

RIP CURRENTS ACROSS THE SHORES OF THE BLACK SEA

Serdar BEJİ ¹ and Barış BARLAS ²

¹Istanbul Technical University, Department of Ocean Engineering, Istanbul, Turkey

²Istanbul Technical University, Department of Naval Architecture, Istanbul, Turkey
sbeji@itu.edu.tr

1. Introduction

Offshore directed currents formed in the surf zone due to breaking waves are called “rip currents” and essentially typical to the oceans. Being a nearly closed basin, the Black Sea is probably the only exception with frequent rip currents on its beaches. As the name implies, the rip currents run counter to the incoming waves and establish itself as a strong stream channel with somewhat different colour. The prominent characteristic of running against the waves is a rather puzzling aspect of rip currents therefore their occurrence and generation mechanism require careful examination. Particularly in countries with shores facing the oceans such as Australia and United States, numerous studies and articles are available regarding rip currents, their formation, and related drowning incidents. Coasts of the Black Sea, while harbouring many rip currents, have not received much attention in this aspect. Apparently, no study on rip currents seems to be undertaken in Turkey until relatively recently (Beji and Barlas 2007).

Formation and physical aspects of rip currents are important to understand the mechanism working behind. Covering these aspects, Dalrymple *et al.* (2011) gave a detailed review on field measurements, instrumentation, laboratory techniques, and numerical modelling. Kumar *et al.* (2011) used a 3D numerical ocean model for surf zone applications using examples of rip current formation in longshore bar. Orzech *et al.* (2011) investigated the formation of mega cusps on rip channel bathymetry. The relationship between alongshore rip channel migration and sediment transport was investigated using time-averaged video images to identify the positions of rip channels by Orzech *et al.* (2010). Thiebot *et al.* (2012) analysed the influence of wave direction on the morphological response of a double sandbar system, and interactions between the patterns in the two shore-parallel bars.

Potential hazards of rip currents to human lives are among the most important issues for studying rip currents. Brighton *et al.* (2013) studied rip current related drowning incidents in Australia while Gensini and Ashley (2010) analysed fatalities caused by rip currents in the United States for the period of 1994-2007. Sherker *et al.* (2010) assessed the beliefs and behaviours of Australian beachgoers in relation to beach flags and rip currents. Miloshis and Stephenson (2011) suggested rip current escape strategies as "do nothing" and "swim parallel to the beach". Drowning risk factors at surf beaches in Australia were analysed by Morgan *et al.* (2009). Chandramohan *et al.* (1997) identified

rip current zones on the Goa beaches in India while Sabet and Barani (2011) did the same for the southern coast of Caspian Sea. Studies on rip current related drownings on the Black Sea beaches of Istanbul were given in Barlas *et al.* (2012) and Beji and Barlas (2013).

The Black Sea beaches of Istanbul are among the most dangerous regions of the world in terms of rip current fatalities. According to the records, each year on the average 33 people fall victim to rip currents on these beaches. This fatality rate for a city of approximately 15 million population is remarkably greater than those observed in Australia and in U. S. Such a high fatality rate raises a number of questions ranging from educational aspects to cultural attitudes. Therefore, extensive campaigning concerning the dangers of rip currents and the relevant rescue techniques as well as other educational recommendations related to social attitudes is needed.

2. General Characteristics of Rip Currents

A rip current is a powerful and separate seaward current that can flow over 2 m/s running usually perpendicular to the beach, out into the sea. In general the speeds of rip currents are between 0.3 to 1.5 m/s (Dalrymple *et al.* 2011). Compared to the 800 m freestyle World record in swimming, which is nearly 1.8 m/s, the speeds of the rip currents are quite high. The rip currents may extend 50 to 300 meter in length, and 6 to 30 meter in width (Short and Hogan, 1994). The formation of rip currents depends on definite aspects, which may be enumerated under the following items (Bowen 1969, Lyons 1991).

- Nearshore bathymetry,
- Wind direction and speed; wave height and period,
- Sand properties of the beach,
- Shape of the shoreline,
- Structures at the beach.

The nearshore bathymetry is probably the most important factor in the formation of rip currents. A bar-trough-bar type bottom configuration is a trademark of a rip current as seen in Figure 1 (Hansen and Svendsen 1986).

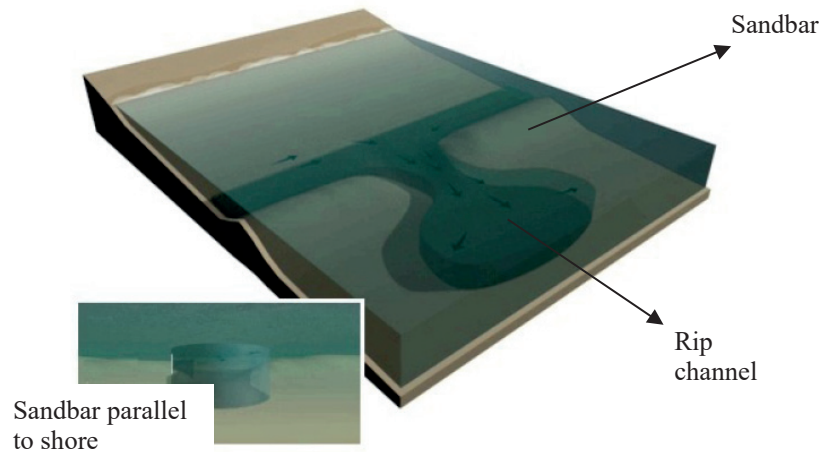


Figure 1. A typical bathymetry allowing rip current formation (COMET 2017)

The offshore directed rip currents interact with the incident waves to produce a negative feedback on the wave forcing, hence to reduce the strength and offshore extent of the currents. The two physical processes arising from refraction by currents; namely, bending of wave rays and changes of wave energy, are both found to be important. The incident wave height has some effects on the strength and offshore extent of rip currents, but these are rather weak compared to the effects of rip channel spacing and depth (Yu and Slinn 2003). Once the waves are high enough to break over the top of the bar, the question of how high they can become is relatively unimportant. Since wave breaking over a bar is primarily dictated by water depth, it is sufficient condition for breaking to get wave heights comparable or greater than the water depth over the bar. If the bar is shallow enough the required wave height for breaking is smaller (Haller and Dalrymple 1999). The process is determined by the ratio of water depth to wave height, which is a relative quantity. On the other hand, the depth of the trough across which the rip flows offshore is a quite important parameter in determining the strength of the rip current. In principle the deeper the channel the stronger the current is. Rip currents are usually observed in the aftermath of a storm or windy weather conditions if the wind blows from a favorable direction to generate sufficiently high waves advancing perpendicular to the beach. Atmospheric conditions are therefore another crucial factor in the formation of rip currents. Average bottom slope in the nearshore region is also observed to influence the current strength by dictating the rate of change of shoaling. Gradual shoaling over long distances or a mild-slope type bathymetry gives rise to stronger currents (Arthur 1962). Finally, fine sand beaches increase the probability of rip current formations, while coarse sand or pebble beaches decrease the probability (Pfaff 2003).

3. Rip Currents on Black Sea Shores

Rip currents are rather common features of beaches facing oceans but rather unusual for relatively small enclosed bodies of water. In this respect, the Black Sea is remarkably different in that rip currents are encountered frequently along the southern shores of it. Reasons for rip current occurrences are related to favourable aspects of the beaches of the Black Sea, as the existence of rip currents depends on the beach bathymetry, wind direction and speed, wave height and wave period, the form of the beach, physical structures at the beach, and the sand characteristics. Especially with cusp-like shore forms, many beaches on the southern coasts of the Black Sea have rather fine sand, bar-trough-bar type underwater formations, and are open to high northerly winds with severe waves as high as 5 meters or even higher. Co-existence of all these factors make the beaches of the Black Sea quite predisposed to rip currents and the overall result is that year after year lives are lost at the beaches due to rip currents. If the bottom topography has gentle slopes and shoals over long distances, rip currents are usually stronger and effective over large regions. For other type bathymetries strength and extend of rip currents are somewhat limited. Depending on the formation type, some rip currents may be permanent; that is to say, they may exist on yearly basis throughout the favourable conditions. However, there are also temporary rip currents which exist only for a few or several hours. In the aftermath of severe storms it is much more likely to observe rip currents. With increasing wave period and wave height, the speed and extend of rip currents increase. Gently sloping and fine sand beach types are especially favourable for rip current formation. Figure 2 shows the rip current formation on the shores of Şile-Kurfallı.

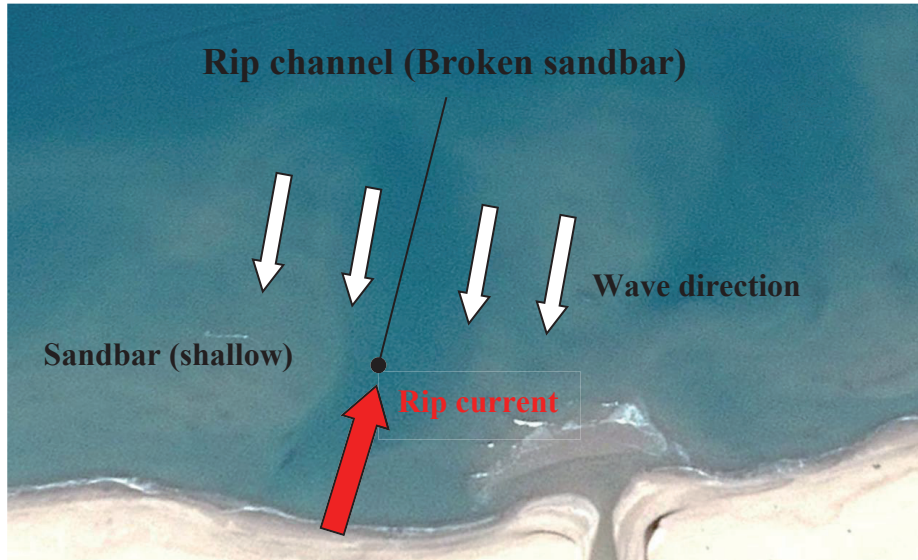


Figure 2. Schematic description of rip current formation on Şile-Kurfallı shores

Sand properties of a beach is another important factor that determine the character of rips and decide whether rip currents form or not. Actually, sand properties affect rip currents not directly but indirectly by shaping the bottom topography or bathymetry. With the action of waves and currents, fine sand spreads more homogenously and evenly over the area and creates gently sloping regions. Such a bathymetry is more favourable for the formation of rips. On the other hand, coarse sand reduces probability of rip formation by creating a bottom topography with somewhat steeper slope. A pebble beach has the least probability of generating rip currents (Pfaff 2003). Figure 3 shows relatively fine sand structure of Aaçlı (Eyüp) and Kilyos (Sarıyer) beaches. Fine sand beaches, as indicated, have gently sloping depths hence provide favourable conditions for the formation of strong rip currents. Coarse sand beaches however have relatively steeper slopes hence generate weaker rip currents or no rip currents at all.



Figure 3. Fine sand structure of Aaçlı (Eyüp) ve Kilyos (Sarıyer) shores (photo by B. Barlas).

Reports from actual rescue operations reveal that the observed rip currents on the shores of the Black Sea are quite severe. Wind speeds basically determine wave heights and in turn wave heights directly affect the strength of rip currents. Therefore, weather condition is the primary factor for rip currents. For the shores of Black Sea, a wind of Beaufort 3-4 may initiate rip currents because the wave heights near the shore may approach 2-3 m. As the weather gets severer, for Beaufort 4-5 the wave heights increase to 4-5 m and for Beaufort 7-8 wave heights exceed 5 m. The latter is a very severe weather condition and normally people would avoid getting into sea but there may be some exceptional cases as for instance one reported by the Underwater Search and Rescue Team of Istanbul Gendarmerie Command. On the eve of a storm on 30 June 2013 a person was reported lost off the Kurna Beach in Sile, Istanbul. But the weather was getting much worse and no other information about the person was obtained therefore no search could be initiated for two days. On 02 July 2013, in presence of a storm with Beaufort 7.9 and nearshore wave heights exceeding 5.5 m the body of the victim was reportedly seen adrift in the sea. Despite the extreme wind and sea conditions, the Underwater Search and Rescue Team arrived at the indicated location and began attempts to recover the body from the water. The Team observed virtually a mega rip channel of 200-300 m long into the sea and a current speed of 4-5 m/s. The body was trapped in a

vicious circle: the rip was carrying the body 200-300 m offshore and wherever the rip was weakening, the body, being free of the current, was overtaken and carried back towards the shore by the very high waves moving onshore. Then, approximately 50 m to the shore the body was again caught up by the rip current and quickly drifted offshore. The Rescue Team was trying to get hold of the body whenever it was closest to the shore but that was a very difficult and dangerous task even for the divers. Despite the heavy diver's equipment they were also being caught up in the current and carried away for hundreds of meters. Most of the times they were trying to save their own lives. Eventually, after more than an hour's efforts the body was recovered from the sea. This single incidence shows clearly that the Black Sea may be even more dangerous than the Oceans when it comes to rip currents and may produce rip channels of 300 m long and 4-5 m/s current speeds, which are extremely rare (Beji 2015).

4. Rip Current Casualties on the Black Sea Shores of Istanbul

When a swimmer is caught up in a rip, he/she is pulled offshore. If the swimmer is inexperienced, he/she attempts to swim back to the shore against the rip current and consequently becomes tired of struggling, suffers exhaustion, fears, and eventually panics. In the end, as a result of wasted efforts, the swimmer drowns.

Literature regarding the casualties due to rip currents is quite diverse about the incident rates. Lushine (1991) reported on the average 150 annual deaths due to rip currents in the United States while his figures were criticized by Gensini and Ashley (2010) who gave 35 annual deaths for the period of 1994-2007. On the other hand, in Australia Sherker *et al.* (2010) indicated an average of 82 annual drownings, many of these attributable to rip currents while Brighton *et al.* (2013) gave 21 annual deaths on the average. Outside the U. S. and Australia, studies are relatively fewer. Chandramohan *et al.* (1997) identified rip current zones on the Goa beaches in India and Sabet and Barani (2011) did the same for the southern coast of Caspian Sea. Arozarena *et al.* (2015) presented an analysis of data from the Judicial Investigation Organization of Costa Rica which indicated 1391 drownings between 2001 and 2012; approximately 590 of those drownings, 42%, were reported as due to rip currents.

Istanbul is the largest city in Turkey with a population over 15 million and has nine known beaches, four in the European and five in the Asian part of the Black Sea coasts as sketched in Figure 4. The total length of the coastline is approximately 153 km (92 km in European side and 61 km in Asian side); the coastline length of popular beaches is approximately 57 km (30 km in European side and 27 km in Asian side).



Figure 4. Beaches (red lines) under the responsibility of Istanbul Gendarmerie Command

Examination of the Istanbul Gendarmerie Command's hazard event data gives a total number of 341 incidents during the period of 2007-2013, and among all the reported drownings, the fatalities associated with rip currents are 227 or nearly 67%. This percentage is higher than the international average range of 49-58% reported by Brighton *et al.* (2013). However, variations do occur depending probably on the beach characteristics; Brewster (2010) for instance, puts the figure to 80% for rip current drownings in California, U.S.A. though this is likely to be an overestimate.

While the figure of 67% for the Black Sea beaches is above the international range, it cannot be attributed solely to uncertainty involved in the identification of the exact cause of drownings. The logs kept according to the reports of the well-trained rescuers and/or the Underwater Search and Rescue Team of the Gendarmerie are quite detailed and the examination of these records shows that every care is taken to ascertain the exact nature of the drownings. The team usually arrives within less than an hour of drowning, question the eyewitnesses and frequently observe the rip current itself if it still exists. Therefore, considering all these points, approximately 67% rate of rip-related events obtained from the records is considered an accurate enough figure. Thus, in an average year approximately 33 people drown due to rip-related drowning incidents on the Black Sea beaches of Istanbul. Considering the range between minimum rate 53% in 2011 and maximum rate 82% in 2009, the lowest and highest number of rip drownings would respectively be 27 and 44 people, depending on wind and wave conditions occurring on that particular summer (Table 1).

Table 1. Reported rip-related drowning fatalities during the period of 2007-2013

Year	Drowning fatalities	Rip current fatalities	Percentage of rip current fatalities (%)
2007	51	36	71
2008	34	27	79
2009	54	44	82
2010	47	30	64
2011	51	27	53
2012	53	31	59
2013	51	32	63
Total	341	227	Avg. 67

A breakdown of fatalities, where deaths by beaches and the percentage of fatalities per kilometre, is given in Table 2. Fatality percentage per kilometre is presented as an indicator of the “danger level” of a particular beach. Since the number of swimmers would be approximately proportional to the beach length; the mere number of deaths or their percentage for a definite beach would not correctly reflect its danger level. Therefore, it should be more meaningful to give the fatality percentage per kilometre of beach. Accordingly, Riva and Karaburun respectively are the most dangerous beaches in terms of rip current fatalities. These two beaches account for 6.9% and 5.1% of total deaths per km. Many of these fatalities occur on weekends, especially on Sundays when daily beach-going tourist population is highest. There is a relatively large difference in fatalities between Saturday and Sunday due to the fact that in Turkey most people in private sector work half a day on Saturdays; therefore, considerably more people go to the beaches on Sundays compared to Saturdays. As expected, weekends with 56% of total fatalities, have more fatalities than all the weekdays combined.

The fatality reports also reveal a difference in gender vulnerability. Males are over seven times more likely to drown in rip currents than females. The percentage of male fatalities due to rip currents stands as 77.2% while female fatalities are 11.9% out of 89.1% fatalities of total incidents. This trend is also reported in international statistics (Brighton *et al.* 2013), but the difference is accentuated in Turkey due to the fact that socially men go to beaches more frequently, while women prefer to stay at home or if they go they refrain from swimming because of religious and cultural attitudes; *i.e.*, not wanting to show her body. In addition, many men are reported to be drown while trying to save their family members or friends from the rip currents. Socially another persistent problem is the over-confident attitude of young adults to warnings. These young people refuse to heed any safety advice and even in some cases go so far as to harass lifeguards or gendarmeries who warn them on the beach.

Table 2. Total number of reported rip current fatalities by beach during the period of 2007-2013

Beach	Rip Drownings	Percentage (%)	Beach length (km)	Percentage of rip drownings per km* (%)
Binkılıç	9	4.6	2	2.3
Karaburun	30	15.4	3	5.1
Ağaçlı	10	5.1	2.5	2.0
Kilyos	9	4.6	4.5	1.0
Riva	20	10.3	1.5	6.9
Sahilköy	7	3.6	2.2	1.6
Alacalı	8	4.1	2	2.0
Sofular	10	5.1	2	2.6
Ağva	9	4.6	3	1.5
Other beaches	83	42.6		

*Percentage of rip drownings per km was calculated by dividing each percentage by beach length in km.

Children aged younger than 18 account for 22% of all rip current fatalities. 54% of fatalities are between the ages 18-35. This group are risk takers and over-represented in drowning statistics. Lifeguards indicate that most beach-going tourists, those other than local inhabitants, lack knowledge and experience about rip currents and most are not good swimmers. When fatalities are considered by month, July stands out as the most dangerous. Half of the total fatalities occur in July, followed by 28% in August. Normally, being a summer vacation time, August would be expected to be nearly as dangerous as July but for the effect of Ramadan. Ramadan, the religious fasting month for Muslims, is very prominent during the period of the data set examined. The beginning and ending of Ramadan are determined by the lunar Islamic calendar. Since the lunar year is 10 to 12 days shorter than the solar year, Ramadan migrates throughout the seasons and each year Ramadan begins about 10 to 12 days earlier than the previous year. The month of Ramadan is spent by Muslims for fasting during the daylight hours from dawn to sunset. Fasting practices are primarily an act of willing abstinence from all food, drink, sexual intercourse and some other activities. Thus, among other refrainments, people do not go to beaches, or if they go, they do not swim to avoid unintentional water intake. The month of Ramadan therefore has a very significant effect on reducing drowning fatalities. For example, fatalities during August were considerably lower than July because the month of Ramadan befall in the month of August from 2009 to 2012.

Although absence of lifeguards in some beaches is a problem, a more dangerous practice is that some families or groups especially prefer desolate beach parts for quite different reasons. In such remote beach areas without lifeguards, when one is in danger, the others from the family or friends try to help him/her, resulting usually in more

fatalities. For example, on July 7th, 2012 four sisters aged 10, 14, 16 and 17 drowned together. According to the drowning report, the two youngest siblings were in danger and the elder ones attempted to rescue them, but they were all caught by the rip current and all four drowned. On July 24th, 2010 two friends aged 30 and 32 drowned together. According to the drowning report, at first, one of the friends was in danger and the other one was trying to rescue him, eventually both were caught by the rip current, and both drowned. There were 18 families or groups involved in the rip current fatality reports, and out of these 38 people died.

5. Winds versus Rip Currents for the Black Sea Shores of Istanbul

The presence of rip currents along a coastline may be related to the presence of onshore wind and associated wind-driven wave breaking activity. While several studies have related the wind speed to the presence and hazard level of rip currents (see for instance Brewster, 2010), here we simply relate wind speed to the occurrence of drowning fatalities in rip currents.

The data set relevant to the analysis presented below was obtained from Turkish State Meteorological Service. The wind data obtained from two different meteorological stations located in close proximity of the beaches, Kumkoy in European side and Sile in Asian side were used here. This database includes atmospheric events, such as wind directions, and magnitudes. The fatality reports and meteorological data were considered together to get an insight into fatalities by first ascertaining whether the casualties were related to the rip currents or not, and then checking if a correlation could be established between the casualties and the atmospheric events. Fatality locations were mapped to depict the spatial distribution of fatal rip currents. On the day that a rip current fatality occurred, the atmospheric condition in relation to the beach was also indicated.

Table 3. Wind speed versus reported rip current fatalities for the period of 2008-2012

Wind speed (m/s)	Rip current fatalities	%
<1.0	0	0.0
1.0-1.5	22	17.2
1.5-2.0	41	32.0
2.0-2.5	21	16.4
2.5-3.0	21	16.4
3.0-3.5	20	15.6
3.5-4.0	3	2.3
4+	0	0.0

Thus, considering the wind speeds versus rip current fatalities, about one third of the fatalities occurs when the wind speed is between 1.5-2.0 m/s as shown in Table 3. When the wind speed is below 0.8 m/s, there are no rip current fatalities, simply because there are no rip currents. When the wind speed is greater than 4 m/s, the people do not go to the beaches because of very severe weather conditions. However, for the wind speeds of 1.0-1.5 m/s, the rip current magnitude is not too intense, so people consider themselves capable enough to swim, but for poor swimmers this is the most dangerous case. Nearly 60% of the fatalities in this wind speed interval is found to be children. By using regression analysis, the wind speed versus fatality risk is shown in Figure 5.

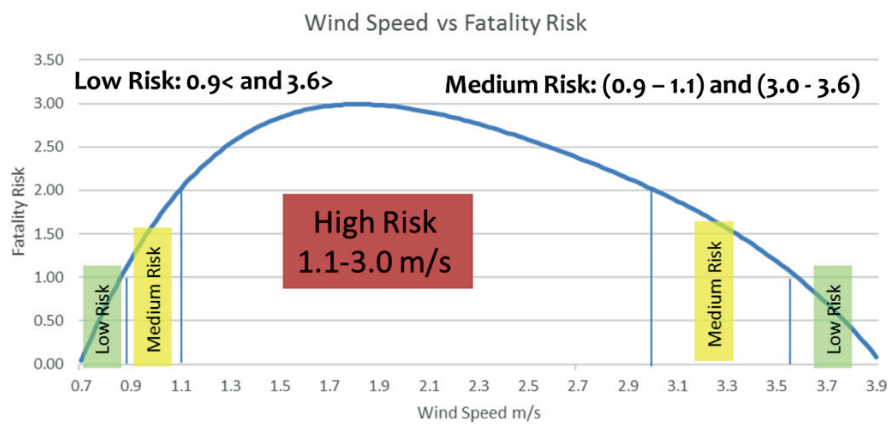


Figure 5. Wind speed versus fatality risk due to rip currents for the Black Sea shores of Istanbul

6. Surviving Rip Currents

Ballantyne *et al.* (2005) studied the behaviour of international and domestic students and their knowledge of beach safety practices while drowning risk factors at surf beaches are analysed by Morgan *et al.* (2009). Dangers of rip currents and prevention methods were reported by Hatfield *et al.* (2012) on a campaign to improve beachgoer recognition of calm-looking rip currents, which are known to contribute to surf drownings. Drozdowski *et al.* (2012) surveyed people who had been caught in a rip current and survived. Williamson *et al.* (2012) compared attitudes and knowledge of beachgoers from rural inland residents and international tourists in Australia concerning beach safety. An important outcome of this study was that the odds of international tourists making a safe swimming choice in the vicinity of a rip current were three times lower than usual beachgoers and rural inland residents. Quite similar views concerning daily tourists were reported by natives and lifeguards of towns on the coasts of the Black Sea in Turkey during in person interviews. Caldwell *et al.* (2013) studied the ability of

beach users' knowledge of rip currents at Pensacola Beach, Florida and found that most beach users, and particularly local participants, are overconfident in their ability to identify rip channels and currents. In the same vein, Brannstrom *et al.* (2014) surveyed the ability of beach users on three heavily used public beaches in Texas to identify a rip current. Only 13% of respondents correctly selected the photograph showing the most hazardous conditions and correctly identified the precise location of the rip current. In a similar vein, Drozdowski *et al.* (2015) reported the experiences of weak and non-swimmers caught in rip currents at Australian beaches. While it may not be always easy to recognize a rip current the following points are helpful for deciding.

- A mixture of water masses irregularly moving away from the shore as if in a channel,
- Notable change of the colour of water in a limited region,
- A foamy region moving into the sea,
- Irregular and turbulent appearance in waves approaching the shore.



Figure 6. Photograph of a clearly identifiable rip current

Existence of one or more of the above items usually indicate the presence of a rip current. An observer on the beach may see these signs easier with the aid of an UV filter sunglass. Figure 6 shows the photograph of a rip current taken above the sea. Note that the current sets the bottom sediments in motion and creates a murky and brownish water region.

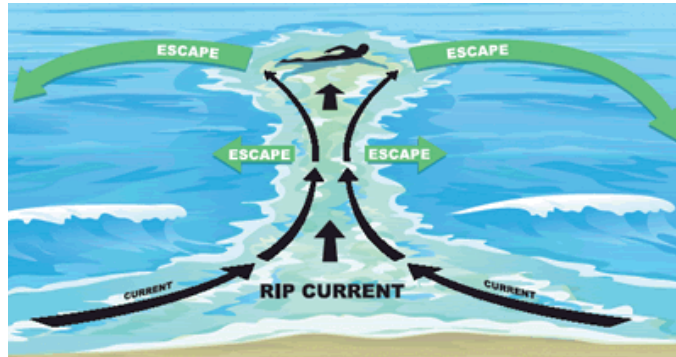


Figure 7. Strategy to escape from a rip current (NOAA 2017)

The foremost escape technique from rip currents advises victim to swim parallel to the beach wherever the rip current weakens in strength as sketched in Figure 7. Likewise, Miloshis and Stephenson (2011) suggest rip current escape strategies as "do nothing" and "swim parallel to the beach". In particular, they indicate that, of the two methods, "do nothing" or "allow the rip current to take a swimmer" is the most effective strategy. However, recent studies have shown dominant rip current re-circulation within the surf zone and have endorsed "just floating" as an appropriate escape strategy (McCarroll *et al.* 2014).

The following items are essential for surviving rip currents:

- Improve your swimming skills,
- Do not swim alone,
- Always be alert about potential dangers,
- If caught up in a rip current, remain calm and do not waste your energy in vain,
- Do not fight against the current. Swim parallel to the shore wherever the current weakens enough to allow you to do so and then swim back to the shore from a different path,
- If too tired to swim, just calmly try to remain afloat and let the current take you till it weakens in strength. Then, swim parallel to the shore outside the rip and return back.
- If too tired to swim back after getting out of the grip of the current, ask for help from the shore by holding your arm.

To help someone caught up in a rip current:

- Ask for help from a lifeguard if within the reach,
- If no lifeguard present throw something floatable (life jacket, buoy ring, beach ball, any kind of personal floatation devices –PFDs) to the person in danger.
- Very loudly tell the person what he/she should do to survive.
- Do not forget that many people who try to rescue a person from a rip current get drowned so unless you are a really expert swimmer do not get into water.

7. Concluding Remarks

Rip currents are mostly encountered across the shores facing the oceans. Therefore, countries like U.S. and Australia have accumulated a considerable literature concerning various aspects of rip currents. The Black Sea, being an almost completely isolated basin, stands out as an unusual case in terms of rip current occurrences. Across the southern shores of the Black Sea, rip currents are considerably frequent and rather dangerous owing to exceptionally high waves at times of northerly winds. Studies on the rip currents of the Black Sea beaches are rather few and have started only recently for the beaches of Istanbul facing the Black Sea (Beji and Barlas 2007). The main reason for this late attention is probably the late identification of the rip currents themselves on the Black Sea shores of Turkey. Nevertheless, in recent years more studies on incident rates, prevention techniques and mechanisms of rip currents on the Black Sea beaches of Turkey have been reported and campaigns for public awareness have been initiated (Barlas *et al.* 2012, Beji and Barlas 2013, Barlas and Beji 2013, 2016).

Records of Istanbul Gendarmerie Command reveal that on the average 33 people are drown each year in rip currents on the Black Sea beaches of Istanbul. Such high drowning rate calls for a questioning of the role of educational aspects and cultural attitudes in this problem. Besides the usual precautions such as warning signs concerning the dangers of rip currents and the relevant rescue techniques of remaining afloat and avoiding to swim against the current, other educational recommendations related to social and cultural aspects are needed. Pamphlets explaining the rip currents and their dangers, one-page brochures advising on correct attitude, educational programs for children, preachers addressing the problem and recommending obedience to authorities in mosques, magazine and TV spots may be considered as educational activities.

The absence of lifeguards on some beaches contributes to fatalities. However, an equally important problem stems from the social attitudes of beach-goers. For different reasons, some young couples and families prefer isolated parts of beaches where no guards are on duty. In such circumstances, when one is in danger, in the absence of lifeguards, family or friends try to help the victim, often resulting in more fatalities.

Precautions appropriate to the cultural attitudes of the people are suggested to reduce drowning incidents and related fatalities. The success of educational or informational activities in this region therefore requires much effort, especially when young adults are in question. Children are relatively easier to reach and they are more willing to listen to the warnings and obey the instructions. Therefore, it is expected that the brochures and billboards prepared in this context will be effective over the medium term by first educating children and youngsters.

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