Acta Aquatica Turcica
E-ISSN: 2651-5474 17(1), 72-77 (2021) DOI:https://doi.org/10.22392/actaquatr.755915

Distributions and Length-Weight Relationships of Some Lessepsian Cardinalfishes (Apogonid species) in the Northeastern Mediterranean (Antalya, Turkey)

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Research Article

Received 22 June 2020; Accepted 27 October 2020; Release date 01 March 2021.

How to Cite: Kebapçıoğlu, T., & Beğburs, C. R. (2021). Distributions and length-weight relationships of some lessepsian Cardinalfishes (Apogonid species) in the Northeastern Mediterranean (Antalya, Turkey). *Acta Aquatica Turcica, 17*(1), 72-77. https://doi.org/10.22392/actaquatr.755915

Abstract

The distributions and length-weight relationships of three cardinalfishes, namely Broadbanded cardinalfish *Ostorhinchus fasciatus* (White, 1790), Spotfin cardinalfish *Jaydia queketti* (Gilchrist, 1903), and Smith's cardinalfish *Jaydia smithi* Kotthaus, 1970 caught as discards in bottom trawl fisheries in the Northeastern Mediterranean (Gulf of Antalya and Finike Bay) were investigated. A total of 607 specimens were sampled with 108 trawl hauls carried out in 3 stations at a depth of 20-200 m seasonally. *Ostorhinchus fasciatus* was the most abundant species with 552 specimens, contributing 90.9% of the total sampling. Total amounts of *Jaydia smithi* and *Jaydia queketti* species had fewer sample numbers like 31 (5.1%) and 24 (4%), respectively. All three species were sampled the most in the summer season. The length-weight relationships were significant ($p > 0.001$), with values of r^2 ranging from 0.90 to 0.94. The b values ranged from 3.09 to 3.20 and positive allometric growth was observed in three apogonid species.

Keywords: trawl fishery, length-weight relationships, Apogonidae, cardinalfishes.

Bazı Lesepsiyen Kardinal Balıklarının (Apogonid türler) Kuzeydoğu Akdeniz'deki (Antalya, Türkiye) Dağılımları ve Boy-Ağırlık İlişkileri

Özet

Kuzeydoğu Akdeniz (Antalya Körfezi ve Finike Körfezi) trol balıkçılığında ıskarta türler olarak yakalanan Kardinal balıklarından *Ostorhinchus fasciatus* (White, 1790), *Jaydia queketti* (Gilchrist, 1903) ve *Jaydia smithi* Kotthaus, 1970 dağılımı ve boy-ağırlık ilişkileri araştırılmıştır. Mevsimsel olarak üç istasyonda, 20-200 m derinlik aralığında gerçekleştirilen 108 trol çekimi sonunda toplam 607 birey örneklenmiştir. Toplam apogonid örneklemesinin %90,9'unu oluşturan *Ostorhinchus fasciatus*, 552 birey ile en çok yakalanan tür olmuştur. Daha az yakalanan *Jaydia smithi* ve *Jaydia queketti* türlerinin örnek sayıları sırasıyla 31 (%5,1) ve 24 (%4) olarak kaydedilmiştir. Her üç tür de en fazla yaz mevsiminde örneklenmiştir. Tanımlayıcılık katsayısı (r^2) değeri 0,90 ile 0,94 arasında değişmiş olup, boy-ağırlık ilişkileri istatistiki açıdan önemli bulunmuştur ($p > 0,001$). Hesaplanan b değerleri 3,09 ile 3,20 arasında gözlenmiştir. Her üç apogonid türünde de pozitif allometrik büyüme görülmüştür.

Anahtar kelimeler: trol balıkçılığı, boy-ağırlık ilişkisi, Apogonidae, kardinal balıkları.

INTRODUCTION

Apogonidae family, commonly known as cardinalfishes, constitute the greatest number of alien species after Tetradontids in Turkish waters (Turan et al., 2016). Five apogonid species except for the native species, *Apogon imberbis* (Linnaeus, 1758), have been reported in Turkish marine waters to date. These are; *Apogonichthyoides pharaonis* (Bellotti, 1874) reported by Gucu et al. (1994); Oz et al. (2007); De Moe et al. (2018), *Jaydia queketti* (Gilchrist, 1903) reported by Eryilmaz and Dalyan (2006); Erguden et al. (2009); Gokoglu et al. (2011); Filiz et al. (2012); Akyol and Unal (2015); Yapici et al. (2015); De Moe et al. (2018), *Jaydia smithi* Kotthaus, 1970 reported by Goren et al. (2009a); Gokoglu et al. (2010); Erguden et al. (2015); De Moe et al. (2018) *Ostorhinchus fasciatus*

(White, 1790) reported by Akamca et al. (2010); Turan et al. (2010); Gokoglu et al. (2012); Erguden et al. (2015); De Moe et al. 2018) and *Cheilodipterus novemstriatus* (Rüppell, 1838) reported by Irmak and Engin (2015); Turan et al. (2015).

In this study, the distribution of three apogonid species (*Ostorhinchus fasciatus*, *Jaydia queketti* and *Jaydia smithi*) in the Gulf of Antalya and Finike Bay were investigated considering seasons and depths. Also, the length-weight relationships of these three species, for the first time in *O. fasciatus* and *J. queketti* in the northeastern Mediterranean, were determined and compared with other studies performed in the Mediterranean Sea.

MATERIALS and METHODS

This study was conducted in the Gulf of Antalya and Finike Bay located in the Northeastern Mediterranean Sea (Figure 1). Totally 108 trawl samples were carried out during the daytime in the three stations (Table 1). Trawling had been banned since 2004 in Station A which was located in the most eastern part of the study. Station B was the main commercial trawl area in the Gulf of Antalya and Station C, located in the most western part of the study, was another commercial trawl area in the region.

The trawl hauls were carried out varying from 20 to 200 m at three depth contours (20-50 m, 51-100 m, and 101-200 m) with the research vessel "R/V Akdeniz Su" from December 2011 to November 2012. The towing duration was about one hour for each haul. The average towing speed was 2.5 knots, and the cod-end mesh size was 22 mm (knot to knot). The apogonid species were identified (Gon and Randall, 2003) on each haul and the total length (TL), body weight (W) of each individual measured nearest 0.01 g and 0.1 cm, regardless of sex.

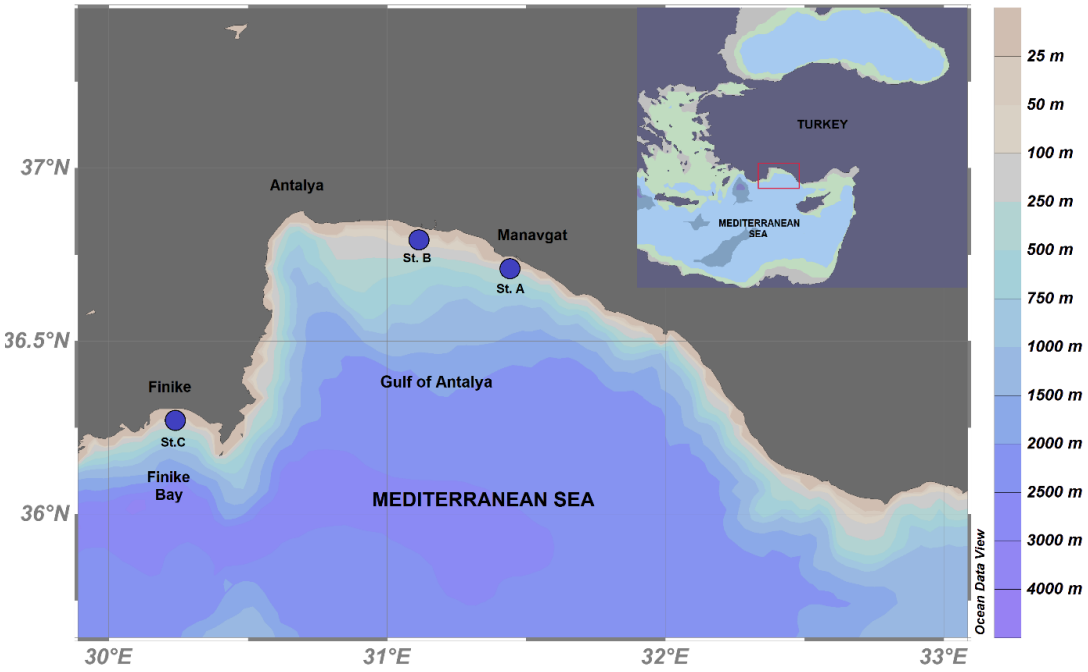

Figure 1. Map of the study area

Table 1. Tow coordinates of the three stations

Stations	No. of hauls	Depth range (m)	Tow co-ordinates
St. A	36	20-200	36°44'N 31°27'E - 36°43'N 31°24'E
St. B	36	20-200	36°47'N 31°07'E - 36°45'N 31°09'E
St. C	36	20-200	36°16'N 30°19'E - 36°15'N 30°13'E

The length-weight relationships were estimated with allometric model $W=aL^b$, where W is the weight (g), and L is the total length (cm) (Froese, 2006). The frequency of occurrence was computed

as percentage of positive trawl hauls (presence of at least 1 specimen). Statistical differences between the seasonal catching amounts of the species were tested by one-way ANOVA ($\alpha = 0.05$) using SPSS v. 23.0.

RESULTS and DISCUSSION

A total of 108 trawl hauls were performed at a depth of 20-200 m. *Ostorhinchus fasciatus* was the most abundant species in the catches with 552 individuals, contributing 90.9 % of the total cardinalfish sampling. Similarly, in the study conducted by Erguden et al. (2015) in the eastern Mediterranean between September 2011 and July 2012, *O. fasciatus* was the most caught Apogonid species with 66%. The distribution of apogonids and biology of *O. fasciatus* were investigated in Taiwan and reported that *O. fasciatus* (86.6%) was the most dominant species at each station of the study (Wu, 2009).

Ostorhinchus fasciatus, first recorded in the Gulf of Antalya in December 2011 (Gokoglu et al., 2012), was caught at all the stations during each season in this study. The species was most sampled with 313 (56.7%) individuals in the summer season. This value was followed by 193 (35.0%) in autumn, 30 (5.4%) in spring and 16 (2.9%) in winter sampling. The total numbers of *J. smithi* and *J. queketti* species were 31 (5.1 %) and 24 (4.0 %), respectively (Figure 2).

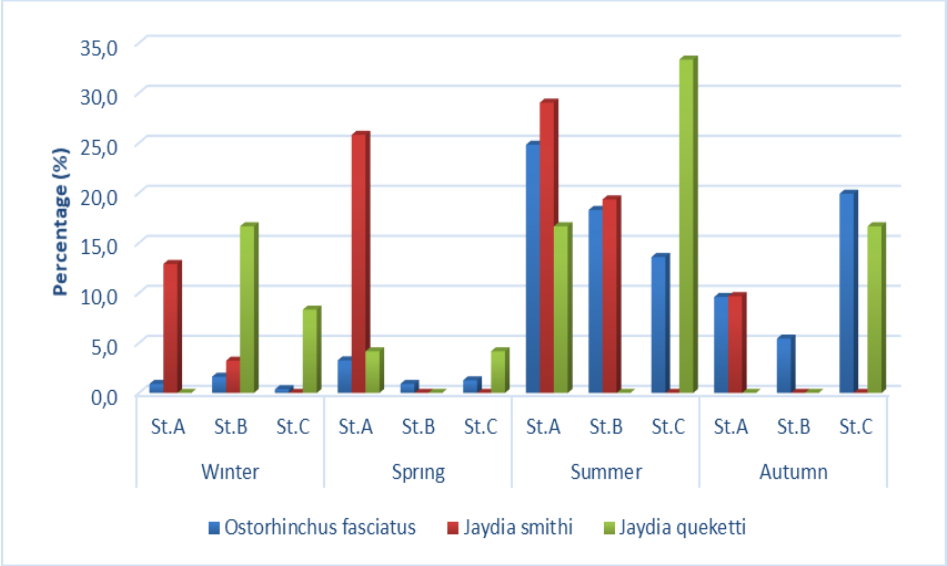

Figure 2. Percentage distribution of *Ostorhinchus fasciatus*, *Jaydia queketti* and *Jaydia smithi* according to stations and seasons.

There was no statistical difference between the catching amounts of *J. smithi* and *J. queketti* species in all stations seasonally. However, the difference between the number of *O. fasciatus* caught in different seasons was statistically significant ($p<0.05$).

Ostorhinchus fasciatus, has been reported to have 2-128 m distribution area (Fraser, 2005) and is generally present at a depth range of 15-40 m in the Mediterranean Sea (Allen and Erdmann, 2012; Goren et al., 2009b). The species was observed at depth of 30-50 m on the Mediterranean coasts of Turkey (Akamca et al., 2010; Turan et al., 2010; Gokoglu et al., 2012). Also, Bilecenoglu et al. (2013) reported a single individual in the Aegean Sea.

Ostorhinchus fasciatus were caught only at a depth between 20 and 50 m in this study. The frequency of occurrence for St. A, St. B and St. C were estimated as 100%, 75%, and 75% respectively.

The minimum size of mature female *O. fasciatus* was 4.64 cm TL, and the size at maturity (L50) was estimated 7.54 cm TL by Wu (2009) and the maximum length for this species was reported as 12.6 cm (Erguden et al., 2015). Total length of *O. fasciatus* ranged from 3.8 cm to 10.1 cm in this study (Figure 3).

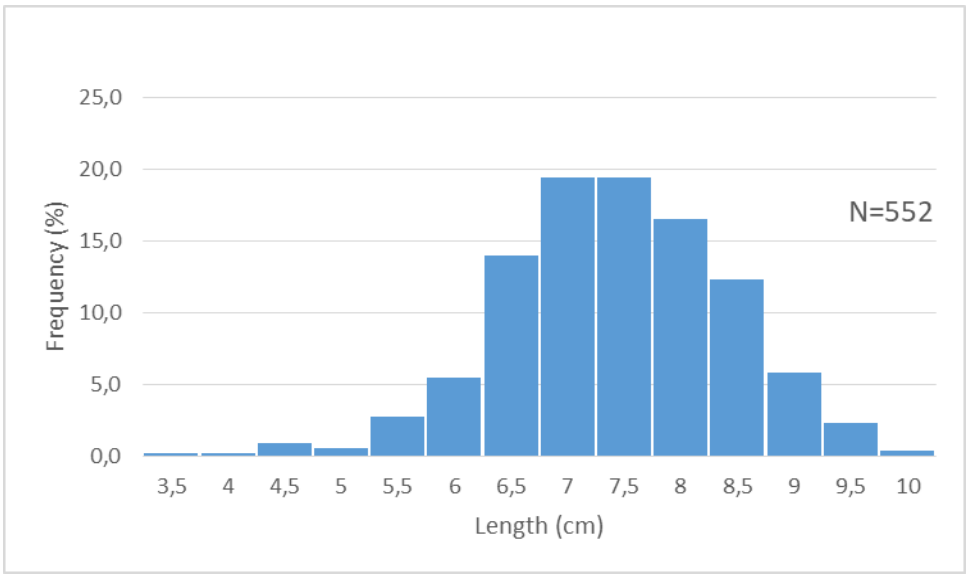

Figure 3. The length-frequency distribution of *Ostorhinchus fasciatus*

Jaydia smithi, which was observed in the Mediterranean Sea at depths of 20-50 m (Goren et al., 2009a; Golani et al., 2008; Gokoglu et al., 2010), was sampled between 20-100 m depth in this study. The frequency of occurrence of this species for trawl hauls at depths of 20-50 m and 51-100 m were 22.22% and 8.33%, respectively.

Jaydia queketti, which extends its distribution to the Aegean Sea and sampled at a depth of 40 m (Akyol and Unal, 2015) and 52 m (Filiz et al., 2012), has been reported at 50 m (Eryilmaz and Dalyan, 2006) and 140-150 m depth (Gokoglu et al., 2011) in the Mediterranean Sea. This species was generally seen at a depth of 51-100 m and the frequency of occurrence of this depth was calculated as 22.22% in this study. *Jaydia queketti* was sampled in only one trawl haul at each depth contours of 20-50 m and 101-200 m.

Length-weight relationships of *O. fasciatus* and *J. queketti* were determined the first time in the Gulf of Antalya and Finike Bay (Northeastern Mediterranean) (Figure 4).

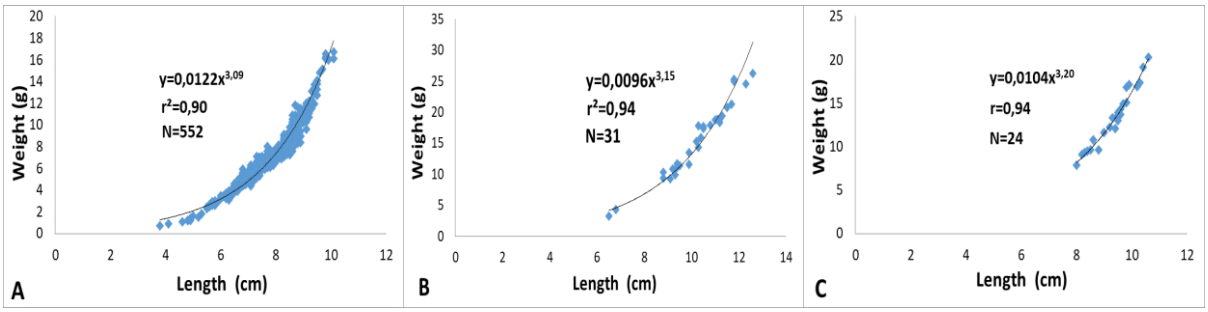

Figure 4. The length-weight relationship of *Ostorhinchus fasciatus* (A), *Jaydia smithi* (B) and *Jaydia queketti* (C)

All relationships were significant ($p > 0.001$) with r^2 values, 0.90 (*O. fasciatus*) and 0.94 (*J. smithi* and *J. queketti*). The r^2 value of *O. fasciatus* is comparably lower than other studies. The estimation of length-weight relationship parameters may be affected by many factors, such as season, sex and maturity of a species (Karachle and Stergiou, 2008). In this study, fish sampling was performed seasonally regardless of sex and maturity. The b values ranged from 3.05 to 3.20 and positive allometric growth was observed in three Apogonidae species. In other studies, conducted in the Mediterranean, the b values varied between 2.95 and 3.61, and negative allometry was reported only for *J. smithi* (Edilist, 2014) (Table 2).

Table 2. Descriptive statistics and length-weight relationships for three Apogonidae species in the Northeastern Mediterranean

Species / Location	N	L_{min}	L_{max}	*a*	*b*	SE_b	r^2	Reference
Ostorhinchus fasciatus								
Israeli continental shelf	42	5.5	9.5	0.0140	3.16	0.009	0.94	Edelist, 2014
Iskenderun Bay, Turkey	230	4.8	12.6	0.0133	3.12	0.038	0.97	Erguden et al., 2015
NE Mediterranean Sea, Turkey	552	3.8	10.1	0.0122	3.09	0.003	0.90	Present study
Jaydia queketti								
Iskenderun Bay, Turkey	48	7.1	12.3	0.0157	3.06	0.100	0.95	Erguden et al., 2009
SE Aegean Sea, Turkey	11	10.7	11.4	0.0869	3.61	0.018	0.92	Yapici et al., 2015
NE Mediterranean Sea, Turkey	31	8.0	10.6	0.0104	3.20	0.005	0.94	Present study
Jaydia smithi								
Gulf of Antalya	32	7.8	11.3	0.0133	3.06	0.093	0.97	Gokoglu et al., 2010
Israeli continental shelf	145	3.4	14.5	0.0161	2.95	0.007	0.98	Edelist, 2014
Iskenderun Bay, Turkey	116	6.3	14.0	0.0044	3.50	0.047	0.98	Erguden et al., 2015
NE Mediterranean Sea, Turkey	26	6.5	12.6	0.0096	3.15	0.006	0.94	Present study

CONCLUSION

This study provides the distribution of three cardinalfishes species, *O. fasciatus*, *J. queketti* and *J. smithi* seasonally and the first information on length-weight relationships for *O. fasciatus* and *J. queketti* from the northeastern Mediterranean coast of Turkey, Gulf of Antalya, and Finike Bay. *Ostorhinchus fasciatus* was the most abundant species and sampled up to 50 m depth. All three Apogonidae species were sampled most during the summer season. It was reported that apogonid fishes that act with parental protection instinct contribute to the survival of young individuals (Moyle and Marchetti, 2006). This advantageous situation can increase the chance of the species to exist among local fish communities (Irmak and Engin, 2015). Cardinalfishes (Apogonid species), although not having economic value and do not threaten human life but needs to be monitored like other lessepsian fish species for sustainable environment and ecological balance.

Acknowledgements: The authors would like to thank the captain and the crew of the R/V "Akdeniz Su". This study was supported by the Akdeniz University Research Fund, Projects No: 2011.03.0121.018

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