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CONTENT

Short Communication
Turkish Journal of Maritime and Marine Sciences Volume: 5 Issue: 2 (2019) 69-73

Occurrence of the Lessepsian *Hemiramphus far* (Hemiramphidae) in Güllük Bay, South-eastern Aegean Sea

Güllük Körfezi'nde (Ege Denizi) Lesepsiyen *Hemiramphus far* (Hemiramphidae)'ın Bulunuşu

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 69-73

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ABSTRACT

A specimen of the spotted halfbeak, *Hemiramphus far* with 282 mm TL has been caught by a commercial gillnet off Küçüktavşan Island, Güllük Bay at a depth of 15 m on 09 February 2019. This paper presents the first occurrence of *H. far* in the Bay of Güllük. At the same time, this short note was the third record of *H. far* for the Turkish Aegean Sea after Gökova Bay and Eski Foça.

Keywords: Rare species, lessepsian, record, Güllük Bay, Aegean Sea.

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ÖZET

Güllük Körfezi Küçüktavşan Adası açıklarında 15 m derinlikte, 282 mm boyunda bir *Hemiramphus far* bireyi 9 Şubat 2019 tarihinde ticari bir solungaç ağıyla yakalanmıştır. Bu makale Güllük Körfezi'nde *H. far*'ın ilk kaydını sunmaktadır. Aynı zamanda bu kısa not, Gökova Körfezi ve Eski Foça'dan sonra *H. far*'ın Ege Denizi'nin Türkiye kıyıları için üçüncü kaydıdır.

Anahtar sözcükler: Nadir tür, lesepsiyen, kayıt, Güllük Körfezi, Ege Denizi.

1. INTRODUCTION

Spotted halfbeak, *Hemiramphus far* (Forsskål, 1775) is an epipelagic, schooling fish that swims usually close to the sea surface in coastal waters. It's size to 40 cm with common 10-33 cm. It feeds on zooplankton and floating matters, *i.e.* sea grasses, but also green algae and sometimes diatoms (Collette and Parin, 1986; Golani et al., 2006).

Originally, it has wide Indo-Pacific distribution and invaded the Mediterranean from the Red Sea via the Suez Canal and well established in its new habitat from Rhodes to Egypt (Golani et al., 2006).

This paper presents the first occurrence of *H. far* in the Bay of Güllük, and at the same time, it is additional Lessepsian fish record going towards to northern latitude of the Aegean Sea.

2. MATERIAL AND METHODS

On 09 February 2019, one specimen of *Hemiramphus far* (Figure 1), was caught by a commercial gillnet (stretched mesh size 72 mm) off Küçüktavşan Island, Güllük Bay (lat 39°09 N, long 27°21 E) at a depth of 15 m (Figure 2). The species was identified according to Collette and Parin (1986) and Golani et al. (2006). The sample, fixed in 6% formaldehyde solution, has been preserved in the fish collection of the Fisheries Faculty, Ege University (ESFM-PIS/2019-01).

Figure 1. *Hemiramphus far*, caught off Küçüktavşan Island, Güllük Bay (scale: 50 mm) (Photo: O. Akyol)

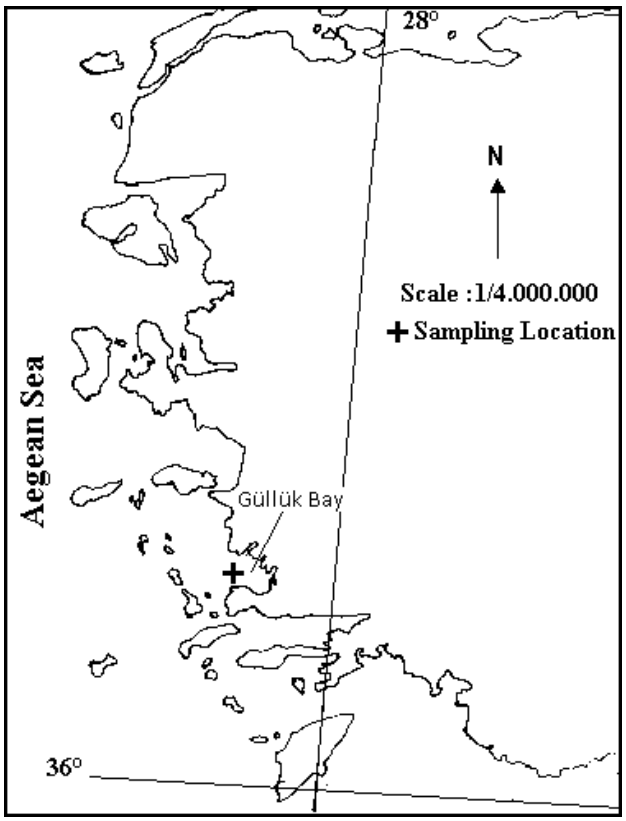

Figure 2. Sampling location of *Hemiramphus far*

3. RESULTS AND DISCUSSION

The specimen was identified as follows: its body laterally compressed, elongate oval in cross-section. Lower lobe of the caudal fin is longer than upper. Triangular portion of upper jaw is naked (*i.e*. no scales), and preorbital ridge is absent. Morphological description, colour, morphometric measurements with percentages of total length (TL%) and meristic counts (Table 1) are in agreement with Collette and Parin (1986), Golani et al. (2006) and Rafrafi-Nouira *et al.* (2012).

In the Mediterranean Sea, *H. far*'s (as *H. marginatus*) first record dates back 1927, when it was caught in Palestinian waters (Steinitz, 1927). Though, *H. far* has only been very common off Israel and Lebanese waters in 1980s (Collette and Parin, 1986), it has reached to the coast of Albania (Collette and Parin, 1986), the Libyan coasts (Shakman and Kinzelbach, 2006), Gulf of Tunis, Tunisia (Rafrafi-Nouira *et al.,* 2012), Collo, eastern Algerian coast (Kara et al., 2012) and Lempedusa Island, Strait of Sicily (Falautano et al., 2014) for the time being.

In Turkish seas, *H. far* has been recorded first from the Turkish coasts of Mediterranean (Kosswig, 1950). A specimen of *H. far* with 286 mm length was caught the stationary nets around the IMS-METU harbour in Mersin Bay in 1980s (Gücü et al., 1994). Then, four specimens (233-282 mm) have been recorded from Iskenderun and Gökova Bays, Aegean Sea during 1991-1994 (Torcu and Mater, 2000). *H. far* (246 mm)

was also recorded from the coasts of Karataş, Iskenderun Bay between 1994 and 1996 (Başusta and Erdem, 2000).

In the Aegean Sea, Geldiay (1969) mentioned the *H. far* (as *H. marginatus*) in the Aegean Sea only by name, but no solid details. Papaconstantinou (1990) reported *H. far* from the north-western Rhodes Island, Greece in southern Aegean Sea. After its record in Gökova Bay, mentioned above (Torcu and Mater, 2000), a specimen (146 mm) has been caught off Eski Foça coasts on 10 November 2009 (Akça and Bilecenoğlu, 2010). This was a northernmost record throughout the Aegean Sea.

The occurrence of *H. far* in the coasts of Güllük Bay is not unexpected due to the previous records of the species from the Rhodes, Gökova Bay and Eski Foça, Aegean Sea. This record reveals that the rare *H. far* is likely to widely settlement in the Aegean Sea.

Table 1. Morphometric measurements, ratios and meristic counts of *Hemiramphus far*, captured from Güllük Bay, Aegean Sea

Measurements	**Size (mm)**	**Proportion (TL%)**
Total length (TL)	282	
Standard length (SL)	240	85.1
Fork length (FL)	250	88.7
Pectoral fin length	32	11.3
Pre-dorsal fin length	145	51.4
Pre-anal fin length	150	53.2
Lower jaw length	59	20.9
Upper jaw length	8	2.8
Maximum body depth	20	7.1
Body width	20	7.1
Head length	41	14.5
Eye diameter	11	3.9
Preorbitary length	14	5.0
Meristic counts		
Dorsal fin rays	11	
Anal fin rays	10	
Pectoral fin rays	12	
Ventral fin rays	6	
Weight (g)	61.4	

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Research Article
Turkish Journal of Maritime and Marine Sciences Volume: 5 Issue: 2 (2019) 74-87

Technical Features of Nets used Industrial Fisheries in the Western Black Sea (Sinop Province)

Batı Karadeniz'de (Sinop İli) Endüstriyel Balıkçılıkta Kullanılan Ağlar ve Teknik Özellikleri

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 74-87

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ABSTRACT

Specifications of fishing gears changes over time due to various factors. Place on record actual design plans of fishing gears are very important for tracking both evaluation of fishing technologies and status of fish stocks. In this study, fishery equipment of fishing boats large than 12m was examined in Sinop province. It was determined two type purse seine nets, two types of bottom trawls and one midwater trawl in the region. Technical plans of the nets were presented.

Keywords: Industrial fisheries, purse seine, trawl nets, technical plan

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ÖZET

Balıkçılıkta kullanılan av araçlarının yapısal özellikleri ve planları çeşitli nedenlerle zamanla değişmektedir. Güncel planların kayıt altına alınması hem av araçlarının gelişimin hem de stokların durumunun izlenmesi açısından çok önemlidir. Bu çalışmada Sinop ili liman ve balıkçı barınaklarında mevcut 12 metreden büyük teknelerin av araçları incelenmiştir. Yörede endüstriyel balıkçı tekneleri tarafından iki çeşit gırgır ağı, iki çeşit dip trolü ve bir adet ortasu trolü ağı kullanıldığı belirlenmiştir. Bu ağlar limanlar, balıkçı barınakları, çekek yerleri ve balıkçı teknelerinde incelenerek teknik özellikleri kayıt altına alınmış ve oluşturulan donam planları detaylı olarak sunulmuştur.

Anahtar sözcükler: Endüstriyel balıkçılık, gırgır ağları, trol ağları, teknik plan

1. GİRİŞ

Türkiye su ürünleri avcılık üretimi 2017 yılı için 354 318 ton olarak tespit edilmiştir. Bu üretimde en büyük pay Karadeniz'e aittir. Karadeniz'de en fazla avlanan türler ise hamsi başta olmak üzere çaça, palamut, istavrit, lüfer ve tirsi gibi pelajik türlerdir (Anonim, 2019). Karadeniz'de balıkçılık faaliyetleri hemen hemen sahil illerinin tamamında sürdürülmektedir. Karadeniz'de avlanan pelajik türler için önemli bir toplanma ve geçiş sahasını oluşturan Sinop kıyılarında balık türlerinin durumuna endüstriyel balıkçılık faaliyetleri av sezonu süresince yoğun olarak devam etmektedir.

Sinop Türkiye su ürünleri üretimin büyük bölümünün yapıldığı Karadeniz'in tam ortasında, göçmen ve yerli balıklar için en önemli geçiş ve avlanma noktasındaki konumu, geniş doğal limanı ve korunmuş doğasıyla geçmişten günümüze önemli bir balıkçılık kenti olmuştur. Endüstriyel gelişimin hızlandığı 1950'li yılların sonunda Et Balık Kurumu tarafından büyük bir soğuk hava deposu ve iskele inşa edilerek balıkçılıktaki önemli yerini geleceğe taşımıştır. Beşinci beş yıllık kalkınma planıyla birlikte 1980 li yıllarda balık unu-yağı sanayine verilen önem ve Sinop'a il bazında sağlanan teşviklerle su ürünleri sanayinin merkezi olmuştur (Baysal, 1971).

Bugün ülkemizin balık unu-yağı sanayinin büyük bölümü Sinop ili sınırlarında bulunmaktadır (Duyar ve Bayraklı, 2005; Yıldırım, 2006). Diğer su ürünleri işleme fabrikaları ve son yıllarda hızla artan soğuk muhafaza tesisleri Sinop ekonomisinde önemli bir yer tutmaktadır. Halen mevcut tesisleri, balıkçılık alt yapıları, balıkçı teknesi varlığı ve son yıllarda balık yetiştiriciliğine yönelik planlamalar ile Sinop geleceğin balıkçılık merkezi olma potansiyelini korumaktadır. Sinop bir balıkçılık merkezi olarak Zonguldak'tan Hopa'ya kadar tüm Karadeniz kıyılarına yön vermeye devam etmektedir (Erdem ve ark., 2018).

Balıkçılık teknolojilerindeki gelişmeleri yakından takip etmek, kullanılan av araç ve donanımlarının planlarını, zamana bağlı değişiklikler ve alternatif donam şekillerini kayıt altına almak gelişimin izlenmesi kadar su ürünleri stoklarının durumu hakkında yararlı bilgiler sunar (Nedelec ve Pradov, 1990; Tokaç, 2011).

Sucul ortamda balıklardan kabuklulara, eklem bacaklılardan yumuşakçalara kadar çok çeşitli su ürünleri bulunmaktadır. Su ürünlerinin toplanması, yakalanması ve avlanmasında kullanılan tüm araç ve gereçlere su ürünleri avlama araçları adı

verilir. Bu araçlara kısaca balık avlama araçları da denilmektedir. Su ürünleri avcılığında kullanılan av araçları; aktif (hareketli) ve pasif (sabit) av araçları olmak üzere 2 grupta toplanır (Sainsbury, 1996; Bjordal, 2001).

Dünyada olduğu gibi Türkiye denizlerinde de büyük ölçekli endüstriyel balıkçılıkta daha çok aktif av araçlarından trol ağları (dip ve ortasu) ve gırgır ağları kullanılmaktadır (Karakulak ve ark., 2002; Erdem ve ark., 2007; Emirbuyuran ve Çalık, 2016).

Türkiye'de yapılan balıkçılık araştırmalarının pek çoğunda materyal olarak av araçlarının genel özelliklerine kısmen değinilirken av aracının detaylı planlarına ve özelliklerine geniş yer verilmemiştir. Denizlerimizde kullanılan av araçlarının teknik özellikleri ve planları üzerine bazı özel çalışmalarda mevcuttur. Bu çalışmalar çoğunlukla Marmara Denizi ve Ege Denizinde kıyı balıkçılığında kullanılan av araçları (uzatma ağları) üzerinedir (Ceyhan ve ark., 2005; Akyol ve Ceyhan; 2007; Altınağaç ve ark., 2008; Ayaz ve ark., 2008; Akyol ve ark., 2008; Tokaç ve ark., 2010; Akyol ve Ceyhan, 2010; Ayaz ve ark., 2012; Yıldız ve Karakulak, 2010a; Yıldız ve Karakulak, 2010b; Yıldız ve ark., 2012). Akdeniz ve Karadeniz'de bu konuda yapılan çalışmalar ise daha az sayıdadır (Demirhan ve ark., 2007; Özdemir ve Erdem, 2006; Demirci ve Demirci, 2007; Ay ve Duman, 2015; Samsun ve Emirbuyuran, 2017).

Türkiye denizlerinde özellikle endüstriyel balıkçılıkta kullanılan gırgır ve trol ağlarının planları ve teknik özelliklerini ele alan detaylı çalışmalar ise oldukça azdır (Akamca, 1996; Karakulak ve ark., 2002; Tokaç ve ark., 2005; Doyuk, 2006; Doğanyılmaz ve ark., 2010; Emirbuyuran ve Çalık, 2016). Bununla beraber Sinop ilinde endüstriyel balıkçılıkta kullanılan trol ve gırgır ağlarının plan ve teknik özelliklerinin kapsamlı olarak ele alındığı herhangi bir çalışmaya rastlanmamıştır.

Bu çalışmada Sinop ili ve sahil ilçelerindeki liman, barınak, çekek yerleri ve kooperatifler ziyaret edilerek toplanan veri ve bilgilere dayalı olarak büyük ölçekli balıkçı tekneleri ile endüstriyel balıkçılıkta kullanılan av araçlarının detaylı planları ve teknik özellikleri belirlenmiştir. Ağları donatan kişinin tecrübelerine göre değişen donam alternatifleriyle birlikte FAO'nun ağ katalogları ve yönergelerine (Nedelec, 1975; Dremiere, ve Nedelec, 1977; Anonim, 1991) uygun teknik planlar çizilmiştir.

2. MATERYAL VE METOT

Araştırma Batı Karadeniz'de yer alan ve önemli bir balıkçılık merkezi olan Sinop il merkezi ve sahilde yer alan ilçeleri Ayancık, Türkeli ve Gerze'de bulunan balıkçı kooperatiflerinde, limanlarda, balıkçı barınaklarında ve çekek yerlerinde balıkçılık faaliyetleri yapan balıkçılar ziyaret edilerek yürütülmüştür (Şekil 1). Araştırma verileri ve gerekli tüm bilgiler 1 Ocak - 31 Aralık 2015 tarihleri arasında belirtilen bölgelerdeki balıkçı gemisi sahiplerinden ve ağları donatan kişilerden temin edilmiştir.

Av araçları yerinde tek tek detaylı bir şekilde incelenerek balıkçılardan endüstriyel balıkçılıkta kullandıkları gırgır ağları, dip trol ağları ve ortasu trol ağlarının teknik özellikleri ve donam planlarına ait veriler temin edilmiştir. Ayrıca bu ağları donatan balıkçılarla yapılan görüşmelerde gerekli ve bazı önemli bilgiler (ağlarda kesim tekniği uygulanması, av aracına eklenen özel bir yapı bulunması, özel yüzdürücü /kurşun donamı, elle ağ örme ve av aracına ekleme, av aracında özel halat donamları gibi) kayıt altına alınmıştır.

Elde edilen tüm veriler ve bilgiler dikkate alınarak gırgır, dip trolü ve ortasu trolü ağ planları Autocad ™ yazılımında ölçeklendirilip PaintShopPro 7.04 ™ yazılımıyla png formatında düzenlenerek FAO standartlarına göre çizilmiştir.

Şekil 1. Araştırma verilerinin ve bilgilerin toplandığı balıkçılık bölgeleri

3. BULGULAR

Sinop kıyılarında yer alan limanlar, balıkçı barınakları, çekek yerleri ve kooperatiflere yapılan ziyaretler sonucunda balık avcılığında trolden gırgıra, salyangoz algarnasından çeşitli uzatma ağlarına kadar çok değişik av araçlarının kullanıldığı belirlenmiştir. Sinop'ta ağırlıklı olarak kıyı balıkçılığı yapılmakla beraber gırgır ve trol tekneleri de büyük öneme sahiptir. Yörede endüstriyel balıkçılıkta veya başka bir ifadeyle büyük ölçekli balıkçılıkta kullanılan av araçları iki çeşit gırgır ağı, iki çeşit dip trolü ve bir ortasu trolü ağında oluşmakta olup donam özellikleri aşağıda sunulmuştur.

3.1. Gırgır Ağları

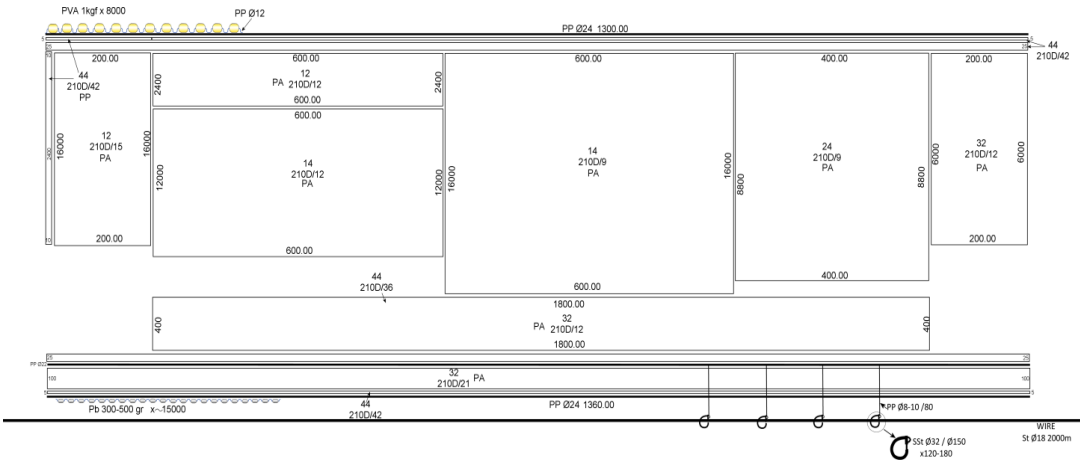
Gırgır ağlarında hedeflenen balık türüne göre 400 göz genişliğinde 200 metrelik bir paket ham ağ bir boy olacak şekilde, 6 ile 10 boy uzunlukta donatılmaktadır. Gırgır ağlarının derinlik ve diğer özellikleri hedef türe, tekne özelliklerine ve planlayan reisin tecrübesine göre değişmektedir.

3.2. Hamsi Gırgırı

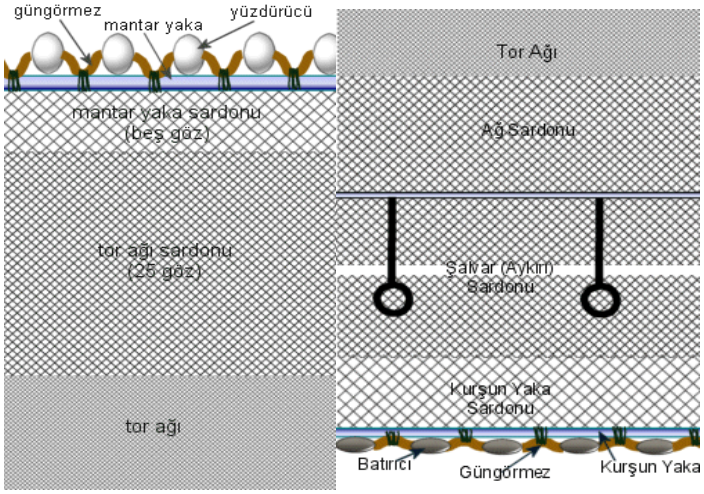
Sinop'ta kullanılan hamsi gırgırı ağları 1100-1300 metre uzunluğunda ve 120-180 metre derinliğindedir. Ağların göz açıklığı bölümlere göre 10 mm ile 32 mm, ip kalınlığı 210D/6 no (R150tex) ile 210D/18 no (R455tex) arasındadır. Sardon ağları ise 32-44 mm göz açıklığında ve 210D/36-42 no (R910tex-R1060tex) ip kalınlığındadır. Donam faktörü mantar yakada 0.60 ile 0.65 (potluk 0.40-0.35) arasında, kurşun yakada ise 0.65-0.70 (potluk 0.35-0.30) civarındadır. 10 boy uzunluğa ve 40 tahta (40x200 m) derinliğe sahip bir hamsi gırgırı donatıldığında mantar yaka

uzunluğu 1300 metre, derinliği ise 180 metre olmaktadır (Şekil 2).

Bocilik ağı mantar yakaya 3-4 mm polipropilen veya poliamid iplerden elde örülmüş göz açıklığı 60-80mm arasında, derinliği 2.5-5 göz arası sardon ağlarıyla birleştirilir. Ağın başucunu oluşturan bociliğin dış kenarına da derinlemesine boydan boya aynı özellikte 10 göz genişliğinde sardon donatılır. Tor ağı bölümünde yaka halatına donam genellikle 40-44 mm göz açıklığında, 210D/36-42 numara ip kalınlığındaki 5 göz derinliğindeki sardon ağları ile yapılmaktadır. Yaka sardonlarının ağ ile birleştirilmesinde mantar yakada 40-44 mm göz açıklığında, 210D/36-42 numara ip kalınlığındaki 25 göz ağ kullanılır. Bu bölüme ağ sardonu adı verilmektedir. Kurşun yakada ise şalvar (aykırı) donam oluşturmak amacıyla, ağa önce 25 göz sardon dikildikten sonra mapaların takıldığı 20-24 mm çapındaki polipropilen aykırı yaka halatı ve ardından 32-36 mm göz açıklığında, 210D/36 numara derinliği 100 göz şalvar ağı olarak donatılır. Şalvar ağı ise 5 gözlük kurşun yaka sardonuna dikilmektedir (Şekil 3).



Şekil 2. Hamsi gırgır ağı



Şekil 3. Gırgır ağı mantar yaka ve yüzdürücü donamı ile kurşun yakanın şalvar donamı

Yüzdürücülerin yaka halatına yerleştirilmeleri donam hariç arada mesafe bırakmaksızın donatılmaktadır. Önce 12 mm çapında polipropilen güngörmeze dizilen yüzdürücüler daha sonra üzerine 5 göz sardon dikili olan 24 mm çapında polipropilenden esas mantar yakaya donatılır. Genellikle her birisi 1 kgf kaldırma gücüne sahip eva yüzdürücüler kullanılmakla beraber halen bazı ağlarda ve ağların belirli bölümlerinde 500 grf kaldırma gücüne sahip içi boş yüzdürücüler de kullanılmaktadır. Böylece her bir metre halat için yüzme gücü 4-8 kgf olmaktadır.

Gırgır ağında her biri 220-500 gram arasında kurşun ağırlıklar batırıcı olarak kullanılmaktadır. Donatım ara verilmeksizin yapılmakta olup her bir metre yaka halatı için 7-14 adet arasında değişmektedir. Batırıcılar önce 8-10 mm çapında güngörmez halatına dizilmekte daha sonra mantar yakada olduğu gibi üzerine beş göz sardon dikilmiş 22-24 mm çapındaki polipropilen esas kurşun yaka halatına donatılmaktadır.

32 mm çapındaki paslanmaz çelikten sustalı olarak imal edilmiş 15 cm çapındaki mapalar aykırı (şalvar) halatına yaklaşık 80 cm uzunluğundaki 8-10 mm çapındaki polipropilen halat ile 9-12 metre aralıklarla bağlanır. Toplam mapa sayısı 120 ile 180 adet arasında değişir. Hamsi gırgırlarında istinga halatı olarak 18-20 mm çapında 1500-2000 m uzunluğunda çok katlı çelik halat kullanılmaktadır.

3.3. Palamut Gırgırı

Palamut gırgır ağı 300 ile 600 kulaç arasında boylarda donatılmaktadır. Ağ gözü açıklığı 32 mm civarında olduğu için palamut gırgırı aynı anda istavrit, lüfer, kolyoz, uskumru ve benzeri türlerin avcılığında da kullanılabilmektedir.

7,5 boy uzunluğundaki bir palamut gırgırı yarım boy (100 m) bocilik ağı ve 7 boy (1400 m) tor ağından meydana gelir. Toplam 1500 metre ağ 0,65 donam faktörüyle donatılarak 975 metre mantar yaka uzunluğu elde edilir. Ağ derinliğinde 32 mm göz açıklığında 3600 göz ve 44 mm göz açıklığında 400 göz ağ mevcut olup toplam 132,8 metredir.

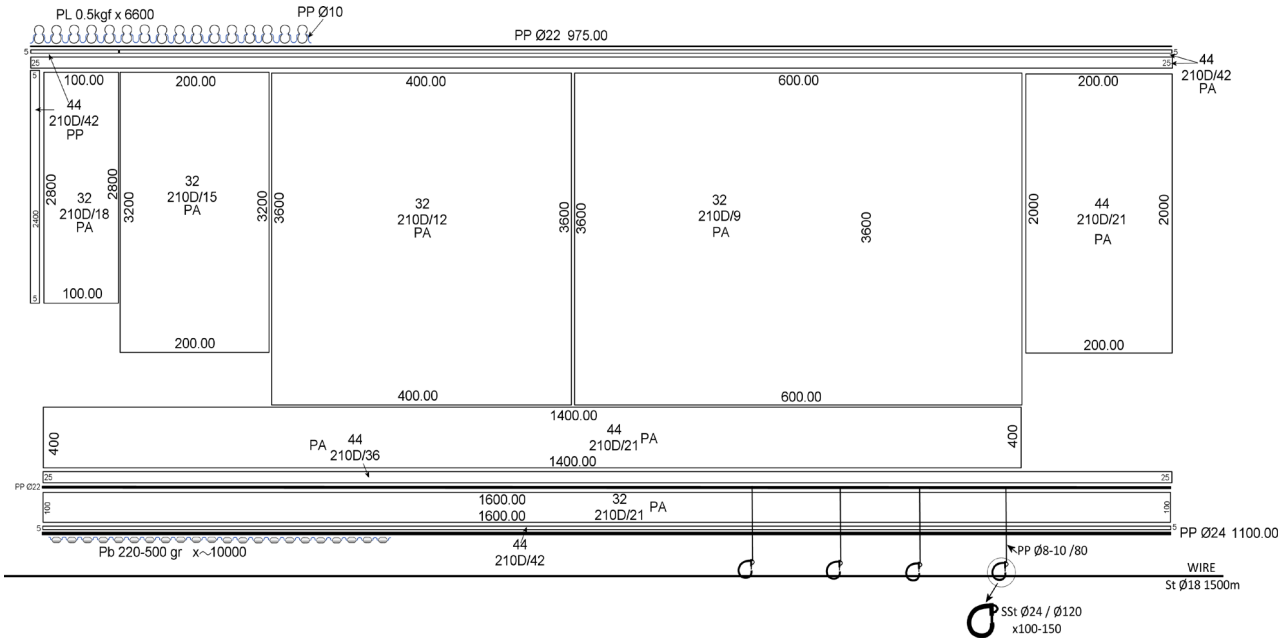
Palamut gırgırında bocilik ağları 32 mm 210D /18 no ağlardan yapılır. Diğer bölümlerde bocilik ağından uzaklaştıkça göz açıklığı aynı kalırken ip kalınlığı sırasıyla
210D/15–12-9 numaraya düşer. Peçe ağında 44 mm göz açıklığında ve 210D/21 numara bir boy (200m) uzunluğa ve 2000 göz derinliğe sahip ağlar kullanılmaktadır. Tor ağlarının altında boydan boya 400 göz genişliğinde 44mm, 210D/21 numara ağdan bulunur (Şekil 4). Mantar ve kurşun yaka ile mapa ve istinga halatı donam özellikleri hamsi gırgırıyla aynıdır.

3.4. Trol Ağları

Karadeniz'de mezgit, barbunya ve kalkan gibi demersal balıkların avcılığında dip trol ağları kullanılırken hamsi, çaça, istavrit gibi pelajik türlerin avcılığında ise ortasu trol ağları kullanılmaktadır. Dip trol ağları tek tekne ile kapılı kullanılırken, ortasu trol ağları kapısız olarak çift tekne ile kullanılmaktadır.

3.5. Dip Trolleri

Sinop'taki trol teknelerinde klasik ve küpeli trol ağı olmak üzere iki tip trol ağı kullanılmaktadır. Trol ağları teknenin boy ve gücüne göre ebatları değişen, benzer yapıdaki ahşap çelik karışımı dikdörtgen trol kapılar ve palamar donanımı ile çekilmektedir.

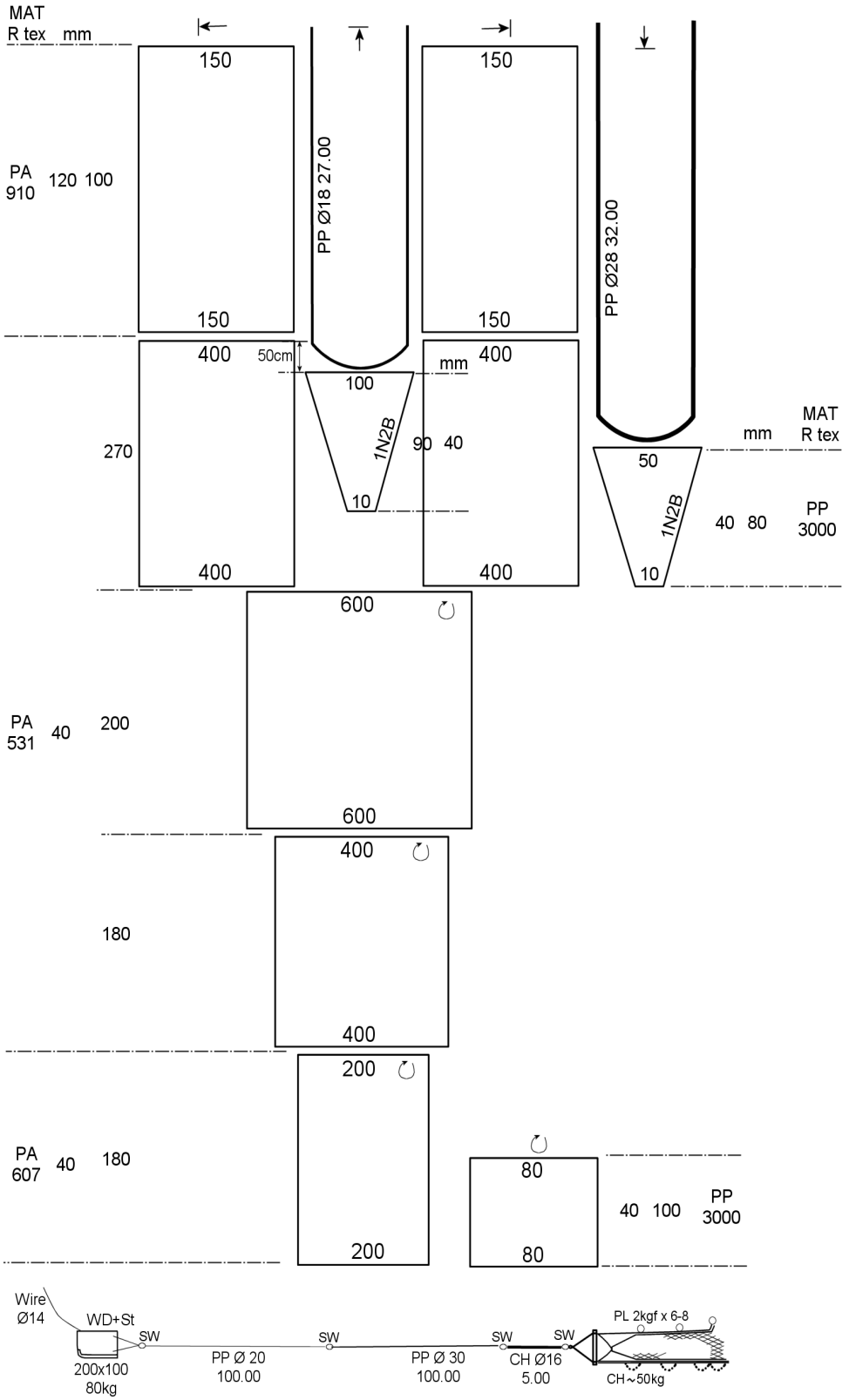


Şekil 4. Palamut gırgır ağı

3.5.1. Klasik Dip Trolü

Türkiye'de geçmişten buyana yaygın olarak kullanılan ve Akdeniz ülkelerine özgü bir trol ağıdır. Bu nedenle Akdeniz tipi kapılı klasik dip trolü olarak isimlendirilir. Ağın yapımında ağ kesim tekniği ve modern ağ yapım kuralları uygulanmadığı için düşük verimlidir. Diğer ağlara oranla yapım ve kullanım maliyeti yüksek, av gücü düşük, seçiciliği yok denecek kadar az bir ağdır.

Teknenin büyüklüğüne göre omuz bölümünde 40 mm göz açıklığındaki ağdan 800-1200 göz bulunacak şekilde yapılmaktadır. Kanat ağları 90-120 mm göz açıklığında çok katlı misina ağdan 10-12 metre uzunluğunda ve 120-200 göz genişliğinde donatılmaktadır. Omuz, karın, tünel ve torba bölümlerinin tamamı açıklığı 40 mm göz ip kalınlığı 210D/21-42 no çok katlı misina ağlarından yapılmaktadır. Ağın toplam uzunluğu 36-44 m civarındadır. Mantar yakaya her birisi 2 kgf kaldırma gücüne sahip 6-8 adet yüzdürücü, kurşun yakaya ise 40-60 kg zincir ağırlık takılmaktadır. Mantar ve kurşun yakanın başuçları 50-60 cm yüksekliğinde metal ya da ahşaptan yapılmış maçaya bağlanmaktadır. Torbanın son yarısının üzeri 4-6 mm çapında polipropilen halattan elde örülen 100 mm göz açıklığında örtü ya da muhafaza ağı ile kaplanmakta olup örtü ağının çevresi torba çevresinden %10 daha küçük yapılmaktadır. Bu ağda baş halatı bulunmaz. Maçanın önünde 5-6 metre bazen çift kat zincirden bazen kalın halatlardan yapılan üçlük (üçleme) halatı vardır. Kapı ile üçleme halatı arasında fırdöndülerle birleştirilmiş 200-300 metre telli halat bulunur (Şekil 5).



Şekil 5. 800 göz klasik dip trolü

3.5.2. Küpeli Dip Trolü

Klasik Akdeniz tipi trol ağların kullanıldığı Fransa ve İspanya gibi ülkelerde bu ağlar 1950'li yıllarda terkedilirken, İsrail ve İtalya'da melez ağlar, diğer tüm ülkelerde ise klasik ağlar kullanılmaya devam etmiştir. Son 30 yıla kadar Türkiye'de tek tip klasik dip trolü kullanılmıştır. 1985-1990 yılları arasında Su Ürünleri Fakülteleri ve mezunlarının katkısıyla ağ kesim tekniği ülkemize girerek değişik ağ modelleri kullanılmaya başlanmıştır.

Küpeli trol ağı melez trol ağlarının en yaygınıdır. Bazı balıkçılar ağı kendisi donatsa da pek çok balıkçı Samsun ve Bartın illerindeki ağ donatıp satan kişilerden satın almaktadır. Fakat her yıl yeni tasarım değişikliklerine gidildiği için ağlarda tam bir standart şekil bulunmamaktadır.

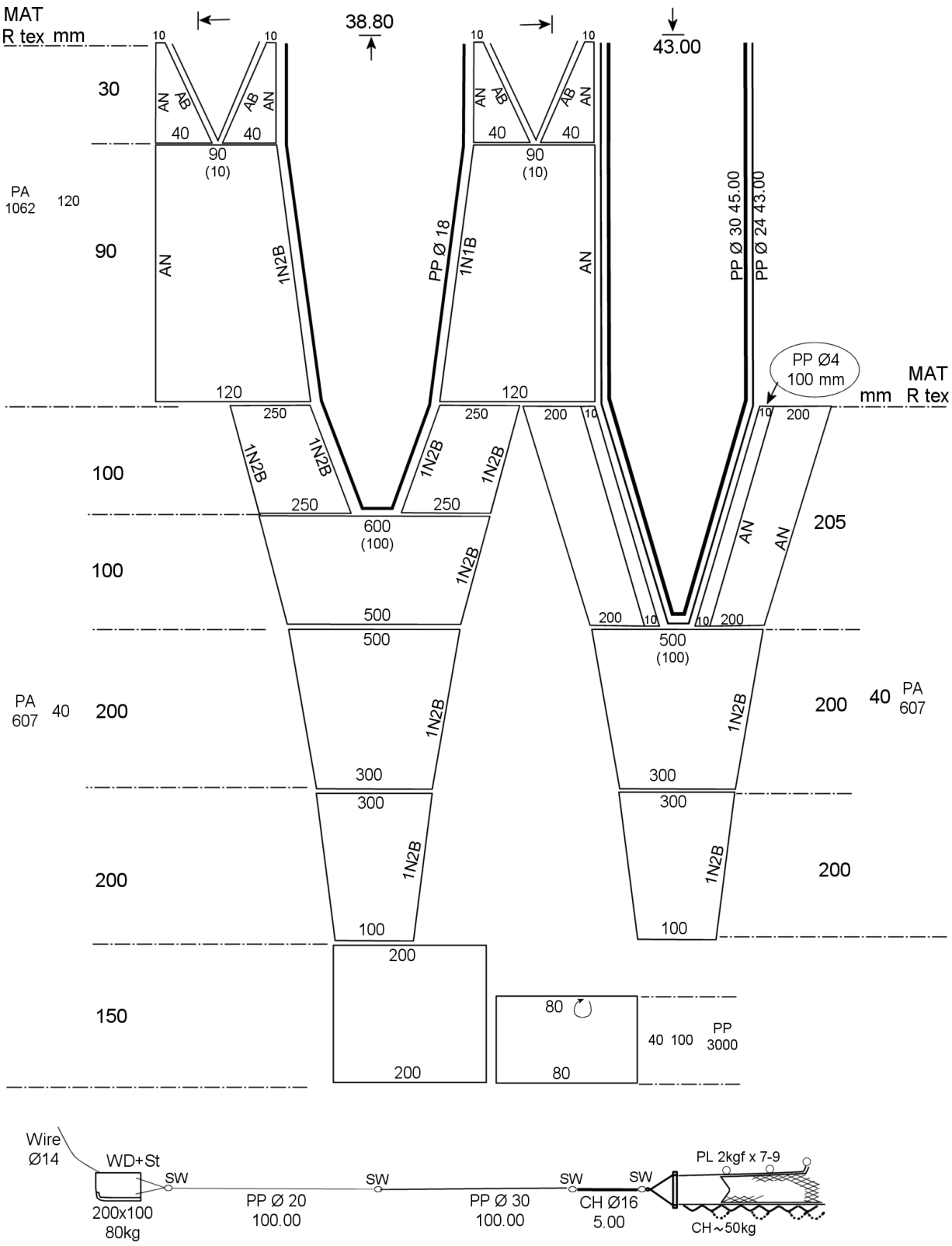
900 göz genişliğindeki bir küpeli trol ağında; kanat ağları göz açıklığı 100, 110 veya 120 mm, ip kalınlığı 210D/60 numara (R 1518 tex) veya daha kalın örgülü PA veya çok katlı misina ağdan yapılmaktadır. Ağın diğer bölümleri 40-44 mm göz açıklığında ve 210D/21-36 no ip kalınlığında çok katlı misina ağlardan yapılır. Ağın halat donanımları klasik trol ağı ile aynı olmakla beraber açış yüksekliğini artırmak amacıyla daha fazla yüzdürücü ve batırıcı kullanılabilir (Şekil 6).

3.6. Ortasu Trolü

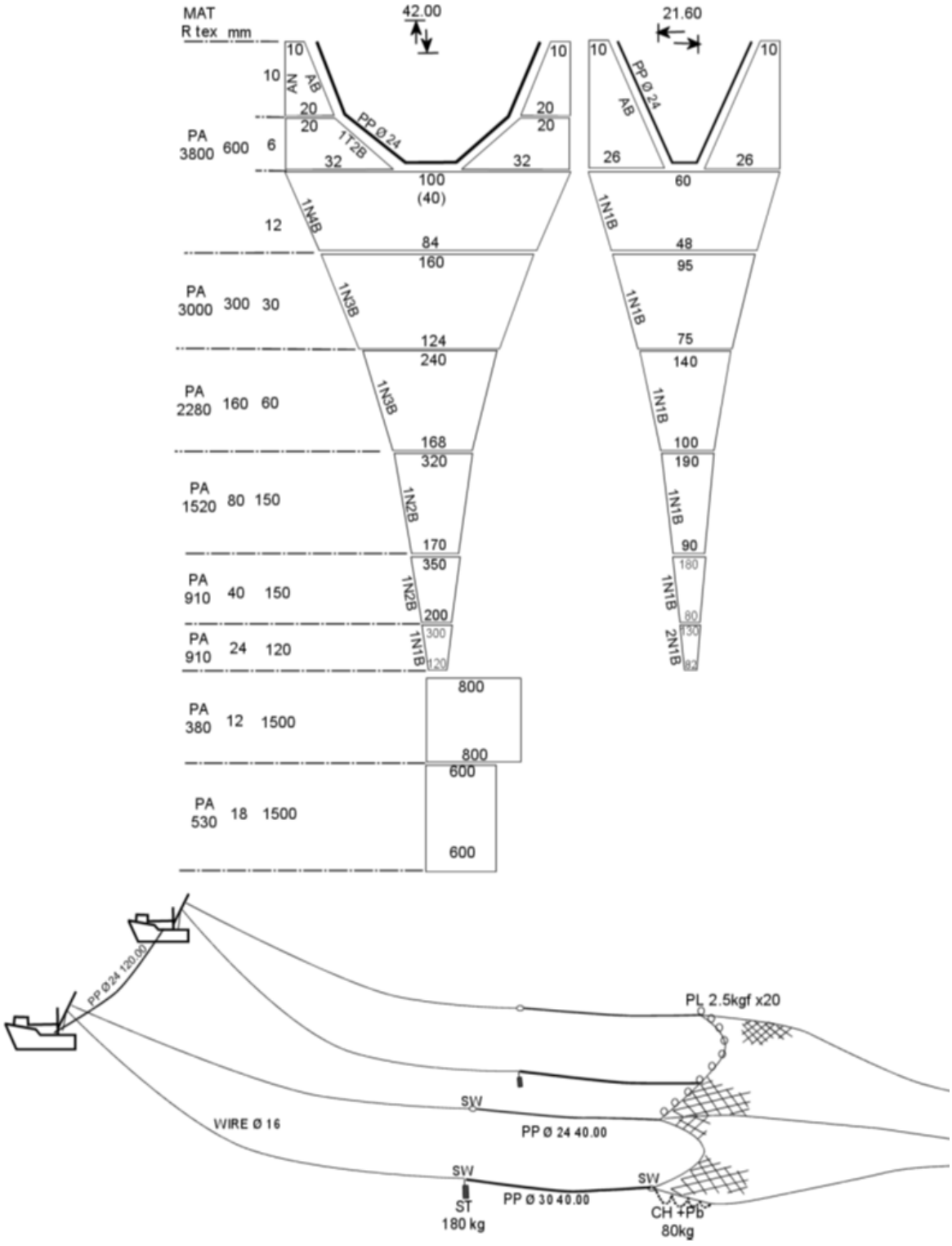
Sinop il limanlarına kayıtlı tekneler sahip oldukları veya ortaklarına ait ağlar ile Samsun kıyılarında çaça balığı ve hamsi avlamaktadır. Kullanılan ağlar iki tekneyle çekilen ilkel ortasu trolü ağları olup ağırlık ve yüzdürücülerin dengesi ve halat donanımı nedeniyle dibe hakim şekilde kullanılmaktadırlar.

Ortasu trolleri yaka halatlarından geriye doğru kademeli olarak 400-800 mm den başlamak üzere, 300, 150, 80, 40, 24, 12 mm göz açıklığındaki ağlardan yapılmaktadır. Ağı donatan ustanın kararına göre bu bölümlerin kesim notasyonları ve uzunluklarında farklılık olabilmektedir.

Ağların mantar ve kurşun yakaları 33 ile 60 metre yan bölümdeki dikine halatlar 18-30 metre arasında yapılmaktadır. Ortasu trollerinde her birisi 2,5 kgf kaldırma gücüne sahip 20-30 yüzdürücü kullanılır. Kurşun ve zincirden oluşan toplam batırıcı miktarı her zaman yüzdürücülerin kaldırma gücünden %30'dan daha fazladır. Baş halatlarının uzunluğu yaklaşık mantar ve kurşun yaka kadardır. Üst bölümde 24, alt bölümde 30-32 mm halat kullanılır. Baş ağırlıkları mandallı bir sistem ile baş halatları ile trol teline bağlıdır ve ağırlıkları 120-200 kg arasındadır (Şekil 7).



Şekil 6. 900 göz küpeli dip trolü



Şekil 7. Ortasu trolü

4. TARTIŞMA VE SONUÇ

Karadeniz'de mezgit, barbunya ve kalkan gibi ekonomik demersal türlerin avcılığında dip trolü ağları kullanılmaktadır (Erdem ve ark., 2007). Dip trol ağlarına hedef olmayan ancak değeri yüksek lüfer, istavrit, tirsi gibi pelajik türler de yakalanabilmektedir (Özdemir ve ark., 2009). Ancak bölgede özellikle palamut, hamsi ve çaça gibi pelajik

türlerin en etkin ve verimli avcılığı gırgır ve ortasu trolü ağları ile yapılmaktadır (Samsun ve ark., 2006; Erdem ve Özdemir, 2008).

Bölge balıkçılarının birçoğu geleneksel yerli dip trolü ağlarını halen kullanmayı tercih ederken birçoğu kesim tekniği ile av sahası, zamanı ve balık türüne göre uyarladıkları ve deneyerek zamanla geliştirdikleri trol ağlarını donatarak kullanma yolunu seçmektedirler (Erdem, 2000; Özdemir ve ark., 2006; Özdemir ve ark., 2007; Emirbuyuran, 2012).

Av araç ve gereçlerinin bölge, zaman ve çeşitli faktörlere bağlı olarak donam ve teknik özellikleri değişmektedir. Örneğin; stokların dengesi bozulup avlanan balık boyları küçüldükçe ağ gözü açıklıkları küçülür ve ağların boyutları büyür. Balıkçılık yönetimi stokların daha fazla yıpranmasını önlemek için av araçlarının özelliklerinde düzenlemeler yapar ve boyut, materyal ve ağ gözü açıklığını düzenler. İletişim olanaklarının artması sayesinde Türkiye'nin faklı yörelerinde denenen veya yurtdışında kullanılan yeni bir donam tüm ülkeye yayılabilir. Malzeme teknolojisindeki gelişmeler, teknelerin boyutları ve güverte üstü teknik olanaklarının artması da planların değişmesine neden olur.

Bu çalışmada Karadeniz'in en önemli balıkçılık merkezlerinden birisi olan Sinop ili sınırları içinde yer alan toplam 15 liman, balıkçı barınağı, bağlama yeri ve çekek yeri ziyaret edilerek büyük boyutlu teknelerde kullanılan av araçlarının teknik özellikleri ve donam planları belirlenmiştir. İlin balıkçı kitlesini kıyı balıkçıları oluşturmakla birlikte pelajik balıkların göç, üreme ve beslenme yolları üzerinde olması nedeniyle Sinop önemli bir gırgır balıkçılığı merkezidir.

Sinop çevresindeki geniş ve düz kıta sahanlığında düzenli olarak trol ağları ile avlanan tekne sayısı da yıldan yıla azalmış olup günümüzde sadece iki adettir. Yöredeki 12 m'den büyük balıkçı teknelerinde yaygın olarak iki çeşit gırgır ağı, iki çeşit dip trolü ve bir ortasu trolü ağı olmak üzere beş çeşit ağ kullanılmaktadır. Bunların teknik planı Karadeniz'in ve ülkemizin diğer bölgeleri ile küçük farklılıklar dışında genel olarak benzerlik göstermektedir (Erdem, 2000; Karakulak ve ark., 2002; Tokaç ve ark., 2005; Özdemir ve ark., 2006; Doğanyılmaz ve ark., 2010; Emirbuyuran ve Çalık, 2016). Ağlar arasında yıllara göre değişen ve gelişen teknolojiye bağlı olarak avcılığın gerçekleştiği av sahaları, avcılık zamanı, hedef balık türü nedeni ile boyutları, ağ gözü açıklıkları, ağ ve diğer malzemelerin materyali, şekli ile kalınlıkları gibi değişiklikler görülmekle birlikte ağların genel yapısı ve diğer pek çok özelliklerinin birbirlerine benzer olduğu tespit edilmiştir.

Türkiye'de av araçlarının planlarının kayıt altına alınması 1915 yılında yayımlanan "Türkiye'de Balık ve Balıkçılık" isimli kitap ile başlamıştır (Deveciyan, 2006). Daha sonra Et ve Balık Kurumu ve İstanbul Üniversitesi Hidrobiyoloji Araştırma Enstitüsü pek çok yayında bu konuya yer vermiştir. Aynı dönemde Dünya Gıda ve Tarım Teşkilatı (FAO) tarafından yayınlanan eserlerin içinde bu enstitüde görev yapan araştırmacıların ağ planları içeren bazı çalışmaları görülmektedir (Kara 1977; Artüz 1981)

Sonuç olarak, Türkiye denizlerinde balık avcılığında kullanılan av araçlarının yapıları ve özellikleri zamanla değişmektedir. Özellikle endüstriyel balıkçılıkta kullanılan av araçlarının seçicilik yönünden güçlendirilmesi, devamlı ve maksimum ürün elde edilmesi için daha fazla iyileştirilmesi gerekmektedir. Güncellenen av araçları ile ilgili yeni bilgiler, teknik planlar paylaşılmalı ve uygun özellikte olanların kullanılması teşvik edilmelidir.

TEŞEKKÜRLER

Bu çalışma Sinop Üniversitesi Bilimsel Araştırma Projeleri Koordinatörlüğü tarafından SÜF-1901-14-05 nolu proje ile desteklenmiştir. Araştırmanın saha çalışmalarında katkı, destek ve bilgi paylaşımını esirgemeyen Sinop ilinin çok değerli balıkçılarına, su ürünleri kooperatiflerinin sayın yetkililerine ve

üyelerine ayrıca teşekkürlerimizi sunarız.

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The Impact of Freight Rates on Pirate Attacks

Navlun Oranlarının Deniz Haydutluğu Saldırılarına Etkisi

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 88-96

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ABSTRACT

The aim of this study is to determine whether freight levels in dry bulk and tanker markets have an impact on pirate attacks. The sample included in the study consists of monthly bulk and tanker freight indices and annual attack values between 2008 and 2018 periods. Annual attack values due to data constraint have been converted to monthly data by cubic transformation in order to carry out the analyzes more accurately. The results reveal that freight rates are the causes of pirate attacks, freight rates significantly affect pirate attacks on both bulk ships and tanker ships in a positive way, and freight rate changes in the bulk market explain the attacks more. This results indicate that increased freight revenues are more motivating for pirates to attack.

Keywords: Pirate attacks, Freight rate, Tanker shipping, Dry bulk shipping.

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ÖZET

Bu çalışmanın amacı kuru dökme ve tanker piyasalarındaki navlun seviyelerinin deniz haydutluğu saldırılarına etkisinin olup olmadığının tespit edilmesidir. Çalışmadaki örneklem 2008 ve 2018 dönemleri arasını kapsayan aylık dökme ve tanker navlun endekslerinden ve yıllık korsan saldırısı değerlerinden oluşmaktadır. Deniz haydutluğu değişkeni analizleri daha isabetli şekilde yürütebilmek için kübik dönüşüm ile aylık veriye dönüştürülmüştür. Sonuçlar navlun oranlarının deniz haydutluğu saldırılarının nedeni olduğunu, navlun seviyelerindeki değişmelerin hem dökme gemilerinde hem de tanker gemilerindeki deniz haydutluğu saldırılarını anlamlı bir şekilde pozitif yönde etkilediğini ve dökme piyasasındaki navlun değişimlerinin deniz haydutluğu saldırılarını daha fazla açıkladığını göstermektedir. Bu sonuçlar, artan navlun gelirlerinin deniz haydutlarını saldırmaları için daha fazla motive ettiğine işaret etmektedir.

Anahtar sözcükler: Deniz haydutluğu saldırısı, Navlun oranı, Tanker taşımacılığı, Kuru yük taşımacılığı

1. INTRODUCTION

Piracy, by taking advantage of the lack of authority for private individuals to gain financial income without any connection to any state, is to say that in areas where the maritime trade is intense, the ships and the personnel present in the ship are attacked and seized. It is observed that maritime piracy causes great damages to the international trade of the states, especially when it is considered that most of the international trade transportation is carried out by sea. The cost of the maritime piracy to the maritime sector amounts to $1-16 billion (IMB 2003-2013). These attacks affect economically, exporters, importers, shipowners or operators (carriers), insurance companies and, consequently, the end consumer. As the attacks increase in the transported regions, insurance premiums increase. Each delay of the ships increases the costs and prolonged port periods impose costs on the carrier. Due to these increasing costs, there is a compulsory increase in freight rates as well.

The aim of this study is to test whether the pirate attacks on ships are affected by freight rates in the market. Increased freight revenues may also lead to an increase in the amount of ransom that ships or cargo owners are willing to pay since the daily charter rates of ships in the live freight market conditions are very high. Therefore, the confiscation of the ship may cause loss of large profits or may bring large costs. As a result of the econometric analysis carried out for the period between 2008 and 2018, freight indices have been found to be Granger cause of pirate attacks and there are positive relationships between pirate attacks and freight levels both in the dry bulk market and in the crude oil market. Although the study does not seem to make a concrete contribution to the actors in a practical and managerial way, it makes an important contribution to the literature with an econometric verification of the clear theoretical relationship.

In the second section of the study, general information about piracy activities in the world is presented. After introducing the method used in the study in the third section, the data set used is examined and the analyzes are applied in the fourth section. In the last section, the findings are discussed

and general evaluations are made.

2. PIRACY IN THE WORLD

At least 6,000 pirate attacks have been reported to merchant ships over the past three decades since the 1990s (Mejia et al., 2013:1). Piracy is a low-risky and good-paying criminal activity. It is generally thought that poverty triggers these activities, but this remains a bit simple. Commonly, piracy activities are organized and dominated by gangsters who see piracy as a business in most regions (Murphy, 2013:8). The regions where these activities are intense are shown in Figure 1. It presents positions of the attacks in the world according to the stages of them in 2018. Most of the attacks have occurred around the African continent and South-East Asia region.

The reason for piracy activities to be observed mostly in these less developed countries can be explained by the low employment opportunities in these regions, but this inference is very optimistic. As mentioned earlier, these activities are carried out by professional gangs since they can earn much more than legal employment conditions and this constitutes their motivation (Hallwood and Miceli, 2015:20). Usually 7 factors allow the development of piracy activities; legal and jurisdictional weakness, favorable geography, conflict and disorder, under-funded law enforcement/inadequate security, permissive political environments, cultural acceptability, promise of reward (Murphy, 2013:12).

Even the only part of piracy activities in Somalia costs billions of dollars to the world maritime sector. These costs are due to the fact that ships necessarily change their routes to Cape of Good Hope for an additional 20 days, raised insurance costs up to $ 20,000 per trip, increased chartering costs due to reduced ship capacity in the market due to longer distances, and increased inventory costs due to longer stay at sea. Furthermore, owners of ships that are taken hostage pay ransom amounts ranging from $ 500,000 to $ 5.5 million (Hallwood and Miceli, 2015:5). For all these reasons, the costs of pirate attacks, which are seen as a means of living for some small groups, reach to enormous amounts in international trade.

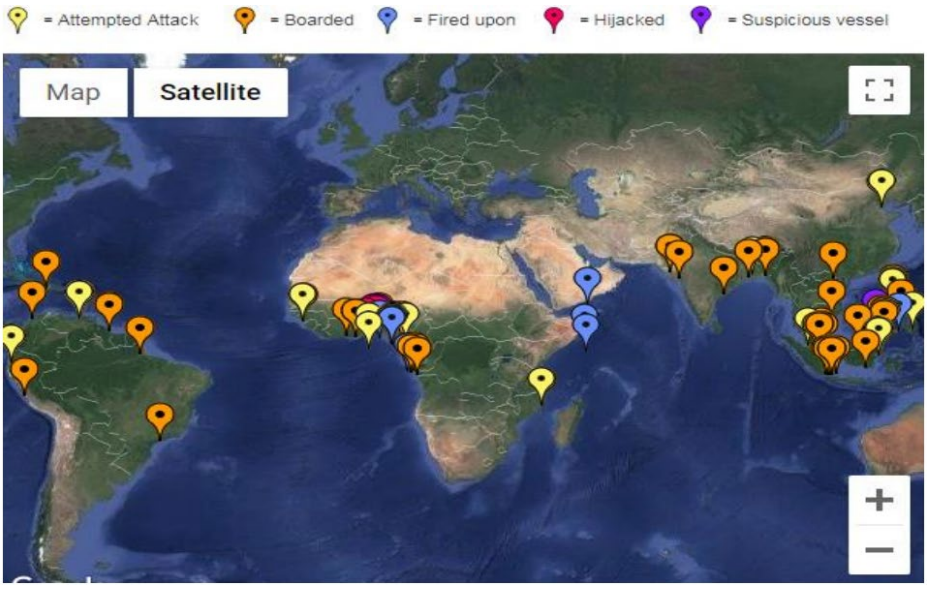

Figure 1. Attacks around the World in 2018 (ICC, 2019).

3. METHODOLOGY

Various statistical methods are used to examine the econometric relationships between variables. These methods differ according to the theory grounded on, the dataset used and the objectives to be achieved. One of the simplest and most common of these methods is regression analysis, which helps to explain the functional relationship between the variables (Chatterjee and Hadi, 2015:1).
The types of the regression analysis are also very wide and varies according to the purpose of use. The most commonly used type is the multiple regression model and is expressed as (1);

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon \quad (1)$$

In this model Y is the dependent variable, X_1, X_2, X_3,..., X_i are the set of independent (explanatory) variables and ε is residuals from the model (Gordon, 2015:5). Since the model includes more than one explanatory variables, it is called multiple regression model (Allen, 2004:4). If the model is developed with only one explanatory variable, it is called simple regression model (Gaurav, 2011:3). When the model is estimated, it becomes possible to determine whether the independent variables explain the dependent variable or to what extent. *Bs* are the most important outcomes of the models since they indicate a direction and strength of the statistical relationships between dependent and independent variables individually (Esquerdo and Welc, 2018:2). In other words, they help to define degree of reaction of the dependent variable in response to one unit change in the independent variable (Archdeacon, 1994:148).
When the model is estimated, the significance of the model and variables should be checked firstly. In addition, several diagnostics tests should be carried out even if the model has significant outcomes. These tests are applied to the residues of the model and are used to verify the validity of some assumptions. These are (i) the conditional mean of ε is zero, (ii) coefficient constancy which reveals that both β and ε are fixed over the sample period, (iii) serial independence in the disturbances of ε, and (iv) a distributional assumption of normality for ε (Pagan and Hall, 1983). When these assumptions are met, the model is considered to be reliable and valid (Menard, 2002:5). However, if the desired results cannot be achieved in any of them, corrections are applied to re-calculate standard errors and therefore the results become interpretable.
Implementing causality tests before regression models are important for the correct design of the models, as using one variable, which is the cause of another variable, as a dependent variable may lead to misleading results. The most widely used method of causality tests has been developed by Granger (1969). This method deals with whether a variable's historical values can explain the current and future values of the other variable (Yu et al., 2015). For instance, when we consider X as a dependent variable Y as an independent variable, if X is better explained by the historical values of Y than its own historical values, Y is expressed as the Granger cause of X (Dura et al., 2017). In this study, first of all, the causality tests among the variables are applied to examine the endogeneity and exogeneity, and then the models are tested.

4. RESULTS AND FINDINGS

Descriptive statistics of the dataset used in the study are presented in Table 1. The period covered is between 2008 and 2018. 132 observations of monthly frequency of Baltic Dry Index (BDI) and Baltic Dirty Tanker Index (BDTI) have been obtained, however only annual data on pirate attacks have been reached. Therefore, the annual data has been converted to monthly frequency data using cubic transformation and this limitation has been tried to be overcome.
Since high frequency data on pirate attacks

could not be found, the annual frequency data has been divided into monthly frequencies using cubic transformation and used in the analyzes. The movements of the data before and after the transformation are shown in Figure 2. Thanks to cubic transformation, the transition between the years is softer and a more realistic process is obtained.

Table 1. Descriptive Statistics of the Variables

	BDI	BDTI	BULK ATT.	TANKER ATT.
Mean	1819	822	67.8	30
Median	1177	762	59	30
Maximum	11440	1993	109	61
Minimum	317	474	38	13
Std.Dev.	1896	271	22.8	14.3
Skewness	3.01	2.25	0.58	0.67
Kurtosis	12.5	9.0	2.09	2.71
Jarque-Bera	696	316	1.0	0.88
Probability	0.00	0.00	0.60	0.64
Observations	132	132	11	11

Source: Investing, 2019; ICC, 2019.

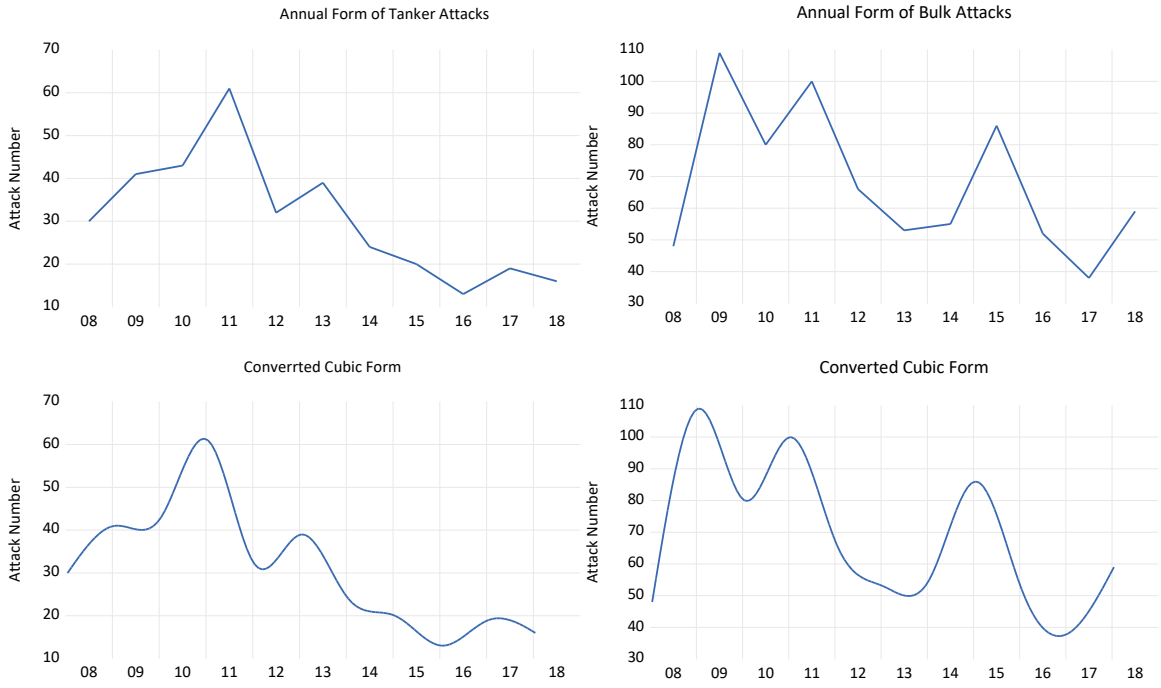

Figure 2. Annual Data and Converted Monthly Data

The variables used in the study have been converted to logarithmic form, thus the discrete data became continuous and the processability of the data has been increased. Also, since the relationship between the variables is examined by time series analysis, it is very important that the variables used are stationary. For this purpose, augmented Dickey-Fuller (Dickey and Fuller, 1979) unit root test has been applied to all variables (See Appendix 1 for the results). According to the results of the analysis, both BDI and BDTI variables are stationary at the level, whereas pirate attack variables become stationary when the first differences are taken. Therefore, the first

differenced pirate attacks variables have been used in the analysis.

In order to develop the regression models correctly in the study, it is important to determine the causality direction between the variables. The reason is that while the study aims to examine the impact of freight rates on pirate attacks, theoretically, pirate attacks also affect freight rates by increasing insurance costs, bunker consumptions, etc. Therefore, the causality relationships between the variables have been examined by Granger method and the results are presented in Table 2. The most appropriate lags for the models have been determined as 4 according to Schwarz and Hannan-Quinn criteria (See Appendix 2 and Appendix 3 for lag selection results). According to the results obtained the null hypotheses of no causalities are rejected as freights are causal factors for pirate attacks in both dry bulk and tanker sectors. This implies that the impact of pirate attacks on freights are statistically insignificant and that the established regression models are correctly designed.

The model estimated in the regression analysis is basically as follows (2); the number of pirate attacks on tanker and bulk carriers are dependent variable, and the freight indices in the tanker and bulk shipping markets are independent variables. Both models have been estimated by ordinary least squares method (OLS).

$$lnATTACK_t = ln\beta_0 + \beta_1 lnFREIGHT_t + \varepsilon_t \quad (2)$$

Both of the estimated models have been obtained as significant as a whole according to F statistics, and independent variables also significantly explain changes in the dependent variables according to t-statistics. However, heteroscedasticity, autocorrelation and non-normal distribution problems have been determined in both models as a result of the several robustness tests applied to the residues of the models. Therefore, the models have been re-estimated by applying HAC (Newey-West) correction and standard errors have been recalculated, and the new results are presented in Table 3. According to the results obtained, both models are significant as a whole, and independent variables are also significant. Considering the bulk ship model, positive changes in the BDI variable positively affect pirate attacks. 100% change in freight rates causes about 3% change in pirate attacks. However, the change in freight rates can account for 25% of the change in pirate attacks. This may be due to data-related constraints, or factors other than freight rates may be more influential. On the other hand, explanatory power of the tanker ship model is much lower. Positive changes in the BDTI variable also positively affect pirate attacks. The coefficient of the freight is almost the same as the previous model (0.029), but the explanatory power of the model is as low as 5%. This can likewise be interpreted as factors other than freight rate being more influential in pirate attacks.

Table 2. Granger Causality Tests

H_0	Chi-sq.	Df.	Prob.
BDI does not Granger cause Bulk Attack	8.00	4	0.09
Bulk Attack does not Granger cause BDI	2.33	4	0.67
BDTI does not Granger cause Tanker Attack	7.92	4	0.09
Tanker Attack does not Granger cause BDTI	0.70	4	0.95

Table 3. Regression Estimation Results

	Variable	Coefficient	Std. Error	t-Statistic	Prob.
BULK	C	-0.2058	0.0691	-2.9756	0.00
SHIP	BDI	0.0288	0.0098	2.9359	0.00
MODEL	**R-squared**	0.25	**F-statistic**		41.2
	Adjusted R-squared	0.25	**Prob (F-statistic)**		0.00
	Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
TANKE	C	-0.2004	0.0939	-2.1322	0.03
R SHIP	BDTI	0.0292	0.0138	2.1176	0.03
MODEL	**R-squared**	0.05	**F-statistic**		7.38
	Adjusted R-squared	0.05	**Prob (F-statistic)**		0.00

5. CONCLUSIONS

Although pirate attacks are mainly caused by lack of security and poverty in the underdeveloped countries, it is seen that the people who have recently been involved in pirate attacks are equipped with modern equipment and they do this professionally. On the other hand, the attacked companies generally submit to the wishes of the pirates, taking into account both the safety of personnel and the costs of detaining the ship. Thus, pirates make the equipment they use more modern by generated income.

Freight levels of ships usually follow an upward trend for two reasons; (i) demand related increase; (ii) cost related increase. The increase in demand is mainly due to the inelasticity of ship supply in the short run. This is due to the fact that the ordered ships to the shipyards have not been able to enter the market at the requested time due to a certain period of time for building. Therefore, high freight rates have high profit margins, and the ship's inability to do business for any reason causes large revenue losses. Increases due to the cost are usually caused by increases in fuel prices since the fuel costs are one of the largest expense items of ships. Whatever the reason is, the last thing the ship owner wants is for her ship to be unable to do business, and the pirates turn it into an opportunity and aim for extraordinary gains. In this context, it is possible that there is a relationship between freight levels and number of piracy attacks. Although this relationship is clear verbally, no study has been found in the related literature which tests this relationship statistically. This lack in the literature forms the motivation of this study and it is aimed to gain a new perspective to the literature with an empirical approach.

In the study, two separate models have established and tested for dry bulk and tanker freight markets. The Baltic Dry Index for the bulk market and the Baltic Dirty Tanker Index for the tanker market are used as freight indicators in the markets. Pirate attacks have been converted from annual frequency to monthly frequency for both markets and included in the analysis. Firstly, Granger causality tests have been applied among the variables to determine the characteristics of endogeneity and exogeneity and it has been confirmed that freight rates are the determinants of pirate attacks. Later, according to the regression models established for both markets as pirate attacks are dependent variables, it has been found that changes in the freight rates significantly explain changes in the number of pirate attacks. 100% increase in freight rates causes a nearly %3 increase piracy attacks. The explanatory powers of the models are relatively low, but both models established are significant. This can be thought to be caused by a constraint from the data set.

Although the results of the study do not provide any practical and managerial implications for the actors in the market, they provide an original contribution to the literature by statistically testing that piracy is affected by freight levels in the market. What can be said in general is that the cost

of pirate attacks is very high for the maritime sector due to factors such as extending the route distances of ships, reducing the available tonnage in the market and increasing insurance costs. On the contrary, the reason for perpetrators who are engaged in pirate activities is not low labor opportunities in their countries, conversely they are attracted by the high returns of piracy. In this context, contributing to the development of job opportunities in countries with high piracy may not be able to reduce piracy activities. Instead, it is considered beneficial to increase the protective measures for the protection of merchant ships in a sustainable manner.

The biggest limitation of this study is related to the dataset since only annual data on pirate attacks could be obtained by ship type since 2008. If a higher frequency data set covering a longer period can be obtained, healthier analyzes can be performed, and thus better results can be obtained.

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APPENDIXES

Appendix 1. Unit Root Test Results

	Level			First Difference		
	Intercept	**Trend and Intercept**	**None**	**Intercept**	**Trend and Intercept**	**None**
BDI	-2.87*	-3.01	-0.75	-9.97***	-10.00***	-9.99***
BDTI	-3.26**	-3.12	-0.09	-12.20***	-12.23***	-12.25***
Bulker Attack	-2.01	-2.37	-0.31	-3.81***	-3.73**	-3.82***
Tanker Attack	-0.05	-2.49	-1.33	-3.79***	-3.98**	-3.56***

CVs for Intercept: -3.47***, -2.88**, -2.57*. CVs for Trend and Intercept: -4.02***, -3.44**, -3.14*. CVs for None: -2.58***, -1.94**, -1.61*

Appendix 2. Lag Length Selection Criteria for Bulk Ship Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	136.7102	NA	0.000309	-2.405539	-2.356994	-2.385843
1	404.3376	520.9176	2.79e-06	-7.113171	-6.967537	-7.054083
2	624.5888	420.8371	5.87e-08	-10.97480	-10.73208	-10.87632
3	695.6571	133.2531	1.77e-08	-12.17245	-11.83264	-12.03458
4	706.7844	20.46623	1.56e-08	-12.29972	-11.86282*	-12.12246*
5	711.1565	7.885448	1.55e-08*	-12.30637*	-11.77238	-12.08971
6	712.5629	2.486299	1.63e-08	-12.26005	-11.62897	-12.00400
7	713.5939	1.785757	1.72e-08	-12.20703	-11.47886	-11.91159
8	721.7936	13.91032*	1.60e-08	-12.28203	-11.45677	-11.94720

Appendix 3. Lag Length Selection Criteria for Tanker Ship Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	251.0241	NA	4.02e-05	-4.446859	-4.398314	-4.427163
1	460.9141	408.5360	1.02e-06	-8.123467	-7.977833	-8.064379
2	658.4713	377.4753	3.21e-08	-11.57984	-11.33712	-11.48136
3	726.6800	127.8913	1.02e-08	-12.72643	-12.38662	-12.58856
4	739.6771	23.90541*	8.68e-09*	-12.88709*	-12.45019*	-12.70983*
5	741.9683	4.132287	8.95e-09	-12.85658	-12.32259	-12.63992
6	742.5246	0.983419	9.53e-09	-12.79508	-12.16400	-12.53903
7	746.4078	6.726362	9.56e-09	-12.79300	-12.06483	-12.49756
8	749.6351	5.474841	9.71e-09	-12.77920	-11.95394	-12.44436

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Hydrographic study of Shatt Al-Arab estuary in the context of climate change

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 97-111

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ABSTRACT

This paper presents the first key results for the impacts of the North Atlantic Oscillation (NAO), the Indian Ocean Dipole Mode (DMI) and the Southern Pacific Ocean Oscillation (SOI) events on the hydrographic and climatic parameters at the mid of Shatt Al-Arab estuary (i.e. Basrah city center) by using correlation analysis and standard ordinary linear regression as an autoregressive process of order 1. The analysis examined the discharge, salinity, sea surface water temperature, and air temperature over the period 2005-2014 (i.e. interannual, monthly and seasonal datasets). The formal regressions have been estimated by using the first-degree autoregressive AR (1) model, which includes calculations of the GLS-Generalized Least Square Error Minimization regression method, for obtaining more stable solutions in the context of climate change. The correlation is accounted for using the standard ordinary bivariate linear regression method. The main results indicated that the hydrographic and climatic variables in the study region experienced general trends of decrease in discharge of 2.0936 (m^3/sec), increase in salinity of 0.0071 (‰), increase in air temperature of 0.0178 (°C) and increase in sea surface temperature of 0.0098 (°C). Significant correlations, as well as prediction equations, were found between discharge and SOI, then, salinity and sea surface temperature with NAO, and finally between air temperature with NAO/DMI/SOI. The Pardé coefficients reflect the Karun influence during spring in the context of climate change .

Keywords: Shatt Al-Arab estuary; North Atlantic Oscillation; Dipole Mode; Southern Oscillation; Parametric methods

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1. INTRODUCTION

Shaṭṭ Al-Arab estuary formed by the confluence of Tigris and Euphrates rivers. It flows southeastward for 204 km from the confluence point. Besides, it receives fresh water from the eastern side by Karun River. Its width increases about 400 m at Basrah city center to 2 km at its mouth. The drainage basin area is around 1000000 km2. The hydraulic gradient rate is between 1-1.5 cm/km. Thus, the study region (Figure 1) is very important for the Iraqi economy, where it used for fishery, oil transportation, and shipping, which links between many harbors in the Persian/Arabian Gulf. The Northern Arabian/Persian Gulf showed significant correlations between each of the climatic events: North Atlantic Oscillation-NAO; El Nino Southern Oscillation-SOI; and Indian Ocean Dipole-DMI with air temperature, barometric pressure, and precipitation during seasonal variations of the period (1973-2012) by following Al Senafi and Anis (2015). The climate in the region is vulnerable to the increased in air temperature especially, in the context of climate change. The influence of climate change on the increase of sea surface water temperature has been increasing constantly (Attrill, 2009). Thus, the current study examines the effects of the atmospheric events on Shatt Al-Arab hydrographic and climatic parameters.

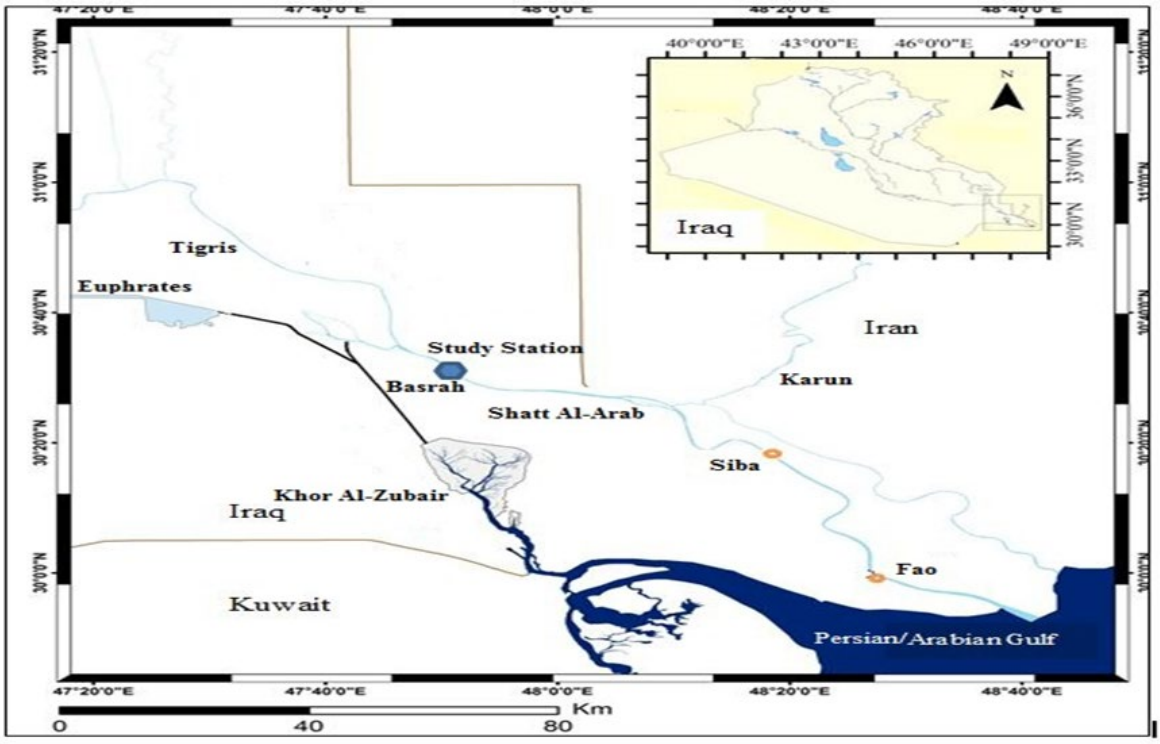

Figure 1. A map showing the study region, i.e. Shatt al-Arab estuary (MSC, 2016).

Determining the regression/ correlation between the above-mentioned events and the hydrographic and climatic parameters (i.e. River discharge-Rd, salinity-S, sea surface water temperature-SST, and air temperature-AT) is the aim of the present work. The linear trend for each parameter is the goal of our study as well.

The global and the regional climate change in the Northern Arabian/Persian Gulf have been detected in the last decades (Al Senafi and Anis, 2015; Attrill, 2009; Jones et al., 1997; Jones, 2003; Naidu et al., 2012). So, it is necessary to investigate if Shatt Al-Arab

hydrographic and climatic features suffer a change during the interannual, monthly, and seasonal means at the Basrah city center station in the context of climate change over the time (2005-2016).
Moreover, to detect the increase or decrease in the extreme values of Shatt Al- Arab discharge during the monthly means, the Pardé coefficients should be calculated in accordance with Bormann (2010). The materials and methods are presented in section 2, as well as, the estimated models are submitted in section 2.1. The results are given in section 3, as well as, the discussion and conclusions are submitted in section 4. Then, the references will submit during section 5.

2. MATERIAL AND METHOD

For the implementation of statistical time series analysis (i.e. correlation analysis and standard ordinary linear regression as an autoregressive process of order 1) to the physical features of Shatt Al-Arab estuary in the conducted research, a great deal of data series were used for the period 2005-2014 in the context of climate change:
1) Monthly data series of R_d (m^3/sec), S(‰), SST (˚C), AT (˚C), (see Figure 2), were measured at the mid of Shatt Al-Arab estuary (i.e. Basrah city center station) with latitude/longitude 30°31'08.9"N 47°50'45.9"E (MSC, 2016).
2) Monthly mean data series of the (NAO) index (see Figure 3), i.e. the difference between the normalized sea level pressure over Gibraltar and the normalized sea level pressure over Southwest Iceland in the North Atlantic Ocean, were collected from Climate Research Unit in Norwich, United Kingdom (CRU) and calculated depending on the method given by Jones et al. 1997.
3) Monthly mean data series of the (DMI) index (see Figure 4), i.e. the Sea Surface Temperature SST gradient between the western equatorial Indian Ocean (50E-70E and 10S-10N) and the southeastern equatorial Indian Ocean (90E-110E and 10S-0N) (Saji and Yamagata, 2003).
4) Monthly mean data series of the (SOI) index (see Figure 5), i.e. the normalized pressure difference between Tahiti and Darwin in the equatorial Pacific Ocean, were collected from (CRU) and calculated depending on the method of Ropelewski and Jones (1987).

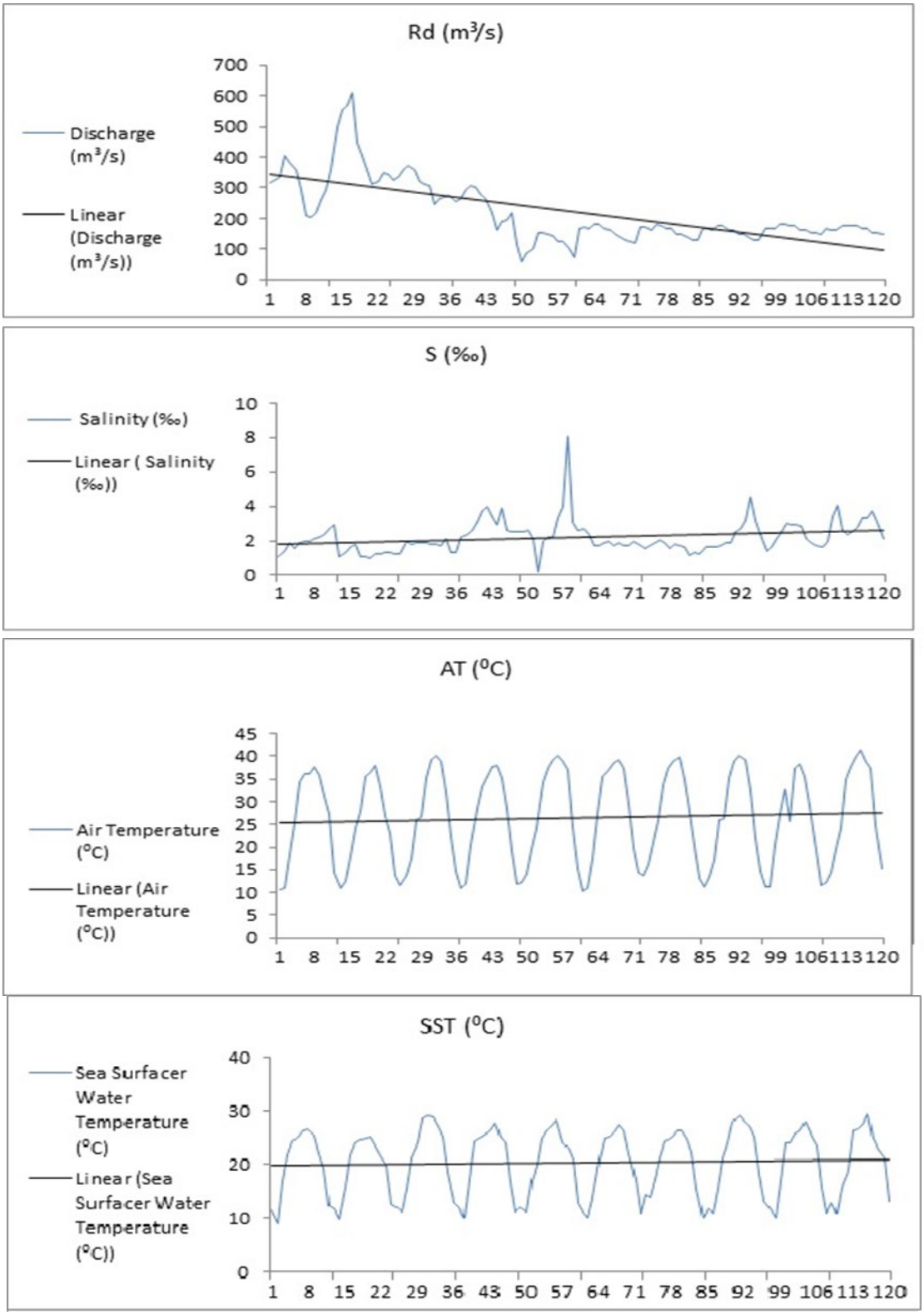

Figure 2. Monthly mean data series of Discharge-Rd, Salinity-S, Sea surface water temperature-SST, and Air temperature-AT at the mid of Shatt Al-Arab estuary (i.e. Basrah city center station) with latitude/longitude 30°31'08.9"N 47°50'45.9"E (MSC, 2016).

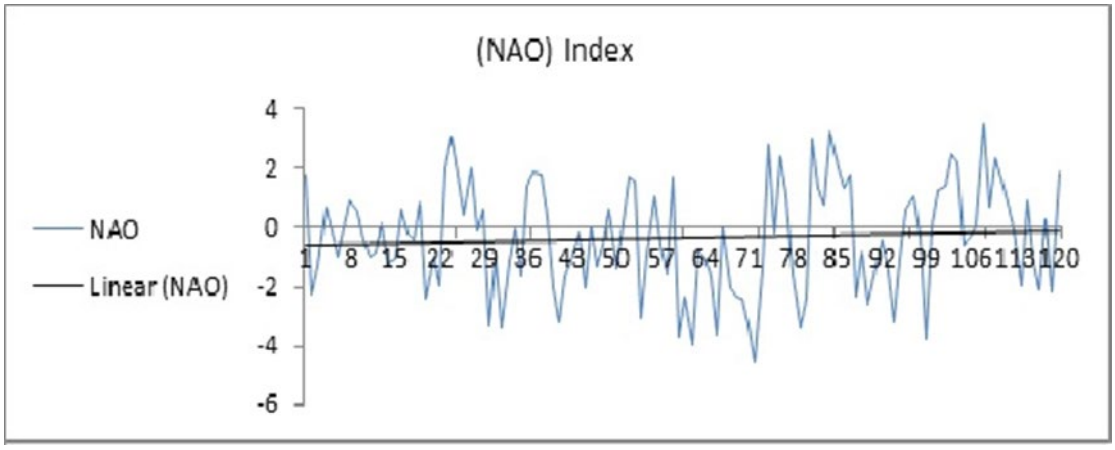

Figure 3. Monthly mean Jones's data series of the (NAO) indices (CRU, 2018).

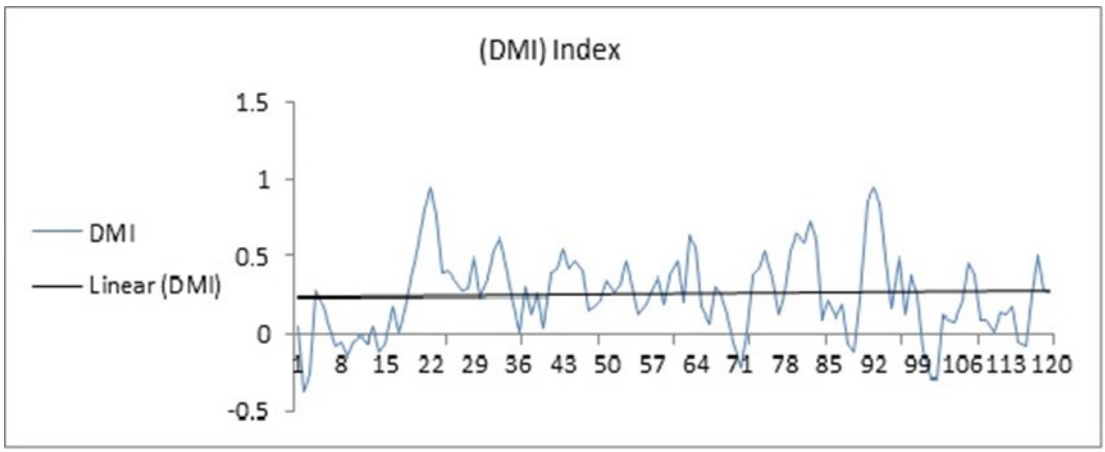

Figure 4. Monthly mean data series of the (DMI) indices (Saji and Yamagata, 2003).

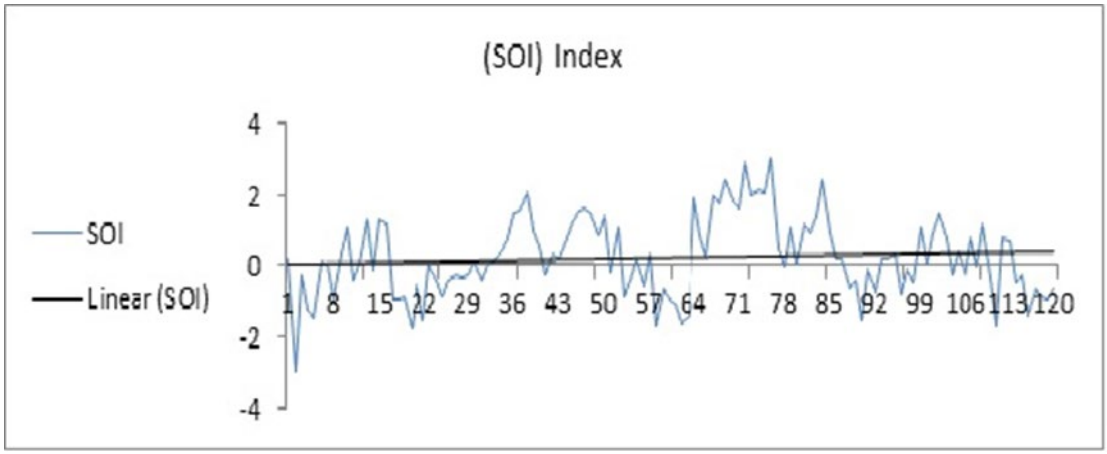

Figure 5. Monthly mean data series of the (SOI) indices (CRU, 2018).

The seasonal form of each studied series were estimated directly such as (the winter season: by the average of December; January and February data series); (the spring season: by the average of March; April and May data series); (i the Summer season: by the average

of June; July and August data series) and (the Autumn: by the average of September; October and November data series). Missing values in any time series, if found, were treated according to Emery and Thomson (2001).

Thus, the total linear trend presented throughout the hydrographic data series (i.e. Rd, S, and SST) and the climatic data series (i.e. AT) was assumed to be linear. Then, it could be described as follows (Mahmood, 2016):

The total linear trend throughout the hydrographic and climatic series ≈ the linear trend caused by the climatic reasons and the linear trend caused by the other reasons **(2.1)**

Where the trend caused by the climatic reasons is superimposed with the other reasons. The trend calculations should be performed before the calculations of correlations exclusively. Hence, it should remove (linearly detrended) from the individual records, if detected. Where the problem associated with not detrending data series is: The climatic reasons are controlled by different atmospheric circulations in the context of climate change. However, the detrended procedure will also eliminate a whole linear trend.

Furthermore, verifying the adopted datasets (i.e. hydrographic and climatic series) have done by using the SNHT test (i.e. the XLSTAT- statistical software) and obtaining no unrealistic values.

2.1. The Estimated Models

Pearson's correlation coefficient has been adopted in the present study. The value of a t-test should be used to study the significance of Pearson's coefficient R.

Regression analysis aims to determine an average relationship between the variables. In this analysis, one variable is taken as a dependent variable (e.g. Rd, S, SST, and AT), while the other is considered as the independent variable (e.g. NAO, DMI, and SOI). Where, the physical links behind using this analysis were the SST and AT showed linear regression behavior in the Northern Arabian Gulf in accordance with Al-Rashi et al. (2009) and Al Senafi and Anis (2015). Similarly, the Rd and S in Shatt Al-Arab Estuary showed like behavior according to Abdullah et al. (2016) and MSC (2016).

A simple linear regression line is fitted between the two variables (or is fitted for a single variable) based on the observed data. Parametric methods have used for calculating the regression models in the present study.

The standard ordinary bivariate linear regression provides accurate estimations when the regression residuals are corrected for a serial autocorrelation and the variance. Therefore, the estimated Rd, S, SST, and AT are characterized as an autoregressive process of order 1, i.e. AR (1) model, during the calculations of the Generalized Least Square Error Minimization regression (GLS) method and can be expressed in accordance with Mahmood (2016):

$$\mathbf{H_t = a+b\ N_t+\rho_1(H_{t-1}-a-bN_{t-1})+\nu_t\ .} \quad \mathbf{(2.2)}$$

i.e.,

a = is the intercept regression coefficient

b= is the linear regression slope coefficient

ρ= is the autocorrelation coefficient (i.e., -1 < |ρ| <1)

v_t= is an independently and identically distributed error term with zero mean and variance.

H_t= $Rd_t/S_t/SST_t/AT_t$ (i.e., River discharge series/Salinity series/Sea surface water temperature series/Air temperature series) t.

N_t = (the NAO series/the DMI series/the SOI series + errors by noise) t.

H_{t-1} = Rd_t-1/S_t-1/SST_t-1/AT_t -1 (i.e., River discharge series/Salinity series/Sea surface water temperature series/Air temperature series) t-1.

N_{t-1} = (the NAO series/the DMI series/the SOI series + errors by noise) t-1.

The linear regression trend T gives accurate estimations when the regression residuals are corrected for a serial autocorrelation and the variance. Therefore, the Rd, S, SST, and AT linear trends are characterized as an autoregressive process of order 1 and can be expressed as follows in accordance with Mahmood (2016):

$$H_t = a+T\,(time)\,t + \rho_1\,(H_{t-1}-a-T\,(time)\,t-1) + v_t. \quad (2.3)$$

For correlation and regression coefficients tests, a suitable null hypothesis can be applied, when there is no impact of the atmospheric events on each of the hydrographic and climatic data series during the studied time scales. However, a null hypothesis for the linear trend coefficient test can be applied, when each of the R, S, SST, and AT fluctuate along with constant mean. The statistical tests for these coefficients have been achieved at a critical value of the significance level (P-value). Where a P-value $\leq$ 0.05 is an indication of statistical significance, a straight-line regression model can be used. If P-value > 0.05, it indicates a lack of statistical significance. Consequently, a straight-line regression model cannot be used.

Shatt Al-Arab discharge regime describes the mean monthly of discharge, influenced mainly by the Tigris and Euphrates rivers discharge as well as Karun river discharge which contribute about 50% of the total discharge (Al-Asadi, 2017), i.e. associated with climatic conditions. As well as the other reasons like land use and river regulation. Thus, the monthly Pardé coefficient (PC; the relation between monthly (MR_{dmonth}) and annual (MR_{dyear}) discharge should be used to describe the monthly distribution of discharge over the year (Bormann, 2010):

$$PC=MR_{dmonth}/MR_{dyear} \quad (2.4)$$

3. RESULTS

3.1. The results in terms of the interannual datasets

The present statistical time series analysis shows a negative correlation between SOI and the discharge series (R=-0.255), see Figure 6. However, insignificant correlations showed with each of the NAO and DMI events. In this context, the linear regression model shows a negative slope as well, (i.e. Rd= 3.872-6.793 x SOI). The linear discharge trend shows a negative response over the studied period (T of discharge series=-2.0936 (m^3/sec)). Also, the analysis shows a negative correlation between NAO and S (i.e. R=-0.211), see Figure 7.

Then, the linear regression equation is constructed, (i.e. S=-1.636-4.313 x NAO), in which a negative regression slope is very clear. The best fit shows a small increase in salinity time series (T of salinity series=0.0071 (‰)). Where, it is proposed that the salinity is influenced by natural and anthropogenic sources in Shatt Al-Arab estuary. However, there is no influence for each of DMI and SOI on the salinity.

The analysis of SST shows similar previous results of salinity in terms of NAO influence (i.e. R=-0.253), see Figure 8.

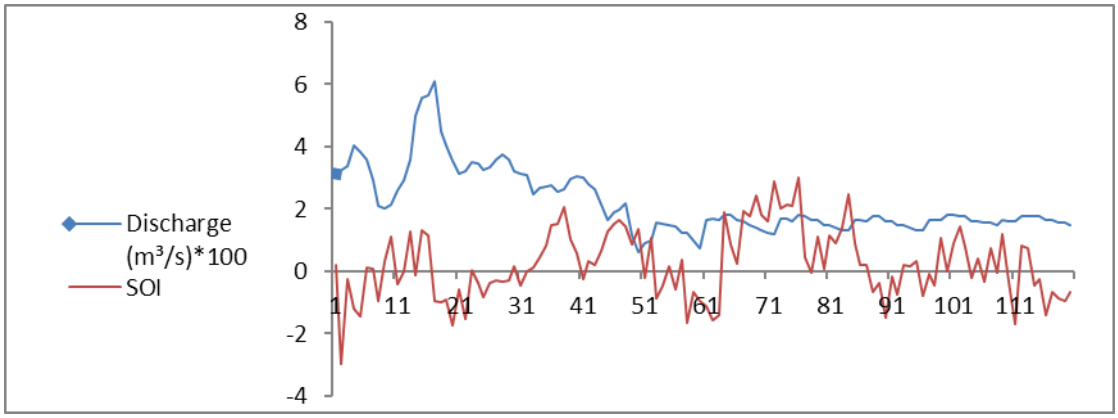

Figure 6. Negative correlation between SOI and the discharge series (R=-0.255) over the period (2005-2014).

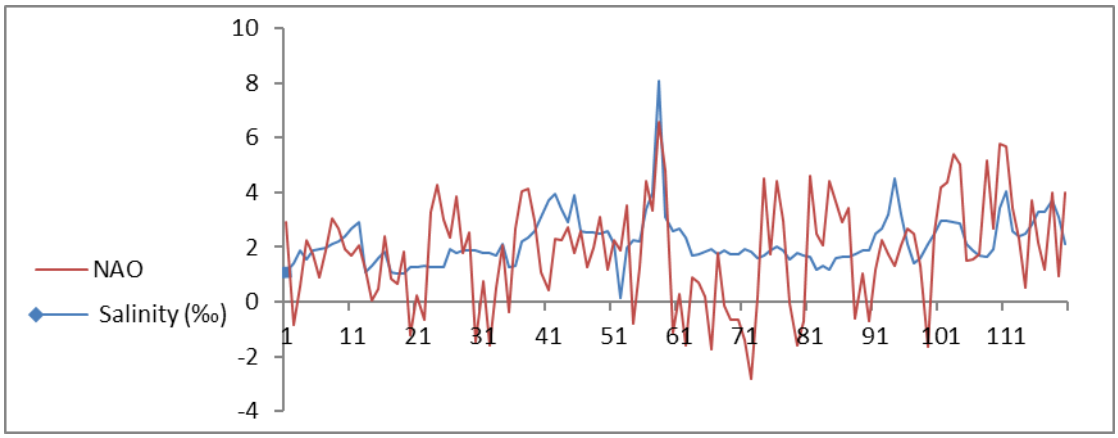

Figure 7. Negative correlation between NAO and the salinity series (R=-0.211) over the period (2005-2014).

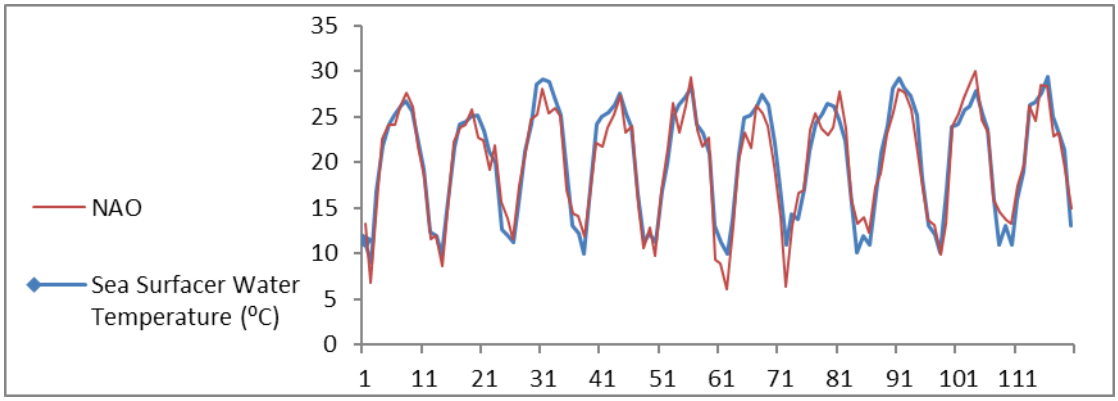

Figure 8. Negative correlation between NAO and the sea surface water temperature series (R=-0.253) over the period (2005-2014).

Where the linear regression equation is (SST = 1.542-4.218 x NAO). On the other hand, there is no influence for each of DMI and SOI on the SST. Results also show a small increase in the SST trend (T of sea surface water temperature series=0.0098(ºC)) could be related to global, regional and local reasons.
The influences of NAO, DMI, and SOI on the AT show significant correlations (i.e., R=-0.335, R=0.183, R=-0.212) respectively, see Figure 9.
These results present three regression equations (i.e., AT= -2.174-5.923 x NAO, AT= -6.682+26.411xDMI, AT= 1.155-5.025 x SOI) respectively. In this regard, the analysis of any air temperature trend indicates an increase in the AT during the same time interval (T of air temperature series = 0.0178 (ºC)).

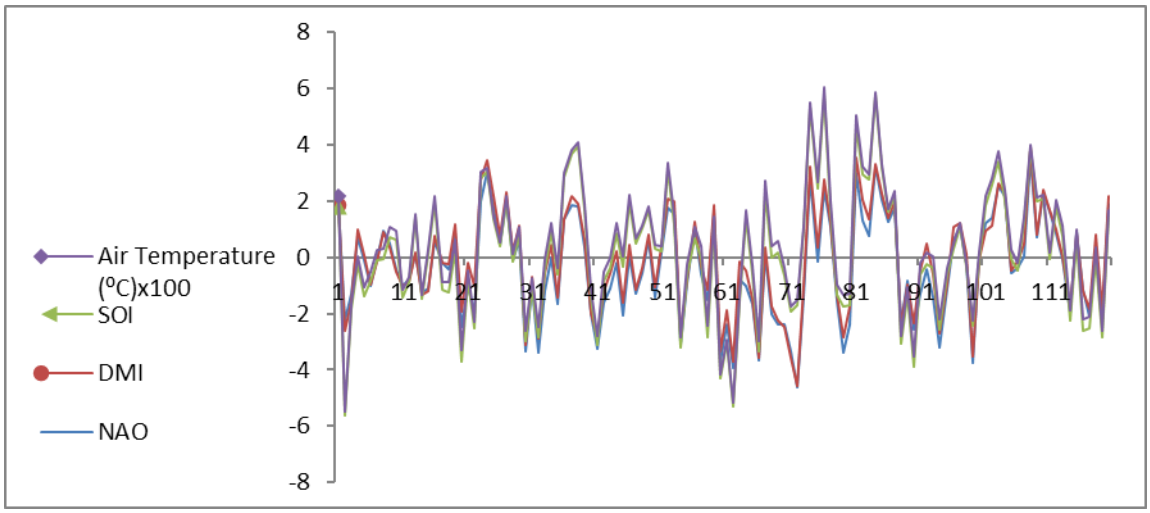

Figure 9. Negative correlation between NAO and SOI with the air temperature series (R=-0.335, R=-0.212), positive correlation between DMI with the air temperature series (R= 0.183) over the period (2005-2014).

3.2. The results in terms of the monthly datasets

A similar analysis has been carried out on the individual month's datasets at Shatt Al-Arab estuary station in the northern Gulf. Results confirm insignificant influences for NAO, DMI and SOI on each of the Rd, S, SST and AT in March, April, May, July, September, and October. In addition, there is no response for each of Rd, S, and AT on the NAO, DMI, and SOI in January and February months.
Insignificant correlations between NAO and DMI with SST have been showed in January. Similar results between NAO and SST showed in February. However, positive significant correlations between SOI and SST during January and February (i.e. R=0.7, R=0.65), what showing a positive regression slope (i.e. SST= -41.518+2.710 x SOI, SST= -47.352+2.515xSOI) respectively. A similar relation has been detected between DMI and SST during February (R=0.64, SST= 49.763+15.768 x DMI).
Moreover, there is no influence for each of the NAO, DMI, and SOI on Rd, S, and SST during June. Also, the results showed an insignificant influence on SOI on AT. However, the negative influence for NAO on the AT (i.e. R=-0.69) and a positive influence for DMI on AT (i.e. R=0.75) have been approved in this analysis. In this regards, regression equations constructed between NAO and DMI versus AT, which showed negative and positive slope respectively (i.e., AT= 22.011 - 6.307 x NAO, AT= 24.740 +

53.609 x DMI). In August, the results confirmed an insignificant relationship between each of NAO, DMI and SOI with Rd, AT and SST respectively. Likewise, an insignificant correlation proved between DMI and SOI with S. However, the results confirmed positive influence of NAO on the S (R=0.7). Thus, the regression equation has been constructed and a positive slope estimated (i.e., S = 16.509 + 11.409 x NAO).
Similarly, insignificant relation manifested between NAO, DMI, and SOI with Rd and S during November. In addition, an insignificant relation between NAO and DMI have detected with each of AT and SST. Furthermore, the conducted results confirmed a negative correlation between each of SOI and AT with SST (i.e., R=-0.79, R=-0.84) respectively, and hence, a negative regression slope was detected between AT and SOI (i.e., AT= -12.039 - 9.137 x SOI). A similar result was detected between SST versus SOI (i.e., SST= -5.945 - 9.272 X SOI).
In December, the analysis manifested an insignificant relation between NAO, DMI, and SOI with S and AT separately. At the same time, no relation demonstrated between DMI and SOI with Rd, as well as, between NAO and DMI with SST. Yet, positive significant correlation between NAO and Rd (i.e., R=0.71), whilst, a negative significant correlation between SOI and SST (i.e., R= -0.67) showed a positive and negative regression slope respectively in the regression models (i.e., Rd= -9.339 + 8.675 x NAO, SST= -39.539 - 2.713 x SOI).
Trend analysis has been carried out on Rd, S, AT and SST data series per each month (T1, T2, T3, …., T12) at the studied station. In general, the results confirmed decreasing in Rd trend per each month (T1 of discharge series = -22.44, T2 = -29.234, T3 = -34.432, T4 = -36.728, T5= -37.239, T6= -28.698, T7= -22.442, T8=-16.737, T9= -11.582, T10= -15.093, T11= -19.321, T12= -21.691 (m3/sec)) but this behavior was more pronounced in March, April and May (i.e. T3, T4 and T5 respectively). The salinity trends showed increase behavior for all months except the December trend (T1 of salinity series = 0.0594, T2 = 0.1018, T3 = 0.1207, T4 = 0.0705, T5 = 0.0729, T6 = 0.067, T7 = 0.1139, T8 = 0.1298, T9 = 0.0869, T10 = 0.1052, T11 = 0.0683, T12 = -0.0328 (‰)), in which December is a winter and cold month. Similarly, the air temperature trends demonstrate increase manner per each month except the last month (T1 of air temperature series = 0.12, T2 = 0.1788, T3 = 0.1776, T4 = 0.0321, T5 = 0.243, T6 = 0.3109, T7 = 0.2533, T8 = 0.2352, T9 = 0.2448, T10 = 0.3624, T11= 0.3006, T12 = -0.0255 (ºC)). The analysis showed negative SST trends in March, April, November, and December (T3 of sea surface water temperature series = -0.0218, T4 = -0.1152, T11= -0.1152, T12= -0.0588 (ºC)) respectively. However, the positive trends have been confirmed for the rest months in Shatt Al-Arab estuary (T1 of sea surface water temperature series = 0.1248, T2 = 0.1776, T5 = 0.0982, T6 = 0.1018, T7 = 0.1236, T8 = 0.2097, T9 = 0.0552, T10 = 0.1176 (ºC)).

3.3. The results in terms of the seasonal datasets

During winter, there is no influence of NAO, DMI, and SOI on the AT and SST. Likewise, insignificant influences of DMI and SOI on Rd as well as on S have been demonstrated. However, the analysis showed positive and negative significant influence for NAO on Rd and S (R= 0.374, R= -0.414) respectively. These results present the following regression equations (i.e., Rd= 5.809 + 5.383 x NAO, S= -9.592 - 6.237 x NAO). Next, the analysis of the spring season shows an insignificant response between NAO, DMI, and SOI with each one (S, AT as well as SST). Similarly, no responses between NAO and SOI with Rd were detected over the studied period but a negative significant effect was very clear for DMI on Rd (R= -0.385). These results showed a negative regression slope in the regression model (Rd= 19.368 - 60.180 x DMI). The statistical analysis of the summer season

showed insignificant correlations between NAO, DMI, and SOI with each one (Rd and S). Also, there were no responses detected between NAO and SOI with each one (AT and SST). However, the positive significant effect was detected for DMI on AT and SST (i.e., R= 0.403, R= 0.411), and hence, the positive regression slope was manifested (i.e., AT= 27.606 + 24.352 x DMI, SST= 24.475 + 11.785 x DMI).

Similar analysis has been done on the autumn datasets, the results showed insignificant correlations between NAO, DMI and SOI with each one (S, AT and SST). Next, insignificance responses detected between NAO and DMI with Rd but a negative response was between SOI on Rd (R= -0.465). Thus, the last results lead to a negative regression slope in the regression model (i.e., Rd= 4.757 - 13.154 x SOI).

Trend calculations showed negative values for the discharge change associated with the contemporary bad situation of freshwater discharge for all seasons (T_{winter} of discharge series = -7.1279, T_{spring}= -10.884, T_{summer}= -9.9262, T_{autumn}= -4.8568 (m3/sec)). Hence, the salinity trends showed increase behavior over the studied period for all seasons (T_{winter} of salinity series = 0.0114, T_{spring}= 0.0318, T_{summer}= 0.0282, T_{autumn}= 0.038 (‰)), which is associated with the same reason mentioned above. The results of the AT trends showed negative values during winter (T_{winter} of air temperature series = -0.0124 (ºC)). However, positive trends for the other seasons (i.e., T_{spring} of air temperature series = 0.1003, Tsummer= 0.0482, T_{autumn}= 0.0566 (ºC)) were detected. Similarly, the trend results of the SST for all seasons showed the similar behavior of the AT trends (T_{winter} of sea surface water temperature series = -0.0062, T_{spring}= 0.0524, T_{summer}= 0.046, T_{autumn}= 0.0225 (ºC)), i.e. associated with weather and climate conditions in the context of climate change.

3.4. The results of the Pardé coefficient (PC)

Figure 10, shows the highest values were more pronounced during March, April, and May, i.e. spring season. The increases in Pardé coefficients and the decreases in the discharge trends are associated with Karun river discharge. All the detail evidences for the mentioned results will submit in the next section.

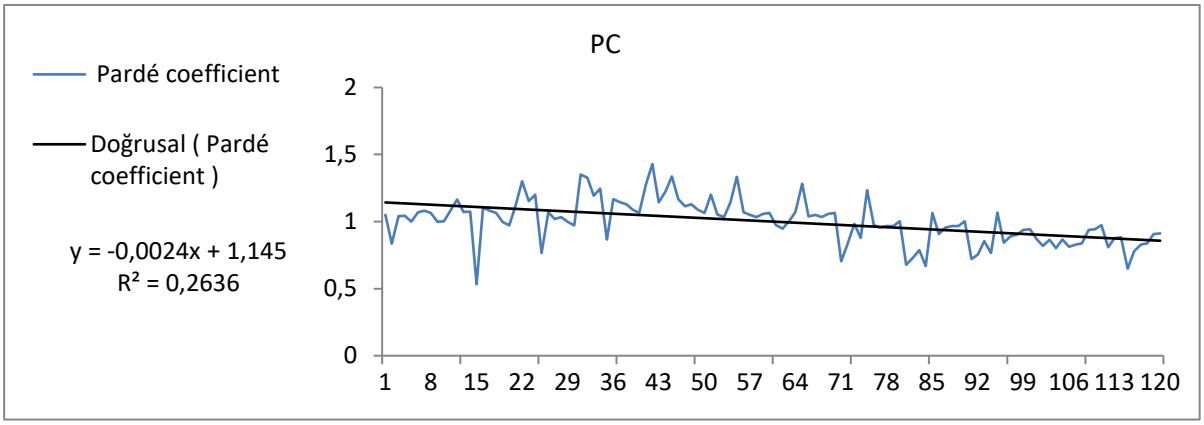

Figure 10. Change in Pardé coefficients describe the variability in discharge regime of Shatt Al-Arab estuary over the period (2005-2014).

4. DISCUSSION AND CONCLUSION

The decrease in the discharge of Shatt Al-Arab estuary (i.e. at study station) is calculated for the time (2005-2014). This station is about 120 km away from the Arabian\Persian Gulf and is proposed to be affected by global, regional, and local effects. Globally, the rainfall amounts in the drainage basin of Shatt Al-Arab what affect the discharge could be affected by the NAO, DMI, and SOI in the context of climate change (Cullen and deMenocal, 2000; Al-Senafi and Anis, 2015). Regionally, the negative trend could be related to the decrease in the Tigris and Euphrates discharges. That is consistent with the fact that the Shatt Al-Arab estuary faced a low freshwater as a result of the decrease in received water from its tributaries. Where it receives a freshwater from the Tigris river only (Al-Asadi, 2017). In this context, Turkey will regulate the flows of Tigris for many uses during the G.A.P. project. In addition, Syria has anticipated regulating the Euphrates flow by operation of three kinds of dams in the mainstream. Locally, Shatt Al -Arab discharge through its estuary is facing serious reductions in freshwater by human interventions as well as due to increased human use with increasing population. On the other hand, the increase in salinity concentration is clear in the conducted results. Generally, the salt concentration in Shatt Al-Arab water is affected by the number of factors, the most important are: the decrease in the discharge, the tide forcing, the evaporation rates, the average temperature, solar radiation, air moisture, and marine waters through the Arabian\Persian Gulf (Al-Muhyi, 2016), where these factors could be increased the salinity levels.

At present time, the trend in salinity along Shatt Al-Arab estuary could be related to the salinity intrusion from the downstream and anthropogenic sources, which could threat people and environment (Abdullah et al., 2016). However, the negative December trend may be related to the fact that the salinity can change from one day to the next depending on the above-mentioned factors. In addition, the majority of the rainfall in Iraq has happened in December (Abd-El-Mooty et al., 2016).

The global carbon dioxide has been increased in the atmosphere since 1950 (from 280 to 399.5 ppm). However, this value has not reached 300 ppm over 650,000 years. The reason behind this rise was the industries, which destroys the natural limit of the atmospheric components (Blasing, 2018). Thus, with other greenhouse gases, the global air temperature has increased by about 0.8ºC during the 20th century, whether the reason is human or natural. The air temperature in the northern Arabian\Persian Gulf showed increased by 0.8 ◦C during 1973–2012 (Al-Senafi and Anis, 2015). In accordance, the air temperature at the studied station showed a positive trend. However, the decrease in air temperature trends during December and winter season could be related to the climate status of Iraq which is short cold in winters, as well as, it is affected by the location of the country close to the sub-tropical wetness of the Arabian\Persian Gulf (Abd-El-Mooty et al., 2016) .

The conducted research proved that the sea surface temperature has increased. The SST trend is significantly affected by local anthropogenic activities as well as regional and global reasons. Where, the SST measurements showed a positive trend in Kuwait Bay (about 300 km from the studied station) over the period 1985-2002, what affected by the regional and global reasons (Al-Rashidi et al., 2009). On the other hand, the monthly SST trends could be related to an El Nin˜o, which is a significant global Oceanic-atmospheric event affecting the weather in the worldwide and working to reinforcement extreme climatic system, hence, it affects the sea surface water temperature in the Northern Arabian Gulf (Jones et al., 1997; Al-Rashidi et al., 2009). This study also submitted negative SST trends during spring, autumn months and winter season. That may be related to local reasons.

Global warming, i.e. caused by climate changes, is the main global driver affecting the discharge, salinity, air temperature, sea surface temperature, local reasons in Shatt Al-Arab estuary and regional reasons in Arabian\Persian Gulf and Shatt Al-Arab tributaries .

Local reasons could be related to the following points:

1. Gravitational circulation and mixing of seawater in Shatt Al-Arab estuary will affect the salinity, discharge as well as SST.
2. Weather condition may affect the SST, salinity, and discharge.
3. Human activities may impact the air temperature, SST, salinity, and discharge.

In addition to the similar points that above-mentioned, the regional reasons could be related to the following points:

1. The discharges of Euphrates and Tigris, as well as Karun rivers, may affect the discharge, salinity as well as SST.
2. The very large tidal range may affect the SST, salinity and discharge.

The increase in Pardé coefficients reflects the Karun influence during the spring season. The Karun River joins the eastern bank of Shatt Al-Arab about 72 km north of the Arabian\Persian Gulf. The mean annual discharge of Karun River is about 8.5 km3/year, and hence, the flow of Karun into Shatt Al-Arab depends mainly on spring snowmelt in the Iran Mountains which are affected by the change in the climate (Al-Asadi, 2017). Thus, the characteristic of the discharge regime (i.e the Pardé coefficients) was considerably affected by climate change .

Global warming is the main global driver affecting the NAO, DMI and SOI events in the context of climate changes, and hence, affecting the discharge, salinity, air temperature and sea surface temperature at Shatt Al-Arab estuary.

The first looking of this study is to establish and quantify the extent of each event and its impacts on each hydrographic and climatic parameter in Shatt Al-Arab station. The correlation results of NAO illustrate the negative responses may be related to the subtropic–subpolar NAO sea level pressure gradient. The more zonal tracks of the North Atlantic heat and moisture brought anomalously wetter conditions what reflects in the negative S/SST/AT (Cullen and deMenocal, 2000).

The positive correlation with salinity is related to summer rainfall in the Middle East under the influence of NAO. In addition, the positive correlation in winter month and season may reflect the winter rainfall percentage associated with the NAO event.

Many studies investigated the correlation between the climate of the Middle East and El Nin˜o (Cullen and deMenocal, 2000; Al Senafi and Anis, 2015). The negative influence of the SOI represents the impact on the summer monsoon. Thus, the effect of SOI on the regional precipitation and temperature is a result of its influence on the summer monsoon. The positive influence of the SOI on the SST during February and June reflects the variations in SST what related to SOI pattern. Thus, this result presents the possible influence of the far-field large-scale SOI event on the Middle Eastern climate, in which the positive phase of SOI starts to develop during the spring and summer producing warmer SST surface along the central Pacific Ocean. This shift causes disturbances to the Asian summer monsoon and hence the weather condition in the south of Iraq (Al Senafi and Anis, 2015).

Many studies investigated the correlation between the climate of the Middle East and the DMI event (Saji et al., 1999; Saji and Yamagata, 2003; Al Senafi and Anis, 2015). The positive influence of the DMI reflects the influence of the Indian Ocean on the Asian summer monsoon (Saji et al., 1999; Al Senafi and Anis, 2015). The influence of DMI during February and June is associated with the development of the DMI event during these months in the context of climate change. The

seasonal variations in the DMI pattern had reflected in the Rd during spring. However, the positive seasonal pattern of the Indian Ocean Mode had reflected in SST/AT during summer .

The unusual temperature conditions during the DMI event affect the Indian summer monsoon and the weather condition in the south of Iraq .

An insignificant relation between NAO/SOI/DMI and each of Rd/S/AT/SST in the results could be related with the fact that the influence of each climate event has spatial and temporal variations on the Middle East climate (Cullen and deMenocal, 2000; Al-Senafi and Anis, 2015.)

In terms of the conclusions, the study region experienced general trends such as:

#Decrease in the discharge of 2.0936 (m^3/sec)

#Increase in salinity of 0.0071(‰)

#Increase in air temperature of 0.0178 (ºC)

#Increase in sea surface temperature of 0.0098 (ºC)

This general trend of discharge could be explained by the change in: (1) the main discharge of the tributaries in the context of climate change, (2) the climatic and anthropogenic conditions, (3) SOI in the context of climate change.

Next, the general trend of salinity could be explained by the change in: (1) the main discharge of the tributaries in the context of climate change throughout the change in: (1-1) precipitation amount in the drainage basin (1-2) Karun discharge (1-3) Dam construction near the source of the main tributaries, (2) mean sea-level change in the Arabian\Persian Gulf (3) sea surface temperature change in the Gulf, (4) El Nin˜o event which affect the SST/AT changes in the Gulf, (5) wind speed causing turbulence leads to break down the salinity stratification during the water column which caused a homogenous water column (6) the evaporation process in the Gulf (7) the tidal range at Shatt Al-Arab estuary mouth (8) industrial and agricultural activities (9) the NAO in the context of global warming .

While the Air temperature trend can be explained by the change in: (1) climate change, (2) NAO/DMI/SOI in the context of climate changes (3) the anthropogenic resources.

Finally, the sea surface temperature trend may be explained by the change in: (1) climate change, (2) the NAO in the context of climate change (3) the anthropogenic resources.

The variations in discharge, salinity, air temperature and sea surface temperature to the NAO, DMI, and SOI is confirmed by significant (p-value < 0.05) correlations.

Similar implications can be concluded in terms of monthly and seasonal timescales.

This study has shown that climate change affects the hydrographic and climatic characteristics of Shatt Al-Arab estuary.

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Research Article
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Evaluation of Line Selection Criteria of Freight Forwarders in Container Transportation

Konteyner Taşımacılığında Nakliye Müteahhitlerinin Hat Seçim Kriterlerinin Değerlendirilmesi

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 112-126

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ABSTRACT

Container transportation, which can offer door-to-door integrated solutions to its customers, consists mainly of importers, exporters and shipping lines There are logistic service providers under the name of the freight forwarder for import and export companies to meet their different logistic demands, to make their dialogue with the lines more effective and to be focused them on the main activity areas. These providers, which are designated as forwarders in international literature, mediate realization of logistics activities like insurance, transportation, storage, customs clearance, packaging and so on. In order for these activities to be particularly economical, freight forwarders must select the optimal line operator. In this process, different criteria emerge that will affect the choice of freight forwarders.

Multi-criteria decision making that determining these criteria and examining the effect levels in the selection process and the decision making process is realized through the solution of models has emerged as a method applied of more than one enterprise in today. The problem mentioned in this study is the determination of the criteria used by the shipping contractor in selecting the container line operator, using the weighting model and using the decision model.

For this reason, it was aimed to determine the criteria affecting line operator preference and to define their weight in decision support system by meeting with international transportation contractors operating in our country. For this purpose, the actual data and the current shipping demand are evaluated and the decision-making process is established by using AHP and EDAS methods.

Keywords: Container Transportation, Freight Forwarder, Multi-Criteria Decision Making, AHP, EDAS.

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ÖZET

Müşterilerine kapıdan kapıya entegre çözümler sunabilen konteyner taşımacılığı, temelde ithalatçı, ihracatçı ve hat operatörlerinden oluşmaktadır. İthalat ve ihracat yapan firmaların, farklı lojistik taleplerinin yerine getirilmesi, hatlar ile olan diyaloğunun daha etkin sağlanabilmesi ve firmaların ana faaliyet alanlarına odaklanabilmesi için nakliye müteahhidi ismi altında lojistik hizmet sağlayıcılar bulunmaktadır. Uluslararası literatürde forwarder olarak belirtilen bu firmalar, sigorta, taşıma, depolama, gümrükleme, ambalaj vb. lojistik faaliyetlerin gerçekleşmesinde aracılık yapmaktadırlar. Bu faaliyetlerin başta ekonomik olması adına, nakliye müteahhitlerinin optimal hat operatörünü seçmesi gerekmektedir. Bu süreçte nakliye müteahhitlerinin tercihini etkileyecek farklı kriterler ortaya çıkmaktadır.

Bu kriterlerin belirlenmesi ve seçim sürecinde etki düzeylerinin incelenerek, karar verme sürecinin modeller üzerinden çözümünün gerçekleştirildiği, çok kriterli karar verme, günümüzde çok sayıda işletmenin uyguladığı, birden fazla amacın gerçekleştirilmesi için uygulanan bir yöntem olarak dikkati çekmektedir. Bu çalışmada belirtilen problem, nakliye müteahhidinin, konteyner hat operatörü seçiminde kullandığı kriterlerin belirlenmesi, ağırlıklarının oluşturularak, karar modelinin kullanılmasıdır. Bu sebeple, ülkemizde faaliyet gösteren uluslararası nakliye müteahhitleri ile görüşme sağlanarak, hat operatör tercihini etkileyen kriterlerin belirlenmesi ve karar destek sisteminde ağırlıklarının tanımlanması amaçlanmıştır. Bu amaç doğrultusunda, gerçek veriler ile güncel nakliye talebi değerlendirilmiş ve karar verme süreci AHP ve EDAS yöntemleri kullanılarak oluşturulmuştur.

Anahtar sözcükler: Konteyner Taşımacılığı, Nakliye Müteahhidi, Çok Kriterli Karar Verme, AHP, EDAS.

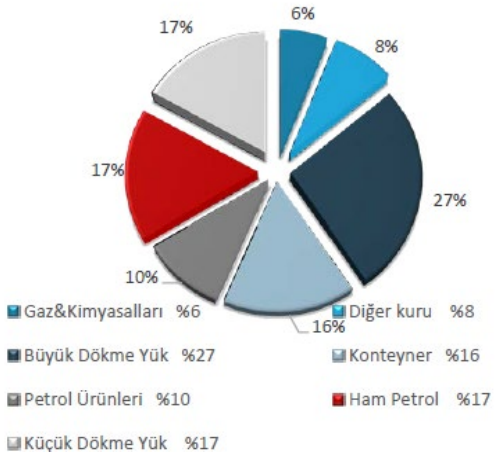
1. GİRİŞ

Deniz yolu taşımacılığı, dünyanın fiziki yapısı, ekonomik doğası, tek seferde yüksek miktarda taşıma performansı, emniyet gibi kriterler dikkate alındığında, uluslararası ticaretin günümüz kapasitesine ulaşmasında önemli faktörlerdendir. 2018 yılı itibariyle dünya dış ticaret hacmi 14 milyar ton üzerinde gerçekleşirken, bu miktarın % 84'lük kısmı deniz yolu ile taşınmaktadır. Deniz yolu taşımacılığı içinde ise en büyük pay dökme yük taşımacılığına aittir.

1960'lı yıllarla birlikte gelişmeye başlayan konteyner taşımacılığı, düşük maliyet, kapıdan kapıya hizmet sağlayabilme, taşıma maliyetlerinin önceden tahmini, yüklerin birimleştirilmesi, taşıma veriminin artması, yük hasar oranının düşmesi de dikkate alındığında, deniz yolu taşımacılığının en hızlı büyüyen türü olarak karşımıza çıkmaktadır. Şekil 1'e göre, deniz yolu taşımacılığı içinde, konteyner taşımacılığının payı 2018 itibariyle % 16 olarak gerçekleşmiştir.

Şekil 2'ye göre, 1980'lerde yıllık 102 milyon ton olan konteyner taşımacılığı, 2017 yılı itibariyle yıllık 1.83 milyar tona ulaşmıştır. Konteyner hatlarının gemi kapasitesi global olarak, yaklaşık 253 milyon ton olup, yeni gemi siparişleri ile bu kapasitesinin % 1-2 aralığında artması beklenmektedir. Global konteyner gemi filosu yaklaşık olarak 20 milyon konteynere ulaşmış olup, yıllık dolu/ boş

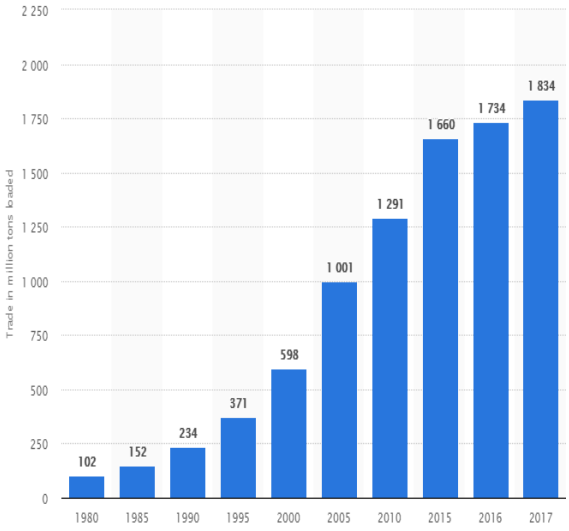
konteyner hareketi yaklaşık 750 milyon TEU düzeyindedir. Global konteyner taşımacılık talebi 2018-2012 yılları arasında % 3.2, 2012-2016 yılları arasında % 2.5 ve 2016-2019 yılları arasında % 4.7 artış göstermiştir (Wagner, 2018).



Şekil 1. Denizyolu taşımacılığının türlerine göre dağılımı (URL-1, 2019).

2017 verilerine göre, ülkemiz dış ticaretinin 347.3 milyon tona karşılık gelen yaklaşık % 88'lik kısmı deniz yolu ile sevk edilmiştir. Bu dönemde, konteyner taşımacılığının kullanım oranı ise ithalat için % 18, ihracat için % 31 olmuştur (DTO, 2018).

Dünya'da ve ülkemizde önemli bir taşıma türü haline gelen konteyner taşımacılığı, intermodal taşımacılık için uygun olması sebebiyle limandan/ limana, kapıdan/ kapıya ve farklı teslim noktalarına esneklik sağlayabilmektedir. Böylece, firmaların değişen talepleri hızlı bir şekilde karşılanarak, maliyetlerini kontrol altında tutabilmelerine yardımcı olunmaktadır. İhracatçı firmalar, konteyner taşıma hizmetini direkt olarak layner adı verilen gemi operatörlerinden alabileceği gibi, nakliye müteahhidi adını verdiğimiz aracı kuruluşlardan da temin edebilmektedirler. Bu kuruluşlar, ithalat ya da ihracat yapan firmaların başta uygun maliyetle konteyner taşıma hizmeti almasına aracılık etmektedirler. Bununla birlikte üçüncü parti ya da dördüncü parti lojistik firmaları olarak, konteyner taşımacılığının önemli bir unsuru haline gelmişlerdir.



Şekil 2. Konteyner taşımacılığının gelişimi (Wagner, 2018).

Uluslararası taşımacılık ve lojistik hizmet üretenler derneği (UTİKAD), freight forwarder kavramının, Türkçe karşılığı olarak "taşıma işleri organizatörü", "nakliye müteahhidi" ve "nakliye yüklenicisi" kavramlarını kullanmaktadır (Tuna, 1994; Deveci, 2006; Sevgili ve Nas, 2017).

Nakliye müteahhitleri için bir eşyayı, en az risk ve maliyetle zamanında gönderme ve zamanında teslim alma konusunda doğru karar verebilmek büyük önem taşımaktadır. Tüm bu süreçlerde nakliye müteahhitleri, birçok amacı ve bunlara bağlı olan kararları bir arada gerçekleştirmek durumundadırlar (Sezer ve Saatçioğlu, 2008).

Forwarderler (nakliye müteahhitleri), konteyner hatları ile ihracatçı firmalar arasında diyaloğu sağlamaktadır. Amerika ve Çin dışında dünyanın birçok noktasında ihracatçı firmalar direkt olarak konteyner hatları ile görüşerek, nakliye organizasyonu yapabilmektedir. Amerika ve Çin'de ise ihracatçı firmaların, NVOCC (Non Vessel Ocean Container Carrier) adını verdiğimiz freight forwarder firmalar üzerinden rezervasyon yapmaları zorunludur. 2000'li yıllar ile birlikte piyasadaki belirsizliklerin artması,

öngörülemez navlun seviyeleri ve geçerlilik süreleri, vade ile ilgili sorunlar, intermodal taşıma taleplerinin artması gibi sebepler neticesinde, hatların ve ihracatçıların forwarderlere ihtiyacı daha fazla artmıştır. Bununla birlikte, hatların uzun vadeli yük beklentileri, ihracatçılardan gelen farklı taleplere duyarsız kalması gibi durumlar da eklendiğinde, forwarder firmalar konteyner taşımacılığın önemli bir unsuru haline gelmiştir. Navlun fiyatlarında oluşan dalgalanmaların tahmini güçtür ve piyasanın istikrarlı olmayan yapısı yatırımcıları zor durumda bırakmaktadır. Bu durum daha çok deniz taşımacılığında hizmet arzının esnek olmayan karakterinden kaynaklanmaktadır (Muslu, 2018). Günümüzde, global konteyner piyasasındaki taşımacılık faaliyetinin % 80'lik kısmı freight forwarderler üzerinden yapılmaktadır (Ho vd., 2017). Konteyner taşımacılığında ihracatçı firmalar, direkt ihracatçı firmalar, forwarderler ve rezervasyon acenteleri (NVOCC) olarak ayrılmaktadır. Konteyner taşımacılığında ihracatçılar açısından hat belirleme kriterlerinin oluşturulmaya çalışıldığı önceki çalışmalar, ihracatçıların ayrımını tam olarak yapamamıştır (Krapfel ve Mentzer, 1982; Brooks, 1985; Brooks, 1990, 1991; Murphy ve Hall, 1995; Tiwari vd., 2003; Yen ve Chen, 2004; Douglas vd., 2006; Salleh, 2007; Zsidisin vd., 2007; Brooks ve Trifts, 2008; Rogerson vd., 2014).

Forwarderler, konteyner taşımacılığında gemi operatörleri açısından taşıtan olarak dikkate alınmaktadır. Bir forwarder aracılığı ile taşıma yaptırılmasının en önemli avantajı, forwarderin taşıma ile ilgili operasyonel ve yasal tecrübesinden faydalanılmasıdır. Forwarder gümrük süreçleri ile ilgili olarak uzmandır. Ayrıca, yükün taşınmasıyla ilgili olarak gerekli olan diğer süreçlere hakimdir ve maliyetin yük sahibi için en uygun şekilde gerçekleşmesini sağlayabilmektedir (Kaçar, 2015). Forwarderlerin faaliyet alanlarından bazıları şu şekildedir:

- Paketleme ve etiketleme ile ilgili olarak taşımanın yapıldığı ülkelere göre danışmanlık hizmeti vermek,
- Taşınan yükler ile ilgili olarak tecrübelerine istinaden sigorta teminatı ve limitleri ile ilgili bilgilendirme ve sigorta yapmak,
- Müşterileri ihtiyaçlarına yönelik depolama ve dağıtım ayarlama ve organizasyonu yapmak,
- Konsodilasyon,
- Müşterilerinin hasar süreçlerine yardımcı ve destek olmak,
- Müşterilere alternatif taşıma modelleri sunmak,

Bir forwarder, ithalat ya da ihracat yapan firmaların ürünlerinin, öncelikle hızlı, ekonomik, zamanında ve hasarsız taşınabilmesi için konteyner hatları ile sürekli iletişim halindedir. Bir ithalat ya da ihracat sürecinde, forwarder öncelikle müşteri talebini optimum düzeyde karşılayan konteyner hattını tercih etmektedir. Bu süreçte, forwarder açısından çok sayıda değişkenin hızlı bir şekilde değerlendirilip, karar verilmesi gerekmektedir. Ayrıca, müşterilerine oldukça geniş bir yelpazede hizmet vermektedirler. Bu açıdan bakıldığında, forwarder firmaların sorumlulukları oldukça fazladır ve hizmet olarak dikkate alındığında konteyner hatlarından daha fazla etkiye sahiptirler.

Orta büyüklükte bir konteyner gemisinde, ithalatçı ve ihracatçı olarak binlerce müşteri yükleme yapabilmektedir. Konteyner hatları açısından bakıldığında, sorumlu olduğu müşteri sayısı onlar ile ifade edilmektedir. Çünkü, yüklemelerin büyük kısmı, direkt olarak hat ile yapılmak yerine, forwarder kullanılarak organize edilmektedir. Bu hususta Tablo 1. forwarder ile konteyner hattı arasındaki farklılıkları ortaya koymaktadır.

Forwarderlerin, müşteri taleplerini maksimum düzeyde karşılayabilmek için farklı kriterleri değerlendirerek, doğru karar verebilmeleri gerekmektedir. Bu kriterlerden başlıcaları, navlun, transit süre, vade, geçerlilik süresi, intermodal

masraflar, lokal masraflar, taşıma belgesinin kolay temini vb. olarak şekillenmektedir. Bu kriterlerin doğru değerlendirilmesi, firmaların zaman, gelir ve müşteri kaybını önleyerek, ithalat ve ihracata dolaylı destek olacaktır.

Tablo 1. Forwarder ile konteyner hattı arasındaki farklar "Yuen ve Thai (2015) ile Fremont (2009)'un çalışmalarından derlenmiştir".

	Forwarder	**Konteyner Hattı**
İhracatçı ya ithalatçı vade talepleri	Genellikle olumlu karşılanır.	Banka teminatı talep edilmektedir.
Vade süresi	Talebi karşılar.	Oldukça kısadır.
Navlun	En uygun seviye elde edilir.	Yüksek kalmaktadır.
Konşimento vb. belge talepleri	Hızlı bir şekilde cevaplanır.	Süreç uzundur.
Intermodal talepler	Hızlı ve ekonomiktir.	Daha uzun ve pahalı olabilmektedir.
Müşteri hizmeti	Memnuniyet yüksektir.	Memnuniyet daha azdır.
Diğer talepler	Hızla cevaplanır ve memnuniyet yüksektir.	Cevaplama süresi uzun ve memnuniyet daha azdır.

Konteyner taşımacılığında forwarder firmaların rolü arttıkça, konteyner hatları da bu pastadan pay alabilmek için bazıları kendi bünyesinde forwarder firma oluşumuna giderken, bir grup da forwarder firma satın alma yoluna gitmişlerdir (Örneğin, Cma-CGM'nin CEVA lojistiği satın alması). Bu durumun ortaya çıkmasına, konteyner hatlarının, forwarder firmaların taşıma piyasasının kontrolünü elde edebilme fikri etkili olmaktadır. Böyle bir durumda ise, piyasanın manipülasyonlara tamamen açık olabileceği ve kendilerinin bu piyasadan sağlıklı bilgi temin edemeyeceklerini düşünmektedirler.

Konteyner taşımacılığında forwarderlerin, değişen müşteri taleplerine zamanında cevap verebilmek için, etkin karar verebilmeleri oldukça önemlidir. Değişen müşteri talepleri ile birlikte, hat tercih kriterleri de artış göstermiştir. Günümüzde birden fazla kriterin dikkate alınarak, doğru karar verebilmek için çok kriterli karar verme yöntemleri uygulanmaktadır. Nakliye müteahhitleri açısından, hat seçim kriterlerinin doğru olarak tespiti ve buna uygun olan yöntemin uygulanması amacıyla, çalışmada AHP yöntemi ile kriterlerin ağırlıkları belirlenecek ve EDAS yöntemi ile de en uygun konteyner hat seçimi gerçekleştirilecektir. Bu doğrultuda forwarderlerin, en uygun hat seçim sürecine destek olunması hedeflenmektedir.

2. LİTERATÜR TARAMASI

Kokkinis, Mihiotis ve Pappis (2006), çalışmasında aracı kurumlar olarak nakliye müteahhitlerinin işlevlerini anlatmış, ihracat yapan firmaların nakliye müteahhidi seçimindeki kriterleri oluşturmuşlardır. Ayrıca nakliye müteahhidinin seçim kriterlerinin ortaya çıkarılması amacıyla anket çalışması yapılmış olup, ihracat yapan firmaların verilen hizmetler, fiyat, çalışanlar ve deneyimden daha çok kalitenin müşteriler için daha önemli olduğu sonucuna varılmıştır.

Sezer ve Saatçioğlu (2008) çalışmasında, düzenli hat taşımacılığında nakliye müteahhidinin gemi operatörü seçimine ait kriterler, anket çalışması ile oluşturulmuştur. Bu sonuca göre toplam 5 adet kriter oluşmuş ve bu kriterler kullanılarak, AHP, Electre ve Topsis yöntemleriyle, nakliye müteahhidinin 3 farklı hat arasından tercih yapması sağlanmıştır. Bu tercihlere göre, her üç yöntem sonucunda da ilk tercih edilen hat aynı olup, 2 ve 3 numaralı hatlar farklılık göstermektedir.

Sevgili ve Nas (2017) çalışmasında, taşıma işleri komisyoncularının, gemi acentesi seçimindeki kriterleri, anket yardımıyla t testi ve anova ile analiz ederek, kriterlerin önem derecelerini sıralamışlardır. En önemli kriterler sırasıyla, navlun ve toplam

taşıma maliyeti", "istenilen yükleme ve boşaltma limanına uğrak yapması", "kriz zamanlarında destek sağlayabilmesi", "ekipman sağlama ve kondisyonu", "hizmet kalitesi/gerekli hizmeti sağlayabilmesi" dir.

Abshire ve Premeaux (1991) çalışmasında, motorlu taşıyıcıların seçiminde ihracatçıların dikkate aldıkları kriterlerin önem sırasını ve ihracatçı ile taşıyıcı arasındaki algısal farklılıkları, Amerika'daki ihracat ve taşıyıcı firmalarda çalışmakta olan yöneticiler arasında, 5'li Likert ölçeğiyle oluşturulmuş anket yardımıyla değerlendirmeye çalışmıştır. Çalışma sonucunda, müşteri memnuniyetinin ihracatçılar açısından en önemli kriter olduğu sonucu ortaya çıkmıştır. En önemli kriter ise düşük navlun olarak gerçekleşmiştir.

Wong vd. (2008) çalışmasında, Güney Çin Pearl nehri deltasında ihracatçıların taşıyıcı seçiminin, ihracatçıların seçeceği taşıma modlarının AHP ile değerlendirilmesi ve bu seçim sürecinde dikkate alınan kriterlerin avantaj ve dez avantajları ile güçlü ve zayıf yönlerinin değerlendirilmiştir. Ziyaret ve anketten elde edilen veriler, SPSS ile ağırlıklandırılmıştır. AHP yönetimiyle, ihracatçılar tarafından sunulan taşıma modu alternatifleri, ihracatçıların kriterlerine göre sıralanmış ve en uygun alternatif belirlenmiştir.

Brooks (1990) çalışmasında, Doğu Kanada'da bulunan ihracatçıların, konteyner hattı seçiminde tercih kriterlerinin ağırlığını, bu firmalarda ihracat satışta görev yapan personele iletilen 800 ankete karşılık, 430 adedine verilen cevap üzerinden belirlemeye çalışmıştır. T testi yardımıyla, 1989 ve 1992 yıllarında ihracatçıların yanıtları ayrı dikkate alınarak karşılaştırma yapılmıştır. Taşıyıcıların iyileştirmesi gereken en önemli kriterin sefer süresi olduğu ortaya konulmuştur.

Kent ve Parker (1999) çalışmasında, mail yoluyla anket yardımıyla Amerika'daki 50 ithalat, 50 ihracat ve 25 adet konteyner taşıyıcı firma ile anket yapmış, firmalar tarafından toplamda 58 anket teslim edilmiştir. 18 adet taşıyıcı seçim kriteri, faktör analizi ile değerlendirilmiştir. Sonuca göre, sırasıyla hat sorumluluğu, ekipman sağlayabilme ve servis sıklığı en önemli kriterler arasında gözükmektedir.

Wen ve Huang (2007), forwarderlerin, hatlardan aldıkları hizmetin niteliği üzerinde yaptığı çalışmada, Tayvan ile ABD arasında hizmet veren forwarderler ile anket yapmıştır. 20 adet forwarder ile yapılan ankete göre, toplamda 3 ana faktör altında multinominal logit model ile 20 kriter değerlendirilmiş ve 9 hat arasında tercih sıralaması yapılmıştır. Bu kriterler arasında forwarderlerin hat tercihini etkileyen en önemli kriterler, sefer süresi, sefer sıklığı, yük gecikmesi, navlun, hız ve sorumluluk olmuştur.

Lu (2003) çalışmasında, Tayvan'da bulunan ihracatçı ve denizcilik firmaları arasındaki servis niteliği ilişkisi incelenmiş olup, anket sonuçları Spss'de regresyon analizi ile değerlendirilmiştir. İhracatçılar açısından öncelikli servis kriterinin belgelerin doğruluğu, gemi programına bağlılık, gemideki yer durumunun yeterliliği, şikayetlerle ilgili taşıyıcının zamanında dönüşü, yükün zamanında teslim alınması, taşıyıcılar açısından öncelikli servis kriteri, şatış personelinin problem çözümü, ihracatçı şikayetine hızlı yanıt, satış personelinin bilgi birikimi, gemideki yer durumunun yeterliliği, dökümanların doğruluğu sonucuna ulaşılmıştır.

Ho vd. (2017) çalışmasında, Tayvan'da bulunan forwarder ve konteyner hatları ile anket çalışması yapılmış ve sonuçlar Dematel yöntemiyle değerlendirilmiştir. Sonuçta, forwarderlerin hat seçiminde dikkate aldığı en önemli kriterlerin, taşıma sorumluluğu, entegre lojistik, taşıma güvenliği, navlun tarifesi, sefer süresi, zamanında teslim, servis durumu, denizcilikte uzmanlık, direkt erişim, uygun taşıma, sefer sıklığı, gümrük işlemleri etkinliği olduğu sonucuna ulaşılmıştır.

Özsümer vd. (1993), uluslararası nakliye

müteahhidi seçimi hakkında uzman sistemler ile bir uygulama yaptıkları çalışmalarında, üçüncü taraf lojistik firmaları olarak nakliye müteahhidi seçiminin günümüz koşullarında önemini anlatarak, karar vericilere kendi ihtiyaçlarını en iyi sekilde karşılayacak nakliye müteahhidinin seçimi için uzman sistemlerin kullanılmasını önermiş ve "freight" adı verilen bir sistem ile uygulama yapmışlardır.

Kannan vd. (2011) çalışmasında, Hintli ihracatçılar açısından hat seçim kriterlerini 45 kriter arasından AHP ile değerlendirmiş olup, en önemli kriterlerin sırasıyla, düşük navlun, fiyat esnekliği ve esneklik olduğu sonucuna ulaşılmıştır.

Çancı ve Erdal'a (2003) göre, taşıma işleri komisyoncularının gemi acentelerini tercih ederken dikkat ettikleri hususlar; taşıma maliyeti (navlun), teslimat zamanı konusunda tutarlılık, gemi acentesinin nitelikleri ve yetenekleri, teknik yeterliliği, programlama esnekliği, etkin müşteri hizmetleri, gemi acentesinin firma saygınlığı ve pazar deneyimi, gemi acentesinin finansal yapısı, taşıma/yük sorumluluğu ve risklere karşı koruma taşıma sürecinin güvenliği olarak sıralanmaktadır.

3. YÖNTEM

Literatür taramasında, nakliye müteahhitlerinin, konteyner hat seçiminde kullanılan kriterler ile ilgili Ho vd. (2017) ile Kannan vd. (2011) tarafından yapılan çalışmalar, günümüzde freight forwarderlerin tercihlerini etkileyen kriterleri derinlemesine dikkate almaktadır. Bu sebeple, iki çalışmada belirlenen kriterler dikkate alınarak, sadeleştirme sonucu 5 ana faktör altında 29 adet kriter şekil 4'deki gibi elde edilmiştir. Ana faktörler navlun, müşteri hizmetleri, sefer kriterleri, operasyon kriterleri ile IT ve iletişim olarak sıralanmaktadır.

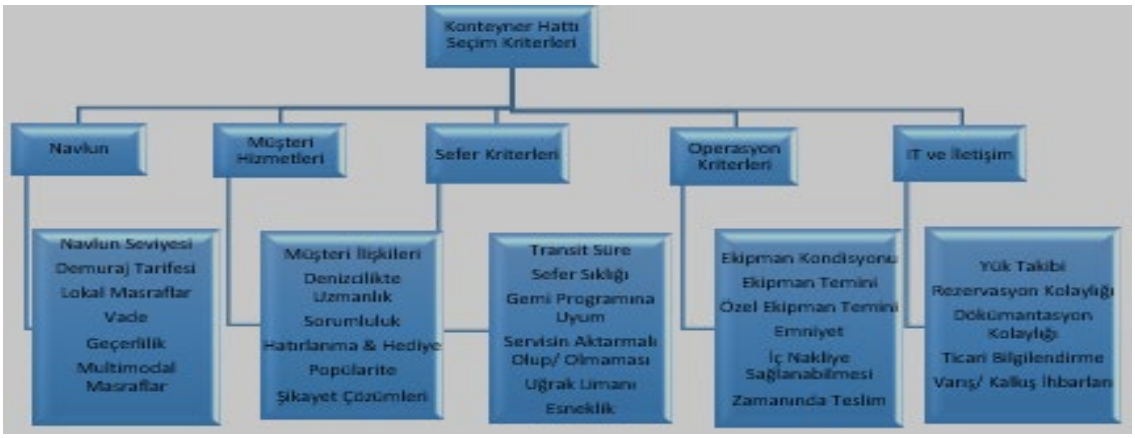
Belirlenen kriterler, sektöründe yıllardır hizmet sağlayıcı olarak görev yapan global 10 adet freight forwarder firmanın Türkiye temsilcilikleri tarafından görüşme ya da anket yoluyla, tablo 3'deki Saaty 1-9 oran ölçeğinde değerlendirilmiştir.

Burada ilk aşama kriter ağırlıklarının AHP yöntemi ile belirlenmesi ve ikinci aşama ise EDAS yöntemi ile güncel bir nakliye talebinin, freight forwarder tarafından 3 adet hat arasında değerlendirilerek, en uygun hattın seçimidir. EDAS yönteminde kullanılacak veriler için, görüşmüş olduğumuz 10 adet freight forwarder firma ile aynı kriterler üzerinden 5'li Likert ölçeği kullanılarak yeni bir görüşme yapılmış olup, her kriter için firmalardan elde edilen sonuçların ortalaması alınarak, değerler belirlenmiştir. EDAS yönteminde kullanılan kriter ağırlıkları, AHP ile ulaşmış olduğumuz ağırlıklardan oluşmaktadır.

Tablo 2. AHP önem ölçeği (Saaty, 1990).

Önem Değerleri	Değer Tanımları
1	Her iki faktörün eşit öneme sahip olması durumu
3	1. Faktörün 2. faktörden daha önemli olması durumu
5	1. Faktörün 2. faktörden çok önemli olması durumu
7	1. Faktörün 2. faktöre nazaran çok güçlü bir öneme sahip olması durumu
9	1. Faktörün 2. faktöre nazaran mutlak üstün bir öneme sahip olması durumu
2,4,6,8	Ara değerler

Son aşamada ise güncel bir nakliye problemi için, freight forwarderlerden elde edilen veriler ile 3 adet konteyner hattı arasındaki tercih sıralamasını oluşturmaktır. Bu sıralama EDAS yöntemi sonucunda elde edilmiştir.



Şekil 3. Nakliye müteahhitlerinin konteyner hattı seçim kriterleri "Ho vd. (2017) ile Kannan vd. (2011)'nin çalışmalarından derlenmiştir".

3.1. Çok Kriterli Karar Verme

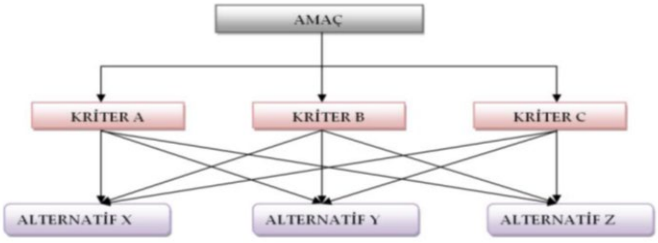
Bireyler, işletmeler ve/veya organizasyonlar yaşamın her alanında çok boyutlu karar problemleri ile karşılaşmaktadır. Yöneticiler çoğu zaman, birden fazla faktörün ve birbirleriyle çatışan amaçların (kriterlerin) gerçekleştirilmek istendiği durumlarda karar vermektedirler. Çok kriterli karar verme teknikleri, birbiri ile çatışan birden fazla kriteri karşılayan olası "en iyi/uygun" çözüme ulaşmaya çalışan yaklaşım ve yöntemlerden oluşmaktadır. Karar vericiler, bu tür problemlerin üstesinden gelmede çok kriterli karar verme tekniklerinden faydalanarak bilimsel ve daha başarılı kararlar verebilirler (URL-2, 2019).

Çok kriterli karar verme (ÇKKV), yönetim, matematik, psikoloji, enformatik, ekonomi ve sosyal bilimler gibi birden çok disiplinin bir araya gelip karar alıcıya birden fazla boyutla karar problemini değerlendirme ve karar alma imkânı sağlayan yöntemlerin bir araya getirildiği bir yapıdır (Yıldırım ve Önder, 2014). Bu çalışmada, çok kriterli karar verme yöntemlerinden AHP ve EDAS tercih edilmiştir.

3.1.1. AHP Yöntemi

Analitik Hiyerarşi Proses (AHP), ilk olarak 1968 yılında Myers ve Alpert ikilisi tarafından ortaya atılmış olup, 1977'de Saaty tarafından bir model olarak geliştirilerek, karar verme problemlerinin çözümünde kullanılabilir hale getirilmiştir (Supçiller ve Çapraz, 2011). Belirli hiyerarşiye göre düzenlenen kriterleri içeren, bu kriterlerin ağırlıklarını değerlendiren, kriterlere göre alternatifleri karşılaştıran ve sıralama yapılmasını sağlayan bir yaklaşımdır (Hu ve Peng, 2008).Yöntemin adımları şu şekildedir:

Adım 1: Modelin kurulması ve problemin formüle edilmesi: AHP yaklaşımında karar sürecini etkileyen tüm nicel ve nitel faktörler anket çalışması veya bu konuda uzman kişilerin görüşlerine başvurularak belirlenmektedir. Sonrasında elde edilen bilgiler sonucunda amaç, kriterler, alt kriterler ve alternatifler belirlenerek hiyerarşik bir yapı oluşturulmaktadır.



Şekil 4. Tam hiyerarşik yapı (Wang vd., 2008)

Adım 2: İkili karşılaştırmalar matrisinin (A) oluşturulması ve ağırlıkların belirlenmesi: Amaç, kriterler ve alt kriterler belirlendikten sonra kriterlerin ve alt kriterlerin kendi aralarında önem

derecelerinin belirlenmesi için (nxn) ikili karşılaştırma matrisi oluşturulur. Her bir ölçütün, amaca katkısı açısından göreceli önemleri ve her bir hedefin de ölçütler yönünden üstünlükleri, uygulayıcıların yargılarına göre, ikili karşılaştırma yolu ile belirlenir. Burada üstünlüklerin belirlenmesi için Saaty tarafından geliştirilen Tablo 2'deki ölçek kullanılmaktadır.

$$A=\begin{bmatrix} 1 & a_{21} & a_{31} & \dots & a_{n1} \\ 1/a_{21} & 1 & a_{32} & \dots & a_{n2} \\ 1/a_{31} & 1/a_{32} & 1 & \dots & a_{n3} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1/a_{n1} & 1/a_{n2} & 1/a_{n3} & \dots & 1 \end{bmatrix}_{nxn} \quad (1)$$

Adım 3: Özvektörün (Görece önem vektörünün) belirlenmesi: İkili karşılaştırma matrislerinin oluşturulmasından sonraki adım, ilgili matristeki her bir öğenin diğer öğelere göre önemini gösteren özvektörün hesaplanmasıdır. Matrisin nx1 boyutunda özvektörü şu şekilde belirlenmektedir:

i=1,2,3,…,n ve j=1,2,3,…,n olmak üzere,

$$\boldsymbol{b_{ij}=\frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}} \quad \boldsymbol{w_i=\frac{\sum_{j=1}^{n} b_{ij}}{n}} \quad (2)$$

Kriterlerin yüzde önem dağılımlarını belirlemek için W = $[w_i]_{nx1}$ şeklindeki sütün vektörlerinin hesaplanması gerekmektedir. W sütün vektörü, 2 numaralı eşitlikte belirtilen b_{ij} değerlerinin meydana getirdiği matrisin satır elemanlarının aritmetik ortalamasından elde edilir.

Adım 4: Özvektörün tutarlılığının hesaplanması: Her ikili karşılaştırma matrisi için tutarlılık oranı (CR) hesaplanır ve bu oran için üst limitin 0,10 olması istenir. Oranın 0,10'un üstünde olması, karar vericinin yargılarında tutarsızlık olduğunu ifade eder. Bu durumda, yargıların iyileştirilmesi gerekmektedir. CR değerine ulaşmak için öncelikle A matrisinin en büyük özvektörünü (λ_{max}) hesaplamak gerekmektedir.

i=1,2,3,…,n ve j=1,2,3,…,n olmak üzere,

$$D = [A_{ij}]_{nxn} \text{ x } [W_i]_{nx1}=[d_i]_{nx1} \quad (3)$$

$$\lambda_{max} = \frac{\sum_{i=1}^{n} \frac{d_i}{w_i}}{n} \quad (4)$$

Tutarlılık oranının hesaplanmasında ihtiyaç duyulan bir başka değer ise rassallık endeksi (RI)'dir. Sabit sayılardan meydana gelen ve n değerine göre belirlenen RI değerlerinin yer aldığı veriler Tablo 3'de verilmiştir. Bu bilgiler doğrultusunda CR değeri aşağıdaki şekilde hesaplanmaktadır.

$$CR=\frac{\lambda-n}{(n-1).RI} \quad (5)$$

Tablo 3. Rassallık Endeksi Verileri (Saaty, 1980)

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Adım 5: Hiyerarşik yapının genel sonucunun elde edilmesi: Önceki dört aşama, hiyerarşik yapının tamamı için hesaplanır. Bu aşamada hiyerarşik yapıdaki n tane ölçütün herbirinin meydana getirdiği mx1 boyutundaki üstünlük sütün vektörleri bir araya getirilerek mxn boyutundaki DW karar matrisi oluşturulur. Elde edilen matrisin ölçütler arası W üstünlük vektörü ile çarpımı sonucunda R sonuç vektörüne ulaşılmaktadır (Supçiller ve Çapraz, 2011).

i=1,2,3,…,m ve j=1,2,3,…,n olmak üzere,

$$DW = [W_{ij}] \qquad R = DW\ x\ W \quad (6)$$

3.1.2. EDAS Yöntemi

EDAS (Evaluation based on Distance from Average Solution), ortalama çözüm uzaklığına göre değerlendirme yöntemi ilk kez Ghorabaee vd. (2015) tarafından geliştirilmiştir. Yöntemde en iyi alternatif, alternatiflerin her bir kritere göre ortalama çözüm (average solution – Vj) uzaklıkları

hesaplanarak elde edilmektedir. Ayrıca yöntemde, alternatiflerin kabul edilebilirliğine dair iki ölçü bulunmaktadır. Bunlardan birincisi, ortalamadan pozitif uzaklık (positive distance from average - PDA_{ij}) ve ikincisi ortalamadan negatif uzaklık (negative distance from average - NDA_{ij})'tır. Alternatif değerlendirme işlemi, PDA_{ij}'nin daha yüksek değerlerine ve NDA_{ij})'nin düşük değerlerine göre yapılmaktadır. Böylece, PDA_{ij}'nin daha yüksek değerleri ve / veya daha düşük NDA_{ij})değerleri, çözümün (alternatif) ortalama çözümden daha iyi olduğunu göstermektedir. Yöntemin adımları şu şekildedir:

Adım 1: Değerlendirmeye alınacak *m* sayıda alternatif belirlenir.

Adım 2: n sayıdaki kriter dikkate alınarak, alternatiflerin *k* sayıda karar verici tarafından değerlendirilmesi sağlanır. Böylece, her bir karar vericiye ait karar matrisi X_{ij}^{k}'ya ulaşılır.

$$X_{ij}^{k}=\begin{bmatrix} X_{11}^{k} & \cdots & X_{1n}^{k} \\ \vdots & \ddots & \vdots \\ X_{m1}^{k} & \cdots & X_{mn}^{k} \end{bmatrix} \quad (7)$$

Adım 3: k sayıdaki karar vericiden elde edilen değerler yardımıyla grup karar değerleri hesaplanır ve grup karar matrisi elde edilir. Grup karar matrisine kriter ağırlıkları ($\boldsymbol{W_j} = \boldsymbol{w_1, w_2, .., w_n}$) de dahil edilerek, EDAS yönteminde dikkate alınacak karar matrisine ($\boldsymbol{X_{ij}}$) ulaşılır.

$$X_{ij}=(\prod_{k=1}^{k} X_{ij}^{k})^{1/k} \quad (8)$$

$$X_{ij}=\begin{matrix} W_1 & \cdots & W_n \end{matrix}\begin{bmatrix} X_{11} & \cdots & X_{1n} \\ \vdots & \ddots & \vdots \\ X_{m1} & \cdots & X_{mn} \end{bmatrix} \quad (9)$$

Adım 4: Tüm kriterlere göre ortalama çözüm (*AV*) belirlenir.

$$AV = [AV_j]_{1xn} \qquad AV_j = \frac{\sum_{i=1}^{m} X_{ij}}{m} \quad (10)$$

Adım 5: Kriterlerin fayda ve maliyet esaslı olmasına göre, ortalamadan pozitif uzaklık (PDA_{ij}) ile ortalamadan negatif uzaklık (NDA_{ij}) değerleri hesaplanır.

j'inci kriterin fayda esaslı olması durumunda;

$$PDA_{ij} = \frac{\max(0,(X_{ij}-V_j)}{V_j} \quad (11)$$

$$NDA_{ij} = \frac{\max(0,(V_j-X_{ij})}{V_j} \quad (12)$$

j'inci kriterin maliyet esaslı olması durumunda;

$$PDA_{ij} = \frac{\max(0,(V_j-X_{ij})}{V_j} \quad (13)$$

$$NDA_{ij} = \frac{\max(0,(X_{ij}-V_j)}{V_j} \quad (14)$$

formülleri kullanılmaktadır.

Adım 6: Her bir alternatif için ayrı ayrı hesaplanan pozitif ve negatif uzaklıkların ağırlıklı toplamları şu şekilde belirlenmektedir:

$$SP_i = \sum_{j=1}^{n} w_j PDA_{ij} \quad (15)$$

$$SN_i = \sum_{j=1}^{n} w_j NDA_{ij} \quad (16)$$

Adım 7: SP_i ve NP_i'ye ait normalize değerler bulunur.

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (17)$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \quad (18)$$

Adım 8: Her bir alternatife ait değerlendirme puanları (AS_i) hesaplanır.

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \quad (19)$$

Adım 9: Her bir alternatif AS_i'ye göre sıralanır. En yüksek değeri olan AS

alternatifi, diğer alternatifler arasından en iyi seçim olarak belirlenir (Çakır, 2018).

3.2. Araştırmanın Bulguları

Nakliye müteahhidinin hat seçiminde dikkate aldığı esaslar, yük türüne, ihracatçının talebine ve yükün aciliyetine göre farklılık göstermektedir. Bu esaslar özel olarak dikkate alındığında, bunun dışında gelen taleplerin değerlendirilmesinde freight forwarderler şekil 4'de belirtilen kriterler üzerinden değerlendirme yapmaktadırlar.

Çok sayıda kriterin bulunduğu bir süreçte, freight forwarderler müşterilerini memnun etmek ve portföylerinde tutmak için, uygun maliyet, istenilen termin süresine uyma, emniyet, vade, navlun geçerliliği gibi çok sayıda değişkenin aynı anda optimum olmasını sağlamaya çalışmaktadırlar.

Çalışmada AHP ve EDAS entegre olarak kullanılacağı için, öncelikle kriter ağırlıkları AHP ile oluşturulmuştur. Bu aşamada, freight forwarderlerden kriterlerin ikili karşılaştırmalarını Saaty 1-9 ölçeğinde yapmaları istenmiştir.

Kriter ağırlıklarının belirlenmesi için AHP yönteminin aşamaları;

- Karar problemi tanımlanır.
- Faktörler arası karşılaştırma matrisi oluşturulur.
- Faktörlerin yüzde önem dağılımları belirlenir.

Her bir sütundaki karşılıklı ağırlıklar (2) numaralı formül yardımıyla dikkate alınarak, sütun vektörünün oluşturulması sağlanmıştır.

Oluşturulan vektör sonucu elde edilen değerlerin, her bir satır için ortalaması alınarak, tablo 4'deki gibi kriterlerin ağırlıkları elde edilmiştir. Bu ağırlıklar, hat tercihi için EDAS yönteminde dikkate alınacaktır.

Bu aşamada güncel bir nakliye talebi, freight forwarderler tarafından 3 konteyner hattı arasından değerlendirilecek ve en uygun hat seçilecektir.

Freight Forwarderler ile yapılan görüşmede, her bir forwarderden, İstanbul'da makine yedek parça üretimi yapan bir firmanın Ambarlı'dan Almanya liman teslimi olarak yapılacak 1x20' yüklemesi için fiyat ve diğer koşulları iletmeleri istenmiş ve 5'li Likert ölçeği dikkate alınmıştır.

Seçim aşamasında EDAS yönteminin aşamaları:

- Belirlenen alternatiflerin içinden en önemli kriterler seçilir.
- Karar matrisi (X) oluşturulur.
- Tüm kriterlere göre ortalama çözüm belirlenir.
- Kriter tipine (maliyet ve kar) göre ortalamanın negatif uzaklığı (NDA) ve ortalamanın pozitif uzaklığı hesaplanır.
- Tüm alternatifler için PDA ve NDA'nın ağırlıklı toplamını belirlenir.
- Tüm kriterler için SPi ve SNi değerlerinin normalize edilmesi,
- Her bir alternatife ait değerlendirme skorları (AS) hesaplanır.
- En yüksek değeri olan AS alternatifi, diğer alternatifler arasında en iyi seçim olarak belirlenir.

Freight forwarderlerin hat seçim kriterlerinin belirlenmesinde, AHP ile elde edilen kriterlerin ağırlıkları dikkate alınacaktır.

Tablo 4. AHP'de alt kriter ağırlıkları.

Alt Kriterler	Ağırlık
Navlun seviyesi	0,09865854
Lokal masraflar	0,08949125
Multimodal masraflar	0,0868045
Transit süre (gün)	0,06317919
Servisin aktarmalı olup/ olmaması	0,06189943
Ekipman temini	0,05370044
Vade (gün)	0,05078136
Demuraj tarifesi	0,0507551
Özel ekipman temini	0,0464351
Geçerlilik	0,04377142
Sefer Sıklığı	0,03924183
Gemi programına uyma	0,03810438
Zamanında teslim	0,02962104
Müşteri ilişkileri	0,02885022
Esneklik	0,02556326
Yük takibi	0,02221349
Sorumluluk	0,02052684
Rezervasyon kolaylığı	0,02000268
İç nakliye sağlanabilmesi	0,01941789
Dökümantasyon kolaylığı	0,01931544
Uğrak limanı	0,01697444
Varış/ kalkış ihbarları	0,01551491
Şikayet çözümü	0,01549737
Hatırlanma & Hediye	0,0106004
Emniyet	0,00960662
Popülarite	0,00646424
Denizcilikte uzmanlık	0,00632658
Ekipman kondisyonu	0,00603067
Ticari bilgilendirme	0,0046514

Alt kriterlerin ağırlıklarına göre önem sıralaması incelendiğinde ilk 5 kriterin navlun ve sefer kriterleri ana faktörlerine ait olduğu görülmektedir. Bu durum, dış ticaret yapan firmaların, freight forwarderlerden öncelikli beklentilerini ortaya koymaktadır.

Tablo 5'e göre, Ambarlı/ Almanya arasında yapılacak 1x20' ürün için freight forwarderin öncelikli tercihi, Hat 2 olmuştur. Diğer hatlar sırasıyla, Hat 1 ve Hat 3 olarak gerçekleşmiştir.

Tablo 5. EDAS'a göre hat tercihleri.

	SPi	SNi	NSPi	NSNi	Asi	Rank
Hat 1	0,043	0,018	0,399	0,857	0,628	2
Hat 2	0,109	0,014	1	0,890	0,945	1
Hat 3	0,008	0,129	0,079	0	0,039	3

Elde edilen sonuç dikkate alındığında, freight forwarderlerin pratikteki tercihi, EDAS yönteminden elde edilen sonuç ile örtüşmektedir. Görüşme yaptığımız freight forwarderlere göre, ilgili yükleme için kullanılacak konteyner hattı da Hat 2 olarak planlanmaktadır.

4. SONUÇ VE ÖNERİLER

Ülkemizde faaliyet gösteren global freight forwarderlerden elde edilen veriler ile çalıştırılan AHP/EDAS yöntemlerinin konteyner hat tercih kriterlerinin önem sıralamasına göre ilk 5 kriter sırasıyla, navlun seviyesi, lokal masraflar, multi modal masraflar, transit süre ve servisin aktarmalı olup/olmaması olarak belirlenmiştir. Navlun seviyesinin en önemli kriter olması ise, ihracatçı firmalarımızın nakliye taleplerinde özellikle en uygun navlun seviyesini talep etmek istemeleridir. Böylece, ihracat maliyetleri daha uygun gerçekleşebileceği için, ürünlerini daha rekabetçi fiyatlardan pazarlara sunma imkanları da artacaktır. Önem sıralaması açısından son 5 kriter sırasıyla, emniyet, popülarite, denizcilikte uzmanlık, ekipman kondisyonu ve ticari bilgilendirmedir.

Kriter sıralamaları dikkate alındığında, navlun ve taşıma maliyetlerinin ön sıralarda olması yöntemlerden elde edilen sonuçların geçerliliğini ortaya koymaktadır. Çünkü bu alanda yapılan çalışmalarda da (Kokkinis vd., 2006; Kannan vd., 2011; Sezer ve Saatçioğlu, 2008; Chu, 2014; Çancı ve Erdal, 2003; Sevgili ve Nas, 2017; Ho vd., 2017; Wen ve Huang, 2007) benzer sonuçlar elde edilmiştir.

Konteyner hatları, yanlış kritere çok fazla önem vermenin ve nakliyeciler için önemli olan seçim kriterlerinin öneminin

vurgulanmamasının, nakliyecinin memnuniyetsizliğine ve daha sonra taşıyıcı kayıplarına yol açabileceğine dikkat etmelidir (Abshire and Premeaux, 1991: 34). Rekabetçi fiyatlarda müşteri memnuniyetini vurgulayarak, uygun bir hizmet bütünlüğü geliştiren taşıyıcılar, mevcut müşterilerini sürdürmek ve yeni iş çekmek için en uygun konumda olacaklardır (Premeaux vd., 1995). Tablo 5'de elde edilen sıralama dikkate alındığında, piyasa koşulları ile birebir uyumlu olduğu ortaya çıkmıştır. Freight forwarderlerin hat tercih kriterlerini sağlayan optimum konteyner hatları, çalışmada bulunan sonuçlar ile aynıdır. Bu sonuca göre, özellikle diğer iş kollarında kullanımı artan Çok kriterleri karar verme (ÇKKV) yöntemlerinin denizcilik sektöründe de etkin olarak kullanılabileceği ortaya çıkmıştır. Günümüz denizcilik piyasasında, freight forwarderlerin müşteri memnuniyetini koruyabilmeleri oldukça önemlidir. Artan rekabet ve azalan taşıma talepleri dikkate alındığında, denizcilik piyasasında da ÇKKV yöntemlerinin kullanımı forwarderler, acenteler, brokerler, servis sağlayıcılar ve hatlar tarafından, yöntemleri kıyaslayabilme ve uygulanacak yöntemi seçme konularında katkı sağlayacağı düşünülmektedir.

Diğer deniz yolu taşıyıcıları da, taşıyıcı seçim kriterlerini ve bu servislerin kullanıcıları tarafından algılanan göreceli önemini bulmak için farklı çalışmalar yapabileceklerdir. Taşıyıcı seçim kriterlerinin belirlenmesi, kara yolu, demir yolu ve hava yolu gibi diğer modlar için de gelecekte incelenecektir.

Taşıyıcı ve taşıtanlar arasındaki algısal farklılıkları bulma çalışmaları önemlidir. Çünkü literatürde, hizmet kalitesi, servis sağlayıcılar ve servis kullanıcıları arasındaki farkların, kullanıcıların servis sağlayıcılarından memnuniyetlerini önemli ölçüde etkileyebileceğini göstermektedir. Bu tür bir çalışma, taşıyıcı teklifleri ile gemi sahibi beklentileri arasındaki negatif açığı daraltarak, taşıtanların memnuniyetini sağlamak için gerekli olacaktır.

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Research Article
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Maximum Length and Weight of Sharpsnout Seabream (*Diplodus puntazzo* Walbaum, 1792) for Black Sea and East Mediterranean Sea

Doğu Akdeniz ve Karadeniz için Sivriburun Karagözün (*Diplodus puntazzo* Walbaum, 1792) Maksimum Boy ve Ağırlık Kaydı

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 127-132

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ABSTRACT

On the shores of the Black Sea in Ordu province, a male *Diplodus puntazzo*, 454 mm long and weighing 1186.48 g was sampled on 15 March 2019 with a trammel net that was set for demersal fish species. This individual is the largest that has been reported from the Black Sea, Sea of Marmara, Aegean Sea and Eastern Mediterranean Sea.

Keywords: *Diplodus puntazzo*, Sharpsnout seabream, Maximum size, Black Sea, Mediterranean, Turkey

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ÖZET

Karadeniz'de Ordu ili sahillerinde, demersal balık türlerinin örneklenmesi amacıyla kullanılan fanyalı dip uzatma ağlarıyla 15 Mart 2019 tarihinde 454 mm uzunluğunda ve 1186.48 g ağırlığında erkek *Diplodus puntazzo* bireyi örneklenmiştir. Örneklenen bu birey Karadeniz, Marmara, Ege ve Doğu Akdeniz için en büyük birey olarak kayıt altına alınmıştır.

Anahtar sözcükler: *Diplodus puntazzo*, Sivriburun karagöz, Maksimum büyüklük, Karadeniz, Akdeniz, Türkiye

1. INTRODUCTION

Sharpsnout seabream (*Diplodus puntazzo* Walbaum, 1792), is a member of Sparidae family with a distribution range from Strait of Gibraltar to the Black Sea (except for the northwestern coast and the Sea of Azov) (Bauchot et al., 1986, Russell et al., 2014). Due to the global warming of seawater temperatures, it continues to spread across the northern European coast of the Atlantic Ocean (Vinagre et al., 2010). It is a common species of the Mediterranean Sea, Aegean Sea and the Sea of Marmara (Russell et al., 2014). Although it inhabits the water column up to 150 m depth, it is a demersal fish that usually lives in 5-20 m depths with a rocky bottom structure (Kraljević et al., 2007; Fischer et al., 1987: Russell et al., 2014). This hermaphrodite species can grow up to 60 cm long but generally it is between 15-30 cm (Fischer et al.,1987). It is considered as a long living species, where 10 years of age was reported from the Canary Islands (Dominguez-Seoane et al., 2006), and 18 years from the Adriatic Sea (Kraljević et al., 2007). While the breeding period is from September to February, the most intense reproduction occurs in November in the northwest of Africa (Pajuelo et al., 2008).

The average production of sharpsnout seabream in Turkey this past decade was 10.2 tons (TUIK, 2018). This commercially important species is reported to feed mostly on mollusk, seaweed and shrimp species (Froese and Pauly, 2019).

In this study, the maximum size of sharpsnout seabream registered to the Black Sea, Sea of Marmara, Aegean Sea and the Eastern Mediterranean is presented.

2. MATERIAL AND METHOD

On the shores of the Black Sea in Ordu province (Figure 1), a male *D. puntazzo*, 454 mm long and weighing 1186.48 g was sampled on 15 March 2019 with a trammel net (inner mesh size: 80 mm) that was set for demersal fish species.

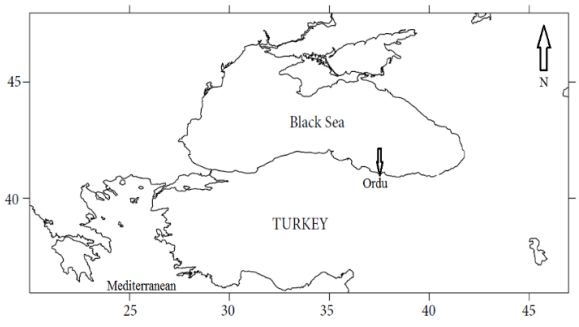

Figure 1. Map of the sampling area.

The total length of the sampled individual was measured with a sensitivity of ± 1 mm, and weighted with a sensitivity of ± 0.01 g. This individual, with the maximum reported length of the Aegean Sea and the Eastern Mediterranean Sea (Figure 2), was identified according to Mater et al. (2009) and its scientific name was checked from Fishbase (Froese and Pauly, 2019).

Figure 2. A male *Diplodus puntazzo* with 454 mm total length and 1186.48 g weight in the Black Sea

3. RESULTS

The measured morphometric measurements of the sampled 454 mm long and 1186.48 g individual' are given in Figure 3.

The metric and meristic characteristics of the male individual are given in Table 1.

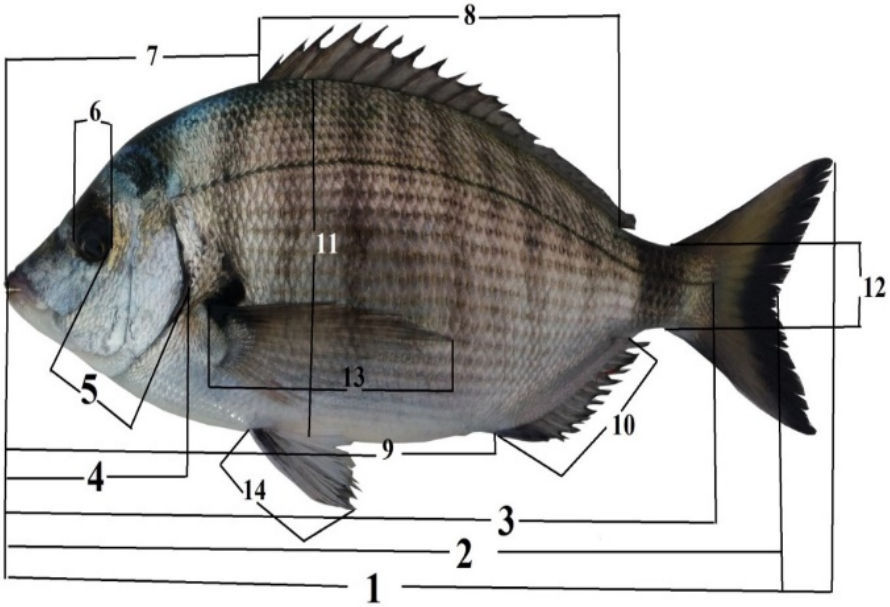

Figure 3. Overview of the morphometric measurements used in this study (1:Total length, 2: fork length, 3: standard length, 4: head length, 5: post orbital length, 6: eye diameter, 7: predorsal fin distance, 8: dorsal fin base length, 9: preanal fin distance, 10: anal fin base length, 11: body depth, 12: minimal caudal peduncle depth, 13: pectoral fin length, 14: pelvic fin length)

Table 1. Metric and meristic values for *Diplodus puntazzo* in the Black Sea (Ordu, Turkey)

Measurements	
Sex	Male
Total length (mm)	454
Weight (g)	1186.48
Standard length (mm)	366
Fork length (mm)	395
Body depth (mm)	135.95
Head length (mm)	100.4
Post orbital length (mm)	41.78
Eye diameter (mm)	18.04
Predorsal fin distance (mm)	142.05
Dorsal fin base length (mm)	178.2
Preanal fin distance (mm)	269
Anal fin base length (mm)	66.28
Pectoral fin length (mm)	109.53
Pelvic fin length (mm)	60.27
Minimal caudal peduncle depth (mm)	33.59
Dorsal fin	XI/14
Anal fin	III/13
Pectoral	15
Pelvic	I/5
Caudal	23
Lateral line	63

4. DISCUSSIONS

This species can grow up to 60 cm long but generally it is between 15-30 cm (Fischer et al., 1987). It is considered as a long living species, where 10 years of age was reported from the Canary Islands (Dominguez-Seoane et al., 2006), and 18 years from the Adriatic Sea (Kraljević et al., 2007). Kraljević et al., (2007) also the reported largest registered individual from the eastern Adriatic Sea as 46.7 cm and 1545 g. A study from the Black Sea by Aydın and Sağlam (2019) reported the largest registered individual as 41.6 cm and 1007.2 g. The individual that was sampled in this study, 45.4 cm and 1186.48 g, is the largest registered sharpsnout seabream for the Black Sea, Sea of Marmara, Aegean Sea and the eastern Mediterranean, and second largest for the whole Mediterranean Sea. The other studies conducted in the Black Sea, Sea of Marmara, Aegean Sea, Adriatic and the Mediterranean Sea are given in Table 2. The maximum length that this species can reach was given by Fischer et al., (1987) as 60 cm.

D. puntazzo is a local species of the Black Sea (Russell et al., 2014) and its population is increasing daily (Personel observation). Yet, there is only one study from the Black Sea, conducted by Aydın and Sağlam (2019). In recent years, a large part of the coastal areas of the southern Black Sea have been filled, due to road construction, airport construction and land reclamation. Contrary to the negative effects of the infilled areas to the coastal habitats there have had positive effects to the population increase of the species (shi drum, brown meagre, sharpsnout seabream, annular seabream, scorpionfish, seabream, seabass, sand striped sea bream, etc.) which inhabit rocky habitats. Lately there has been an increase in these species (Aydın and Sozer, 2016). Since there are very sparse algae communities when compared to the Mediterranean Sea and Aegean Sea shores, the rocky areas cannot provide sufficient shelter for the juveniles of these species. These juveniles inhabit the sparse algae communities of the rocky habitats, and as

they grow, they migrate to deeper waters (Fischer et al., 1987). It is thought that the infilled shore areas provide suitable habitats for the young of these species. There is no study on sharpsnout seabream population structure in the Black Sea. With this study, the maximum length registered for the Black Sea, Sea of Marmara, Aegean Sea and eastern Mediterranean Sea has been updated.

Table 2. The other studies conducted in the Black Sea, Sea of Marmara, Aegean Sea, Adriatic and the Mediterranean Sea

References	Locality	N	L_{max} (cm)	W_{max} (g)
Karakulak et al., (2006)	Aegan Sea	7	25.2	-
Özaydın et al., (2007)	Aegan Sea	27	21.4	-
Kraljević et al., (2007)	Adriatic Sea	630	46.7	1545.00
Kapiris and Klaoudatos (2011)	Aegan Sea	29	23.9	209.00
Chaouch et al., (2013)	Mediterranean	490	26.1	230.83
Altın et al., (2015)	Aegan Sea	87	24.5	209.80
Öztekin et al., (2016)	Marmara	2	32.3	535.00
Kara et al., (2017)	Aegan Sea	61	13.5	41.30
Aydın and Sağlam (2019)	Black Sea (Hopa)	11	41.6	1007.2
This study	Black Sea (Ordu)	1	45.4	1186.48

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Research Article
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Proximate Composition of Three Different Fish (Trout, Anchovy and Whiting) Waste During Catching Season

Üç Farklı Balık Türü (Alabalık, Hamsi ve Mezgit) Atıklarının Avlama Sezonu Boyunca Besin Komposizyonu Bileşimi

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 133-140

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ABSTRACT

The aim of this study was to determine the proximate composition (lipid, crude protein, crude ash and moisture) of three different fish wastes [trout (*Onchoryncus mykiss*), anchovy (*Engraulis encrasicolus*), and whiting fish (*Merlangius merlangus)*] during the catching season (November through April). As a result of the proximate composition, it was varied among the species and months. On wet weight basis, total lipids ranged between 16.4% (January) and 30.5% (November) (w/w) for trout, 5.8% (February) and 8.9% (December) for anchovy and 2.5% (March) and 9.6% (December) for whiting fish wastes. The protein content for all species waste varied between 10.4%- 16.8% among the species studied on wet weight basis. The highest ash content estimated in trout, anchovy, and whiting fish wastes were 4.2% in January, 4.7% in April and 2.6% in December, respectively ($p<0.05$). Moisture content was found in the lowest trout waste (52.3%, November) and the highest whiting waste (81.4%, March). In dry weight basis, the highest lipid, crude protein and ash content in different months were found in trout waste (70.7%, November), whiting waste (65.6%, March) and whiting fish waste (20.7%, March), respectively ($p<0.05$). Marked significant differences basis in wet and dry weight basis were observed among fish species waste for the mean moisture, lipid, and ash contents ($p<0.05$).

Keywords: fish waste, proximate composition, catching season, months

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ÖZET

Bu çalışmada, (alabalık (*Onchoryncus mykiss*), hamsi (*Engraulis encrasicolus*) ve mezgit (*Merlangius merlangus*) atıklarının avlanma mevsimi boyunca (Kasım ile Nisana arası) besin komposizyonunun belirlenmesi amaçlanmıştır. Yapılan çalışma sonucunda, besin komposizyonu türler ve aylar arasında değişiklik göstermiştir. Yaş ağırlığa göre , toplam lipit alabalık atığında % 16.4 (Ocak) ile % 30.5 (Kasım) (a / a), hamsi atığında % 5.8 (Şubat) ve % 8.9 (Aralık), mezgit atığında % 2.5 - % 9.6 arasında değişmiştir. Tüm türlerin atıkları için protein içeriği, yaş ağırlık bazında %10.4- %16.8 arasında değişmiştir. Alabalık, hamsi ve mezgitte tahmin edilen en yüksek kül içeriği sırasıyla, Ocak ayında %4.2, Nisan ayında %4.7 ve Aralık ayında %2.6 olarak bulunmuştur. Nem içeriği en düşük alabalık atığında (% 52,3, Kasım) ve en yüksek mezgit atığında (% 81,4, Mart) tespit edilmiştir. Kuru ağırlık bazında en yüksek lipid, ham protein ve kül içeriği sırasıyla alabalık atığında (% 70.7, Kasım), mezgit atığında (% 65.6, Mart) ve mezgit atığında (% 20.7, Mart) bulunmuştur ($p < 0.05$). Yaş ve kuru ağırlık olarak ortalama nem, lipit ve kül içeriği bakımından balık türleri atıkları arasında belirgin farklılıkların olduğu gözlenmiştir ($p<0.05$).

Anahtar Sözcükler: balık atığı, besin komposizyonu, avlanma mevsimi, aylar

1. INTRODUCTION

Every year, around 20 million tons of fishery products, which consist of irrigated species and processing wastes, are disposed of without any use and this amount corresponds to 25% of annual fishing production (Kim and Mendis, 2006). In the European Union countries, approximately 5.2 million tons of solid waste is produced each year from aquaculture processing, and 3 million tons of these wastes come from the companies that make fillet extraction, salting and smoking (Ferraro et al., 2010). This leads to the loss of valuable nutritional components in terms of nutrition content which, if not properly processed for use in human or animal nutrition, and economic cost increase (Rustad, 2007). On the other hand, disposing of waste processing wastes with rich organic matter content creates a problem in terms of the environment. (Kotzaminis et al., 2001; Kim and Mendis, 2006; Hayes and McKeon, 2014).

The fish processing industry produces more than 60% by-products as waste, which includes head, frames, fins, tails, skin and gut. These fish wastes are a rich source of many value added products such as proteins, amino acids, bioactive peptides, collagen, gelatin, oil, calcium and enzymes (Ramakrishnan et al., 2013). Fish processing wastes are alternatively used as fish mince, applications of fish gelatin, fish as a source of nutraceutical ingredients, fishmeal production, the possible use of fish and protein concentrate as a food source (Jayathilakan et al., 2014).

Limited attention has been paid to studies on the proximate compositions of wastes during catching season. The aim of this study was to assess variability in the proximate composition of three different fish the wastes [trout *(Onchoryncus mykiss*), anchovy (*Engraulis encrasicolus*) and whiting fish (*Merlangius merlangus*)] during the catching season (November through April).

2. MATERIAL AND METHOD

Waste material of trout, anchovy and whiting, which consisted of head, fins, and viscera, gills and vertebral column with adhering meat obtained during filleting of fish, were obtained from a commercial fish processing plant (Figure 1). Fish wastes were iced in a styrofoam boxes and immediately transported to the laboratory. Then, the samples were stored at -80°C until used. To determine the proximate composition, total protein was analyzed using Kjeldahl method (AOAC 981.10, 1998), and lipid analysis was performed using Bligh & Dyer (1959) method. Moisture was determined according to AOAC (1990) and crude ash was analyzed according to AOAC 935.47 (1998).

Figure 1. Trout *(Onchoryncus mykiss*), anchovy *(Engraulis encrasicolus)* and whiting *(Merlangius merlangus)* wastes

3. RESULTS

As a result of statistical analysis, the difference between lipid content of trout, anchovy and whiting wastes were found to be significant according to months ($p<0.05$). The highest lipid content of trout, whiting and anchovy was 30.54% in November, 9.6% in December and 8.87% in December, respectively ($p<0.05$). The highest moisture content was 63.48% in trout waste, 81.4% in whiting waste and 78.6% in anchovy waste ($p<0.05$). The highest ash contents for trout, whiting and anchovy wastes were 4.17% in January, 3.78% and 4.68% in March, respectively ($p<0.05$). The highest protein content of trout and anchovy wastes was 16.84% in January and 13.28% in March, respectively ($p<0.05$). In the whiting waste, the difference between the months in terms of protein was statistically insignificant ($p>0.05$). Marked significant differences ($p<0.05$) were observed among fish species waste for the mean moisture, lipid, and ash contents (Table 1)

Table 1. The proximate compositions of trout, whiting and anchovy wastes (%)

Trout				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	30.539±0.346^{e}	52.314±0.784^{a}	2.159±0.036^{a}	10.522±0.004^{a}
December	27.913±0.586^{d}	52.825±1.080^{a}	3.257±0.005^{c}	10.368±0.204^{a}
January	16.448±0.355^{a}	59.512±0.396^{b}	4.167±0.001^{e}	16.836±0.269^{c}
February	21.077±0.019^{c}	60.846±0.790^{b}	3.783±0.015^{d}	15.794±0.178^{c}
March	18.340±0.023^{b}	63.210±0.068^{c}	2.632±0.328^{b}	12.789±1.107^{b}
April	18.360±0.163^{b}	63.478±0.143^{c}	2.340±0.088^{ab}	12.577±0.927^{b}
Anchovy				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	8.279±0.076^{d}	75.132±0.056^{a}	4.279±0.013^{b}	11.819±0.730^{ab}
December	8.874±0.056^{e}	74.674±0.202^{a}	4.211±0.176^{b}	10.924±0.152^{a}
January	7.656±0.011^{c}	75.198±0.551^{a}	4.210±0.140^{b}	12.544±0.067^{bc}
February	5.726±0.044^{a}	78.581±0.326^{c}	4.467±0.083^{bc}	11.781±0.763^{ab}
March	5.845±0.462^{a}	77.266±0.310^{b}	3.814±0.172^{a}	13.276±0.763^{c}
April	6.980±0.054^{b}	77.793±0.071^{b}	4.677±0.051^{c}	12.648±0.147^{bc}
Whiting				
Months	**Lipid**	**Moisture**	**Ash**	**Protein**
November	8.617±0.422^{d}	73.334±0.086^{a}	2.680±0.098^{a}	11.766±0.680^{a}
December	9.557±0.031^{e}	73.311±0.231^{a}	2.557±0.047^{a}	11.930±0.478^{a}
January	5.978±0.154^{c}	78.103±0.593^{b}	3.772±0.410^{c}	12.096±0.422^{a}
February	5.676±0.586^{c}	78.540±0.033^{b}	3.287±0.194^{b}	11.811±0.316^{a}
March	2.522±0.394^{a}	81.408±0.002^{c}	3.784±0.050^{c}	12.002±0.454^{a}
April	4.030±0.071^{b}	80.767±0.033^{c}	3.265±0.036^{b}	12.044±0.005^{a}

The proximate compositions of trout, whiting and anchovy wastes on dry weight basisare given Table 2. When the lipid, ash and protein levels of trout, whiting and anchovy wastes were taken into consideration on the basis of dry matter, it was found that the difference between the months was significant ($p<0.05$). The highest lipid content in trout waste was determined in November with a significant 70.66%. The highest ash and protein content in trout waste was 11.13% and 44.96% in January, respectively ($p<0.05$).

The lipid content of whiting fish waste was determined in December with 39.76% ($p<0.05$). The highest ash and protein

content in whiting fish waste was 20.67% and 65.56% in March ($p<0.05$).
The highest lipid content in anchovy waste was 36.96% in December ($p<0.05$). The ash content of whiting waste was highest in February (20.33%) ($p<0.05$). Protein content was 57.88% in March ($p<0.05$).

Table 2. The proximate compositions of trout, whiting and anchovy wastes (g/100g dry weight basis)

Trout			
Months	**Lipid**	**Ash**	**Protein**
November	70,658±0,301^{e}	4,995±0,119^{a}	24,347±0,181^{a}
December	67,197±0,141^{d}	7,843±0,161^{c}	24,960±0,020^{a}
January	43,917±0,217^{a}	11,128±0,188^{e}	44,955±0,030^{c}
February	51,844±0,186^{b}	9,305±0,078^{d}	38,850±0,264^{b}
March	54,372±2,279^{bc}	7,782±0,635^{c}	37,846±1,645^{b}
April	55,199±1,465^{c}	7,032±0,016^{b}	37,769±1,449^{b}
Anchovy			
Months	**Lipid**	**Ash**	**Protein**
November	33,976±0,831^{d}	17,564±0,535^{a}	48,460±1,366^{ab}
December	36,961±0,110^{e}	17,537±0,674^{a}	45,502±0,785^{a}
January	31,365±0,235^{c}	17,246±0,418^{a}	51,389±0,184^{bc}
February	26,060±0,200^{a}	20,334±0,690^{b}	53,606±0,890^{c}
March	25,492±2,157^{a}	16,632±0,846^{a}	57,876±3,002^{d}
April	28,719±0,076^{b}	19,243±0,010^{b}	52,038±0,067^{bc}
Whiting			
Months	**Lipid**	**Ash**	**Protein**
November	37,368±2,090^{d}	11,623±0,505^{a}	51,008±2,595^{a}
December	39,755±0,635^{d}	10,640±0,400^{a}	49,606±1,035^{a}
January	27,388±1,556^{c}	17,246±1,341^{b}	55,366±0,215^{b}
February	27,286±1,382^{c}	15,820±0,099^{b}	56,894±1,480^{b}
March	13,742±1,554^{a}	20,696±1,174^{c}	65,562±0,380^{d}
April	20,839±0,247^{b}	16,883±0,089^{b}	62,278±0,336^{c}

4. DISCUSSIONS

When the lipid contents of trout wastes were evaluated according to months, the highest lipid content was 30.54% in November and the highest lipid content of whiting fish and anchovy wastes was 9.6% and 8.87% in December, respectively ($p<0.05$). The presence of head in the content of trout wastes used in our study is thought to increase the lipid value and opted as being a good source of lipid. It is remarked that the lipid contents of fish wastes are similar to findings of other researchers (Nguyen et al., 2011; Suvanich et al., 2006; Tahari et al., 2012; Kolakowska et al., 2006). Changes in lipid contents of fish wastes were evaluated according to months were found to be significant ($p<0.05$). As well, these values are almost similar to those of Nguyen et al. (2011), the average chemical composition of the head, tail and internal organs of the yellow tail (*Thunnus albacares*) were investigated. The most important differences were found in terms of lipid content. Accordingly, the lipid content was found to be 3.73% in the internal organs and tail, while the lipid content in the head region was found to be at least 3 times richer (13%). On the other hand, Suvanich et al. (2006) according to the changes in the nutritional composition of catfish, cod, flounder, mackerel and salmon, and the highest fat content among these fish was found in mackerel (11.7%). Finally, Tahari et al. (2012) found that rainbow trout (*Onchoryncus mykiss)* in viscera lipid content was found %13. In this study, 54.38

% lipid content was determined on dry weight basis in trout waste in March. These values are almost similar to those Kolakowska et al (2006), found that the composition of rainbow trout offal in March %47 lipid.

The highest moisture content was 63.48% in trout, 81.4% in whiting and 78.6% in anchovy in April ($p<0.05$). Other researchers have reported similar findings (Murray et al., 2001; Nguyen et al., 2011; Suvanich et al., 2006). Changes in moisture contents of fish wastes evaluated according to months were found to be significant ($p<0.05$). As well, the moisture values of anchovy waste consist of the head, internal organs and the spine was found as 73.85 ± 0.14% by Koç (2016). On the other hand, Roslan et al. (2015) found that tilapia (*Oreochromis niloticus*) waste contained 66.57% moisture and Detkamhaeng et al (2016) found that yellowtail *(Thunnus albacares*) and Skipjack tuna (*Katsuwonous pelamis)* waste contained 73.17% and 74.51% moisture, respectively. Finally, Tahari et al. (2012) found viscera moisture content of rainbow trout (*Onchoryncus mykiss)* as 71.65 %.

Changes in ash contents of fish wastes evaluated according to months were found to be significant ($p <0.05$). The highest ash content for trout waste was 4.17% in January, 3.78% and 4.68% in March for whiting and anchovy ($p <0.05$). These values are almost similar to those of Koç (2016). As well, Tahari et al. (2012) found the ash content of rainbow trout (*Onchoryncus mykiss)* viscera as %2.73.

The highest protein content of trout was 16.84% in January and 13.28% in anchovy in March ($p <0.05$). It is remarked that the protein contents of fish wastes are similar to findings of other researchers (Nguyen et al., 2011; Tahari et al., 2012; Kolakowska et al., 2006; Koç 2016). Roslan et al. (2015) found that tilapia (*Oreochromis niloticus*) waste contained 14.60% crude protein. As well as Nguyen et al. (2011) investigated the average chemical compositions of the head, tail and internal organs of the yellow tail (*Thunnus albacares*). It was found that all by-products consisted mainly of protein and ranged between 15 to 17%. Similarly, Koç (2016) estimated 14.54 ± 0.05% protein content in anchovy waste consist of the head, internal organs and the spine. Finally, Tahari et al. (2012) found that rainbow trout (*Onchoryncus mykiss)* in viscera protein content was %15. Raghavan (2008) reported that the amount of protein in fish waste can be up to 10-20% of the total protein in fish (w / w). On dry weight basis, %57.9 protein content in anchovy waste was determined in March in this study. These values are almost similar to those Estaban et al., (2007), examined the nutrient composition of wastes obtained from fish-selling businesses. Accordingly, the nutrient composition of wastes for protein 58%.

Ghaedian et al (1998) claimed, most fish contain 15-30% protein, 0-25% fat and 50-80% moisture It is seen that the values obtained by Ghaedian et al. (1998) are close to the results obtained in this study. The chemical composition of fish wastes can vary according to the type of fish, body parts of the waste, season, feeding, and moisture content of waste (Benjakul and Morisey, 1997; Kotzaminis ve ark., 2001; Kołakowska ve ark., 2006).

5. CONCLUSION

In the study, it was determined that the chemical composition of fish wastes may vary according to the type of fish and months during catching season. Regarding to suitable lipid and protein content, all waste in this study could be used as a decent substitute source to extract fish lipid and protein. This lipid and protein could be considered as the attention source for human consumption as well as industrial use. In this sense, in order to prevent waste at source, to encourage recycling, to use waste as source and to extract additional natural resources, it is considered that fish processing wastes could be evaluated in functional food, animal feed, organic fertilizer, medicine and pharmacology

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Research Article
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Maritime Investigation Reports Involving Man-Over-Board (MOB) Casualties: A Methodology for Evaluation Process

Denize Adam Düşme (DAD) Kazaları İçeren Deniz Kazası İnceleme Raporları: Bir Değerlendirme İşlem Yöntemi

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 141-170

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ABSTRACT

Flag states must issue their maritime investigation reports in accordance with the International Maritime Organization (IMO) circulars with the inclusion of 'lessons learned' items from recorded accidents or incidents. To identify the root cause of an event, there must be enough detail of information about the investigated event presented in reports. The information included in reports may help identifying the procedural deficiencies or technical challenges. Considering the Man-Over-Board (MOB) events as a sub group of maritime accident investigations, authors systematically reviewed over 100 reports containing MOB events in this study.

In this study, reports are reviewed and major differences in formats as well as level and type of information are recorded. A systematic methodology for reviewing and reporting the overall information retrieved from maritime accident reports is presented. To cover all information from reviewed reports, 113 information items are identified. An associated standard form is developed for use in extracting information from all investigation reports. Enabling the data collected systematically from reports, issued by the world maritime accident reporting states and agencies, and successively populated into a database for overall analysis, this form is called "Maritime MOB Events Investigation Form (MEI Form)". This paper presents the content of the MEI Form and demonstrates the methodology of use for retrieving, formatting and analyzing the information from the MOB investigation reports using case examples.

Keywords: Maritime Accident Investigation, Casualty Investigation Code, Man Over Board (MOB), Lessons Learned, Database, Data Format, Report Forms.

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ÖZET

Bayrak devletleri, deniz kazaları inceleme raporlarını Uluslararası Denizcilik Örgütü (IMO) genelgelerine uygun olarak ve kaza veya olaylardan öğrenilen dersleri içerecek şekilde yayınlamak zorundadırlar. Bir olayın kök sebebinin tanımlamak için ve bu nedenle raporlardan "Çıkartılan Dersler" dâhil edebilmesi için, sunulan raporlarda araştırılan olay ile ilgili yeterli bilgi detayı olması gereklidir. Raporlarda yer alan bilgiler olay esnasında yapılan işlemlerdeki eksikliklerin veya oluşan teknik zorlukların belirlenmesine yardımcı olabilir. Bu çalışmada, Denize Adam Düşmesi (DAD) olayları deniz kazaları araştırmasının bir alt grubu olarak değerlendirilmiş ve DAD olaylarını içeren 100'den fazla rapor sistematik olarak gözden geçirilmiştir. İncelenen raporlarda, format ve bilgilerin yanı sıra bilgi içeriklerinde de önemli farklılıkların olduğunu tespit edilmiştir.

Bu çalışmada, deniz kazaları raporlarından elde edilen genel bilgilerin gözden geçirilmesi ve raporlanması için sistematik bir yöntem sunulmuştur. İncelenen raporlardaki tüm bilgileri kapsayacak şekilde 113 bilgi maddesi tanımlanmıştır. Tüm araştırma raporlarından bilgi çıkarmada kullanmak amacıyla bir standart form oluşturulmuştur. Dünyada deniz kazalarını rapor eden devletler ve ajanslar tarafından yayınlanan ve genel analiz için bir veri tabanına yerleştirilen raporlardan sistematik olarak toplanan verilerin sağlanması için kullanılacak olan bu form "Denizcilik DAD Olayları İnceleme Formu (DAD Form veya MEI Form)" olarak adlandırılmıştır. Bu çalışmada DAD Formunun içeriği tanımlanmış, oluşturulan bu formlar kullanılarak araştırma raporlarından bilgi derlenmesi, formatlanması ve analiz edilmesi amacıyla olay örnekleri ile birlikte sistematik kaza inceleme yöntemi gösterilmiştir.

Anahtar sözcükler: Deniz kazaları İnceleme, Kaza İnceleme Yönetmeliği, Denize Adam Düşmesi, Öğrenilen Dersler, Veri Formatlanması, Rapor Formatı.

1. INTRODUCTION

International conventions, such as the Safety of Life at Sea (SOLAS) (URL-1, 2019), the Maritime Pollution Act (MARPOL) (URL-2, 2019) and the Load Line Convention (Contracting Governments, 1966), introduce liability and responsibility of casualty investigations assumed by the flag states. Therefore, flag states must prepare accident or incident reports and share findings as mandated by these international agreements. An international convention (United Nations, 1982) clearly states that flag states are required to carry out an inquiry for the ships sailing under their flag at open seas. The IMO adopted the Casualty Investigation Code (CI Code) (IMO MSC, 2008a) in the year 2008 in order to set an international standard for conducting the safety investigations and reporting. This code brings liability to very serious marine casualties. While MSC brings responsibility for the investigation of very serious marine casualties, the Maritime Labor Convention (MLC) additionally introduces flag states to investigate serious marine casualties (ILO, 2006). In order to classify a marine casualty as 'very serious marine casualty', the incident must involve; 'the total loss of the ship or death or severe damage to the environment (URL-3, 2019).

CI Code also clearly states that the objective of a marine safety investigation is 'preventing marine casualties and marine incidents in the future' (IMO MSC, 2008b).

It also states the inclusion of 'the identification of causal factors and the making of safety recommendations' as necessary and yet 'the reports must be provided to the Organization to enable wide dissemination of information to assist the international marine industry to address safety issues' (IMO MSC, 2008a).

A marine safety investigation report is written as a result of a marine safety investigation that must contain certain information, such as basic facts about the casualty or incident, relevant details about the ship, and narrative detailing of the incident or marine accident (IMO MSC, 2008a). Casualty investigation reports including such information are submitted to the IMO Secretariat by the member flag states. IMO has a designated group called Correspondence Group on Casualty Analysis and this group reviews the submitted reports according to the guidelines included in a document called Casualty Analysis Procedure (URL-4, 2019). This group drives important information from casualty investigation reports, such as the analysis and lessons learned information, which is published for the maritime community. In this study we studied the investigation reports and identified several inconsistencies in presentation of the data as well as missing information.

In current practice, MSC recommends root-cause analysis performed in the investigations; however, there is no guideline provided. In literature, according to comparison criteria (Gano, 2007), an effective Root Cause Analysis process compares the six generalized criteria. There are several methods for analyzing the root causes of an accident/incident. Arslan (2011), listed main root cause analysis methods (Arslan, 2011) for chemical tanker management as; FTA (fault tree analysis), ETA (event tree analysis), FMEA (Failure Mode and Effect Analysis), What/If Method, HAZOP (Hazard and Operability Analysis) and SWOT-AHP. According to a study, there are 20 different accident analysis methods; however, the most commonly used ones are fault tree analysis and Pareto analysis.

Kececi (2015) developed and presented criteria, with 18 items, as conditions for appropriate application of the root cause analysis of marine accidents. Akyuz and Celik (2014a) proposed an investigation model to apply to marine accidents that may help identify and reduce human errors in marine accidents (Akyuz and Celik, 2014b). Their study included a man overboard situation during a lifeboat drill, chosen as a novel case for their model demonstration. So far, there are no proposals in literature for the standardization of the investigation forms to use or process the current data other than what is laid out by current procedures issued by the IMO. Current IMO procedures seem to be generic, which is causing inconsistencies in formats between reports. Additionally, inconsistencies in reports result in a big yet unstructured data being used by the maritime agencies as well as academia. Some of the other studies about marine casualty investigation and CI Code focus on limited aspects of casualty investigation and proposal for use in local regions (Lim, 2010). Schröder- Hinrichs (2011) studies Accident investigation reporting deficiencies related only to organizational factors limited only with machinery space fires and explosions (Schröder-Hinrichs, 2011). Some of these studies are centered on general casualty investigation for a specific event, however, these studies are not focused on the use of the IMO casualty investigation code. For example, Moradi *et al.* (2014) proposes a fuzzy model for Iranian marine casualty management and Fukuoka (2016) studied the relationship between latent conditions and the characteristics of holes in marine accidents based on the Swiss cheese model. Another perspective of maritime casualty reporting is the data being publicly available and structured such that agencies of academia may digitally retrieve and conduct analysis. The methodology introduced in this paper provides a methodology of

structuring the data and sharing the information using a proposed form for enabling automated processes for analysis. With this approach, lessons learned based on statistics from the world's reported MOB events may easier be driven. Therefore, this methodology may be viewed as the first step definition and guidance for automating the lessons learned process for better understanding the areas for procedural improvements or introducing new techniques and technologies.

The most important outcome of maritime accident reports is the lessons learned and sharing this outcome with maritime user's community and technology developers. Weber *et al.* (2000), defines tasks in lessons learned process as; collecting, validating, storing, disseminating, and reuse. Weber *et al.* (2000) lists various methods of lessons learnt systems and proposes a system called 'Active Lessons Delivery System (ALDS)' (Weber *et al.*, 2000). Such studies point out that there is a wide range of lessons learned processes and procedures. However, for driving lessons learned information from marine casualty investigations, specific procedures and processes are yet to be described.

The outcome of this study is the proposed use of the form, MEI Form, which is specific to the MOB event reports. It may be viewed as guidance for automating the information acquisition and formatting the reports for driving a more structures process for driving lessons learned from MOB cases. World maritime investigation agencies can also use the proposed MEI Form as guidance in standardizing their data collection process.

2. CURRENT METHODOLOGY EMPLOYED IN MARITIME ACCIDENT REPORTING

2.1. Process for Maritime Accident Investigation Reporting Involving MOB Events

According to IMO Maritime Safety Committee Regulation (IMO MSC, 2008a), a marine safety investigation report is written as a result of a marine safety investigation which must contain the following specific information:

- a **summary** outlining the basic facts of the marine casualty or marine incident and stating whether any deaths, injuries or pollution occurred as a result
- the **identity** of the flag State, owners, operators, the company as identified in the safety management certificate, and the classification society (subject to any national laws concerning privacy)
- where relevant the **details** of the dimensions and engines of any ship involved, together with a description of the crew, work routine and other matters, such as time served on the ship;
- a **narrative** detailing the circumstances of the marine casualty or marine incident;
- analysis and comment on the **causal factors** including any mechanical, human and organizational factors;
- a discussion of the marine safety investigation's findings, including the identification of **safety issues**, and the marine safety investigation's **conclusions**; and
- where appropriate, **recommendations** with a view to preventing future marine casualties and marine incidents.

For further review and analysis of these reports focusing on events involving casualties, these reports are reviewed by various different groups of the IMO according to the guidelines included in a document called Casualty Analysis Procedure. Figure 1 shows the details of this process. In this process, IMO Casualty Analysis Working Group (CAWG) drives out the following information from casualty investigation reports (URL-4, 2019):

- the analysis of casualty report
- draft lessons learned for presentation to seafarers;
- potential safety issues, when appropriate; and
- draft safety recommendations, when appropriate.

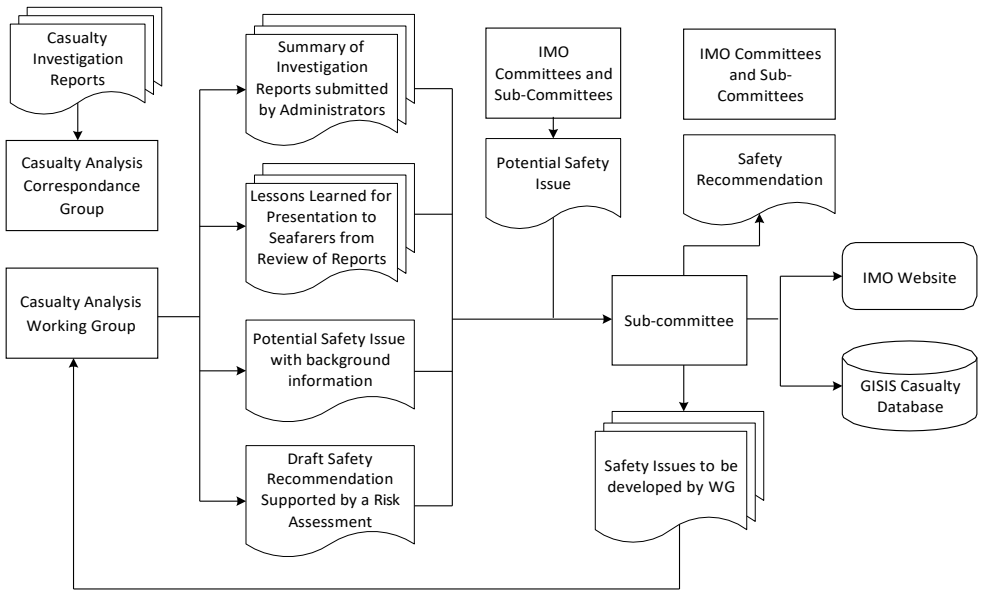

Figure 1. Graphic Representation of a Typical Flow of Casualty Information (URL-4, 2019) (redrawn for clarity).

2.2. Investigation of Current Maritime Safety Reports

Authors accessed to IMO's public database, called Global Integrated Shipping Information System (GISIS) (URL-5, 2019), and studied the current maritime safety reports and relevant publications. Until 31.12.2018, there have been 3876 recorded incidents categorized as 'very serious' in the IMO database with 1603 of these incidents having maritime safety reports. Table 1 shows the number of reports submitted to IMO by some of the Flag States and populated on the IMO website. The countries with the highest submission records are also shown. Table 1 includes both "total number of 'very serious incidents'" and "with public investigation form", respectively, reported to IMO for the ships under Flag of the mentioned state. As these are involving ships with the respective Flag State, some of these investigation reports might be a submission by other countries.

So far, authors found 24 'Lessons Learned' documents in different formats published by IMO in English (URL-6, 2019), 13 of which is found published in French (URL-7, 2019) and 15 of which is in Spanish (URL-8, 2019). However, up to date, there are 3100 reports are submitted in the GISIS website (URL-5, 2019) This may be an indicator for that the GISIS website could announce not many lessons learned items, using the current process.

For better understanding the content of current submitted reports with MOB involvement, authors studied and evaluated more than 50 reports and selected seven reports randomly among the collected reports, Table A.1 (Appendix A) lists the specifics about these reports and Table 2 presents an overview of these reports, as a case study and presentation. The first 7 rows in Table 2 include the information required by CI Code (IMO MSC, 2008b), listed in the previous section, and the next four rows provide the total number of information available in the pertaining report, shown in the next seven respective columns. Some of the reports included very little information, as specified in the CI Code and listed in Table 2; therefore, those reports were purposely discarded for use in this study for presentation. Table 2 gives some ideas about total pages, what type of information included and the total number of words used in the reports, yet it does not provide enough detail for what specific information and how much detail is provided. This and several

other issues noted when reviewing these reports are, for example:

- Report No 5 provides four recommendations while Report No 7 provides only one.
- All recommendations were for different targets. For example, one recommendation was for 'the Ministry of Health Care Services' while several recommendations were reminding notes on 'Code of Practice on Safety Standards for Class II Vessels.
- CI Code clearly states that, an investigation report must contain, 'where relevant the details of the dimensions and engines of any kind of ship involved.' One report provides detailed information about the relevant engine details whereas another report gives only engine power and one other includes no engine information.
- Additionally, the format of the content between the reports is inconsistent; yet there is no tool to identify this observation by measurable methods.
- The total number of pages used in several reports is a few pages, i.e. only 4 in one report, while some other reports are more than 30 pages.
- There are some reports with one or several missing information areas. For example, there is information in all of them about the narrative; however, specifying seven items in the contents does not indicate what detailed level of information exists.

Below is a summary of learnings that we obtained as the outcome of this study:

i. CI Code requirement gives a general idea about what must be the contents of an investigation report; however, it does not specify how the detailed contents should be. This may be because the investigation reports, in practice, are about specific subjects, such as ship accident and personal injury during work.

ii. CI Code's content recommendation is not specific for the MOB events. However, when a specific MOB event is studied from investigation reports, some specific information could be very important for understanding the procedures, techniques, and the root causes. In other words, these information are essential to include to identify tangible lessons learned items.

iii. For populating the report information such that those can be crosschecked through analysis tools from databases, the MOB reports should be structured accordingly, allowing the reports to have consistent formats. It would also allow statistical analysis of reports.

Table 1. Number of Investigation Reports Submitted to IMO by Major Flag States.

	Italy	Belgium	France	Japan	Turkey	Tunisia	US	Norway	Egypt	Brazil
Total very serious incidents	35	13	141	223	187	1	294	209	31	32
With public investigation form	6	4	71	50	14	0	13	18	5	8

Table 2. Review Results of Several Accident Investigation Reports According to Requirements of RESOLUTION MSC.255(84).

Report Number	1	2	3	4	5	6	7
Summary	√	-	-	√	√	√	√
Identities	√	√	√	√	√	√	√
Details	√	√	-	√	-	√	√
Narrative	√	√	√	√	√	√	√
Casual Factors	√	√	√	√	√	√	√
Discussions	√	√	-	√	√	√	√
Recommendations	-	√	-	√	√	√	√
Total Pages	8	8	4	17	35	33	11
Total Pages Without Cover Page	8	4	4	14	31	31	11
Total Number of Words (estimate)	3806	1738	1317	2433	12305	10468	4221
Percent Field Complete (estimate)	85,70%	85,70%	42%	100%	85,70%	100%	100%

3. INVESTIGATION OF MOB EVENTS FOR DEVELOPING THE MEI FORM

We studied the factors affecting a MOB event to start driving the required information that should be presented in investigation reports involving MOB events. Section 3.1 presents these factors with several examples from the studied reports.

3.1. Important Factors in a MOB Event

Detailed information is needed to understand all details associated with a MOB event. Initially, we made the following considerations to understand what areas of information should be included in the reports:

- What information is already requested by IMO
- The information areas missing in the reports for extracting lessons learned information
- Factors affecting the event is being initiated
- Factors affecting the development of the process negative or positively
- Techniques used during the response action
- Factors affecting the end result, which is casualties survival or ending with minimal health risks
- Information to derive should be standard such that it can be extracted and inserted into a database with appropriate tags.

Examples below provide an understanding of what detail level of information needs to be included in the reports.

Example 1: During cargo operation at port, a deck rating fell overboard resulting in a fatality on vessel Joanna (UK Inv., 2011). Even though there was an alcohol policy, the analysis of postmortem blood revealed that Stanislaw had a blood alcohol concentration of 93mg/100ml. There was a procedure but it was not applied properly. The casualty was not using proper safety equipment and there were no proper safety equipment onboard. From this event, the following questions were driven and added on the MEI form:

- Alcohol / Drug Influence; 'Describes the alcohol or drug influence of the casualty at the time of the event.'
- Working as per the safety rules; 'Was the work being performed as per the safety rules and instructions?'
- Workplace conditions as per the safety rules; 'Was the work conditions set as per the rules and safety instructions'

Example 2: Response actions and times are very critical when removing the casualty from the water. According to the report of MOB event onboard Hyundai Dangjin (Appendix A, Report No. 2), the casualty was alive when seen and became not meanwhile there was a removal procedure continuing. To understand the details of why the casualty could not survive, sea temperature and time of removal of the casualty from the water must be known, yet this information is not found in this report.

3.2. Factors Considered for Developing the Contents of the Proposed MEI Form

MOB event starts with the time of a person falling overboard and ends when the MOB response operation is terminated. There are many factors affecting a MOB event, for example, "how it occurred", "how it developed", "how it was responded", and "how it was terminated". To understand what specific details are associated, we reviewed over 100 reports and focused on the details of the information. Starting with the seven content items provided in CI Code, we studied over 100 reports and labelled information items with a unique code. There became 113 information fields identified in this study with unique codes assigned for each information item, as presented in section 4.

Using the evaluation of the reviewed reports as well as listed aforementioned factors, which are specific to MOB event information in reports, all information that can be found in reports was categorized as follows:

- Vessel Information
- Navigation Conditions
- Information about the Casualty/Casualties
- Meteorological Conditions
- Work Type and Conditions
- Managerial/Procedural Conditions
- Start of the Event and Initial Timings
- Response Times and Actions
- Search and Rescue (SAR) Operation
- Health Status of the Casualty
- Type of Recommendations

Breakdown of the above categories yielded in 113 information items with unique codes, shown in the sections of the MEI form, presented in sections below.

4. PROPOSED FORM

This section describes the contents of the MEI Form, proposed to use by Maritime Investigators when the investigation involves a Man-Over-Board (MOB) casualty. There is a group of 11 sub-categories with 113 form items under all categories in the proposed MEI Form. Each item has a unique identifier, named as 'Field Code', for future use in electronic form submissions into a database. The user could search the MEI Reports Database with the Field Code of the specific item and do analysis for one item or do a more complex analysis with correlation study.

Note: For the tables presented in this section, from table 3 to table 12, 'NA' means 'Not Applicable' and 'NI' means 'Not Indicated' in the report.

4.1. Vessel Information

This field group is to drive information from a report about the vessel, associated with the MOB event at the time of the event occurring. Table 3 shows the detailed contents of the Vessel Information to retrieve from reports with short descriptions for guidance.

4.2. Navigation Conditions

This field group is for extracting the navigation conditions under which the ship is navigating on the sea and /or what operations it is performing during the MOB event. Table 4 indicates the detailed contents of the 'Navigation Conditions' category of information to retrieve from reports.

Table 3. Proposed MEI Form: 'Vessel Information' Section.

Field Code	Field Name	Short Description /Guide
V01	Event number	Event investigation number, which is an identifier for the MOB event.
V02	Vessel name	Name of the ship recorded during the MOB event investigation.
V03	Flag	Registered flag of the vessel.
V04	Vessel type	For example, cargo ship, passenger ship, research ship, military ship, etc.
V04.1	Vessel sub category	G04.1 is a sub-category for the vessel type. For example, crude oil tanker, container, and bulk carrier fall under cargo ship sub-category.
V05	Age group	The age group of the ship's age. Age intervals mainly are as follows: 0-3, 4-6, 7-10, 11-15, 16-20, 21-30, 31+, or 'NI'. If the report does not specify, the difference between the MOB event date and ship's construction date is used.
V05.1	Exact age	Construction year of the vessel.
V06	Tonnage group	Gross Tonnage of the vessel, which specifies the predetermined tonnage range of gross tonnage of the ship. Tonnage intervals are: 0-49, 50-99, 100-299, 300-499, 500-999, 1000-1999, 2000-2999, 3000-4999, 5000-9999, 10000-49999, and 50000+.
V06.1	Tonnage (GRT)	The exact value of the gross tonnage recorded in the ship's registry.
V07	Length group	The following interval of the registered full length (LOA) of the vessel, in meters: 0-11, 12-19, 20-49, 50-99, 100-199, or 200+.
V07.1	Vessel length	The registered full length (LOA) of the vessel in meters.
V08	Vessel classification	The classification organization of the ship.
V09	Number of personnel	The number of personnel listed in the ship's log at the time of the MOB event. At ports or during anchorage, registered personnel or passenger's being out of the ship does not change this number.

Table 4. Proposed MEI Form: 'Navigation Conditions' Section.

Field Code	Field Name	Short Description /Guide
N01	Navigation status	Select 'Yes', 'No', 'NA' or 'NI' as an answer for the following question: 'Was the ship in navigation during the MOB event?'
N02	Operational state	The operational status of the ship during the accident. Enter Navigation, Port, Anchorage, Drift, Shipyard, In-Maneuver, Other, or 'NI'.
N03	Was the on-duty officer alone?	Select 'Yes', 'No', 'NA' or 'NI'. Note: Need to fill this item if S03 is one of the following choices: Navigation, anchorage, drift, In-Maneuver, or Other (the ship has way?). Otherwise, enter 'NA'.
N04	Who has the command-in-charge?	Indicates which one of the personnel had the responsibility of the ship at the time of MOB event: 'Watch keeping Officer', 'Ship's Captain', 'Pilot', 'No Command'. Note: Need to fill this item if S03 is one of the following: Navigation, anchorage, drift, In-Maneuver, or Other (the ship has way?). Otherwise, enter 'NA'.
N05	Distance to the nearest land	The distance, in nautical miles, to the nearest land part at the time of the event.
N06	Location	Preferably the latitude and longitude of the ship's location. If exact location is not available in the report, geographic name of the location is used.
N07	Ship's draft (m)	Draft of the vessel, in meters.
N08	Ship's speed (knots)	Ship speed, in nautical miles (knots). Enter: Ship speed value in knots, if the ship in navigation or "0" is the ship is anchored or at port

4.3. Casualty Status/Information

This section provides a piece of general information about the person(s) involved in the MOB event according to the studied report. It also helps to understand whether a person was under the influence of alcohol or drug recorded at the time of the event. Table 5 gives detailed information about casualty and his familiarization to ship.

4.4. Meteorological Conditions

This section of the form is to extract the environmental, especially meteorological conditions during the MOB event. Table 6 shows very detailed information about the meteorological conditions such as wind, visibility, rain, etc.

4.5. Work Type and Conditions

This section of the form is to extract the information about the work type and conditions during the MOB event. Table 7 describes if work type and place are compatible with safety rules.

4.6. Managerial/Procedural Conditions

This section of the form is to extract the documentation and process-related managerial/procedural conditions of the vessel, indicated in the event report. Table 8 gives very detailed information about managerial procedures and by examining this table, the root cause can be distinguished.

Table 5. Proposed MEI Form: 'Information about the Casualty/Casualties' Section.

Field Code	Field Name	Short Description /Guide
C01	Rank	Enter the rank or status of the casualty on-board ship. Captain, Deck Officer, Passenger, Other Service Personnel are some examples. "Integrated Rating" classification can be entered if the casualty's position is identified as both deck and engine personnel.
C02	Nationality	Nationality of the casualty.
C03	Age	Age of the casualty.
C04	Overall on-board work experience	Work experience of the casualty in years.
C05	Work duration (on-board Ship)	Work duration on-board the current ship of the casualty, in months.
C06	Alcohol/drug Influence	Describes the alcohol or drug influence of the casualty at the time of event. Select 'Yes', 'No', 'NA' or 'NI'.

Table 6. Proposed MEI Form: 'Meteorological Conditions' Section.

Field Code	Field Name	Short Description /Guide
M01	Adverse weather	Information to drive the weather conditions having any adverse effects on the MOB event. Information to consider in general are the effect of wind, sea waves, current, visibility, and temperature. Select 'Yes', 'No', 'NA' or 'NI'.
M02.1	Wind speed	Wind speed in 'beafort scale'.
M02.2	Wind direction	Wind direction in angle, as true direction.
M03	Sea scale	Sea Scale indicating the condition of sea waves, entered in 'beafort scale'.
M04.1	Sea current speed	Enter sea current speed in knots.
M04.2	Sea current direction	Direction of the sea current's angle, as true direction.
M05	Rain	Indicates the existence of rain or snow conditions during the event. Information to include rain, snow, slow rain, no rain, etc.
M06	Visibility	Indicates the visibility recorded at the time of the event. The information is entered as per the visibility scale from 0 to 8 or 'NI' is entered. If the reports states 'normal visibility', enter '6' for a neutral visibility level.
M07	Sea temperature	Sea temperature in Celsius (°C).
M08	Air temperature	Air temperature, in Celsius (°C).
M09	Sea depth	Sea depth in meters.
M10	Darkness	Indicate the weather being 'dark' or 'not dark'.
M11	Lightning conditions	Lightning conditions, recorded at the time of the event. Enter as follows: Yes: Enough light conditions No: Lightning is not enough
M12	Day/night	Enter 'Day-time' or 'Night-time' if additionally indicated in the report.

Table 7. Proposed MEI Form: 'Work Type and Conditions' Section.

Field Code	Field Name	Short Description /Guide
W01	Relevance to work	Information to drive whether the event was work related. Yes: Work related event No: Not a work related event During transportation: Both for passengers and for employees during their transportation to/from work. Enter 'NI' if no information found in the report.
W02	Working as per the safety rules	Was the work being performed as per the safety rules and instructions? Fill this section with a 'Yes', 'no', or 'NI. Example: The answer is 'No' when not wearing a life jacket where a person 'must' wear, at the time of the event.
W03	Workplace conditions as per the safety rules	Select 'Yes', 'No', 'NA' or 'NI' as answer to the following q: "Was the work conditions set as per the rules and safety instructions?". Example: The answer is 'No' when there is no life jacket available where there 'must' be, at the time of the event.
W04	Wearing a life jacket	Was the casualty wearing a life jacket (or personal floatation aid), as recorded at the time of the event? Select 'Yes', 'No', 'NA' or 'NI'.
W05	Alone	Information to understand if there was a secondary person (other than the casualty) witnessing the event. Select 'Yes', 'No', 'NA' or 'NI'.

Table 8. Proposed MEI Form: 'Managerial/Procedural Conditions' Section.

Field Code	Field Name/Short Description	Guide
P01	Applicable checklist	Is there a document requirement (checklist or form) before the work of which the event occurred? For example, a checklist must be filled at each time a work will be at the overboard. Select 'Yes', 'No', 'NA' or 'NI'.
P01.1	Checklist filled	If P01 cell is filled with a 'Yes', then this section is filled. Select 'Yes', 'No', 'NA' or 'NI'.
P01.2	Checklist filled properly	If P01.1 cell is filled with a 'Yes', then this section is filled. Select 'Yes', 'No', 'NA' or 'NI' depending on the checklist or form fulfilled properly as per the instructions.
P02	Applicable general work procedures	This section is to understand whether the safety instructions or procedures were described per the safety manuals. Select 'Yes', 'No', 'NA' or 'NI'.
P02.1	General work procedures implemented properly?	Select 'Yes', 'No', 'NA' or 'NI'. Note 1: If the result of the section P02 is a 'yes', then this section is to fill. Note 2: If the result of the section P02 is other than a 'yes', 'NA' is to enter in this field.
P03	Fatigue condition	This section is to extract information from the report for that there could be a fatigue situation involved with the casualty. Select a Standard Answer.
P04	Implementation of MOB drills	Was the MOB drills were carried out in required periods? Select 'Yes', 'No', 'NA' or 'NI'.
P05	Was there a SAR Procedure?	Select 'Yes', 'No', 'NA' or 'NI'.
P05.1	SAR Procedure implemented appropriately?	Select 'Yes', 'No', 'NA' or 'NI'. Fill this section only if the result of the section P05 is a 'yes'. Or, fill with 'NA'.

4.7. Start of the Event and Initial Timings

This section of the form is aimed to extract information about the MOB Event's Time and Initiation from the event report. In other parts of this study, this time is mentioned as T0. All other times are given as time passed from this moment. Table 9 gives information related to key elements and timings of the accident.

4.8. Response Times and Actions

This section of the form is prepared to extract information about the initial practices implemented for preventing a casualty or further damage. Table 10 gives information both if specific initial response actions were carried out and their timings if they were carried out.

4.9. Search and Rescue (SAR) Operation

This section of the form is targeted to drive information about the rescue operation, as indicated in the event report. Table 11 gives information about both search and rescue actions and their timings.

4.10. Health Status of the Casualty

This section of the form (Table 12) is to extract information about the health status of the casualty. Note that the investigator should fill all sections of the MEI Form separately for each casualty. Table 12 gives detailed information related to the health status of casualty.

4.11. Type (Category) of Recommendation

This section of the form is generated to extract recommendations properly from reports. Recommendations are categorized as 'Human', 'Management', and 'Equipment'. The form shown in Table 13 is used for extracting the recommendations with categorizations.

Table 9. Proposed MEI Form: 'Start of the Event and Initial Timings' Section.

Field Code	Field Name/Short Description	Guide
M01	Date	Date of the MOB event.
M01.1	Time	Time recorded for the man become overboard. Time format in formats, such as ZT, GMT or national time formats are all acceptable.
M02	Action causing the MOB event	The action casualty was performing when the MOB event occurred. Some examples: 'Rigging pilot ladder', 'engaging in fishing', 'slipping', 'hit by waves', 'extreme wind', 'intentional'.
M03	From where?	Information about from which part of the vessel, the casualty fall overboard. The following are the choices to enter: 'Forecastle', 'Starboard bow', 'Starboard', 'Starboard quarter', 'Aft deck', 'Port quarter', 'Port', 'Port Bow', 'Other', or 'No information'.
M04	Immediate/late awareness	Was the MOB event seen immediately by another person? Fill this section with an answer, namely, 'yes', 'no', or 'NI'.
M05	Latency	Minutes passed between MOB and the time that a person became aware of the situation.
M06	Assumed overboard	There are cases where man-over-board event is not witnessed but assumed with an investigation. Was the MOB event had to be the assumed? Select 'Yes', 'No', 'NA' or 'NI'.
M06.1	Decision duration	Minutes passed between the time of the actual event and the time the MOB event had to be assumed. Enter 'NA' if M06 is other than a 'yes'.

Table 10. Proposed MEI Form: 'Response Times and Actions' Section.

Field Code	Field Name/ Short Description	Guide
T01	Event notification to the bridge	When MOB event actual time is considered to be t0, enter the duration, in minutes, passed between t0 and the time of the event notified to the bridge (when in navigation) or cargo control station (during loading/unloading).
T02.1	Alarm	Enter the duration, in minutes, passed between t0 and the time of alarm.
T02.2	Announcement	Enter the duration, in minutes, between t0 and the time of internal announcement.
T02.3	Whistle	Enter the duration, in minutes, between t0 and the time of whistle.
T03	Buoy	Enter the duration, in minutes, between t0 and the time of throwing the buoy.
T04	Maneuvering	Enter the duration, in minutes, between t0 and the time of the start of maneuvering. For search and rescue events, generally 'Williams Turn' method is implemented. If the ship is not in navigation, enter 'NA'.
T05	Captain	Enter the duration, in minutes, between t0 and the time of the ship's captain gaining control over the situation.
T06	GPS MOB	Enter the duration, in minutes, between t0 and the GPS MOB system's activation time.
T07.1	Notification to close by ships	Enter the duration, in minutes, between t0 and the time of the notification broadcast to close by ships. Note: If the notification to the SAR stations performed with a VHF type general announcement, this could also be considered as the announcement to the close by ships.
T07.2	Notification to SAR stations?	Enter the duration, in minutes, between t0 and the time of the notification broadcast to the Shore or SAR stations.
T07.3	Other notifications	Enter the duration, in minutes, between t0 and the time of the notification to other organizations, such as ship operating company.
T08	Rescue boat is ready	Enter the duration, in minutes, between t0 and the time of the Rescue Boat is ready.

Table 11. Proposed MEI Form: 'Search and Rescue (SAR) Operation' Section.

Field Code	Field Name/Short Description	Guide
R01	Rescue boat	Was there a rescue boat utilized in the MOB event? Select 'Yes', 'No', 'NA' or 'NI'.
R02	Timing of rescue boat in water	Duration, in minutes, between t0 and the time of the rescue boat placed in water.
R03	Other ships	Was there other ships involving with the rescue operation? Select 'Yes', 'No', 'NA' or 'NI'.
R04	Timing of other ships	Duration, in minutes, between t0 and the time of the other ships joined in the rescue operation. Note 1: If there are more than one ship joined to the operation, the duration is for the first ship involved Note 2: If R03 is 'no', fill this with 'NA'.
R05	SAR ships	Was there SAR ships joined into the SAR operation? SAR ships are boats designed to operate only for SAR operations. Select 'Yes', 'No', 'NA' or 'NI'.
R06	Timing of SAR boats	Duration, in minutes, between t0 and the time of the SAR Boat joined in the SAR operation. Note 1: If R05 is 'no', fill this with 'NA'.
R07	Air operation	Was there Air Vehicles joined into the SAR operation? Select 'Yes', 'No', 'NA' or 'NI'.
R08	Timing of Air operation	Duration, in minutes, between t0 and the time of the Air Vehicle(s) joined in the SAR operation. Note 1: If R07 is 'no', fill this with 'NA'. Note 2: If there are more than one air vehicle, enter the duration for the first air vehicle.
R09	Shore assistance	Was there shore personnel or teams (such as ambulance and medical teams) joined into the SAR operation? Select 'Yes', 'No', 'NA' or 'NI'. Note: Enter 'NA' if the ship is not in port.
R10	Timing of shore assistance	Duration, in minutes, between t0 and the time of the Shore Assistance started in SAR operation. Note 1: If R09 is 'no', fill this with 'NA'. Note 2: If there are more than one team or person, enter the duration for the first team joined into the SAR operation.
R11	Casualty removed from the water	Was the casualty removed from water (regardless of survival status)? Select 'Yes', 'No', 'NA' or 'NI'.
R12	Removed by	Enter the team or personnel removed the casualty from water. Fill this item if R11 is 'yes' or fill with 'NA'.
R13	Timing of removal	Duration, in minutes, between t0 and the time of the casualty was removed. Note: Fill this item if R11 is 'yes' or fill with 'NA'.
R14	Cancellation of the SAR operation	Enter the reason which cancelled the SAR operation other than 'removal' of the casualty from water. Examples are: Shore authorities command/order Ship decision Heavy weather conditions Other No info
R15	Duration, cancellation of the SAR operation	Duration, in minutes, between the start and cancellation time of the SAR operation.

Field Code	Field Name/Short Description	Guide
R16	Limited Sighting of the Casualty in Water	Was there eye watch of the casualty, after the MOB, meanwhile the casualty in the water, for a limited time? Select 'Yes', 'No', 'NA' or 'NI'.
R17	Duration, limited sighting of the casualty in the water	Duration, in minutes, of the casualty was under eye watch. Enter a value if R16 is a 'yes' or enter 'NA'.
R18	Uninterrupted sighting of the casualty in water	Was there a continuous eye watch of the casualty until the end of the MOB operation? Select 'Yes', 'No', 'NA' or 'NI'.

Table 12. Proposed MEI Form: 'Health Status of the Casualty' Section.

Field Code	Field Name/Short Description	Guide
H01	Death	Enter the status of the casualty (Did the casualty die?). Fill this section with: 'yes: Death', 'no', 'NA', or 'NI'.
H01.1	Witnessing death	Was the death identified through a medical check, such as controlling the pulse or with a similar method? Select 'Yes', 'No', 'NA' or 'NI'.
H01.2	Decision for death	Was the death of the casualty the result of a decision, considering the conditions, such as seawater temperature, waves, during the operation? Select 'Yes', 'No', 'NA' or 'NI'. Note: If the casualty could not be found, as per the report, select 'Decision for Death'.
H01.3	Timing of death	Was the death before or after the end of SAR operation? Fill this section with a 'before', 'after', 'missing/assumed death', 'NA', or 'NI'.
H02	Cause of death	Fill this section if H01 is a 'yes' or, enter 'NA'. Some examples to enter are 'hypothermia', 'cardiac arrest', 'head injury', 'drowning'.
H03	Duration until death	Duration, in minutes, between t0 and the time of death. Fill this section with a 'yes', 'no', 'NA', or 'NI'. Note 1: If the report does not include this information, use the information in the death announcement. Note 2: If the casualty could not be found or not taken from the sea, enter 'not clear'.
H04	Rescue to death timing	Duration, in minutes, between the time of rescue and time of casualty's death. Note 1: Fill this section only if both H01 and R11 are 'yes'. Note 2: If the report does not include this information, use the information from the death announcement.
H05	First aid	Was there a first aid needed? Select 'Yes', 'No', 'NA' or 'NI'.
H05.1	Duration MOB to first aid	Duration, in minutes, passed between the MOB and first aid given. Note 1: Fill this section only if H05 is 'yes' or enter 'NA'.
H05.2	Duration rescue to first aid	Duration, in minutes, passed between the times of rescue of the casualty to the first aid started. Note 1: Fill this section only if both H05 and R11 are 'yes' or enter 'NA'.

Field Code	Field Name/Short Description	Guide
H06	First Aid at or by the medical facility (Shore side)	Was there a first aid performed by the medical care personnel (shore based), i.e. at an ambulance, hospital or at a health center? Select 'Yes', 'No', 'NA' or 'NI'.
H06.1	Duration, time passed until first aid given by at or by an established medical facility (shore side)	Duration, in minutes, passed between MOB time and time of first aid given by shore side medical care personnel. Enter 'NA' if H06 is not a 'yes'.

Table 13. Proposed MEI Form: 'Type of Recommendation' Section.

Field Code	Field Name/Short Description	Guide
L01	Existence of Recommendation	Fill this section with a 'yes' or 'no'.
L02	Number of Recommendation	Enter the number of recommendations indicated.
L03	Recommendation Cat I	Enter 'yes' if there is a recommendation in 'Human' category Enter 'no' if there is no such recommendation. 'Yes' would indicate at least one recommendation is made in this category.
L03.1	Content of Rec Cat I	Enter all recommendations as indicated in the report in 'Human' Category'.
L04	Recommendation Cat II	Enter 'yes' if there is a recommendation in 'Management' category Enter 'no' if there is no such recommendation. 'Yes' would indicate at least one recommendation is made in this category.
L04.1	Content of Rec Cat II	Enter all recommendations as indicated in the report in 'Management' Category.
L05	Recommendation Cat II	Enter 'yes' if there is a recommendation in 'Equipment' category Enter 'no' if there is no such recommendation. 'Yes' would indicate at least one recommendation is made in this category.
L05.1	Content of Rec Cat II	Enter all recommendations as indicated in the report in 'Equipment' Category.

5. BENEFITS OF USING THE MEI FORM

Appendix A shows the use of the MEI Form for extracting information from three different Investigation Reports. List of these three reports are as follows:

We noted benefits while implementing the MEI Form for these reports. This section summarizes the benefits of using the MEI Form with standard content and format, allowing the data from MOB investigations populated in a database, called the MEI database.

We were able to populate information from over 50 investigation reports with MOB events and derived many results. This paper's focus is to describe the MEI Form and discuss

the benefits; therefore, some of the benefits observed during this analysis and research study are reported and discussed in sections below. Further discussion on the analysis results will be issue of another report paper.

5.1. Obtaining Statistical Data

Using standard fields in digital forms populated in a database, statistical data can easily and accurately be driven. As an example, according to data provided by the Boat Owners Association of the United States Reports, U.S. boating MOB events between 2003 and 2007 (Edmonston, 2012):

- In deaths from MOB events occurring during day times, the rate of the casualties' being under the influence of alcohol was 27 percent. Whereas, the same rate was found as 50 percent at night times.
- 90 percent of events occurred in low weather conditions with wave height is less than one feet.
- 24 percent of the deaths were at night and 76 percent were during the day.

Academia and industrial researchers can easily generate similar statistical results using the data from a global perspective. Additionally, several parameters between the information across all reports could be analyzed for more elaborated statistical evaluations.

5.2. Providing Useful Data for Obtaining Lessons Learned

Very few of the current reports provide some lessons learned information which IMO Sub-committees are then can review and evaluate. However, the statistical results using the data can provide direct information as 'lessons learned'. For example:

- Alcohol has a very high (27 percent at day time, 50 percent at night time) in MOB casualties in boating events
- Influence of alcohol in MOB casualties at night time is nearly twice (1,852 times) a day.
- A great percentage (90 percent) of events occur in favorable weather conditions (wave height being less than 1 feet).

As well as providing useful data for obtaining lessons learned, standardized and digitized forms provide exact numbers and data instead of generic numbers.

5.3. Better Understanding of the Root Cause

In the MOB event of Graig Rotterdam, casualty fell overboard when cargo at deck collapsed. There was an applicable checklist titled; 'Refer to Log & Timber Cargo Operations Checklist'. The checklist was filled by the chief officer and verified by the master but no control measures were taken and the requirements of the checklist were matched. When the information is extracted from this report using the MEI Form, P01, P01.1, and P01.2 are the applicable fields and while extracting the information, the process is shown in Figure 2. To better understand this process, below mentioned three questions are taken from the proposed MEI form:

- P01 Applicable checklist; was there a document requirement (checklist or form) before the work of which the event occurred?
- P01.1 Checklist filled; if P01 cell is filled with a 'Yes', then this section is filled with a 'yes', 'no', 'NA', or 'NI'
- P01.2 Checklist filled properly; if P01.1 cell is filled with a 'Yes', then this section is filled. Fill this section with a 'yes', 'no', 'NA', or 'NI' depending on the checklist or form fulfilled properly as per the instructions.

Answers of these three questions are enough to distinguish that the root cause of this event is a human factor or managerial issue.

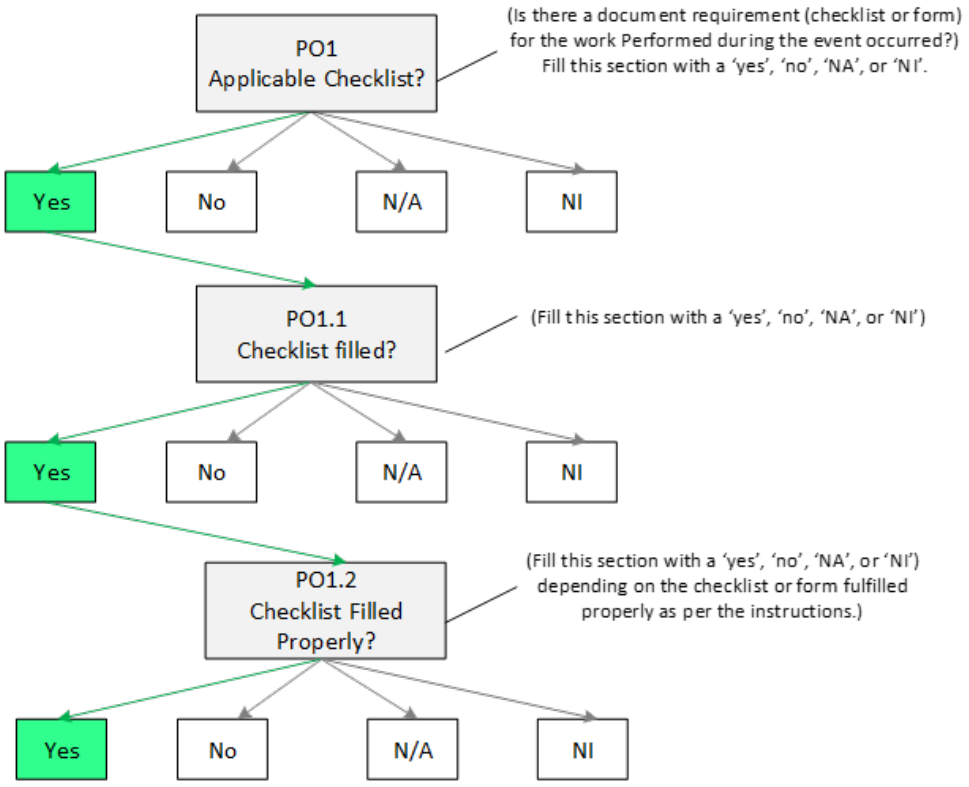

Figure 2. Methodology Applied for Extracting the Data related to Checklists

5.4. Correlation between Relevant Parameters in a Report

From data mentioned above 'Obtaining Statistical Data' title, 24 percent of the deaths were at night time and 76 percent were during the day time. In order to drive this sort of information and to find out the factors affecting the event, many questions are required to be asked and analyzed for relevance to see if the relationship is coincidental or actual.

Using the MEI Form data applied to 50 MOB event reports, the following statistical results were obtained: 36.7 percent of the casualties were alone and 63.3 percent of the casualties were not alone at the time of the MOB event. In the MEI Form, P03 under 'Managerial/Procedural Conditions', fatigue condition is specifically indicated. According to this, in 85 percent of the events, fatigue was not an issue.

5.5. Automating the Lessons Learned Process

Although the MEI Form does not directly cover a 'Lessons Learned' section, the relational topics to 'Lessons Learned' can easily be generalized and information extracted from the reports via categorizations. Designing a database architecture considering the categories of the lessons learned could improve the current Lessons Learned process of the IMO, shown in Figure 1. The use of the MEI Form and process described in this paper helps bring lessons learned from five studies that could be performed on the reports populated in the MEI Database (Figure 3).

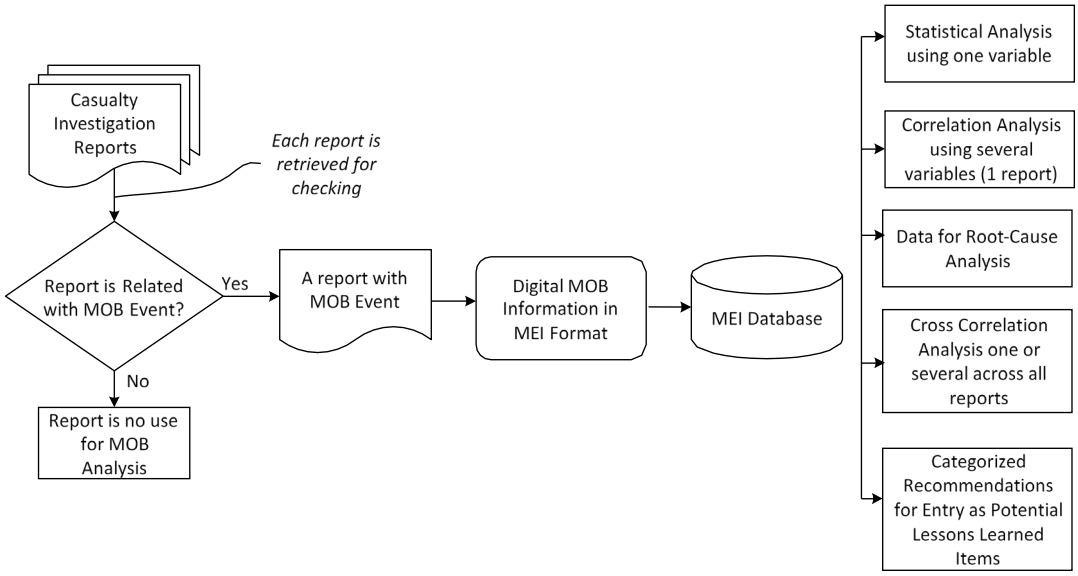

Figure 3. Methodology of MOB Reports Data Retrieval, Formatting, and Analysis Process.

6. CONCLUSIONS

More than 50 reports, involving MOB accident data, were reviewed. Reviewed reports indicated major differences in formats as well as in the level and type of information. A structured methodology was developed and presented for reviewing and retrieving the data systematically from MOB event reports. As part of this process, a standard form, called the MEI Form, is introduced. The MEI Form, with 113 information items, is presented with how to retrieve the information as a standard process. Several case examples are presented to demonstrate the standard use of the MEI Form including how to format, populate, and analyze the data.

Having the data investigated using the MEI Form showed a structured methodology for populating all MOB related maritime accidents digitally with a unique format. We propose the use this methodology to maritime investigating agencies in order to utilize the MEI Form. With this manner, structured data can be compared and consistently analyzed, which enables to drive measurable and usable "lessons learned" information and "recommendations". Data can be populated into the IMO websites for community use. Case examples also demonstrated how to perform the root cause analysis as well as how to retrieve the "lessons learned" items using the proposed methodology.

The use of the MEI Form for obtaining the statistical analysis results may be automated and the results may directly help areas to identify as for the improvements in, for example:

- MOB procedures
- Innovative technologies to utilize for detecting the event, preventing it from happening, or minimizing the risk level to the casualty before, during or after the MOB event respectively
- Analyzing one or several parameters for allowing lessons learned information gathered from analysis results

Casualty Investigation Code, which is adopted to set international standard for conducting the safety investigations and reporting is;

- Very generic
- Does not offer use of a specific method for analyzing root cause
- Does not guide key elements to be included

As a result of preparing these forms with the guidance of this generic code, serious inconsistences is observed in reports published by different agencies. To avoid these inconsistences, code must include;

- A specific approved method for analyzing root cause
- Minimum information required to drive root cause and lessons learnt.
- Format of investigation report
- Information required to acquire statistical data to analyze maritime accidents.

Benefits of using a common form when investigating maritime accidents and publishing these investigation reports are;

- Preparing a digital database instead
- Obtaining cross-check data between different factors
- Obtaining serious data to create simulations

If a digital database is prepared and enough data is collected, simulation scenarios may be established. As an example; a survivability simulation of a casualty that is immersed in cold water can be prepared if enough cross-check data is acquired. From such simulations very important data can be acquired to improve response methods. The data collection and data analysis are important issues for future research on MOB casualties. In future investigations, it might be possible to use big scale data sets. Therefore, a further study with more focus on big data analysis for MOB casualties is therefore suggested.

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APPENDIX A: Investigation Reports

Table A.1. Reports Selected for Reviewing their Contents as per the Requirements of RESOLUTION MSC.255(84).

#	Ship Name	Publishing Agency	Flag State	Report Name	Report Date
1	Forth Guardsman	MAIB Marine Accident Investigation Branch	UK	Fatal injuries to a crewman during mooring operations on FORTH GUARDSMAN South of Jura	September 2011
2	Hyundai Dangjin	Australian Transport Safety Bureau	Australia	Man overboard fatality from Hyundai Dangjin	19 January 2016
3	Federal Champlain	The Transportation Safety Board of Canada	Canada	Marine Transportation Safety Investigation Report M17C0292	06 September 2018
4	Kwong Fei 38	Marine Accident investigation Section	Hong Kong	Report of investigation into the fatal accident of a sailor fell overboard a local dumb lighter "Kwong Fei 38" and drowned in the waters east of Round Island on 13 January 2017	20 July 2018
5	Ribeye 785	Accident Investigation Board	Norway	REPORT ON MARINE ACCIDENT RIB, FALL OVER BOARD IN OLDEN 22 JULY 2015	March 2017
6	Skawlink III and Nord Gardenia	The Danish Maritime Accident Investigation Board	Denmark	2017SKAWLINK III and NORD GARDENIA Fall overboard on 29 September 2016	11 May 2017
7	MV MSC Ravenna	Marine Safety Investigation Unit	Malta	MV MSC RAVENNA Fatal fall overboard of a crew member in the port of M'Xlokk 22 June 2017	June 2018

APPENDIX B: Case Studies for Use of the MEI Form

This appendix show these of the MEI Form with three example reports as shown in Table B.1 to Table B.12. The report examples shown in Table B.1 to B.12 are the first three reports shown in Table A.1 in respective order.

Table B.1. Vessel Information

Code	Field Name	Report 1	Report 2	Report 3
V01	Event Number	1	2	3
V02	Vessel Name	Forth Guardsman	Hyundai Dangjin	Federal Champlain
V03	Flag	British	Liberia	Marshall Islands
V04	Vessel Type	Commercial (Other)	Cargo Ship	Cargo Ship
V04.1	Sub Category	Landing craft	NI	Bulk Carrier
V05	Age Group	21-30	0-3	NI
V05.1	Exact Age	28	3	NI
V06	Tonnage Group	500-999	50000+	NI
V06.1	Tonnage (GRT)	654	132587	NI
V07	Length Group	20-49	200+	NI
V07.1	Vessel Length	48.46	329.95	NI
V08	Vessel Classification	None	Nippon Kaiji Kyokai	NI
V09	Number of Personnel	6	NI	NI

Table B.2. Navigation Conditions

Code	Field Name	Report 1	Report 2	Report 3
N01	Navigation Status	No	No	No
N02	Operational State	In-Maneuver	Port	Port
N03	Was Duty Officer Alone?	No	NA	NA
N04	Who has the Command-in-Charge?	Ship's Captain	NA	NA
N05	Distance to Nearest Land	0	0	0
N06	Location	55°47.4'N 006°01.3W	20° 35.33' S 117° 10.50' E	Thunder Bay Terminals
N07	Ship's Draft (m)	NI	NI	8,08
N08	Ship's Speed (knots)	0	0	0

Table B.3. Casualty Status / Information

Code	Field Name	Report 1	Report 2	Report 3
C01	Rank	Deck Rating	Deck Officer	Deck Officer
C02	Nationality	Polish	NI	NI
C03	Age	47	NI	NI
C04	Overall Work Experience (On- board)	NI	NI	NI
C05	Work Duration (On-board Ship)	18 months	NI	NI
C06	Alcohol / Drug Influence	NI	NI	NI

Table B.4. Meteorological Conditions

Code	Field Name	Report 1	Report 2	Report 3
M01	Adverse Weather	Yes	Yes	Yes
M02.1	Wind Speed	6 (Beaufort)	3-4 (Beaufort)	0
M02.2	Wind Direction	NNE	NI	Calm
M03	Sea Scale	3.Nis	NI	0
M04.1	Sea Current Speed	NI	NI	NI
M04.2	Sea Current Direction	NI	NI	NI
M05	Rain	No	NI	No
M06	Visibility	NI	NI	6
M07	Sea Temperature	8	22	-2
M08	Air Temperature	NI	NI	-12,1
M09	Sea Depth	NI	NI	NI
M10	Darkness	Yes	NI	NI
M11	Lightning Conditions	Yes	NI	NI
M12	Day/Night	Night	NI	NI

Table B.5. Work Type and Conditions

Code	Field Name	Report 1	Report 2	Report 3
W01	Relevance to Work	Yes	Yes	Yes
W02	Working as per the safety rules	No	No	NI
W03	Workplace conditions as per the safety rules	No	Yes	NI
W04	Wearing a Life Jacket	No	Yes	No
W05	Alone	No	No	No

Table B.6. Managerial/Procedural Conditions

Code	Field Name	Report 1	Report 2	Report 3
P01	Applicable checklist	Yes	No	NI
P01.1	Checklist filled	Yes	NA	NA
P01.2	Checklist filled properly	No	NA	NA
P02	Applicable general work procedures	No	No	NI
P02.1	General work procedures implemented properly	NA	NA	NA
P03	Fatigue condition	NI	NI	NI
P04	Implementation of MOB drills	NI	NI	NI
P05	Was there a SAR Procedure?	NI	NI	NI
P05.1	SAR Procedure implemented appropriately?	NA	NA	NA

Table B.7. Start of the Event

Code	Field Name	Report 1	Report 2	Report 3
M01	Date	13.03.2011	10.07.2015	8.12.2017
M01.1	Time	1912	458	1950-2008
M02	Action causing the MOB event	Impact of rope	Reading Draft Marks	Reading Draft Marks
M03	From Where	Starboard Bow	Port	Port
M04	Immediate/Late Awareness	Yes	Yes	Yes
M05	Latency	NA	NA	NA
M06	Assumed Over Board	No	No	No
M06.1	Decision Duration	NA	NA	NA

Table B.8. Response Times and Actions

Code	Field Name	Report 1	Report 2	Report 3
T01	Event Notification to the Bridge	1-2	1	0
T02.1	Alarm	1-2	14	1-18
T02.2	Announcement	1-2	14-22	2-20
T02.3	Whistle	No	No	No
T03	Buoy	1-2	1	0
T04	Maneuvering	No	NA	NA
T05	Captain	0	2-4	0
T06	GPS MOB	NA	NA	NA
T07.1	Notification to Close by ships	2	No	No
T07.2	Notification to SAR Stations?	No	No	No
T07.3	Other Notifications	No	22-42	6-37
T08	Rescue Boat is Ready	4-9	No	6-24

Table B.9. Search and Rescue (SAR) Operation

Code	Field Name	Report 1	Report 2	Report 3
R01	Rescue Boat	No	No	Yes
R02	Timing of Rescue Boat In Water	NA	NA	6-24
R03	Other Ships	Yes	No	Yes
R04	Timing of Other Ships	11-20	NA	6-37
R05	SAR Ships	Yes	No	No
R06	Timing of SAR Boats	NI	NA	NA
R07	Air Operation	Evet	No	No
R08	Timing of Air Operation	49-72	NA	NA
R09	Shore Assistance	No	Yes	No
R10	Timing of Shore Assistance	NA	22	NA
R11	Casualty Removed from the Water	Yes	Yes	Yes
R12	Removed by	Ship's crew and other ship crew	Ship crew	Other ship crew
R13	Timing of Removal	11-20	14-22	8-37
R14	Cancellation of the SAR operation	NA	NA	NA
R15	Duration, Cancellation of the SAR operation	NA	NA	NA
R16	Limited Sighting of the Casualty in Water	No	No	NI
R17	Duration, Limited sighting of the casualty in the Water	NA	NA	NA
R18	Uninterrupted Sighting of the Casualty In Water	Yes	Yes	NI

Table B.10. Health Status of the Casualty

Code	Field Name	Report 1	Report 2	Report 3
H01	Death	Yes	Yes	No
H01.1	Witnessing death	Yes	Yes	NA
H01.2	Decision for death	No	No	NA
H01.3	Timing of Death	After	Later	NA
H02	Cause of Death	Trauma (chest)	NI	NA
H03	Duration until Death	120	67	NA
H04	Rescue to Death Timing	100-109	45-53	NA
H05	First Aid	Yes	Yes	NI
H05.1	Duration MOB to First Aid	1.Eyl	14-22	NA
H05.2	Duration Rescue to First Aid	Kas.20	1.Ağu	NA
H06	First Aid at or by the Medical Facility (Shore Side)	Yes	No	Yes
H06.1	Duration, time passed until First Aid given by at or by the Medical Facility (Shore Side)	72-120	NA	19-37

Table B.11. Type of Recommendation

Code	Field Name	Report 1	Report 2	Report 3
L01	Existence of Recommendation	No	No	No
L02	Number of Recommendation	0	0	0
L03	Recommendation Cat I	No	No	No
L03.1	Content of Rec Cat I	NA	NA	NA
L04	Recommendation Cat II	No	No	No
L04.1	Content of Rec Cat II	NA	NA	NA
L05	Recommendation Cat II	No	No	No
L05.1	Content of Rec Cat II	NA	NA	NA

Review Article
Turkish Journal of Maritime and Marine Sciences Volume: 5 Issue: 2 (2019) 171-180

Strong Ties Between Unsettled Global Economy & Maritime Economics: An Assessment of Today's Maritime Economy

İstikrarsız Global Ekonomi ve Denizcilik Ekonomisi Arasındaki Güçlü Bağ: Güncel Denizcilik Ekonomisine Genel Bakış

Türk Denizcilik ve Deniz Bilimleri Dergisi Cilt: 5 Sayı: 2 (2019) 171-180

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ABSTRACT

Maritime sector has been severely affected by the global economic crisis of the years 2007-2008. The process of recuperation was quite long for the world economy as well as global maritime industry. With sudden decrease of cargo volumes on board of even from globally well-known shipowners' till the medium and small size ship management companies/shipowners were in urgent need of the cargo to fill up their vessels and to be able to compensate running cost of their fleets. Strategic partnerships among shipping lines have been emerged. The recovery period has been quite slow while some shipping lines declare bankruptcy and had to close down the business. Therefore, this review article aims to present current status quo of global maritime economy and the evaluation of existing and emerging trade lanes in recent years. This article helps researchers to point up the assessment of the general situation of world maritime trade. Remarkable articles on maritime economy, shipping business and international trade are evaluated in this paper.

Keywords: Maritime economics, shipping business, international trade, global crisis, world trade, shipping lines.

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ÖZET

Denizcilik sektörü 2007 -2008 yılları arasında yaşanan global ekonomik krizden oldukça etkilenmiştir. Yaşanan global ekonomik krizin etkilerini hem dünya ticaretinde hem de deniz ticaretinde atlatmak uzun yıllar almıştır. Ekonomik krizin etkisiyle gemilerinde yük hacmi düşen dünyanın en güçlü armatörleri, gemi işletmecileri, orta ve küçük çaplı hat işletmecileri ekonomik durağanlığı atlatmak ve gemi işletim maliyetlerini karşılayabilmek adına ortak gemi işletmeleri ve stratejik ortaklıklara kaymışlardır. Dolayısıyla bu derleme çalışması, sadece global ticaretin deniz ticaretine ve denizcilik ekonomisine etkisi alanında yayınlanmış, bilinen literatürü sunmasının yanı sıra 2020 yılı global ekonomik durum değerlendirmesi ve tahminleri sunarak araştırmacıları aydınlatmayı amaçlamaktadır.

Anahtar sözcükler: Denizcilik ekonomisi, deniz ticareti, uluslararası ticaret, global kriz, dünya ticareti, hat işletmecileri

1. INTRODUCTION

World global economy is directly affected by political developments, conflicts, currency fluctuations, countries' developments, industrial problems, production rates, emerging countries recessions, China's deceleration and weaker import demand in both developed and developing countries. The slowdown of global trade and Gross Domestic Product is due to rise of fluctuation in exchange currency and marked-up tariffs and price volatility on traded goods in massive economies. According to the President of World Trade Organization (WTO), Global maritime trade dropped at an average annual rate of 1% between 2008 and 2018. Current global trade market has gloomy atmosphere however hope is still alive. Apart from its direct effect on imports and exports, in some pioneer businesses has been slow down in production, uncertainty reached the peak and the business (Azevêdo, 2019). Trade tensions appear to have contributed significantly to the slowdown. Maritime business is one of the leading sectors in global economy. Thus, shipping is directly affected by political and social issues in the world. The year 2018 wasn't an easy year for both global and maritime economy since there had been dozens of slowdowns due to existing political problems. Therefore, maritime trade growth had its share as well. Global maritime economy seems like it dresses slowly the wounds after suffering mercilessly from economic downturn during between the years of 2007- 2015. From 2007 and on, remarkable fluctuations in the Container Ship Time Charter Assessment Index (New Con Tex) Baltic dry İndex, Istanbul Freight Index (ISTFIX) have been observed. According to the United Nations Conference on Trade and Development (UNCTAD) (2019), International Trade has been slowly risen up in 2018 while volumes reached 11 billion tons. Although international trade and global economy have performed some expansions, international global trade slackened in 2018. International cargo volume developed at 2.7 per cent in 2018 while in 2017 volumes performed better with 4.1 per cent in 2017. Slowdown in global economy that effected any type of

maritime cargo was wide-ranging. For instance, in 2017 the movement of container business in global ports declined to 4.7 per cent, down from 6.7 per cent (UNCTAD, 2019). In regard to data taken from WTO, world merchandise imports and exports grew 3.0 per cent in 2018 while world GDP has increased 2.9 per cent.

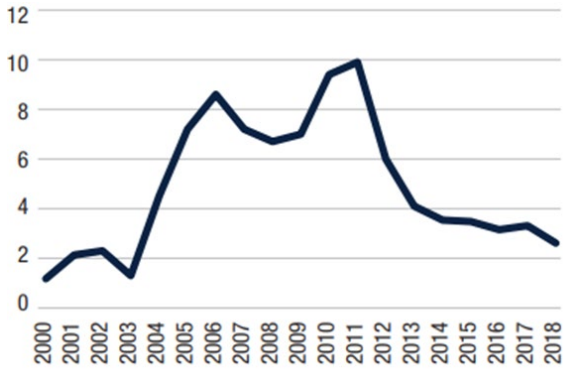


Figure 1. Annual growth of world fleet, 2000–2018 (Percentage of dead-weight tonnage) (UNCTAD, 2019).

As per UNCTAD 2019, as it is observed in above Figure 1, annual growth in world fleet in deadweight tonnage. The rise in annual growth of world fleet from 2003 to 2006 was remarkable until the economic downturn in late 2006 – the beginning of 2007. The effect of the financial crisis has been noted between the years of 2007 – 2011. Besides the developments in the global economy and world merchandise trade, international seaborne trade carried over to expend in 2011 tough at a slower rate than in 2010 (UNCTAD, 2012).

It is an undeniable fact that powerful ties among GDP growth, global commodity trade, seaborne trade, industrial production keep going unabated (UNCTAD, 2011). Figure 2 shows that in 2016 the drop of import rates in developing countries was the most remarkable.

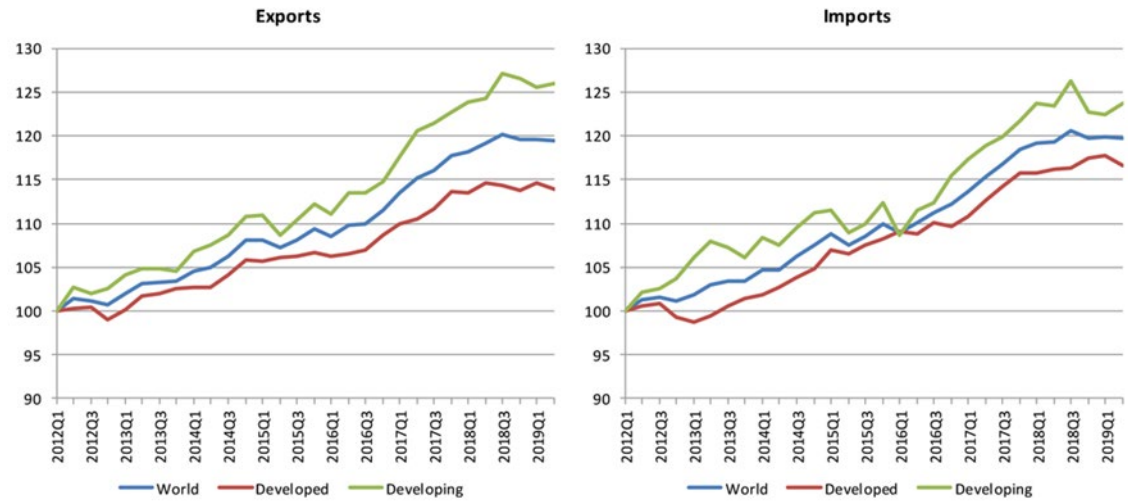
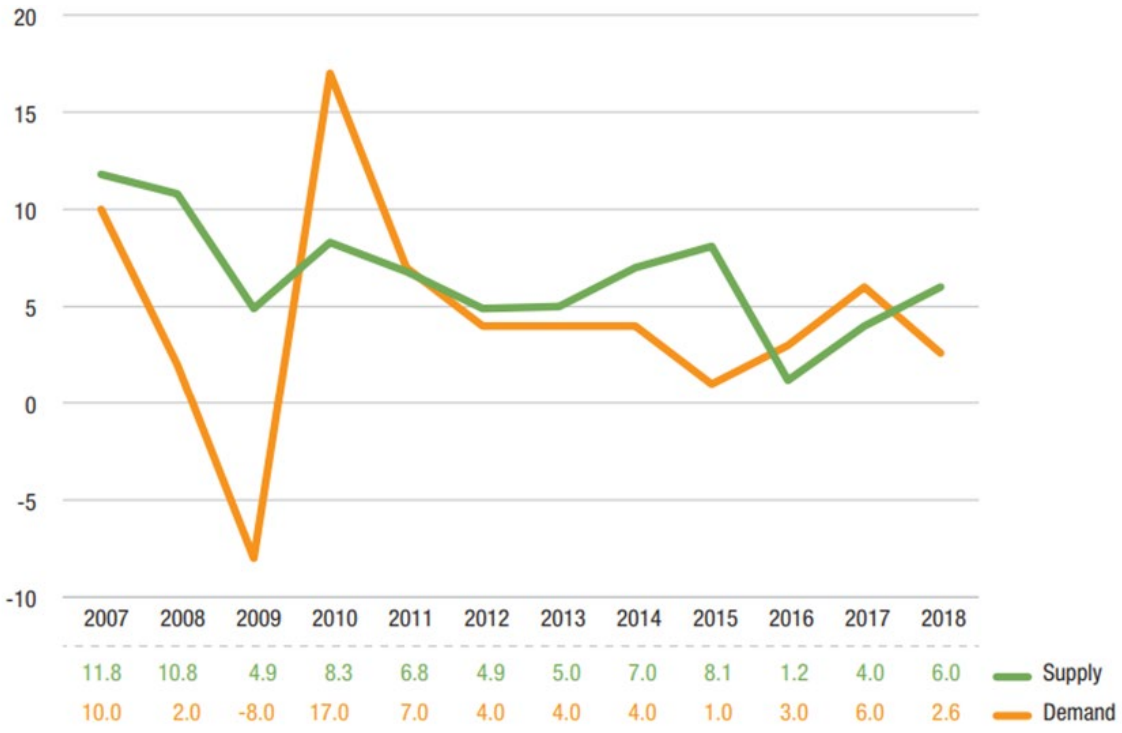


Figure 2. Merchandise exports and imports by region, 2012Q1-2019Q2 (Volume index, 2012Q1=100) (WTO,2019; UNCTAD, 2019).



Note: Data contains total capacity of the container-carrying fleet. Demand growth is based on million TEU lifts.

Figure 3. Growth of demand and supply in container shipping, 2007–2018 (Percentage) (Clarksons Research, 2019)

In Figure 3, decrease in supply boosts in 2007 and then the dramatic downfall in demand is observed in 2009. In the same breath 4.9 % of decline is marked in supply. The volatility in supply and demand is observed from 2007 to 2018 (rise in supply for 2014, rise in demand for 2014 and 2015). Considering that shipping market is one of the riskiest markets in the world, an entrepreneur may gain steam competition and makes use of an opportunity of the unstable economy. Thus, she makes the right step by foreseeing the future scope. That's why maritime companies may be generally taken into consideration as 'dinosaurs of classical economics' in which shipowners guarantee themselves with strategic partnerships, albeit no combination in restraint of trade (Stopford, 2009). As per global reports of 2019, the gap between supply and demand for trade finance still exists. One of the leading banks on a global arena states that supply is far from catching the demand although transactions of commerce finance are expected to be pure arbitrage and well-grounded asset class (Asia Development Bank Briefs, 2019). Therefore, the slew rate of supply seems to be reluctant.

2. MATERIAL AND METHODS

Shipping is a quite adventurous and costly business. All or none principle is applicable in maritime industry. It is an undeniable fact that the high risk in maritime market emerges the application and usage of quantitative administrational innovation methods as in finance and economics. Aforementioned analyses were started in 1930's by Koopmans (1931;1932). The statistical researches regarding maritime trade mainly concentrates on transportation costs and

freight index. One of them is analyzed by Bulut et al. (2012) by applying fuzzy integrated logical forecasting methodology to forecast dry bulk time charter rates. Also applied vector autoregressive methodology is studied in the paper. Moreover, Chen et al. (2012) used autoregressive integrated moving average with explanatory variable (ARIMAX) and vector autoregressive model. Duru and Yoshida (2009) also use fuzzy time series methodology in order to forecast dry bulk shipping index. Cointegration analysis can be found also in several articles, particularly for non-stationary data. Addition to these analysis tools, panel data techniques are used to identify relationships in maritime trade.

2.1. Time Series Analysis in Shipping

Time series analyses is one of the techniques when forecasting takes place in maritime economics. Through time series data movements by time are determined (rise, decline or stability of the data). The main idea behind analysis time series data is to identify relationship and forecasting in time. The data consists of four main components namely cyclical, trend, seasonal, and irregular parts. Trend component gives information about how the data moves in the long-run time period. The cyclical component shed lights on the regular pattern of time series. The irregular part comprises important section for econometricians and statisticians. This part is mainly analyzed for forecasting and prediction. Enders (2014) related time series econometrics to find and analyze stochastic part of difference equations. Below equations can be given as an example for difference equations:

$$y_{t+1} = y_t + \varepsilon_{t+1}$$
$$\Delta y_{t+1} = \varepsilon_{t+1} \quad (1)$$

y_t = dependent variable at t time
y_{t+1} = dependent variable at t+1 time
ε_{t+1} = error term at t+1 time

Two comparison techniques that are stationary and non-stationary time series can be found (Priestley, 1983; Michis and Nason, 2017). According to Priestley (1983), non-stationary time series is comprehensive treatment whereas Dahlhaus concentrates on locally stationary time series. The case is to determine type of time series (stationary or non-stationarity) earlier in order to evaluate. In order to check stationary time series, unit root tests such as Dickey–Fuller, Augmented Dickey–Fuller and correlograms on autocorrelation and partial autocorrelation functions are applied. The decision on opting suitable time series model, several criteria are stated: Akaike, Bayesian, and Hannan–Quinn information criteria. The most popular method among time series is The Box–Jenkins method (Profillidis and Botzoris, 2018).

2.1.1. Autoregressive Moving Average Models

Autoregressive moving average models are mainly applied to find irregular part of the data and by finding this it is applied to forecast of data. ARMA estimation mainly consists of two parts. Moving average parts are integrated with the autoregressive part in ARMA models (Enders, 2014). The difference equation can be written as;

$$y_t = a_0 + \sum_{i=1}^{p} a_i y_{t-i} + x_t \quad (2)$$

y_t = dependent variable at t time
y_{t-i} = dependent variable at t-i time
$\sum_{i=1}^{p} a_i y_{t-i}$ = autoregressive part of equation

Adding moving averages part to the model, below formula will be formed;

$$y_t = a_0 + \sum_{i=1}^{p} a_i y_{t-i} + \sum_{i=0}^{q} \beta_i \varepsilon_{t-i} \quad (3)$$

$\sum_{i=0}^{q} \beta_i \varepsilon_{t-i}$= moving averages part of equation

It should be taken into account that if this equation has root equal or greater than one, the integrated model should be applied. This process called an autoregressive integrated moving average (ARIMA) model. To apply ARIMA methodology, the data must be stationary. In order to make the series stationary, the difference of data should be taken. Having differenced data, the ARIMA methodology could be applied the data. Stationarity means generally the series has constant mean, variance and covariance. The series shouldn't change over time (Enders, 2014).

2.1.2. Autoregressive Conditional Heteroskedastic Models

Autoregressive Conditional Heteroskedastic models (ARCH) are used to determine and predict the volatility. In general, first differences are modelled in this methodology and the model used to check whether the variances differ by time. Kavussanos (1996) applied ARCH methodology to tanker market in order to assess price risks.

2.1.3. Vector Autoregregressive Models

Vector autoregressive model is developed by Christopher Sims (1980). Gujarati and Porter (2009) explains these models as "the term autoregressive is due to the appearance of the lagged value of the dependent variable on the right-hand side and the term vector is due to the fact that we are dealing with a vector of two (or more) variables". Geomelos and Xideas (2014) apply this methodology in order to forecast spot prices in bulk shipping.

2.2. Linear Regression

Linear regression is the most basic methodology to be used in Maritime Economics. It is a prediction of connection between the dependent and independent variables. Therefore, linear regression exposes if the single action has any relationship to response. Different subjects within maritime economics are studied and explained in linear regression. Yazir and Sahin (2017) examined the impacts of share prices, volatility and interest rate on put options through a linear regression approach. Being able to present solutions for the coercions in the maritime economics. The Black-Scholes Merton (BSM) model is used to provide option pricing, pricing and risk management. However, in order to calculate put and call options, Linear regression models were found more efficient than The Black-Scholes Merton model according to the data analyses. By using linear regression model, the effects of variable parameters such as volatility and interest rates on option premium, freight rates are analyzed (Yazir and Sahin, 2017). Simple Linear Regression is convenient to use for finding relationship between to continuous variables in which formula is found below:

$$y= \beta1+ \beta2x+e \quad (4)$$

y — Dependent Variable / Explained Variable / Regressand
x — Independent Variable/ Exploratory Variable/ Regressor
$\beta1$ = intercept
$\beta2$ = coefficient of regressor
e = error term

2.3. Freight Index Measures

Index measures are generally one of the methods used in maritime economics and determining a specific system of a financial institution. Freight market indices are applied to show not only composite effect of a system but also by merging various individual series in different time spans. Many examples can be given to show the appliance of freight index such as Drewry, Baltic Exchange, Tramp Data Co., J.E. HYDE. The combination of qualitative and quantitative methods is observed in the literature. Freight index is calculated different alternative indices in pursuant of age of ships as qualitative measures of shipments and route particularities. Late researches indicate that previous and

current index measures can justify fluctuations resulting with simultaneous results. In long term, freight market indices the cessation of commodity rates, maritime trade and life expectancy in various years, albeit the log-linear model is just reference and far from being a noteworthy model due to the artificial regression prospects (Duru and Yoshida, 2011; Duru et al., 2010; Duru, 2010). Therefore, the research that has been conducted by Başer and Açık (2019) analyses the World Gross Domestic Product (GDP) as a measure of economic activities and Baltic Dry Index (BDI) as a measure of dry bulk freight rates. The correlation analysis between BDI and GDP have shown that there has been an important positive correlation.

2.4. Likert Scale

Likert scale is the one of the common measures that is used as a research method in Maritime Sector. While collecting data of strategic factor by the respondents in maritime sector, Likert scale gives the researcher flexibility to assess the respondents answers regardless geographical constraints. By this methodology, correlations can be grouped and an importance-based narrative for the performance, challenges and competitiveness of maritime companies or partners are developed. The competitiveness within maritime clusters are categorized (Stavroulakis *et al*., 2019). As an example, the content validity is one of the pioneer evaluation methods in maritime economics. In port economics especially in port selection, to define priorities of shipping lines and customers that effect port competitiveness is defined by Likert scales (Talley, 2012).

Table 1. Likert scale results of the port selection ranking criteria (Talley, 2012)

	Response rate (%)	*Mean*	*Std. dev.*
The port's berth capacity	95	6.33	.730
The port's flexibility in meeting your special needs	100	6.09	1.151
The navigation costs related to the port are reasonable	100	6.05	0.785
The availability of EDI capabilities	100	6.05	0.899
The average length of your ship's service time by the port	23	6.00	0.000
The cargo-handling charges of the port are reasonable	100	6.00	1.024
The cargo-handling information service	100	5.95	0.950
The cargo-tracing information service	100	5.95	1.133
The berth service fees of the port are reasonable	100	5.95	0.950
The quality of the personnel involved in port operations	95	5.86	1.195
The use of modern IT and computerized information systems by the port	100	5.82	1.140
The loading/discharging rate that the port or port terminal is capable of	23	5.80	1.095
The connectivity of the port/port terminal to a multimodal interface	86	5.68	1.293
The port's Management Information System	41	5.67	1.000
The frequency of freight loss and damage at the port	95	5.48	1.250
The port's shore container handling equipment	91	5.45	1.701
The terminal provides cost-effective multimodal operations	100	5.41	1.260
The frequency of departures that the port can facilitate	95	5.38	1.532
The average cargo dwell time	18	5.25	0.500
The port's ship container handling equipment	95	5.19	1.940
The efficiency of the port's/terminals multimodal operations	27	5.17	0.753
The capacity to handle the transferring of cargo from one mode to another	86	5.11	1.197
The assistance provided by the port with claims handling	95	5.05	1.627
The capacity of the container storage facility provided at the port	100	5.05	1.527
The range of warehousing services provided by the port (e.g. cross-docking; consolidation, palletization; packing; labeling; stuffing; de-stuffing; inventory management; continuous replenishment)	86	4.95	1.129
The reliability of the terminal's service operations for the multimodal interface	27	4.83	0.753
The provision of support services (e.g. incoming goods inspection; spare parts support)	86	4.74	1.284
The size of the port's container yards	100	4.59	1.709

The literature review in shipping lines presents that researchers generally take the view of shippers as a reference for selecting port choices. Whereas the latest improvements in liner shipping underline the importance of shipping lines preferences when it comes to decision making (Talley, 2012). In Table 1, the results of port selection indicated depending on which criteria shipping lines choose to call a port.

Table 2. An example of Likert scale ordinal order (source: author)

Value	**Importance**
1	Not important/Not applicable
2	Slightly important
3	Moderately important
4	Important
5	Very important

The restrictions of Likert-type scales (Carifio and Perla, 2008) when involving a numeric 'importance scale' were scrutinized and as the respondents were asked to consider the distances between the points of the scale equidistant, bias can be considered to have been retained at a minimum.

3. CONCLUSIONS

Maritime trade is very profound sector and constitutes the backbone of the global economy. Data provided from maritime trade among countries should be scrutinized very carefully. In time series economics, methodology must be chosen according to what researcher aims. ARIMA is one of the good options to forecast future movements in maritime trade, like tanker markets or dry bulk markets. Also, vector autoregression method could be applied to find out whether scrutinized variables explain variance of the same variables.

Researchers targeting to find out the view or expectations of sector players and seamen could conduct surveys including Likert scale analyses. Additionally, some freight rate indicators give a clue about the conjuncture of the maritime sector. The reviews have revealed that maritime economics research trends and models are considered to be developed in shipping in order to analyze the nature of maritime economics and variables that effect shipping economy directly. To forecast in maritime economics, the importance of the modeling application in maritime economics has an immense validity. However, strengthening the number of researches on modelling of maritime economics would significantly help the industry to progress.

When it comes to evaluate what future brings to maritime sector is still in suspense. The imbalance in supply and demand forms various problems for maritime sector. Since the shipping market, especially supply is unsteady, still market and expert predictions are needed in order to see what future forms (Başer and Açık, 2019). While economic growth triggers the demand, maintaining supply in balance is fundamental in sustainable economies. Albeit the political downturn is expected to be high in 2020 so that the normalization of trade relations is needed between leading and economically powerful countries.

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