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BAROTRAUMA TREATMENT EFFECTS ON SURVIVAL RATES FOR SOME DISCARDED FISH BY TRAWL FISHERY

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ABSTRACT

The discard and its losses is an important issue with the principles of sustainable and responsible fishery for researchers and the fishing technology. In this study, discard fate, which is caught and released into the sea by discarding in the Iskenderun Bay trawl fishery, was investigated. Small individuals of *Nemipterus randalli* (N: 340), *Sparus aurata* (N: 236) and *Pagellus erythrinus* (N: 148) with low economic value were evaluated as discard fish in the commercial trawl fishery. In order to estimate survival rates, the three fish species individuals were taken to observation tanks on the fishing vessels and waited for 30 minutes after trawl was hauled. In addition to, barotrauma treatment experiments were carried out with a formed pressure tank which produces the pressure gradient at the depth where the species is caught. Barotrauma treatment has been providing a significant contribution to increase the discard survival rate. In particular, it was observed that barotrauma treatment significantly contributed to the survival rate of the *N. randalli* individuals. The discard survival rates of *N. randalli*, *S. aurata* and *P. erythrinus* were calculated 53.4%, 65%, 68.1% with barotrauma treatment and 12.9%, 41.8%, 59% with 1 atm respectively.

KEYWORDS:
Survival rate, discarded fish, Barotrauma treatment tank (BTT), Trawl Fishery

INTRODUCTION

Concept of fisheries has been changing day by day in accordance with the ecosystem approach. Nowadays, in global fisheries, ecosystem and protection are at the forefront instead of to catch more items [1, 2]. Sustainability, selectivity, charismatic fish species, protected species and discard concept in fisheries are essential issues in the fisheries research [2, 3].

Discard term in fisheries add up to the part of the catch giving back to the sea [4]. The annual amount of global discards was cited by Alverson et al. [5] in 1994, as 27 million tons while Kelleher [6] estimated it at 7.3 million tons in 2005. Studies have indicated that this value is approximately 10 million tons, in the last five years [2, 3]. This value ranges from 30% to 70% in the total catch for Iskenderun Bay trawl fishery [7]. The recent reform of the Common Fisheries Policy creates a landing obligation for species which are focus on catching limits and for species which are focus on the Minimum Conservation Reference Size as defined in Annex III of the 1967/2006 Regulation (EC) in the Mediterranean [8].

Fishing technology researches have been conducting very comprehensive studies sustainable ecosystem frame in different regions of the world to discard mitigation. [9-16]. These studies include modifications to increase species and length selectivity in trawl fishing gear [17-27]. Although there are positive results of these studies, discard and related mortality are still not well known in the trawl fishery. Estimation of discard mortality in fishery is basically carries out by using 2 methods. A method that can be defined as direct estimation. In this method, the survival rate is determined by observing in the tank the discarded individuals after the fishing operations [28, 29]. The other method can be called indirect methods. This method is evaluated by determining the differences in physiological parameters and behavioral impairment of discarded fish [30-35].

The main factor that affects survival rate when fish are discarded is the pressure differences and the resulting barotrauma effect [36-42]. These effects restrict swimming ability and behavior of fish by swelling the gases in body cavities especially in air-bladder [43]. This is an important problem especially in bony fish with swimming bladder [44-48]. In this study, exchanges of survival rates of discarded fish were investigated by turning depth pressure corresponding to the depth of the fish are caught with barotrauma treatment tank (BTT) after trawl operation.

MATERIALS AND METHODS

This study was conducted with commercial trawl fishing vessel in the Iskenderun Bay (Fig. 1). This region is preferred because of the depth and availability of the species used in the research.

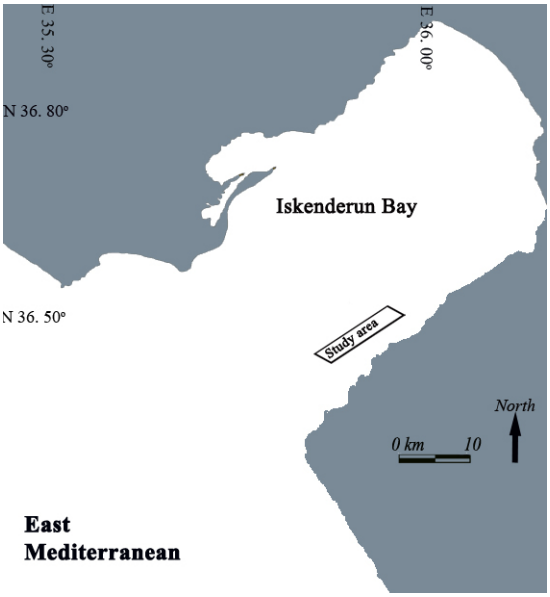

FIGURE 1
Study area (Iskenderun Bay-East Mediterranean)

TABLE 1
The information about the species used in the study.

Species	Barotrauma Treatment		Direct observation
	(N)	Mean length (cm)	Mean length (cm)
N. randalli	170	11.3±0.7	11.6±1.3
S. aurata	118	18.4±2.3	18.1±3.3
P. erythrinus	74	14.3±3.6	15.4±3.2

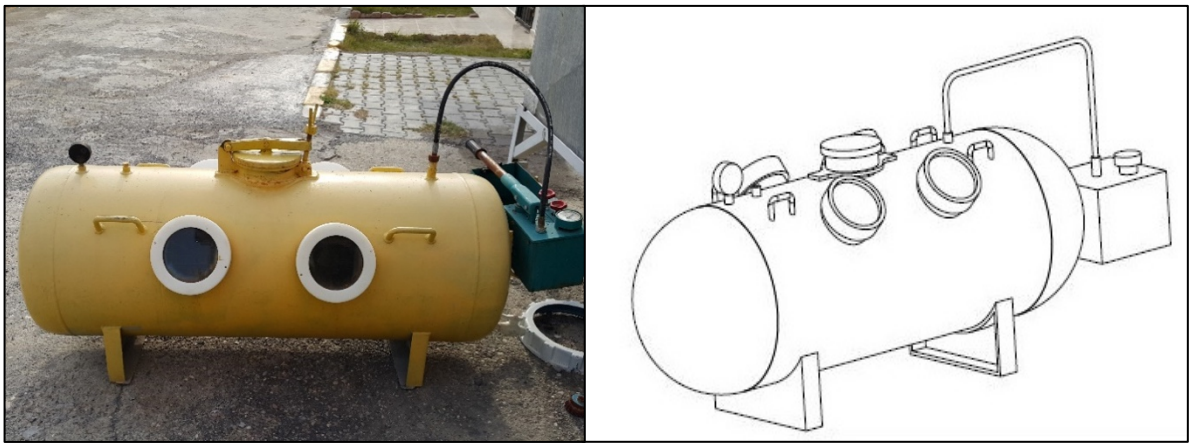

FIGURE 2
Barotrauma Treatment Tank (BTT)

10 trawl hauling operation were made for this study. All trawl hauling time is 120 minutes as standard for this study. The information about the species used in the study are given in Table 1.

Except for physically injuries or death, the fish exposed to barotrauma after trawling operation were observed in normal tank and barotrauma treatment tank (BTT). The tank is given Fig. 2 shows both real appearance and technical drawing. BTT is made of steel material and pressure to 16 bar test pressure. It has a capacity of 300 liters, transparent glass and water inlet. In this tank (BTT), the pressure is provided by simple hand pump. Immediately after fish have been put in this tank, the pressure is increased to 3 bar. Likewise, in the other group, the fish was taken to polyamide fish tanks size (Normal Tank) approximately the same.

The survival rates of discard were determined as percentages in the 30-minute observation results. The obtained results were compared with each other species separately by using ANOVA analysis in

SPSS package program. In addition, MANOVA test was used to demonstrate the overall effect of barotrauma treatment.

RESULTS AND DISCUSSION

In this study all individuals were treated with the assumption that they could be discarded after trawling operation. Because a significant proportion of the captured *P. erythrinus* and *S. aurata* individuals was below the minimum landing size (MLS) in this study. There was no minimum landing size (MLS) for *N. randalli*. At the same time mean length at first sexual maturity (Lm) for *N. randalli* in Iskenderun Bay is 11.02 cm [49]. At the end of this study it was observed that there were larger and smaller individuals in the *N. randalli*. In these experiments, the majority of *N. randalli* individuals affected by barotrauma indicated high survival rate with barotrauma treatment. This case was identified as a remarkable result for discarded N. randalli fate. were It was observed that When *N. randalli* individuals were observed in normal tanks without barotrauma treatment, it was recorded that the mortality occurred in a very short time. *N. randalli* individuals, which could not exhibit normal swimming behavior 15-20 minutes due to barotrauma in the normal fish observation tank, were showed rapid improvement and natural swimming behavior with 3 bar in barotrauma treatment tank (BTT). Because these barotrauma treatment experiments were limited to 30 minutes on the commercial fishing vessel, dead and survival individuals of *N. randalli* were determined rapidly (Table 2).

Survival rates of *N. randalli* individuals were showed that the barotrauma treatment gave successful results for survival rate after fishing operations. When SPSS ANOVA analysis was applied, it was observed that there were significant differences in survival rate. The survival rate data of *N. randalli* is the first data given after fishing operations.

TABLE 2
Survival rates for *N. randalli* after commercial trawl hauling operations with 30-minute observation in barotrauma treatment tank (BTT) and normal tank.

Hauling number	BTT (3 bar)			Normal Tank (1atm)		
	(N)	Survive	Survival rate (%)	(N)	Survive	Survival rate (%)
1	16	11	69	16	3	19
2	18	10	56	18	1	6
3	15	9	60	15	2	13
4	12	6	50	12	1	8
5	20	13	65	20	5	25
6	17	10	59	17	1	6
7	23	9	39	23	5	22
8	17	6	35	17	2	12
9	18	8	44	18	2	11
10	14	8	57	14	1	7
Mean			53.4±3.53			12.9±2.17

TABLE 3
Survival rates for *S. aurata* after commercial trawl hauling operations with 30-minute observation in barotrauma treatment tank (BTT) and normal tank

Hauling number	BTT (3 bar)			Normal Tank (1atm)		
	(N)	Survive	Survival rate (%)	(N)	Survive	Survival rate (%)
1	10	7	70	10	6	60
2	12	10	83	12	8	67
3	15	14	93	15	12	80
4	8	5	63	8	3	38
5	14	9	64	14	7	50
6	10	6	60	10	3	30
7	11	7	64	11	2	18
8	18	10	56	18	4	22
9	6	2	33	6	1	17
10	14	9	64	14	5	36
Mean			65±5.02			41.8±6.87

TABLE 4
Survival rates for *P. erythrinus* after commercial trawl hauling operations with 30-minute observation in barotrauma treatment tank (BTT) and normal tank

Hauling number	BTT (3 bar)			Normal Tank (1atm)		
	(N)	Survive	Survival rate (%)	(N)	Survive	Survival rate (%)
1	6	4	67	6	3	50
2	5	4	80	5	5	100
3	6	5	83	6	4	67
4	8	6	75	8	5	63
5	4	3	75	4	3	75
6	5	3	60	5	3	60
7	11	6	55	11	4	36
8	9	6	67	9	5	56
9	7	4	57	7	2	29
10	13	8	62	13	7	54
Mean			68.1±3.09			59±6.29

Survival rates for *S. aurata*, which is an important concentration in Iskenderun Bay trawl fisheries, were observed after trawl operation. Minimum landing size (MLS) for *S. aurata* 20 cm in the area. Nevertheless, lengths of captured *S. aurata* individuals in the area are below minimum landing size (MLS). It was observed that *S. aurata* had a very high survival rate after trawl operation. Although we were not observed barotrauma effects on *S. aurata* individuals after trawl hauling operation, we performed barotrauma treatment with barotrauma treatment tank (BTT). According to the results, barotrauma treatment gave positive result for survival rate of *S. aurata* not as much as *N. randalli* (Table 3). In statistical comparisons, barotrauma treatment was found to be beneficial by SPSS ANOVA analysis.

Survival rates of *P. erythrinus* were high after trawling fishery operations. This species has been evaluated as "Least Concern" according to the IUCN Red List of Threatened Species since 2014 [50]. However, there is no minimum landing size (MLS) for this species in our country commercial fishery regulations. At the same time mean length at first sexual maturity (Lm) of 14.2 cm for *P. erythrinus* in the Eastern Mediterranean [51]. Barotrauma treatment also gave positive results for this species according to observations of survival rate after the trawl hauling operation. The difference between the survival rates of barotrauma treatment and normal tanks was found to be significant by the ANOVA analysis of the SPSS package program.

Information of discard ratio was presented (as discards/total species catch) in EU Mediterranean (for Croatia, Greece, Italy and Spain) bottom trawl fisheries for selected bony fish, elasmobranch and decapod species [16]. According to Tsakagaris et al. (2017) [16], *P. erythrinus* showed different discard ratios depending on the regions. However, we could not find any literature about discard survival rates for *N. randalli*, *S. aurata* and *P. erythrinus* after trawl fishery operations. Therefore, discard survival rate data of these species could not be evaluated comparatively in this study.

CONCLUSIONS

As a result of this study, it was understood that pressure factor played an important role during the released for discard survival rates of *N. randalli*, *S. aurata* and *P. erythrinus* into the sea again. This study has showed that discards can survive after fishing operations if they release to sea under suitable conditions. The relevant literature on this issue also supports this idea.

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