Received: 5 June 2017 | Accepted: 6 July 2017

DOI: 10.1111/jai.13458

TECHNICAL CONTRIBUTION

WILEY Journal of Applied Ichthyology DWK

# Length-weight relationships of four freshwater fish species from the coastal drainage system in Peru

D. Faustino-Fuster[1,2] | J. Chuctaya[1,2] | R. Quispe[1] | J. Espino[1]

[1]Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Perú

[2]Programa de Pós-graduação em Biologia Animal, Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, UFRGS, Porto Alegre, Brazil

**Correspondence**
Dario Faustino-Fuster, Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Perú.
Email: dariorff36@gmail.com

**Funding information**
Programa de Monitoreo y Conservación de la Biodiversidad (Smithsonian Institution and Peru LNG)

**Summary**

The morphometric relationships of three native and one exotic freshwater fish species from the Lower San Juan and Lower Pisco River basins, central Coast of Peru, are presented. Specimens were collected in May and November 2010 using seine nets and electrofishing. Length-Weight (LWR) relationships for *Andinoacara stalsbergi*, *Trichomycterus punctulatus*, *Basilichthys archaeus* and *Poecilia reticulata* are provided for the first time, contributing information towards the effort to conserve freshwater fishes.

## 1 | INTRODUCTION

Coastal Pacific rivers of Peru are the main source of water that is utilized by the population and industry for supply, irrigation, energy, mining and groundwater recharge. Due to this use, human development has caused an increase in pressure to divert water from rivers in order to feed and clothe an increasingly large population as well as extractive activities (Bebbington & Williams, 2008), thus producing negative environmental impacts to the aquatic ecosystem including fragmentation, pollution and loss of biodiversity. The San Juan and Pisco rivers, forming part of a system of central coast rivers, are two of the largest bodies of water located in the department of Ica. Like most coastal rivers, these aquatic environments are also threatened due to progressive degradation by pollution, canalization of the channels, use of their waters for irrigation, introduction of foreign species, destruction of the riparian vegetation and the growing human population (Ortega et al., 2011).

Knowledge of the relationship between the length and weight of a fish species in a given geographic region is useful in fisheries and environmental monitoring programs (Froese, 2006; Froese, Tsikliras, & Stergiou, 2011; Giarrizzo et al., 2015; Petrakis & Stergiou, 1995; Richter, Luckstadt, Focker, & Becker, 2000; Teixeira-de Mello et al., 2006).The aim of this study is to generate information on biological aspects (the relationships of length-weight [LWR]) of three fishes, *Andinoacara stalsbergi*, *Trichomycterus punctulatus* and *Basilichthys archaeus* endemic to this region (and therefore more vulnerable) and an exotic species for which information is scarce, *Poecilia reticulata*.

## 2 | MATERIALS AND METHODS

Samplings were carried out in May and November of 2010 in the Lower Pisco (PR) and Lower San Juan (SR) River basins, in Pisco state, Peru. Sampling was done in two sites for each river (PR1: 13°42′51.59″S 75°59′54.08″W; PR2: 13°42′56.33″S 75°59′40.35″W; SR1: 13°28′46.29″S 76°3′29.61″W; SR2: 13°28′28.92″S 76°2′24.79″W). Fishes were collected using seine nets (mesh sizes = 5 mm) and mobile backpack electrofishing (Electrofisher Samus 725G) covering 1,000 $m^2$ approximately. After capture, the fishes were anesthetized, fixed in 10% formalin (48 hr) and preserved in a 75% ethanol solution. The fishes were identified to the lowest possible taxonomic level based on specific literature (Dyer, 1997, 2000, 2006; Musilová, Schindler, & Staeck, 2009). All scientific names, authorship and years of description were checked from recent descriptions and taxonomic revisions (Eschmeyer, Fricke, & van der Laan, 2017). Subsequently, after 2 weeks specimens were measured to the nearest 0.1 cm total length (TL) and standard length (SL), and weighed to the nearest 0.01 g total weight (W). Voucher specimens were deposited in the ichthyological

  

**TABLE 1** Descriptive statistics and estimated parameters of the length-weight relationships for four small freshwater fish species from Pisco and San Juan River, Peru. *N* = sample size; SL = standard length (cm); *W* = weight (g); Min = minimum; Max = maximum; CL = confidence limits; $r^2$ = Pearson coefficient

| Order/Family/Species | *N* | SL (cm) Min–Max | *W* (g) Min–Max | *a* (95% CL of *a*) | *b* (95% CL of *b*) | Residual standard error ($\varepsilon_t$) | $r^2$ |
|---|---|---|---|---|---|---|---|
| Siluriformes | | | | | | | |
| Trichomycteridae | | | | | | | |
| *Trichomycterus punctulatus* Valenciennes 1846 | 525 | 1.3–14.75 | 0.03–36.72 | 0.013 (0.012–0.014) | 3.01 (2.98–3.04) | 0.048 | .99 |
| Atheriniformes | | | | | | | |
| Atherinopsidae | | | | | | | |
| *Basilichthys archaeus* (Cope 1878) | 12 | 8.48–11.61 | 9.08–19.35 | 0.050 (0.019–0.132) | 2.41 (2.00–2.83) | 0.023 | .94 |
| Cichliformes | | | | | | | |
| Cichlidae | | | | | | | |
| *Andinoacara stalsbergi* Musilová et al., 2009 | 26 | 4.13–9.11 | 2.83–31.07 | 0.046 (0.034–0.060) | 2.94 (2.80–3.09) | 0.034 | .99 |
| Cyprinodontiformes | | | | | | | |
| Poeciliidae | | | | | | | |
| *Poecilia reticulata* Peters 1859 | 890 | 1.15–4.23 | 0.02–2.56 | 0.015 (0.015–0.016) | 3.47 (3.43–3.52) | 0.067 | .97 |

collection at Museo de Historia Natural de la Universidad Nacional de San Marcos (MUSM).

## 3 | RESULTS

A total of 1,464 specimens distributed in four different species belonging to four families were analyzed, including the three endemics, *Trichomycterus punctulatus* (Trichomycteridae), *Andinoacara stalsbergi* (Cichlidae) and *Basilichthys archaeus* (Atherinopsidae) and the exotic *Poecilia reticulata* (Poeciliidae), were examined. Regressions were highly significant for all four species ($p < .001$), with $r^2$ values between .94 and .99, three of which showed $r^2$ values for LWR greater than 0.97. The allometric coefficient *b* ranged from 2.41 (*Basilichthys archaeus*) to 3.47 (*Poecilia reticulata*) (Table 1).

## 4 | DISCUSSION

The values of *b* should normally be between 2.5 and 3.5 (Carlander, 1969; Froese, 2006). In this study, specimens of *Andinoacara stalsbergi*, *Trichomycterus punctulatus* and *Poecilia reticulata* show this growth patterns. However *Basilichthys archaeus* slightly exceeded this range that may be due to the narrow range of sampled size as defined Carlander (1977) for the values of $b < 2.5$ or >3.5 are often derived from samples with narrow size ranges (Carlander, 1977) which is the case for *B. archaeus* (*N* = 12). For that reason the weight-length relationships for *B. archaeus* should be treated with caution due to the small sample size (Table 1).

These results provide basic information about LWRs for three endemic species of central Pacific rivers in Peru which are strongly impacted by agricultural and urban activities and the introduction of exotic fish species. Information, education and public awareness are important components of any effort to conserve native fishes and prevent the spread of alien species.

## ACKNOWLEDGEMENTS

We thank the members of the Department of Ichthyology of MUSM, H. Ortega for his help and S. Martinez and I. Gamboa for their assistance during the field work. Thanks to K. Kubicek and anonymous review for the English suggestion previous to submission. This study was financially supported by Programa de Monitoreo y Conservación de la Biodiversidad (Smithsonian Institution and Peru LNG).

## REFERENCES

Bebbington, A., & Williams, M. (2008). Water and mining conflicts in Peru. *Mountain Research and Development*, *28*(3), 190–195.

Carlander, K. D. (1969). *Handbook of freshwater fishery biology*, Vol. 1. Ames, IA: The Iowa 400 State University Press.

Carlander, K. D. (1977). *Handbook of freshwater fishery biology*, Vol. 2. Ames, IA: The Iowa 402 State University Press.

Dyer, B. S. (1997). Phylogenetic revision of Atherinopsinae (Teleostei, Atherinopsidae), with comments on the systematics of the South American freshwater fish genus *Basilichthys* Girard. *Miscellaneous Publications, Museum of Zoology, University of Michigan*, *185*, 1–64.

Dyer, B. S. (2000). Revisión sistemática de los pejerreyes de Chile (Teleostei: Atheriniformes). Chile. *Estudios Oceanológicos*, *19*, 99–127.

Dyer, B. S. (2006). Systematic revision of the South American silversides (Teleostei, Atheriniformes). *Biocell*, *30*(1), 69–88.

Eschmeyer, W. N., Fricke, R., & van der Laan, R. (Eds.) (2017). Catalog of Fishes: Genera, Species, References. (http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp). -Electronic version accessed 28 April 2017.

Froese, R. (2006). Cube law, condition factor and weight–length relationships: History, meta-analysis and recommendations. *Journal Applied Ichthyology*, *22*, 241–253.

Froese, R., Tsikliras, A. C., & Stergiou, K. I. (2011). Editorial note on weight–length relations of fishes. *Acta Ichthyologica Et Piscatoria*, *41*, 261–263.

Giarrizzo, T., Sena Oliveira, R. R., Costa Andrade, M., Pedrosa Gonçalves, A., Barbosa, T. A. P., Martins, A. R., … Melo de Sousa, L. (2015). Length–weight and length–length relationships for 135 fish species from the Xingu River (Amazon Basin, Brazil). *Journal of Applied Ichthyology*, *31*(2), 415–424.

Musilová, Z., Schindler, I., & Staeck, W. (2009). Description of *Andinoacara stalsbergi* sp. n. (Teleostei: Cichlidae: Cichlasomatini) from Pacific coastal rivers in Peru, and annotations on the phylogeny of the genus. *Vertebrate Zoology*, *59*(2), 131–141.

Ortega, H., Hidalgo, M., Correa, E., Espino, J., Chocano, L., Trevejo, G., … Quispe, R. (2011). *Lista anotada de los peces de aguas continentales del Peru. Estado actual del conocimiento, distribución, usos y aspectos de conservación*. Lima: Ministry of the Environment, General Bureau of Biological Diversity—National History Museum, National University of San Marcos (UNMSM).

Petrakis, G., & Stergiou, K. I. (1995). Weight–length relationships for 33 fish species in Greek waters. *Fisheries Research*, *21*, 465–469.

Richter, H. C., Luckstadt, C., Focker, U., & Becker, K. (2000). An improve to access fish condition on the basis of length weight relationship. *Archive of Fishery and Marine Research*, *48*, 255–264.

Teixeira-de Mello, F., Iglesias, C., Borthagaray, A. I., Mazzeo, N., Vilches, J., Larrea, D., & Ballabio, R. (2006). Onthogenic allometric coefficient changes. Implicances of diet shift and morphometric attributes in Hoplias malabaricus (Bloch) (Characiforme, Erythrinidae). *Journal Fish Biology*, *69*, 1770–1778.

**How to cite this article:** Faustino-Fuster D, Chuctaya J, Quispe R, Espino J. Length-weight relationships of four freshwater fish species from the coastal drainage system in Peru. *J Appl Ichthyol*. 2017;00:1–3. https://doi.org/10.1111/jai.13458