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CASE REPORT DURUM RAPORU

Lateral line and caudal fin anomalies in common sole (*Solea solea* Linnaeus, 1758) from southern Aegean Sea

Güney Ege Denizi'nden yakalanan dil balığında (*Solea solea* Linnaeus, 1758) yanal çizgi ve kaudal yüzgeç anomalileri

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Abstract: This study presents two anomalies that were found in two wild common sole (*Solea solea* Linnaeus, 1758) specimens. Specimens were captured with 80 mm stretched mesh size trammel net incidentally (in June 2014 and in December 2015) from Güllük Bay, southwest of Turkey where is one of the important common sole fishery areas. Female common sole specimen has lateral line anomaly. According to observations, the lateral line has unordinary shape – labyrinth like, furcate. Other sample, male specimen, has caudal fin anomaly. The specimen has large body size and hence, it was thought that having no caudal fin did not affect its swimming ability besides activities like feeding. The present study contributes to literature about rare anomalies in wild fish stocks.

Keywords: Soleidae, common sole, fish anomaly, small-scale fishery, Güllük Bay

Öz: Bu çalışmada doğal ortamdan yakalanan iki dil balığı (*Solea solea* Linnaeus, 1758) bireyinde bulunan anomalilere yer verilmiştir. Bireyler, önemli dil balığı avlak sahalarından biri olan Türkiye'nin güneybatısında yer alan Güllük Körfezi'nden tesadüfi olarak (Haziran 2014, Aralık 2015) 80 mm ağ göz genişliğine sahip fanyalı uzatma ağları ile yakalanmıştır. Dişi dil balığı bireyinde yanal çizgi anomalisi görülmektedir. İncelemelere göre yanal çizgi sıra dışı bir şekle sahiptir (labirent gibi, çatallı). Diğer erkek birey ise kaudal yüzgeç anomalisine sahiptir. Bu bireyin kaudal yüzgecinin olmaması, büyük bir vücuda sahip olması nedeniyle beslenme gibi aktivitelerinin yanı sıra yüzme yeteneğini etkilenmediğini düşündürmüştür. Bu çalışma literatüre doğal balık stoklarında nadir görülen anomaliler ile ilgili katkı yapmaktadır.

Anahtar kelimeler: Soleidae, dil balığı, balık anomalisi, küçük ölçekli balıkçılık, Güllük Körfezi

INTRODUCTION

Anomalies seen in various fish species, when scientific literature is taken into consideration, affect wild and reared species (Akyol and Şen, 2012; Lagardere et al., 1993). Additionally, fish anomaly researches include different species such as *Solea solea* (Dulcic and Soldo, 2005), *Dicentrarchus labrax* (Costa et al., 2015) and *Grahamina capito* (Jawad et al., 2006). Cases of fish anomalies are reported as deformity in pigmentation (ambicolouration, albinism, and xanthochroism) (Jawad et al., 2006; Tokaç et al., 2013; Golani et al., 2019), malformations of lateral line, scale and ray shape (Costa et al., 2015; Metin et al., 2009), absence of caudal fin (Dulcic and Soldo, 2005), vertebral and caudal skeleton deformities (Gavaia et al., 2002), anomalies in cephalic structures (Lagardére et al., 1993), disorders in skeletal formation (Boglione et al., 2013) and otolith anomalies (Vinagre et al., 2014). The diversity of anomalies seen at fish species necessitates both recording of anomalies and the investigation of underlying reasons.

The aforementioned necessity is not only related to anomaly types but also originates from its problematic nature regarding biological diversity and rearing environments. The diversity of the underlying causes of anomalies extends the scope of the problem. The pollution of sediments due to anthropogenic and industrial activities (Akyol and Şen, 2012), genetic factors (Costa et al., 2015), exposition to unfavourable conditions during embryological stages (Dulcic and Soldo, 2005) have been suggested as the reasons for fish anomalies. Yet, the etiology of most anomalies largely remains unknown, and it is mentioned that a wide range of physical, chemical and biological factors might be the causes of anomalies (Tutman et al., 2000).

Common sole, *Solea solea* (Linnaeus, 1758), is a commercially important flatfish in all around the world (Bolle et al., 2012; Seafish, 2013; Diopere et al., 2014; Saleh et al., 2016) and also in Turkish fisheries (Türkmen, 2003). In Turkey, common sole is one of the most important targeted species for southern Aegean Sea small-scale fishermen. This species is captured mostly with different mesh sized trammel nets in some seasons (Cerim, 2017).

The aim of this study is to present lateral line and caudal fin anomalies of two common sole specimens, caught in the Southern Aegean Sea, Turkey.

MATERIAL AND METHODS

Güllük Bay is an overused area for several sectors like tourism, aquaculture systems, fisheries and sea transport. Besides these exposures, domestic pollution also affects here (Yıldız et al., 2002).

Two common sole individuals, one with lateral line and other one caudal fin anomalies, were captured in June 2014 and December 2015, respectively. Both individuals were obtained by 80 mm full mesh size trammel net in Güllük Bay (Figure 1).

Figure 1. Sampling area (Güllük Bay, southern Aegean Sea of Turkey)

After capture, individuals were stored in ice and were brought to the laboratory for morphological examinations. Lateral line and caudal fin anomalies subsequently photographed with a DSLR camera. Due to having no x-ray machine, it was not possible to obtain the radiographic photograph of the caudal fin anomaly.

RESULTS

Morphometric measures and sexes of two sole specimens are presented in Table 1. According to otolith readings, age of both sole specimens were determined as 3 years. A total of 225 individuals (527.4 kg) were caught in the thin 210d/2 gillnets, and 165 individuals (415.1 kg) were caught from the thicker 210d/3 gillnets. Mean lengths and weights for 140, 150, 160, 180 and 200 mm mesh size in the 210d/2 and 210d/3 are presented in Table 1. According to increasing mesh size; mean lengths and weights of the carp increased linearly for both twine thicknesses of gillnets, expect for the 140 and 150 mm mesh sizes of the 210d/3.

Lateral line anomaly in common sole

Normally, the main lateral line starts from caudal fin and can be seen clearly on the eyed side of the fish. However, one of the common sole specimens, female, had meandering and ramous lateral line shape (Figure 2). These abnormal meanders and disfigurations of lateral line were observed to appear mostly on the dorsal portion of the eyed side.

Caudal fin anomaly in common sole

During examinations it was seen that the caudal fin of the specimen was absent and obviously had not developed (Figure 3). Although the general morphology of specimen was normal, a ventral oriented curve on the distal part of vertebra was evident

Table 1. Morphometric values of specimens

	TL (cm)	SL (cm)	W (g)	Sex
Common sole with lateral line anomaly	20.6	17.5	174.37	Female
Common sole with caudal fin anomaly	19.3	-	158.69	Male

(TL: total length, SL: standard length, W: weight)

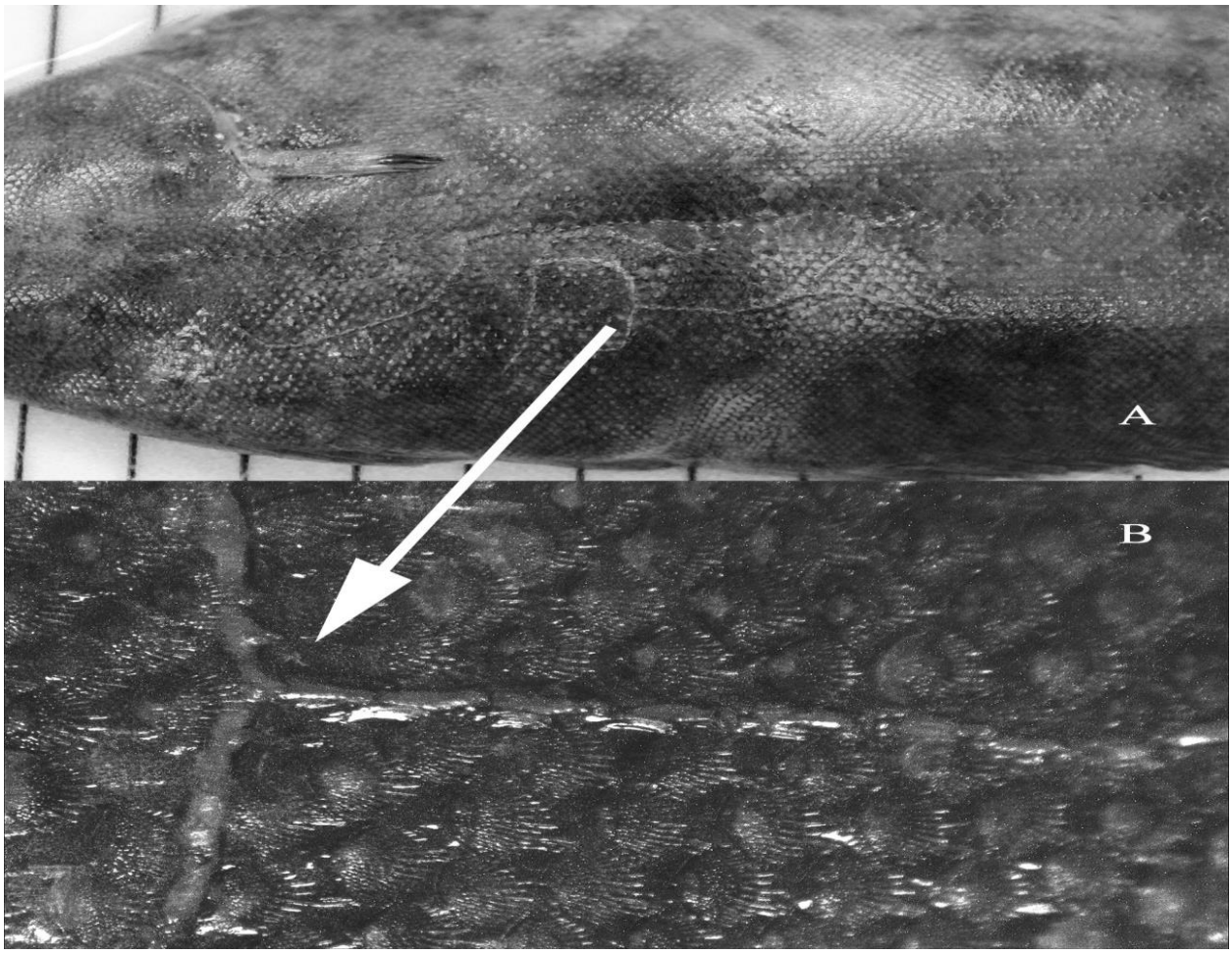

Figure 2. General view of lateral line anomaly for female specimen (A); close-up image of a section of lateral line anomaly (B)

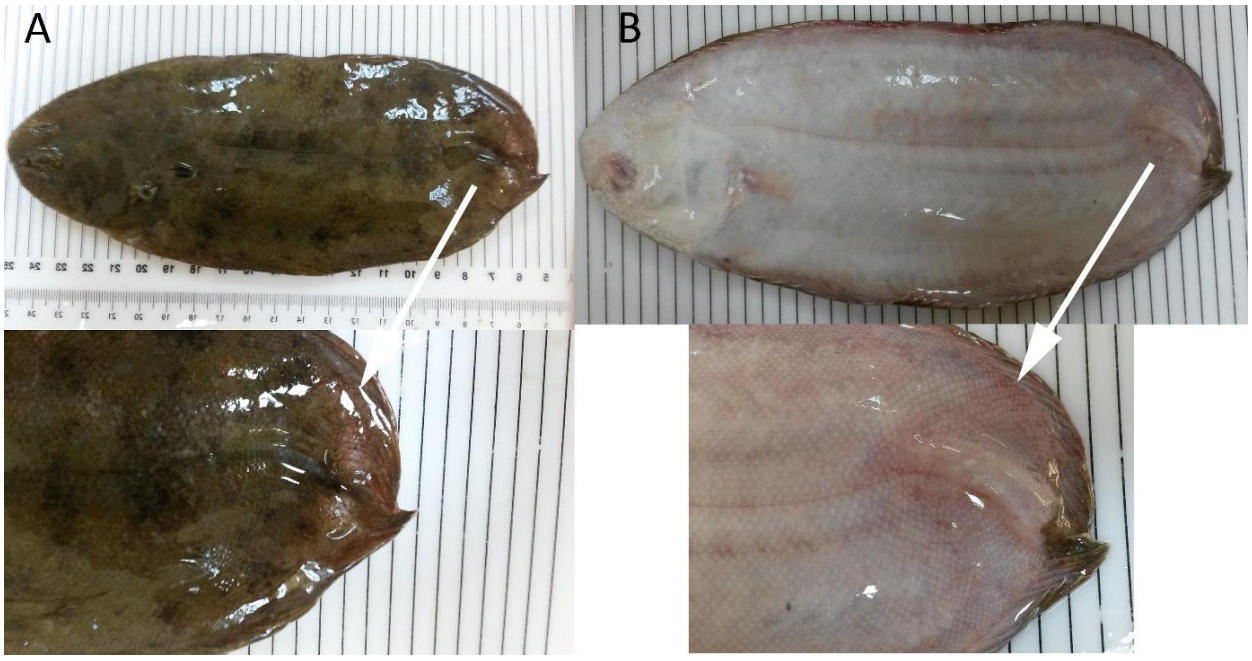

Figure 3. Caudal fin anomaly in the male specimen of common sole; Eyed side (A); Blind side (B)

DISCUSSION

Current study presents two common sole specimens with external morphological anomalies. It is stated that lateral line malformations can be linked to several factors: irregular scalation, mechanical dysfunction in ontogeny, nervous system dysfunction, and environmental factors, genetic mutations (Popovici, 1930; Popov, 1931; Kozikowska, 1960; Whitfield et al., 1996 in Jawad et al., 2006). It is also suggested that the shape of the lateral line could be a useful tool to detect the spine anomalies (especially lordosis) (Andrades et al., 1996).

When literature on the caudal fin anomalies and/or absence were taken into consideration, it was seen that this anomaly can be related to hereditary factors, damage during embryonic phases, injuries caused by predators, diseases, and damage due to environmental factors. Because the caudal fin plays a major role in the life of fish, revealing the underlying factors and causes of these anomalies earns the utmost attention (Tutman et al., 2000). Moreover, it has even been suggested that skeletal deformities in fish could serve as useful bioindicators of pollution (Gavaia et al., 2009).

Skeletal anomalies have a negative impact on animal well-being, biological performance, product quality and product cost. Also, morphological abnormalities in species sold as a whole reduce the consumer's expectation from aquaculture products. Moreover, skeletal abnormalities reduce the biological performance of reared species. The reflection of this situation is mainly seen in the growth rate (Koumoundouros et al. 1997). Skeletal abnormalities such as lordosis also reduce endurance and swimming speed in fish (Başaran et al., 2007).

Considering todays' disasters occurring in aquatic environments, documentation of life traits of aquatic organisms is becoming critical more than ever. Because, malnutrition linked to environmental problems can also be another reason for skeletal development defects (Fjelldal et al., 2021).

Güllük Bay is an overused area for several sectors like tourism, aquaculture systems, fisheries and marine transportation. Besides these exposures, domestic pollution also affects here (Yıldız et al., 2002).

CONCLUSION

Anomalies that were found in this study, may have been affected by aforementioned environmental and human originated pressures. Jawad et al. (2018) mentioned that scale abnormalities can be indicators of polluted environments. In connection with this perspective, minimizing of pollution may prevent or reduce the anomalies in wild populations. However, impacts of genetic factors were also considered as other effects on anomalies besides environmental influences.

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AUTHORSHIP CONTRIBUTIONS

Hasan Cerim: Sampling, visualisation, writing – original draft preparation. Sercan Yapıcı: Conceptualisation, writing, reviewing, editing. Özgen Yılmaz: Conceptualisation, writing – original draft preparation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest or competing interests.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

The data supporting the conclusions of this paper are available in the main paper.

REFERENCES

Akyol, O., & Şen, H. (2012). First record of abnormal pigmentation in a wild common sole, *Solea solea* L., from the Aegean Sea. *Turkish Journal of Veterinary and Animal Sciences*, 36(6), 727-729. DOI: 10.3906/sag-1207-83

Andrades, J.A., Becerra, J., & Fernandez-Llebrez, P. (1996). Skeletal deformities in larval, juvenile and adult stages of cultured gilthead sea bream (*Sparus aurata* L.). *Aquaculture*, 141(1-2), 1-11. DOI: 10.1016/0044-8486(95)01226-5

Başaran, F., Özbilgin H., & Özbilgin Y.D. (2007) Effect of lordosis on the swimming performance of juvenile sea bass (*Dicentrarchus labrax* L.). *Aquaculture Research*, 38, 870–876. DOI: 10.1111/j.1365-2109.2007.01741.x

Boglione, C., Gavaia, P., Koumoundouros, G., Gisbert, E., Moren, M., Fontagné, S., & Witten, P.E. (2013). Skeletal anomalies in reared European fish larvae and juveniles. Part 1: normal and anomalous skeletogenic processes. *Reviews in Aquaculture*, 5, 99-120. DOI: 10.1111/raq.12015

Bolle, L.J., de Jong C.A.F., Bierman S.M., van Beek P.J.G., vanKeeken O.A., Wessels P.W., van Damme C.J.G., Winter, H.V., de Haan, D., & Dekeling R.P.A. (2012). Common sole larvae survive high levels of pile-driving sound in controlled exposure experiments. *PLoS ONE*, 7 (3): e33052. DOI: 10.1371/journal.pone.0033052

Cerim, H. (2017). Güllük Körfezi'nde Uzatma Ağları ile Avcılığı Yapılan Dil Balığı (*Solea Solea* Linnaeus, 1758)'nın Bazı Biyolojik ve Popülasyon Parametrelerinin Belirlenmesi. Doktora Tezi. Muğla Sıtkı Koçman Üniversitesi, Fen Bilimleri Enstitüsü, Su Ürünleri Mühendisliği Anabilim Dalı, Muğla.

Costa, C., Vandeputte, M., Antonucci, F., Boglione, C., De Verdal, H., & Chatain, B. (2015). Are trunk lateral line anomalies and disoriented scale patterns in European seabass (*Dicentrarchus labrax*) influenced by genetics? *Aquaculture*, 448, 38-43. DOI: 10.1016/j.aquaculture.2015.05.024

Diopere, E., Maes G.E., Komen H., Volckaert F.A.M., & Groenen M.A.M. (2014). A genetic linkage map of sole (*Solea solea*): A tool for evolutionary and comparative analyses of exploited (flat) fishes. *PLoS ONE*, 9 (12): e115040. DOI: 10.1371/journal.pone.0115040

Dulčić, J., & Soldo, A. (2005). Absence of caudal fin in *Solea solea* (Soleidae) collected in the Northern Adriatic. *Cybium*, 29(3), 308-309. DOI: 10.26028/cybium/2005-293-009

Fjelldal, P.G., Madaro, A., Hvas, M., Stien, L.H., Oppedal, F., & Fraser, T.W. (2021). Skeletal deformities in wild and farmed cleaner fish species used in Atlantic salmon *Salmo salar* aquaculture. *Journal of fish biology*, 98(4), 1049-1058. DOI: 10.1111/jfb.14337

Gavaia, P.J., Dinis, M.T., & Cancela, M.L. (2002). Osteological development and abnormalities of the vertebral column and caudal skeleton in larval and juvenile stages of hatchery-reared Senegal sole (*Solea senegalensis*). *Aquaculture*, 211(1-4), 305-323. DOI: 10.1016/S0044-8486(02)00167-9

Gavaia, P.J., Domingues, S., Engrola, S., Drake, P., Sarasquete, C., Dinis, M.T., & Cancela, M.L. (2009). Comparing skeletal development of wild and hatchery-reared Senegalese sole (*Solea senegalensis*, Kaup 1858): evaluation in larval and postlarval stages. *Aquaculture Research*, 40(14), 1585-1593. DOI: 10.1111/j.1365-2109.2009.02258.x

Golani, D., Corsini-Foka. M., & Tikochinskic, Y. (2019). The occurrence of two xanthochromic fish, *Epiniphelus marginatus* (Serranidae) and *Diplodus vulgaris* (Sparidae) (Osteichthyes) in the eastern Mediterranean. *Zoology in the Middle East*, 65(3), 215-220. DOI: 10.1080/09397140.2019.1627700

Jawad, L.A., Ahyong, S.T., & Hosie, A. (2006). Malformation of the lateral line and ambicolouration in the triplefin *Grahamina capito* (Jenyns, 1842) (Pisces: Tripterygiidae) from New Zealand. *Museo Civico di Storia Naturale - Ferrara*, 9-10: 89-97.

Jawad, L.A., Näslund, J., Rutkayová, J., Nebesářová, J., Beneš, K., Wagnerová, P., Didenko, A., & Park, J.M. (2018). Catalogue of morphological scale deformities from 13 species of freshwater fish from the Kaniv Reservoir (Dnieper), Ukraine. *Marine and Freshwater Research*, 69(10), 1569-1594. DOI: 10.1071/MF18018

Koumoundouros, G., Oran G., Divanach P., Stefanakis S., & Kentouri M. (1997) The opercular complex deformity in intensive gilthead sea bream (*Sparus aurata* L.) larviculture. Moment of apparition and description. *Aquaculture*, 156, 165–177. DOI: 10.1016/S0044-8486(97)89294-0

Kozikowska, Z. (1960). Interesting deviations from usual form in the lateral line of the carp, *Cyprinus carpio* L. from the breeding ponds near Radziadz in Silesia. *Zoologica Polonica*, 10, 333-336.

Lagardère, F., Boulhic, M., & Bürgin, T. (1993). Anomalies in the cephalic area of laboratory-reared larvae and juveniles of the common sole, *Solea solea*: oral jaw apparatus, dermal papillae and pigmentation. *Environmental Biology of Fishes*, 36(1), 35-46. DOI: 10.1007/bf00005978

Metin, G., İlkyaz, A.T., & Kinacigil, H.T. (2009). Morphologic deformation in a ray: a case report. *Turkish Journal of Veterinary and Animal Sciences*, 33(3), 261-263. DOI: 10.3906/VET-0805-10

Popov, A.M. (1931). Einige bemerkugen über die variationen der seitenlinien bei *Hexagrammus stelleri* Til. (Pisces: Hexagrammidae). *Zoologischer Anzeiger*, 95, 51-55.

Popovici, Z. (1930). Missbildungen der Seitenlinie bei einigen teleodeern. *Zoologischer Anzeiger*, 91, 125-138.

Saleh, H.H.E., Allam, S.M., Abou-Zied, R.M., Mohammed, R. A., Safaa, S.A., & Aljilany, S.S.A. (2016). Effect of diet type and stocking density on growth performance and blood parameters of the Egyptian sole (*Solea aegyptiaca* Chabanaud, 1927). *Abbassa International Journal for Aquaculture*, 9 (1): 84-134. DOI: 10.30564/jzr.v2i2.2053

Seafish, (2013). *Responsible sourcing guide – Dover sole*. Retrieved from: http://www.seafish.org/media/publications/SeafishResponsibleSourcingGuide_Doversole_201305.pdf (13.01.2020).

Tokac, A., Akyol, O., Aydin, C., & ULAŞ, A. (2013). First report of abnormal pigmentation in a surmullet, *Mullus surmuletus* L. (Osteichthyes: Mullidae). *Turkish Journal of Veterinary and Animal Sciences*, 37(6), 754-755. DOI: 10.3906/vet-1211-2

Tutman, P., Glamuzina, B., Skaramuca, B., Kožul, V., Glavić, N., & Lučić, D. (2000). Incidence of spinal deformities in natural populations of sand smelt, *Atherina boyeri* (Risso, 1810) in the Neretva river estuary, middle Adriatic. *Fisheries Research*, 45(1), 61-64. DOI: 10.1016/S0165-7836(99)00098-3

Türkmen, M. (2003). Investigation of Some Population Parameters of Common Sole, *Solea solea* (L., 1758) from İskenderun Bay. *Turkish Journal of Veterinary and Animal Sciences*, 27: 317–323.

Vinagre, C., Maia, A., Amara, R., & Cabral, H.N. (2014). Anomalous otoliths in juveniles of common sole, *Solea solea*, and Senegal sole, *Solea senegalensis*. *Marine Biology Research*, 10(5), 523-529. DOI: 10.1080/17451000.2013.831178

Whitfield, T.T., Granato, M., Van Eeden, F.J., Schach, U., Brand, M., Furutani-Seiki, M., Haffter, P., Hammerschmidt, M., Heisenberg, C.P., Jiang, Y.J., Kane, D.A., Kelsh, R.N., Mullins, M.C., Odenthal J., & Nusslein-Volhard, C. (1996). Mutations affecting development of the zebrafish inner ear and lateral line. *Development*, 123(1), 241-254. DOI: 10.1242/dev.123.1.241

Yıldız, H., Doğan, H. M., & Urla, Ö. (2002). Muğla ili Güllük Körfezi'nde deniz suyu kirliliğinin coğrafi bilgi sistemleri ve uzaktan algılama sistemleri ile izlenmesi. *Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi*, 11(1-2): 142-149.