*, 2009; Sakar *et al.*, 2013). Man *et al.* (2010) and Froese (2008) reported that the length value is better than fish age value for data collected. Also, this relationship was initially used to obtain information on the growth condition of fish and to find out whether the somatic growth was isometric or allometric (Ujjania *et al.*, 2012).

There are many methods of measuring length of fish. These methods can be divided into two categories: contact methods and non-contact methods. Much work has been devoted to the development of equipment for non-contact length measurement for automatic manufacturing research, real-time monitoring, and the achievement of optimal production quality (Mathiassen *et al.*, 2012).

By using the digital image processing techniques, the fish information can be obtained to help the research. Fabic *et al.* (2013) described an efficient method for fish detection, counting and species classification from underwater video sequences using blob counting and shape analysis. An image analysis method was developed to measure volume and surface area of Alaska Pollock (Balaban *et al.*, 2011). They found that the R^2 value for the correlation between the length, width and depth versus measured volume was 0.987. Toh *et al.* (2009) presents a simple method of counting feeder fish automatically using image processing techniques. Fish length and orientation were measured using an online method to differentiate between flatfish and round fish (100% accuracy) and sorting by species at 99.8% reliability (Svellingen *et al.*, 2006; White *et al.*, 2006) using a digital camera and image processing techniques. Also, Shafry *et al.* (2012) shown that the confident level of the fish length from digital images framework accuracy is as high as 95% for fish length measurement. Similar results have been reported by Abdullah *et al.* (2009); Mathiassen *et al.* (2011); Man *et al.* (2010) and Sidek *et al.* (2010).

Currently in Iran, researchers have to measure the biometric parameters of fish one by one manually by using measurement tools. This method cussed of stress in fish and increases the risk of disease and sudden death. Therefore, the objective of this study is to determine the biometry parameters of fish by image analysis.

Materials and methods

Fish samples

One- hundred fishes (*Rutilus rutilus Caspicus*) at different sizes were obtained at Fisheries Research center, Iran and carefully transferred to the experimental fish tanks.

Imaging system

A stable image taking technique for fish developed based on lighting method. The imaging system consisted of two cameras (10-MPixel; Pentax), aquarium (glass type; Rectangular cuboids form with height: 45 cm length: 90 cm, width: 50 cm and wall thickness: 0.03 cm), three florescent lamps, and a microcomputer (Fig. 2). A water recycling and filtration device and aerator installed on aquarium. The second camera (C-2) was used for determining the position fish from the camera -1 (Williams *et al.*, 2010). For imaging experiments, the fish were transferred one by one into the aquarium imaging system.

The process flow chart of a fish image was in Fig. 1. To detection the head and tail of image fish used the Serkan method. The pre-processing phase is initially performed, which mainly consists of four major parts: Frame resampling (size transformation), iterative bilateral filtering and canny edge detection to form the scale-map, sub segment formation and analysis and finally the selection of the relevant sub-segments using a relevance model. More detail on this pre-processing phase can be found in Serkan *et al.* (2007) and Ferreira *et al.* (2006). After pre processing phase, bending ratio can be expressed as follows (Shafry *et al.*, 2012):

$$BR = \frac{L_\infty}{d_\infty(p_1 + p_2)} \qquad (1)$$

where L_∞ is the number of pixel from p_1 to p_2, BR is the bending ratio, and d_∞ represents the distance in L_∞ norm. Researchers checked for true corner during the tracing process, if $BR > T_{BR}$, where $T_{BR} \geq 1$ is an empirical threshold, which can be set higher to detect only sharper (with smaller angle) corners in particular (Abdullah *et al.*, 2009; Shafry *et al.*, 2012; Serkan *et al.*, 2007).

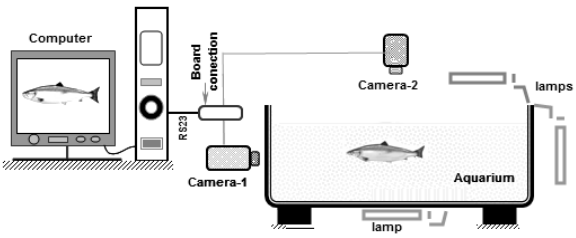

Fig. 1. Schematic of experimental appearance.

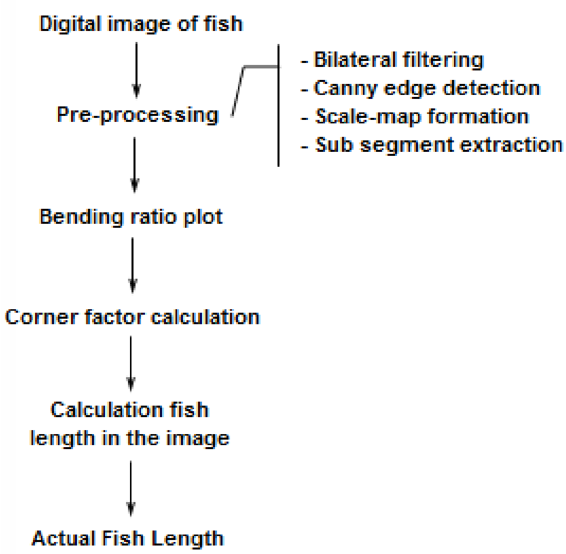

Fig. 2. Flow diagrams for the image processing method.

Also, it is a possible consequence that a single corner can create two or more peaks in BR plots, all in close vicinity, during the sequential tracing of the walking ant. Therefore, we apply non-maximum suppression in order to favor the one with highest corner factor, which is the dot product of the bending ratio and the curvature value. The corner factor can be expressed as follows:

$$\text{Corner factor} = BR \times K_p \qquad (2)$$

where K_p is the curvature function and can be calculated by from the positions of neighboring pixels. After determine of the head and tail pixel points, the image of fish length (FLI) can be calculated by multiplying the number of pixels with pixel size (Abdullah *et al.*, 2009). The actual of fish length is calculated as (Shafry *et al.*, 2012):

$$\text{Actual fish length} = FLI \times \frac{\text{Distance object}}{\text{Focus length}} \qquad (3)$$

Measurement of biometric parameters

After image processing, total length was measured to the nearest millimeter. Weight was determined with a digital balance to an accuracy of 0.01 g. The WLR was calculated using the equation $W = a \times L^b$, where W is the total weight in g and L the total length in cm, while a and b are constants (Ujjania *et al.*, 2012; Sakar *et al.*, 2013; Ferreira *et al.*, 2008). The parameters a and b were estimated by linear regression of the transformed equation: $\ln(W) = \ln(a) + b \times \ln(L)$. Additionally, the coefficient of determination (R^2) was calculated to evaluate the fitting of mathematical relationship to experimental data.

Results

The correlation between measured length and calculated length by imaging system is shown in Fig. 3. As can be seen, the dots in Fig. 3 are closely banding around at a 45° straight line ($R^2 = 0.969$) – a very good agreement between calculated and experimental data, which indicates that the image analyze method could adequately measure the length of fish. This observation is in agreement with the result reported by Abdullah *et al.* (2009); Sidek and Sami (2010); Shafry *et al.* (2012); Serkan *et al.* (2007); Balaban *et al.* (2011) and White *et al.* (2006).

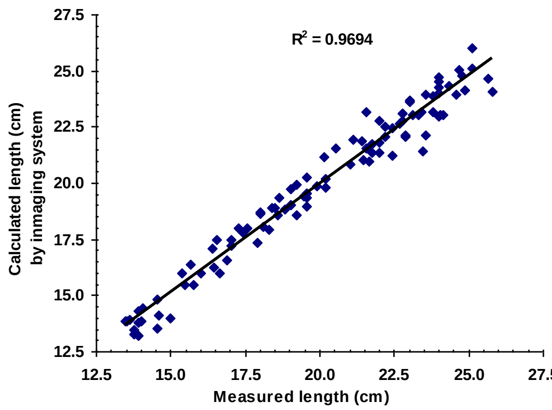

Fig. 3. The comparison of the measured length with the data calculated by imaging system.

The relationship between length and weight is shown in Fig. 4. These results clearly depicted that coefficient of determination (R^2) for LWR was high (R^2 = 0.9872), which indicate increase in length with increase in weight. Similar findings were given by Sarkar *et al.* (2013), Ghazvini and Kateb (2014), Chu *et al.* (2012) and Oscoz *et al.* (2005). The value of parameter b falls within the range of 2.5 - 3.5, which is reported for most fishes (Yılmaz *et al.*, 2012). Further, when the growth is isometric, the value of exponent 'b' would be equal to 3 (b=3). If fish retains the same shape and its specific gravity remains same during the lifetime (Saha *et al.*, 2009). However, a value significantly more or less than 3 (b<3 or b>3) indicates allometric growth (Isa *et al.*, 2010). The value of exponent 'b' is when less than 3 (b<3) and more than 3 (b>3) indicates that fish become lighter and heavier, respectively for particular length as it increase in size (Ujjania *et al.*, 2012, Ghazvini and Kateb, 2014). Length- weight relationship is expressed by the following regression equation:

$$W = 0.0148\,L^{3.0437} \qquad R^2 = 0.9872 \qquad (4)$$

The length–weight relationship and length values were calculated by image analysis was used to estimate the weight of the samples. The results obtained for the estimated weight of the fish with the actual weight is shown in Fig. 5. The actual weight data are banded around the straight line (R^2 = 0.9522) representing data found by computation, which indicates that the image analyze method could adequately measure the weight of fish.

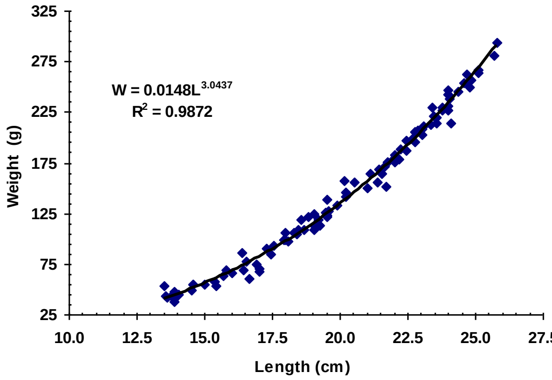

Fig. 4. Length-weight relationship of *Rutilus rutilus Caspicus*.

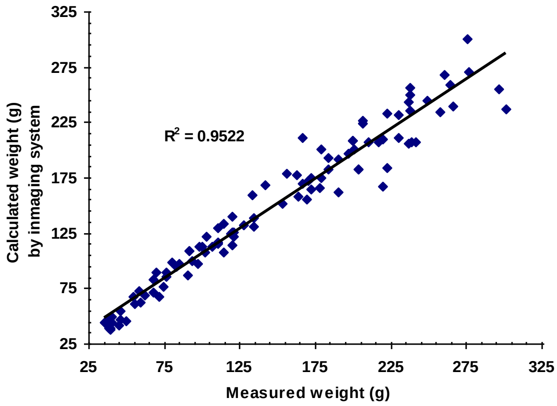

Fig. 5. The comparison of the measured weight with the data calculated by imaging system.

Discussion

Knowledge of biometric parameters of fish is an important tool for the study of fishing biology. The current method of fish biometric measurement requires measuring of each fish physically using one of the traditional measuring tools. The main disadvantage of this method is its time consuming and increases the risk of disease and sudden death. Therefore, a method to measure the biometric parameters of a fish automatically is greatly needed to solve these problems. This paper studies the using of image processing technique in the measuring fish biometric parameters. The R^2 values for the correlation between the estimate biometric parameters versus measured values were higher 0.95. Therefore, image analysis technique can be used reliably to determine the biometric parameters of fish.

References

Abdullah NB, Rahim MSM, Amin IM. 2009. Method of measure length of fish from digital image. ICIS '09 Proceedings of the 2nd International Conference on Interaction Sciences: Information Technology, Culture and Human, Seoul, Republic of Korea p: 38-43

Balaban MO, Chombeau M, Gumus B, Cirban D. 2011. Determination of Volume of Alaska Pollock (Theragra chalcogramma) by Image Analysis. Journal of Aquatic Food Product Technology **20**, 45–52

Chu WS, Hou YY, Ueng YT, Wang JP. 2012. Correlation between the length and weight of Arius maculatus off the wouthwestern coast of Taiwan. Brazilian Archives of Biology and Technology **55**, 705-708

Fabic JN, Turla IE, Capacillo JA, David LT, Naval PC. 2013. Fish Population Estimation and Species Classification from Underwater Video Sequences using Blob Counting and Shape Analysis, 2013 International Underwater Technology Symposium (UT), Mar. 2013. p: 1-6.

Ferreira M, Kiranyaz S, Gabbouj M. 2006. A novel shape descriptor over multi-scale edge field: 2D Walking Ant Histogram. Proc. of IWSSIP, Budapest, Hungary p: 475-378.

Ghazvini S, Kateb A. 2014. Sturgeon fish and related impressing factors. WALIA Journal **30**, 45-49

Isa MM, Rawi CSM, Rosla R, Shah SAM, Shah ASR. 2010. Length – weight relationships of freshwater fish species in Kerian River Basin and Pedu Lake. Research Journal of Fisheries and Hydrobiology **5(1)**, 1-8

Man M, Zakaria MZ, Rahim MSM, Amin IM, Abdullah N. 2011. Digital tool for measuring fish length using Hsiu's method. 7th International Conference on Information Technology in Asia (CITA 11), Kuching, Sarawak 12-13 July 2011 p: 1-4

Man M, Zakaria MZ, Zaki FAM. 2010. A web based fish stock assessment tools for generating fish statistical population information using fish length method. OCEANS 2010 IEEE – Sydney, NSW p: 1-6

Mathiassen JR, Misimi E, Bond M, Veliyulin E, Østvik SO. 2011. Trends in application of imaging technologies to inspection of fish and fish products. Trends in Food Science and Technology **22**, 257–75

Mathiassen JR, Misimi E, Ostvik SO, Aursand IG. 2012. Computer vision in the fish industry. Woodhead Publishing p: 352-378

Oscoz J, Campos F, Escala MC. 2005. Weight–length relationships of some fish species of the Iberian Peninsula. Journal of Applied Ichthyology **21**, 73–74

Saha SN, Vijayanand P, Rajagopal S. 2009. Length-weight relationship and relative condition factor in Thenus Orientalis (Lund, 1793) along east coast of India. Current Research Journal of Biological Sciences **1(2)**, 11-14

Sarkar UK, Khan GE, Dabas A, Pathak AK, Mir JI, Rebello SC, Pal A, Singh SP. 2013. Length weight relationship and condition factor of selected freshwater fish species found in river Ganga, Gomti and Rapti, India. Journal of Environmental Biology **34**, 951-956

Serkan K, Hantao L, Ferreira M, Gabbouj M. 2007. An Efficient Approach for Boundary Based Corner Detection by Maximizing Bending Ratio and Curvature. 9th International Symposium on Signal Processing and Its Applications, ISSPA, p: 1- 4

Shafry MRM, Rehman A, Kumoi R, Abdullah N, Saba T. 2012. FiLeDI framework for measuring fish length from digital images. International Journal of the Physical Sciences **7(4),** 607 – 618

Sidek ZM, Sami MH. 2010. Computer vision application in measuring fish length. European Journal of Scientific Research **45**, 47-54

Svellingen C, Totland B, White D, Jan T, Øvredal J. 2006. Automatic species recognition, length measurement and weight determination, using the CatchMeter computer vision system. International Council for Exploration of the Sea. CM 2006/N:03 p: 1-10

Toh YH, Ng TM, Liew BK. 2009. Automated Fish Counting Using Image Processing. Computational Intelligence and Software Engineering **10**, 1-5

Ujjania NC, Kohli MPS, Sharma LL. 2012. Length-weight relationship and condition factors of Indian major carps (C. catla, L. rohita and C. mrigala) in Mahi Bajaj Sagar, India. Research Journal of Biology **2**, 30-36

White DJ, Svellingen C, Strachan NJC. 2006. Automated measurement of species and length of fish by computer vision. Fisheries Research **80**, 203–210

Williams K, Rooper CN, Towler R. 2010. Use of stereo camera systems for assessment of rockfish abundance in untrawlable areas and for recording pollock behavior during midwater trawls. Fishery Bulletin **108**, 352–362

Yılmaz S, Yazıcıoğlu O, Erbaşaran M, Esen S, Zengin M, Polat N. 2012. Length-weight relationship and relative condition factor of white bream, Blicca bjoerkna (L., 1758), from lake ladik, Turkey. Journal of Black Sea/Mediterranean Environment **18**, 380-387.