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Migration Characteristics of the Black Sea Trout (*Salmo trutta labrax*, Pallas, 1814) in the Eastern Black Sea Coasts and Streams

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Abstract

This study was done on the main streams and coastal zone where Black Sea Trout is mainly distributed. Although fario ecotype has reproductive and alimental migration in streams, the marine ecotype migrates between freshwater and marine in certain seasons. According to the data obtained, the smolt individuals of the marine ecotype living in streams since spawn have smoltification in stream mouths in spring (March- May) and go to the sea first in their lives. Some fish have smoltification in autumn. Black Sea Trout spawner individuals pass to freshwater at a period between April and June and have egg maturation there by autumn. Their return to the sea following spawning is between November and December. The findings obtained indicate that Black Sea Trout population has been depleted due to overfishing and disruption of their habitats. As a result, a new management strategy and protection programmes are vital for the recovery of the stocks.

Keywords: Black Sea trout, *Salmo trutta labrax*, Eastern Black Sea Region, migration characteristics (structure), ecotype.

Türkiye'nin Doğu Karadeniz Kıyılarında ve Akarsularında Dağılım Gösteren Karadeniz Alabalığı (*Salmo trutta labrax,* PALLAS, 1814)'nın Göç Özellikleri

Özet

Bu çalışma Doğu Karadeniz'de; Karadeniz alabalığının (*Salmo trutta labrax*) yayılım gösterdiği önemli akarsularda ve kıyısal bölgede yürütülmüştür. Dere ekotipi akarsu ortamında mevsimsel olarak üreme ve beslenme göçü yapmasına karşın, deniz ekotipi tatlısu ve deniz arasında belirli mevsimde yoğunlaşan göç hareketinde bulunmaktadır. Elde edilen bulgulara göre; **y**umurtadan itibaren yaşamını akarsuda geçiren deniz ekotipine ait smolt bireyler, ilkbahar döneminde (mart-mayıs) akarsu ağızlarında smoltlaşmakta ve yaşamlarında ilk olarak denizel ortama geçiş yapmaktadır. Bir kısım balık ise sonbahar döneminde smoltlaşmaktadır. Karadeniz alabalığı ergin bireyleri nisan-haziran aylarında, akarsuya giriş yapmakta ve anaçların yumurta olgunlaşması sonbahar sonuna kadar tatlısu ortamında gerçekleşmektedir. Doğal ortamda üreme sonrasında tekrar denize dönüşleri, kasım-aralık ayları arasındaki bir dönemde olmaktadır. Elde edilen tüm bulgular değerlendirildiğinde, yıllardan beri Karadeniz alabalığı populasyonunun gerek aşırı avcılık, gerekse de yaşama alanlarının bozulması sonucunda yıpratıldığı ve stokların bu durumunun yeniden düzeltilmesi için yeni bir yönetim stratejisinin ve koruma programlarının hayata geçirilmesi gerektiği sonucuna varılmıştır.

Anahtar Kelimeler: Karadeniz Alabalığı, *Salmo trutta labrax*, Doğu Karadeniz Bölgesi, göç yapısı, Ekotip.

Introduction

Brown trout is a kind of salmonid with the ability to adapt the environmental conditions largely and to migrate (Okumuş *et al*., 2002). There are anadromous populations of migrating brown trout on the north of 42° North Latitude (Elliot, 1994). Such populations are also found on the North East coasts of Black Sea and in the streams flowing there. Migratory individuals are called the Sea Trout. When they come back for reproduction, they are two or three times or more as big as the trout not migrated. Eastern Black Sea populations with migratory characteristics are defined as another subspecies, *Salmo trutta labrax* (Slastenenko, 1956; Geldiay and Balık, 1996).

Behaviour differences, phenotypic, morphological, and ecological characteristics are the key factors in identifying the species or subspecies of brown trout populations. According to these criteria, three different ecotypes of *Salmo trutta labrax* (natio marina, natio fario, and natio lacustris) were found in the studies done in Turkey (Slastenenko, 1956; Tabak *et al*., 2001; Okumuş *et al*., 2002).

Çelikkale *et al*. (1999) believe that brown trout

is the member of ihtiyofauna in the waters of Turkey. According to the environment and geographical region they adapt, there are stream trout, sea trout, and lake trout ecotypes. According to Tortonose (1955), there is only *Salmo trutta* in the waters of Anatolia. There are the subspecies of *Salmo trutta labrax* in the streams flowing to the Black Sea and *Salmo trutta caspius* in the Aras flowing to the Caspian Sea.

Although sea trout (*Salmo trutta labrax*) is accepted as a subspecies of brown trout, it is probably an opportunist ecotype. It is only seen in the waters of Eastern Black Sea Region. A similar ecotype is found in the streams and on the coasts of Northern Europe (Ireland, Scotland, Norway, Sweden). Unlike the Salmon, the Sea trout does not have true smoltification, and it moves to inshore brackish water after it reaches a certain size (some 20-60 g) under favourable conditions. However, unlike the salmon, it does not wait until the general maturity and, when necessary, it passes to freshwater frequently. As this local trout is specific to the Black Sea, it may not be as sensitive as rainbow trout and salmon to temperatures above 22°C (Çelikkale *et al*., 1999).

In conclusion, this trout in the northeast part of our country can be called as "Black Sea trout" to indicate its adaptation region and origin. However, it is morphologically the same species as the trout in Europe (Lelek, 1980; Chernitskii, 1988; Radchenko and Aleyev, 1997; Solomon, 2000; Nikandrov and Shindavina, 2007; Vassilev and Trichkova, 2007).

Materials and Methods

This study was done in the Eastern Black Sea and the region between Trabzon and Artvin, Turkey on the main streams of Kapistre, Çağlayan, Fırtına, İyidere, and Solaklı where The Black Sea trout is heavily distributed, sampling studies were done at the coastal stations where these streams join the sea, and the study aimed to find out the migrational characteristics of the Black Sea trout and its marine - fario transition periods (Figure 1).

At stream sampling studies, two different sizes (5 and 6.5 m. in diameter) and mesh sizes (17 and 22 mm) of casting net and electrofishing (Auseng brand IG.00 Baujahr 11/84 type back portable shocker) were used which can create 300-600-800 volt direct current performing better especially in small streams and side streams. The sampling study was done by using cast-net on the main streams and shocker on the side streams. Fish traps were used to do the sampling better in the migration periods of the fish. The number of drift gillnet used and the approximate areas of the field work, when the shocker was used, were recorded to identify the migration and fish movements in the streams.

In marine sampling studies, different types of coastal extension nets were used, eight of which were 100-meter-long un-tangle net of 28 and 40 mm mesh size, and two of which were 100-meter-long tangle net of 17 and 28 mm mesh size. Coastal extension nets upright to the coast were used in the area between Çağlayan and Kapistra rivers. Tangle nets were placed in so called brackish water to close the stream mouth completely for full detection of the entry into the stream, and field works were longer in these periods. Fish were transferred to the laboratory in a chilled container, then measured (total length) to the nearest millimeter. Fish measuring boards and sticks were used for the measurement of morphometric characters. Weight measurements were done with 0.01 g precision electronic scales after draining the water and mucosal secretion of the fish

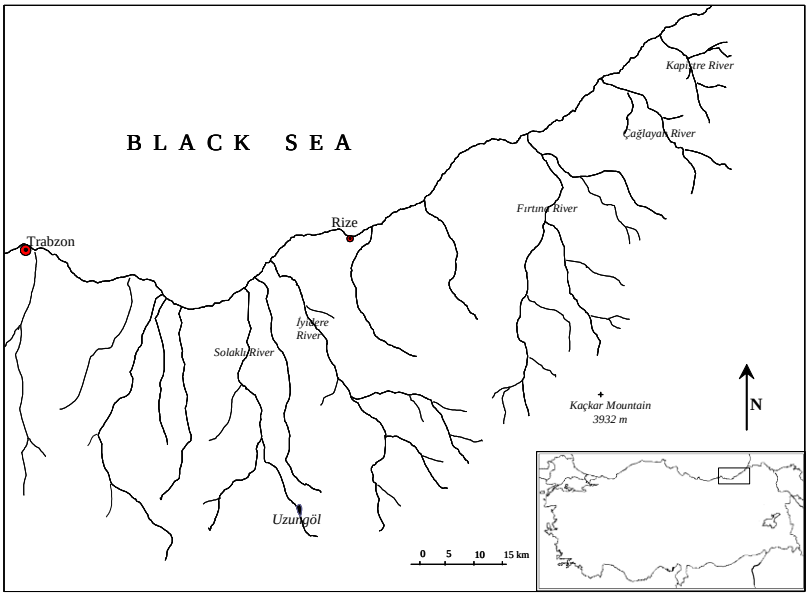

Figure 1. Study area in the North-east Turkey Region.

with a dry cloth or blotter. As there are no other distinguishing features in the samples, morphometric and meristic studies, the individuals which had smoltification and lost their spots by turning silver were accepted as marine ecotypes (Chernitskiy, 1988; Tabak *et al*., 2001; Okumuş *et al*., 2002). Age was determined using the otoliths. Whether there was some change in body fat and protein amounts of the fish during their migration periods was sought to be found out with the analysis of the samples caught at different environments.

Results

In general, many animals need to migrate for such reasons as the desire for proximity to feeding environment and natural habitat (summer and wintering migrations) and suitable environment for reproduction. Every fish population in water environment has its unique migration behaviour and distribution area. The individuals in stock in this area move either passively (migration of larva with currents) or actively. Migration may not be valid for every stock. Some fish and especially the demersal ones (e.g. the Gobiid) are not migratory. Some of them have corresponding feeding and wintering areas. In those stocks, only migrations for spawning and feeding are seen.

Migration is a complex process for the Black Sea trout and the salmon in general. As with the Black Sea trout, the fish moving between marine and freshwater is called anadromous fish. Feeding, reproduction, and other life activities as well as external factors like water temperature are important to the fish not only for its behaviour in freshwater and the sea but also for its movement between those environments.

Migration in Freshwater

The Black Sea trout of fario ecotype has seasonal migration in freshwater. The larvae coming out of the nests close to the upstream and in side streams spend their first feeding period in these areas but move to other places afterwards due to water temperature, food abundance, and instinctual drive. All members of the Black Sea trout are believed to have the same behaviour patterns prior to smoltification as there are not any clear differences between the ecotypes before smoltification.

As to the findings, the members of fario ecotype mostly move along the coast and in a region 5 km inside the coast in winter (54.9%) and spring months (66.7%), and sampling was done during this period in the plump area of the marine water and stream water. That water temperature at coast is about 8°C in winter but 2 to 6°C in the higher parts, and the region of 1500-2000 m high is under snow are the factors affecting nutritional status and, thus, fish movement in rivers. The water temperature increases to 20 or 25°C in waters close to the coast in summer, which causes the fish to migrate to the source of the stream or to relatively cooler creeks. In addition to sampling close to the source of the stream (above 20 km) as 57% in summer, 37% in autumn, 26.4% in winter, and 21.0% in spring, the fish close to the source are relatively bigger in autumn and winter, and reproductive activities take place in these months, which indicate that feeding, reproductive and environmental parameters (wintering) are effective on the movement of the fish. Between 5 and 20 km from the coast, the sampling of 18.7 % in winter, 12.3 % in spring, and 48.5 in autumn when the fish moves to the coast show that the fish does not remain in only one area but moves in a large area (Table 1).

Although there are not any statistical differences between the population parameters of the faro ecotype and size distribution in monthly periods as stated before, there are differences in terms of length and weight in variance analysis done between the coast and the source and in seasonal distribution when the stations (coast (0-5), the intermediate (5-20), and the

Table 1. The Black Sea trout fario ecotype seasonal migration status

Area	Parameter	Spring	Summer	Autumn	Winter
0-5 km	n	238	72	48	150
	Length (cm)	15.1±0.16 (9.21-24.5)	16.2±0.30 (11.9-23.6)	14.3±0.40 (8.5-24.8)	14.8±0.29 (9.2-35.7)
	Weight (g)	33.7±1.25 (7.06-130.62)	43.4±2.59 (14.25-116.48)	28.6±3.16 (7.0-143.9)	31.4±2.90 (7.17-351.0)
5-20 km	n	44	79	161	51
	Length (cm)	16.4±0.33 (11.6-20.6)	15.3±0.33 (6.2-24.5)	13.2±0.21 (6.8-24.2)	14.9±0.66 (8.1-29.2)
	Weight (g)	41.0±2.51 (13.21-77.36)	36.9±2.43 (2.4-142.18)	23.1±1.31 (3.28-137.52)	35.2±5.07 (4.48-208.8)
20 km<	n	75	200	202	72
	Length (cm)	14.1±0.34 (9.9-27.0)	14.7±0.19 (6-25.2)	18.3±0.38 (10.1-39.38)	17.5±0.75 (8.6-36.2)
	Weight (g)	27.4±3.09 (7.25-210.91)	32.5±1.68 (1.99-168.1)	75.6±6.87 (8.93-171.81)	65.9±9.15 (6.24-363.52)

source (20<) are examined individually.

When the migrations of such small and fatty fish as anchovy, horse mackerel, etc. in shoals as well as water temperature in winter and spring and zooplankton density in the Eastern Black Sea Region are examined, the dates of migration coincide with the smoltification in streams, which is estimated to be effective in the movement of marine ecotypes towards the sea. However, the question of why some fish move to the sea (the marine ecotype) but others stay in the freshwater (the fario ecotype) has long been unanswered but being investigated.

Smoltification and Migration to the Sea

In this study, the marine ecotype individuals were observed to have two different types of migration in autumn and spring. In spring, the parr have smoltification in places close to the stream mouth and leave for the sea, while the adults move into the stream for reproduction. There are also two different types of behaviour in autumn when the movement is one way, that is, only to the sea. While the fish move to the sea in post-spawning period, some smolt fish migrate to the stream mouth and move to the sea for the first time contemporarily (Figure 2).

Having stayed in the sea for 1 to 3 years and reached adequate size, the individuals move to the freshwater for reproduction. Although the individuals of about 3.89 years (3-6+) are seen in the stream mouths in March, they enter the streams heavily in the late May and early June. In this period, although the male are 3.55 years old (3-5+), 57.64 cm long (42.5-79.2), and 2,742.34 g (795-5,625.5) in average, the female are comparatively bigger, that is, 4.02 years old (3-6+), 63.71 cm long (49.1-96.0 cm), and 3895.28 g (1,500-12,108 g).

The average age of the samples usually taken by fish traps during their return in the reproduction period (November- December) is 4.14 years (3-8+). In this period, the male are 3.88 years old (3+-5+), 55.28 cm long (43.2-75.0), and 2,373.42 g (786-6,200) in average; however, the female are bigger, that is, 4.23 years old (3-8+), 61.24 cm long (43.4-99.0), and 3,435.29 g (769.7-16,200).

The results of the researches done in the area indicate that the smoltification process continues from the second half of the March to the end of May depending on water temperature. Given the climatic conditions of many years, this period may change ± 15 days. The spring smolts are 1.19 years (430 days) and 18.43 cm tall (12.4-36.1) on average. Moreover, some fish have smoltification in autumn due to various factors. In this period, the mean age is 1.88 years (675 days) and the mean size is 24.32 cm (11.7–36.3). The smoltification is lower in this period (1/5) compared to the spring. The difference between the length and weight of spring and autumn smolts is statistically significant (P<0.01) (Table 2).

Discussion

There are a lot of variances in the life cycle of the anadromous fish (Johnson, 1985). That some fish in the same population migrate to the sea but some stay in the stream, and come back to the stream for reproduction have been to the interest of the researchers. Although all the salmonid have tolerance to the marine water to some extent, the migration of the juvenile to the sea or their stay in stream is a hotly debated issue. A good many researchers claim that such environmental parameters and photoperiod as feeding ground and water temperature as well as fish size, gender, genetics, and physiological capacity are affective on this issue (Jonsson, 1985; Chernitskii, 1988; Hoar, 1988; Jonsson and Jonsson, 1993; Lysfjord and Staurnes, 1998; Frosman *et al*., 1998; Ugedal *et al*., 1998).

The salt concentration of trout body fluid is

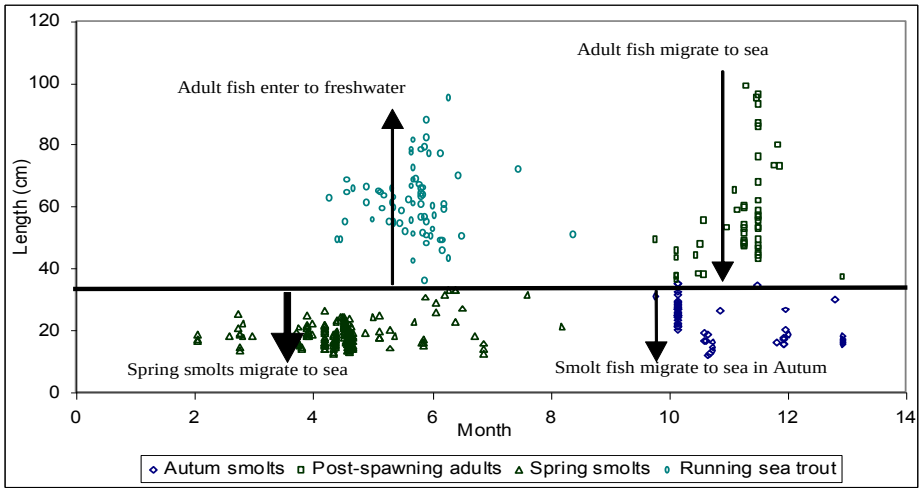

Figure 2. Smolt and reproduction migration of sea trouts trout between marine and freshwater.

Table 2. Some population parameters of Black Sea trout marine ecotype

Parameter		Smolt Fish		Anadromous population			Downstream Migrant Adult Fish		
		Spring	Autum	Total	Female	Male	Total	Female	Male
N		208	57	68	48	20	42	28	14
Age		429 days	675 days	III-VI+	III-VI+	III-V+	III+-VIII+	III+-VIII+	III+-V+
Mean Age (Year)		1.19	1.86	3.89	4.02	3.55	4.14	4.23	3.88
Total Length (cm)	Mean.	18.43	24.32	62.14	63.71	57.64	59.8	61.24	55.28
	Min.	12.4	11.7	42.5	49.1	42.5	43.2	43.4	43.2
	Max.	33.1	36.3	96.0	96.0	79.2	99.0	99.0	75.0
Weight (g)	Mean.	60.13	165.77	3573.13	3895.28	2742.34	3145.69	3435.29	2373.42
	Min.	17.89	13.41	795.00	1500.00	795.00	769.70	769.70	786.10
	Max.	349.00	462.30	12108.00	12108.00	5625.50	16200	16200	6200
Cond. Fact.		0.809	0.884	1.341	1.363	1.286	1.170	1.158	1.236

equal to the mixture of one proportion sea water and two proportions of freshwater. When the anadromous types of the salmonid change their environment for the first time, chloride cells are formed in the gills, Na^+, K^+, Mg^+, and Cl^+ ion concentrations in blood serum raise, and increases in the activities of some enzymes and hormones are seen due to excessive salt taken outside. The proportions of these items are normal in the fish fully adapted to sea water (Salman and Eddy, 1989; Leatherland *et al*., 1993; Lysfjord and Staurnes, 1998).

The trout moving to the marine have some physiological changes to adjust the osmotic balance in the body as a result of which hormone (T_4, T_3, Thyroid, etc.) and enzyme (LDH, ATPase) activities increase and trace elements in blood serum (Na^+, K^+,Cl^-, Mg^+) change as well. Excessive activity of pituitary gland for several weeks during this period cause rapid growth of the fish (Jonsson, 1985; Chernitskii, 1988; Hoar, 1988; Frosman *et al*., 1998; Ugedal *et al*., 1998). According to Hoar (1988), the salmonid prefer to move towards the sea water after smoltification (after he highest level of smoltification).

The smoltification of the salmonid is usually limited to a definite period in spring. This period is believed to be related to the onset of the suitable environmental conditions in the sea (Björnsson and Bradley, 2007). It is stated that the rise in the amount of stream water will increase the stream discharge and decrease the degree of salinity in the stream mouth, and thus facilitate the osmotic adaptation of the fish, which is, therefore, an important factor affecting the migration to the sea (Ruggles, 1980; Solomon, 1995). However, it has been found out that there is smoltification and migration to the sea even in autumn (Barachi, 1962; Chernistkii, 1988; Bagliniére and Maisse, 1999).

The findings on smolt migration are similar to the studies done on the Kara River and the Kodori River (Chernistkii, 1988; Barachi, 1962).

Chernistkii (1988) states that the spring and autumn smolts in the Kodori River are about the same size and the first migration of the Black Sea trout fry occurs after they reach a certain size. In our study, the difference between the length and weight of spring and autumn smolts was found to be statistically significant ($P<0.01$). This difference can be explained with the better feeding ground in the stream during summer and with autumn smolts' being some six months older (mostly 2+ years). The findings on the smolt fish are given in Table 3.

As mentioned above, the length- weight parameters of the smolt ones on Turkish coasts are comparatively bigger than other regions. The differences between the values are probably due to water temperature, nutrition status, regional characteristics, etc. Chernitskii (1988) states that the upper part of the Kodori River has lower water temperature and poorer food sources. In his article editing the studies on the sea trout in different parts of England, Scotland, and Wales, Solomon (1995) claims that there is a similar difference in the smolt sizes of the northern and southern regions and the effect of water temperature and nutrition abundance on growth led to this difference. It has been reported in the studies done in northern countries like Norway that the smolt size of the sea trout (19.1 cm) is bigger than the Atlantic trout (13.3 cm) and the condition factor is the lowest in this period (0.74) (Lyford and Staurnes, 1998).

When the individuals staying in the streams and migrating to the sea (anadromus) are compared, the individuals of the fario ecotype in the same age group (1-2+) are found to be smaller ($P<0.01$). This is contrary to the findings of Solomon (1995) and Jonsson (1985), who assert the individuals in streams to be bigger.

It is seen in the studies of adaptation to the sea water that the fry of the hatchery have smoltification in the smallest size of 11.7 cm, but the fish of 13-15 cm have real smoltification ability, and some individuals do not have any colour changes (25-30%) or sea water adaptation in five months (Tabak *et al*., 2001). It is still under investigation why some members of the same population stay in the stream but others migrate to the sea, and whether the differences between the ecotypes result from genetic

Table 3. Smolt size of Black Sea trout populations

Seasons			Barachi (1962)		Chernitskii, 1988	
	Length (cm)	Weight (g)	Length (cm)	Weight (g)	Length (cm)	Weight (g)
Spring smolt	18.4±0.7 (12.4-33.1)	60.1±46.5 (17.9-349)	16.8±0.3	51.0±0.2	13.8±0.2	27.3±2.4
Autum smolt	24.3±1.3 (11.7-36.3)	165.8±85.4 (13.4-462.3)	20.6±0.2	90.0±3.0	14.1±0.5	34.2±3.5

differences or not.

In his study on the Luvenge River, Chernitskii (1988) has found that the water temperature is from 6 to 16°C during the migration of the sea trout to the sea. Frosman *et al*. (1988) states that the smoltification in northern Europe takes place when the sea water is above 7-8°C. Jonsson (1985) claims more suitable environmental parameters in the sea to be effective factors on the migration of the fish to the sea and on the smoltification period. According to Hutchinson and Iwata (1998), the increase in thyroxine level (T_4) and some other thyroid gland enzymes leads to aggressive behaviours in all types of trout, and any change in these enzyme levels according to the water temperature in the natural environment and day length plays key role in migration to the sea and encouraging smoltification.

Chernitskii (1988) has also found out that the smolt migration takes place after dark but daytime smolt migration has been observed in the streams in the east of the Luvanga River. Solomon (1995) reports the intensity of the daytime smolt migration in the Great Britain. The difference in the migration dynamics is related to the environmental conditions. In this project, the period of smolt migration during the day has not been observed. However, in the observations for sampling studies and the interviews with the fishermen, it has been realized that the fishing is better at cloudy, foggy, and rainy weather, early in the morning or close to the night fall, which shows the increase in the fish movement depending on the day light.

Whether there are any changes in the body fat and protein amounts of the fish during the migration has been examined with the analysis of the samples caught in different environments. In the muscle tissue analysis of the mature individuals with access from the sea, the protein was 24.9%, fat 2.71%, and ash 1.85 %. There, however, is a thick layer of fat under the skin of the fish in this period, which is not taken into account in the analysis done. In the analysis following the reproduction of the individuals with mature eggs, the protein was 19.2 %, fat 1.59 %, and ash 1.16%. That the individuals migrate by swimming against the current, there are not many feeding activities in summer, and there are destructions of the materials stored in the body during the gonad maturation stage cause the proportions of the food to change. In the analysis done in summer months when the feeding is the best for the individual of the fario ecotype, the protein was 22 %, fat 3.65 %, and ash 1.66% (Tabak *et al*., 2001).

In the previous studies on this subject, it was reported that there are differences between the fat and protein proportions both for the smolt and the parr and before and after the reproduction of the fish migrating for it (Jonsson and Jonsson, 1993).

The Behaviour and Growth in the Marine Environment

Although there is a lot of information about the biology and migration of the trout of natural environment in the freshwater and streams, it is not clear how the anadromous forms and the salmonid behave in marine environment. That the fish with acoustic devices and radio transmitters have not been followed or well recorded with the electronic devices and at the stations on the land, or marking studies requiring very good recording systems have not been done are the factors limiting the study.

The marking study has indicated that the smolt moving to the marine environment spend their first few weeks in stream mouths and regions close to the coast (Johnstone *et al*., 1995) and that some fish move in and out of the stream many times in the smoltification period (Berg and Berg, 1987). Same results is supported by studies conducted Çakmak *et al*. (2004).

It is known that the sea trout and the salmonid migrate in the oceans for thousands of miles (Okumuş *et al*., 2002). Sedgwick (1990) states that feeding in the regions where some fish such as sardines, anchovy, and some species of shrimp-like crustaceans are abundant, the fish grow faster. The Black Sea trout caught by chance during offshore fishing is believed to be moving with the small fish such as anchovy and horse mackerel (Solomon, 2000). This fish has been found in the stomach of the fish caught in the marine, which proves this idea. In addition, the biggest growth has been observed in the sampling period of the individuals migrating to the sea between two and three years of age while going back and this gives information about the marine behaviour.

Over the last fifty years, the destruction in the natural flora and fauna of the Black Sea due to environmental factors and pollution has indirectly affected the sea trout supply. In particular, eutrophication caused by the streams carrying the heavy pollutants of the European heavy industry, and

exotic species like *Mnemiopsis leidy* transmitted outside have destructive effect on pelagic stocks (Kıdeyş, 1993). However, the increase in the planktonic and pelagic food due to phosphorus and nitrogen input is interesting with its effect on sprat and anchovy stocks in particular. Therefore, the Black Sea trout is believed not to be affected by the environmental factors much (Solomon, 2000).

In the project sampling studies, the individuals of the marine ecotype have been caught with anchored drift gillnet mostly in the area between Rize and Hopa (Torosi, Güzelyalı, Camili regions, and the east of the Kapistre River), and this indicates that the fish moves along the coast to the stream mouths and probably benefits from the currents. However, this information is inadequate to explain the marine behaviour. Marking, monitoring with acoustic transmitters and similar studies should be done to obtain accurate information about the distribution of the anadromous trout in the Black Sea.

Reproductive Migrations and Behaviour in Streams

The smolt and reproductive migrations of the marine ecotype take place between the stream and the sea. The fario ecotype has its feeding, seasonal, and reproductive migrations at the source, upstream, and downstream of the streams due to environmental parameters and food abundance (Bagliniére and Maisse, 1999).

As in the Black Sea basin, non-migrating populations of the trout (fario ecotype) are found in all streams with anadromous populations and in many streams in the interior region (Chernistkii, 1988). Except for the lake ecotypes, freshwater ecotypes depend only on one stream and spend all their lives there. Although they do not migrate to the sea, they have short distance migrations in the stream, between the source, upstream, and the stream mouth. In spring and summer, their feeding periods, they move to the lower parts of the stream and in winter, their reproduction period, they move up to the source to leave their eggs in shallow and gravelly places (Geldiay and Balık, 1996; Slastenenko, 1956).

With the marking of the fish taken from the natural environment or culture environment, it has been found that some individuals pass to the marine environment, and that the individuals of the fario ecotype, despite being physiologically adaptable to the sea water in experimental studies, stay in the freshwater and have localized migrations there (Frosman *et al*., 1998; Bagliniére and Maisse, 1999).

Barachi (1962) reports that the Black Sea trout migrate between the sea and the freshwater, and reproduction can take place every year. As there was not a marking study in this research, whether the fish goes back to the stream they were born or reproduction takes place every year could not be determined.

The anadromous individuals of the salmonid go back to the fresh water after having moved to the marine environment for feeding. In particular, in the studies done on the Pacific salmonid, there are a great many theories concerning the fish going back to the stream they were born from thousands of miles away. According to these theories not verified completely, the world's magnetic field and the position of the sun and the stars are effective on the migration behaviour; however, another opinion is that, as in other migratory animals, instinctual movements and seabed structure are kept in the fish memory or essential substances or trace elements are effective on the migration behaviour (Quinn and Groot, 1984). Another opinion is that going back to the stream born for the salmonid moving between the freshwater and the marine is related to the hormonal changes during smoltification. It is believed that the ability of the sea trout to distinguish between the pheromone caused by the hormonal activity and released to the environment very little and similar chemicals helps it go back to the same stream (Edwards *et al*., 1992).

The condition factor in smoltification period is the lowest, that is, 0.81 in spring and 0.88 in autumn but it is the maxium, 1.34, for the individuals rapidly fed in the marine environment. The condition factor declines in the reproduction period of the individuals not fed enough in streams. The difference between the size and weight of the female and male mature individuals is statistically significant ($P<0.05$).

According to the findings, marine ecotype of the Black Sea trout stays in the sea for about 1 to 3 years and move into streams for reproduction after having reached enough size. Although the individuals of 3.89 years old (3-6+) in average are seen in stream mouths from March onwards, they are found to enter streams heavily in the late May and early June. The sample individuals in autumn are 4.14 years old (3+-8+), 59.8 cm long (42.5-99.0), and 3,145.7 g (769.7-16,200).

According to the results of the marking studies done on the sea trout in the Vistül River by Skrochowska (1969), the spawning migration is first seen after living 3 to 4 years in the sea, and the time spent in the sea ranges from 8 to 60 months. In the same study, it was realized that migration intensity is the highest in March and August but less in November and December. Jonsson (1985) and Alm (1959) state that the sea trout in Scandinavia stay in the freshwater for 1 or 3 years before smoltification and then move to the sea. Elliot (1994) indicates that the individuals passing to the marine go back to the stream after feeding in the sea for about 1 or 3 years.

The fry are found in small streams or the coastal waters of the bigger streams, close to the source (in regions of 15-35 cm deep), and in gravelly and sandy streambed after leaving the nest and till they are 5-7 cm long. In this period, in parts where the folk are, water velocity is variable and 13.6-40 cm/mn.

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