

The length–weight relationship parameters of demersal fish species off the western coast of Baja California Sur, Mexico

By J. Rodríguez-Romero¹, D. S. Palacios-Salgado², J. López-Martínez¹, S. Hernández Vázquez¹ and J. I. Velázquez-Abunader²

¹Programa de Ecología Pesquera, Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, Baja California Sur, México; ²Departamento de Pesquerías y Biología Marina, Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), La Paz, Baja California Sur, México

Summary

The length–weight relationship parameters were recorded for 24 families, 34 genera and 46 species of 10 963 specimens sampled off the western coast of Baja California Sur, Mexico, many for the first time. New maximum length records were obtained for seven of these species. The *b* values ranged from 2.62 for *Sebastes rubrivinctus* to 3.80 for *Peprilus simillimus*.

Introduction

The demersal fish community in the area off the west coast of Baja California Sur includes many species, which have a wide range of distribution in the eastern Pacific Ocean. The commercial exploitation of these species has increased in the last few decades; however, for many of them the length–weight relationships (LWRs) were not known.

This contribution presents the parameters of LWRs for 46 species of demersal fishes captured in this area by Mexican shrimp trawlers. For 35 of these species no corresponding data are yet available in the ‘FishBase’ database (Froese and Pauly, 2007).

Material and methods

The reported demersal fish specimens were among fish sampled during four surveys in October 2004 to March 2006 along the length of the Mexican state of Baja California Sur (23°35′–28°06′N; 110°24′–114°45′W). The samplings came from a network of stations located along the coast and extending some distance offshore. After collection, the specimens were stored in a refrigerator for transfer to the laboratory where they were identified, measured to the nearest mm and weighed with an electronic balance to the nearest 0.01 g.

Table 1

Characteristics of the sample (n, sample size; Min, minimum size; Max, maximum size), and estimated parameters of the length–weight relationship [*a*, *b* ± 95% confidence interval (CI) and coefficient of determination *r*²] for 46 fish species off the west coast of Baja California Sur, Mexico

| Species | n | Length (cm) | | Weight (g) | | Regression parameters | | |
|---|------|-------------|------|------------|-----|-----------------------|---------------|-----------------------|
| | | Min | Max | Min | Max | <i>a</i> | <i>b</i> ± CI | <i>r</i> ² |
| Family Engraulidae | | | | | | | | |
| <i>Engraulis mordax</i> Girard, 1854 | 71 | 7 | 15 | 2 | 29 | 0.011 | 2.860 ± 0.20 | 0.915 |
| Family Argentinidae | | | | | | | | |
| <i>Argentina sialis</i> Gilbert, 1890 | 407 | 8.3 | 15.7 | 4 | 33 | 0.003 | 3.306 ± 0.10 | 0.901 |
| Family Aulopidae | | | | | | | | |
| <i>Aulopus bajacali</i> Parin and Kotlyar, 1984 | 746 | 10.9 | 21.2 | 8 | 94 | 0.004 | 3.217 ± 0.07 | 0.893 |
| Family Synodontidae | | | | | | | | |
| <i>Synodus evermanni</i> Jordan and Bollman, 1890 | 977 | 9.3 | 30.5 | 5 | 245 | 0.007 | 3.031 ± 0.05 | 0.915 |
| <i>Synodus luciocephalus</i> (Ayres, 1855) | 2620 | 4.5 | 46 | 9 | 771 | 0.009 | 2.907 ± 0.03 | 0.929 |
| <i>Synodus scituliceps</i> Jordan and Gilbert, 1882 | 163 | 12 | 42 | 10 | 667 | 0.005 | 3.090 ± 0.11 | 0.941 |
| Family Macrouridae | | | | | | | | |
| <i>Nezumia liolepis</i> (Gilbert, 1890) | 25 | 8 | 20 | 2 | 40 | 0.003 | 2.932 ± 0.37 | 0.920 |
| Family Moridae | | | | | | | | |
| <i>Physiculus rastrelliger</i> Gilbert, 1890 | 565 | 7.3 | 25 | 1 | 100 | 0.005 | 3.063 ± 0.10 | 0.860 |
| Family Merlucciidae | | | | | | | | |
| <i>Merluccius productus</i> (Ayres, 1855) | 561 | 8.2 | 28.5 | 1 | 168 | 0.007 | 3.003 ± 0.08 | 0.902 |
| Family Ophidiidae | | | | | | | | |
| <i>Lepophidium microlepis</i> (Gilbert, 1890) | 22 | 16 | 41.5 | 14 | 360 | 0.002 | 3.174 ± 0.27 | 0.967 |
| <i>Lepophidium pardale</i> (Gilbert, 1890) | 37 | 10 | 22.7 | 3 | 57 | 0.001 | 3.482 ± 0.33 | 0.926 |
| <i>Ophidion scrippsae</i> (Hubbs, 1916) | 41 | 18 | 23.4 | 24 | 63 | 0.001 | 3.398 ± 0.28 | 0.900 |
| Family Batrachoididae | | | | | | | | |
| <i>Porichthys analis</i> Hubbs and Schultz, 1939 | 582 | 6 | 28.2 | 1 | 215 | 0.004 | 3.250 ± 0.08 | 0.900 |
| <i>Porichthys myriaster</i> Hubbs and Schultz, 1939 | 229 | 8.7 | 19.5 | 3 | 85 | 0.002 | 3.547 ± 0.16 | 0.881 |
| <i>Porichthys notatus</i> Girard, 1854 | 121 | 8.3 | 25.5 | 5 | 153 | 0.008 | 3.047 ± 0.14 | 0.933 |

Table 1
Continued

| Species | n | Length (cm) | | Weight (g) | | Regression parameters | | |
|--|------|-------------|------|------------|-------|-----------------------|---------------|-----------------------|
| | | Min | Max | Min | Max | <i>a</i> | <i>b</i> ± CI | <i>r</i> ² |
| Family Lophiidae | | | | | | | | |
| <i>Lophiodes caularis</i> (Garman, 1899) | 33 | 8 | 35.5 | 12 | 1047 | 0.015 | 3.176 ± 0.28 | 0.945 |
| <i>Lophiodes spilurus</i> (Garman, 1899) | 31 | 8 | 27.8 | 9 | 767 | 0.010 | 3.373 ± 0.33 | 0.935 |
| Family Scorpaenidae | | | | | | | | |
| <i>Pontinus sierra</i> (Gilbert, 1890) | 81 | 6.3 | 19.4 | 6 | 142 | 0.005 | 2.650 ± 0.17 | 0.920 |
| <i>Scorpaena guttata</i> Girard, 1854 | 30 | 10 | 26 | 29 | 539 | 0.033 | 2.996 ± 0.22 | 0.963 |
| <i>Sebastes rubrivinctus</i> (Jordan and Gilbert, 1880) | 23 | 8.7 | 11.2 | 14 | 26 | 0.045 | 2.620 ± 0.37 | 0.913 |
| <i>Sebastes semicinctus</i> (Gilbert, 1897) | 104 | 6.7 | 16.5 | 3 | 60 | 0.019 | 2.810 ± 0.25 | 0.822 |
| Family Triglidae | | | | | | | | |
| <i>Bellator gymnostethus</i> (Gilbert, 1892) | 188 | 8 | 14 | 11 | 56.2 | 0.052 | 2.645 ± 0.12 | 0.901 |
| <i>Prionotus stephanophrys</i> Lockington, 1881 | 1343 | 10 | 23 | 15 | 200.5 | 0.03 | 2.793 ± 0.06 | 0.849 |
| Family Hexagrammidae | | | | | | | | |
| <i>Zaniolepis latipinnis</i> Girard, 1858 | 26 | 9.3 | 16.3 | 6 | 37 | 0.003 | 3.323 ± 0.37 | 0.934 |
| Family Serranidae | | | | | | | | |
| <i>Diplectrum maximum</i> Hildebrand, 1946. | 14 | 19.5 | 35 | 82 | 582 | 0.006 | 3.301 ± 0.69 | 0.900 |
| <i>Diplectrum pacificum</i> Meek and Hildebrand, 1925 | 63 | 9.7 | 34 | 5 | 937 | 0.003 | 3.535 ± 0.25 | 0.924 |
| <i>Pronotogrammus multifasciatus</i> Gill, 1863 | 128 | 8 | 28.5 | 5 | 394 | 0.011 | 3.160 ± 0.16 | 0.918 |
| <i>Serranus aequidens</i> Gilbert, 1890 | 42 | 9 | 19.5 | 10 | 115 | 0.011 | 3.104 ± 0.13 | 0.981 |
| Family Haemulidae | | | | | | | | |
| <i>Haemulopsis elongatus</i> (Steindachner, 1879) | 13 | 10.5 | 19.5 | 30 | 163 | 0.048 | 2.737 ± 0.19 | 0.989 |
| <i>Pomadasyx branickii</i> (Steindachner, 1879) | 49 | 15.5 | 26 | 100 | 450 | 0.017 | 3.135 ± 0.20 | 0.954 |
| Family Sciaenidae | | | | | | | | |
| <i>Cheilotrema saturnum</i> (Girard, 1858) | 29 | 21.3 | 33.2 | 199 | 665 | 0.013 | 3.106 ± 0.33 | 0.930 |
| Family Labridae | | | | | | | | |
| <i>Polylepion cruentum</i> Gomon, 1977 | 29 | 10.5 | 20 | 12 | 134 | 0.002 | 3.630 ± 0.30 | 0.957 |
| Family Uranoscopidae | | | | | | | | |
| <i>Kathetostoma averruncus</i> Jordan and Bollmann, 1890 | 314 | 8 | 22.5 | 14 | 400 | 0.025 | 3.076 ± 0.15 | 0.834 |
| Family Callionymidae | | | | | | | | |
| <i>Synchiropus atrilabiatus</i> (Garman, 1899) | 47 | 8 | 16.7 | 4 | 35 | 0.009 | 2.945 ± 0.28 | 0.905 |
| Family Stromateidae | | | | | | | | |
| <i>Peprilus medius</i> (Peters, 1869) | 18 | 12 | 18.7 | 45 | 188 | 0.025 | 3.073 ± 0.42 | 0.937 |
| <i>Peprilus snyderi</i> Gilbert and Starks, 1904 | 96 | 9.5 | 16.7 | 9 | 90 | 0.004 | 3.550 ± 0.22 | 0.915 |
| <i>Peprilus simillimus</i> (Ayres, 1860) | 134 | 10.5 | 18.5 | 13 | 169 | 0.002 | 3.804 ± 0.21 | 0.902 |
| Family Paralichthyidae | | | | | | | | |
| <i>Citharichthys fragilis</i> Gilbert, 1890 | 234 | 7 | 15 | 4 | 42 | 0.004 | 3.455 ± 0.14 | 0.903 |
| <i>Citharichthys gordae</i> Beebe and Tee-Van, 1938 | 246 | 7.3 | 14.7 | 5 | 57 | 0.006 | 3.384 ± 0.13 | 0.907 |
| <i>Citharichthys platophrys</i> Gilbert, 1891 | 17 | 10.4 | 17 | 13 | 72 | 0.006 | 3.220 ± 0.58 | 0.901 |
| <i>Hippoglossina stomata</i> Eigenmann and Eigenmann, 1890 | 184 | 8.8 | 26 | 5 | 230 | 0.007 | 3.170 ± 0.14 | 0.912 |
| <i>Syacium latifrons</i> (Jordan and Gilbert, 1882) | 57 | 10.8 | 21 | 15 | 148 | 0.012 | 3.075 ± 0.24 | 0.940 |
| <i>Xystreurus liolepis</i> Jordan and Gilbert, 1880 | 56 | 10.1 | 36 | 16 | 930 | 0.012 | 3.125 ± 0.24 | 0.921 |
| Family Pleuronectidae | | | | | | | | |
| <i>Pleuronichthys verticalis</i> Jordan and Gilbert, 1880 | 55 | 6.3 | 20 | 5 | 130 | 0.014 | 3.124 ± 0.25 | 0.918 |
| Family Bothidae | | | | | | | | |
| <i>Bothus leopardinus</i> (Günther, 1862) | 23 | 6 | 13 | 2.9 | 47 | 0.009 | 3.303 ± 0.33 | 0.953 |
| Family Tetraodontidae | | | | | | | | |
| <i>Sphoeroides lobatus</i> (Steindachner, 1870) | 89 | 5.4 | 24 | 9 | 400 | 0.046 | 2.873 ± 0.17 | 0.924 |

Based on the equation $\text{Log}(TW) = \text{Log}(a) + \text{Log}(TL) b$, where *TW* is the weight of the fish in g, *LT* is its standard length in cm, the parameters *a* and *b* were estimated by linear regression.

Results for the individual species are arranged in systematic order as given by Nelson (2006), and common names are used according to Nelson et al. (2004).

Results

A total of 10 963 specimens belonging to 24 families, 34 genera and 46 species are included in this LWR study. The most common family was Paralichthyidae (seven species). The species, sample size, lengths, LWR parameters *a* and *b*, and the coefficient of determination (*r*²) are given in Table 1. Sample size for individual species varied from 2620 (spotted lizardfish, *Synodus lucioceps*) to 13 (elongate grunt, *Haemulopsis elongatus*).

The coefficients of determination (*r*²) of the LWRs varied from 0.989 (elongate grunt, *H. elongatus*) to 0.822 (half-

banded rockfish, *Sebastes semicinctus*), all models were statistically significant (*P* < 0.05) and the *r*² values were > 0.90 in 41 species. The *b* values varied from 3.80 (Pacific pompano, *Peprilus simillimus*) to 2.62 (flag rockfish, *Sebastes rubrivinctus*). 54% of species showed an isometric growth with values not significantly different from three (*P* > 0.05).

Conclusion

Compared to the information available in Froese and Pauly (2007), this study produced new records of maximum total length for seven species: hundred-fathom codling (*Physiculus rastrelliger*, 250 mm), finescale cusk-eel (*Lepophidium microlepis*, 415 mm), leopard cusk-eel (*Lepophidium pardale*, 227 mm), Pacific sand perch (*Diplectrum pacificum*, 340 mm), threadfin bass (*Pronotogrammus multifasciatus*, 285 mm), blacklip dragonet (*Synchiropus atrilabiatus*, 167 mm), and mimic sanddab (*Citharichthys gordae*, 147 mm).

The estimations of LWRs shall be helpful in future works on bycatch of fish species in the shrimp fishery in Mexico.

Acknowledgements

This study was supported by the project SAGARPA 2003-C01-179; additional funding was received from CIBNOR (project C-130).

References

- Froese, R.; Pauly, D. (Eds), 2007: FishBase. World Wide Web electronic publication. Available at: <http://www.fishbase.org> (accessed on 10 September 2007).
- Nelson, J. S., 2006: Fishes of the world, 4th edn. John Wiley & Sons, Inc., Hoboken, NJ, USA.
- Nelson, J. S.; Crossman, E. J.; Espinosa-Pérez, H.; Findley, L. T.; Gilbert, C. R.; Lea, R. N.; Williams, J. D., 2004: Common and scientific names of fishes from the United States, Canada, and Mexico, 6th edn. Special Publication 29, American Fisheries Society, Bethesda, MD, USA, pp. 9, 386.
- Author's address:** J. Rodríguez-Romero, Centro de Investigaciones, Biológicas del Noroeste (CIBNOR), Apdo. Postal 128, La Paz, Baja California Sur 23000, México.
E-mail: jrodri04@cibnor.mx