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Blast-fishing (Julatina): Effects on seawater properties and fish composition in some locationsin the Libyan coast- Experimental study

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ABSTRACT

In November 2021 and May 2022, several bombs of (Julatina) were detonated in some (unannounced) areas, near of coasts of Susah, RasLanuf, and Zliten, Libya, to study the effects of Blast-fishing on the physicochemical properties of seawater, and on fish composition in fisheries of the studied areas. By taking measurements (before and after the blasting test) directly in each study field, and counting and identifying the captured fish specimens and their sizes. This study shows the extent of change, that results from the use of Blasts and their impact on the marine habitat and fish community in the short and long terms. This study also serves to develop plans for the recovery of the damaged areas, in addition to activating laws that forbid this illegal fishing on the Libyan coast.

الصيد بالتفجير (الجلاطينة): التأثير على خصائص مياه البحر والتركيب السمكي في عدة مناطق بالساحل الليبي- دراسة تجريبية

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الملخص

في شهري نوفمبر 2021 ومايو 2022 ، تم تفجير عدة قنابل من نوع (الجلاطينة) في عدة مناطق (غير معلن عنها) قريباً من سواحل سوسة ، رأس لانوف وزليتن– ليبيا لدراسة تأثيرات الجلاطينة علي كل من الخصائص الفيزيائية الكيميائية لمياه البحر ، وعلي التركيبة السمكية للمصائد في المناطق قيد الدراسة ، بأخذ قياسات لما قبل وبعد اختبار التفجير مباشرةً في كل منطقة ، بالإضافة إلي حصر وتعريف أنواع وأحجام الاسماك التي تم صيدها . هذه الدراسة تبين مدي التغيير الناتج عن استخدام الجلاطينة وتأثيرها علي البيئة البحرية والمجتمع السمكي علي المدي القريب ، كما توصي هذه الدراسة بوضع خطة لتعافي الأماكن المتضررة بالإضافة إلي تفعيل قوانين تقنن هذا النوع من الصيد الغير قانوني بالساحل الليبي.

1. INTRODUCTION:

Blast fishing, or dynamite fishing, is the illegal practice of using explosives to stun or kill fish stocks for easy collecting. As long as it was the most immediate reason for destruction in many marine ecosystems globally (Fox and Caldwell 2006 & England, 2014), where there are many negative impacts on their productivity and leading to immediate declines in fish species richness (Raymundo et al. 2007 & England, 2014). Lauridsen, (2013) stated that dynamite fishing destroys the coastal habitat and kills all organisms within a 15 - 20 m radius (Guard & Masaiganah, 1997), and a 5 - 10 m depth of each bomb (England, 2014). This fishing method is extremely wasteful as only roughly 3% of the organisms involved are recovered from the blast and are able to be collected and sold (Lauridsen 2013). Despite the prohibition internationally, blast fishing is moving on in a lot of countries, because of the immediate work and high profits, even fishermen more recently believe that it is the only way to catch enough fish to support their families; due to the decline of production in other fisheries sectors (England, 2014), although cause many kinds of damage; such as fishermen who have died or lost limbs as a result of blasting incidents (Pet Soede and Eardman, 1998), as well as the collapse of fish populations and the destruction of habitats. Even the dynamics of recovery in the ecosystems are still little known, which takes ages (Ulaş et al., 2014).

The first blast fishing has been reported in South-East Asia, and investigated in detail by Alcala and Gomez,1987; McAllister, (1988); Pauly et al., (1989); Salia et al.,(1993); ICRI, (1995); Mc Manus, (1997); Pet Soede and Eardman, (1998) & Edinger et al., (1998), because, then and so far; it is popular among the fishers due to the widespread availability of the major components; only the waterproof wicks are difficult to obtain and they are typically sold by middlemen (Pet-Soede & Erdmann, 1998). A few studies exist from the Middle East, where the remnants of World Wars I and II are used, especially in some southern Mediterranean areas, as a way to catch fish schools (England, 2014).

On the Libyan coast, this illegal way was banned, according to Law No. 14 in 1989, section 2, in articles (7), (14), and (15). However, this practice continues to occur, especially since 2011, when fishermen have flourished, with impunity, because of the uprising that left the country awash with weapons and explosives.

This study aimed that the effect of blast-fishing on some physical and chemical parameters of seawater, and the fish composition of catch captured on the shores of Susah, RasLanuf, and Zliten as well, as to prove how it is dangerous, to propose a correction-action to save the remaining places and then diminish the usage degree. However, it would be asked how to indicate to study the speed of recovery in the damaged areas and fisheries in the future.

2. MATERIALS & METHODS

2.1. Study field [Note: GPS data of locations are hidden]:

2.1.1. *Susah shore*: An area with poor shelter by the old jetty, protected by a barrier. Moorage for small artisanal fisheries, including the gillnetters (Reynolds et al., 1995; Abu-Madinah, 2008 & Buzaid, 2021).

2.1.2. *Ras-Lanuf Compound*: A permanent landing site, about 7 km west of the entrance of Ras-Lanuf port. with an artificial breakwater to protect from northern and western waves (Reynolds et al, 1995).

2.1.3. *Zliten area*: Modern harbour facility 156 km east of Tripoli; entrance shallow, difficult in heavy seas (Reynolds et al, 1995). Abu-Madinah, (2008) mentioned that the shores are covered by weeds of *Posidonia oceanica* most of the year, which impede the anchoring of boats with small anchors, and also limit the movement of the line-up in these areas. There are also high sand dunes, some of which directly overlook the seawater (Sharaf, 1963), with heights between 50-70 meters (British Admiralty, 1992).

2.2. Preparation & experiment: Local dynamite (Julatina) which is made of TNT (Trinitrotoluene), was equipped with a fuse and igniter, which were provided from the remnants of World Wars I and II, prepared by local fisherman. Dynamites were composed of 250g weight in small cans, and blow up at less than 3 meters' depth, according to Ulaş et al., (2014).

2.3. Physi-chemical parameters: Such as Temperature (Co), Sp Conductivity, Salinity, Dissolve Oxygen (D.O.) Concentration and pH were measured according to

Ali et al., (2019). These measurements were recorded (before and after) the explosion at less than 3 m depth.

2.4. Fish composition: In the fieldwork, the fish specimens have been identified according to Golani, et al., (2006); Iglésias, (2006), and Ben-Abdalla et al., (2009 & 2012), measuring the total length (cm.) and total weights (gm.).

2.5. Statically analyze: Changes in physical and chemical parameters of water, were examined using of Student T test (using SPSS V. 21). Results were carried out in mean ± s.e, using MS Excel 2010 as well.

3. RESULTS & DISCUSSION

3.1. Water conditions

3.1.1. *Temperature*

Before blasting: Compare to the other locations of the study area; Ras-Lanuf was the warmest in the range of 23.05 Co in winter, till the beginning of spring by 22.06 Co. Meanwhile the nadirs were valued in Zliten and Susah by 19.55 and 19.18 Co in March, respectively Table (1-A).

After blasting: In general, the scales were minimized slightly in the sites after the experiment. The sharpest drop was 1.33 Co reaching 21.72 Co on the coast of Ras-Lanuf in November, while 18.91 Co was recorded as the lowest temperature after the bombing in the waters of the Zliten area when the spring has begun Table (1-A)and Figure (1). These small differences do not differ from Ulaş et al., (2014) records in the Ege sea.

3.1.2. *Potential of Hydrogen* [pH]

Before blasting: The zenith values of pH value were 8.41 in Ras-Lanuf in March Table (1-A), followed by 8.13 in Zliten, in the same month, whereas the nadir value was in Susah (7.43). On average, Ras-Lanuf was alkaline (8.23) while Susah tended to be neutral with a drop value in this study (7.66) in Figure (1). In this work, the pH values were on the alkaline side, close to Buzaid, (2018) records in Dernah and AinGhazala lagoons.

After blasting: A significant rise in the pH value was recorded in the study sites, with the highest difference in Susah March 2022 (about 0.23); to reaching 8.12, while Zliten shores in winter; the value was less than the increment (0.04) Table (1-A)and

Figure (1). This raise is close to Ulaş et al., (2014) on the Turkish shores of Ege, regardless of the recorded pH values. According to Forsyth et al., (1995); nitrates of explosives are related to the temperature and pH of the water, thus; they can affect aquatic life in three ways: direct toxicity, reduction in dissolved oxygen, and eutrophication.

3.1.3. *Salinity*

Before blasting: Water salinity in November was determined in Zliten coasts as 35.58 ‰, followed by Ras-Lanuf (35.23 ‰), saltier than in Susah with an average salinity (32.40 ‰) Table (1-A) and Figure (1). These values are mainly lower than the majority of the Mediterranean (Nassim, 1988 and Mamdouh et al., 2010), probably as an indirect result of the rates of precipitation and the physical and climatic conditions as well (Riley and Skirrow, 1995).

After blasting: A slight increase varied in locations of the study area Table (1-A) and Figure (1); where the most saline was rated in Zliten in March till 36.03 ‰, with a raise (0.45 ‰) after the bomb, while the highest difference was (0.65 ‰) as a boost in the site of Ras-Lanuf shore in March to become 31.23. These changes may affect the pH variation in the aquatic system (Mamdouh et al., 2010 & Buzaid, 2018).

3.1.4. *Dissolved Oxygen* [D.O.]:

Before blasting: The maximum recorded value of dissolved oxygen was in Susah and Zliten with values of 7.65 and 7.43 in March, respectively. while a value of D.O. in Ras-Lanuf in November had a minimum recorded of 6.99 (Table 1-Band Figure 1). These records might be mainly from the organic constituent, that subjected to oxidation dissolved oxygen in high salinity (Ghallab, 2000 and Hasan, 2006).

After blasting: Basically, most dissolved oxygen was valued after the explosion at 7.71 in Susah, followed by 7.51 in Zliten, both values were in March as shown in Table (1-B) and Figure (1). However, levels of D.O. have moved up, with slight differences, starting within 0.01 to reach 7.32 in Zliten in November, and with 0.16 to become 7.15 in the coast of Ras-Lanuf in March. Despite the nitrates of explosives could lead to a reduction in dissolved oxygen (Forsyth et al., 1995).

3.1.5. *Conductivity*

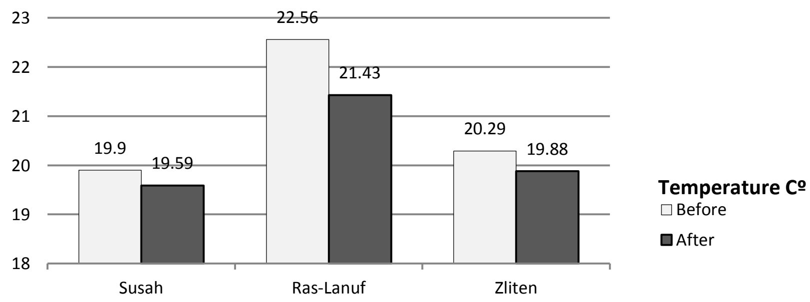
Before blasting: According to table (1-B) and Figure (1); The conductivity was (51.3427) in Ras-Lanuf in November, while it was in value of 43.3186 in Susah in March. In general, Susah had the least average conductivity value 44.6428 during the study period. These scales are less than the results of Ulaş et al., (2014) in Turkey.

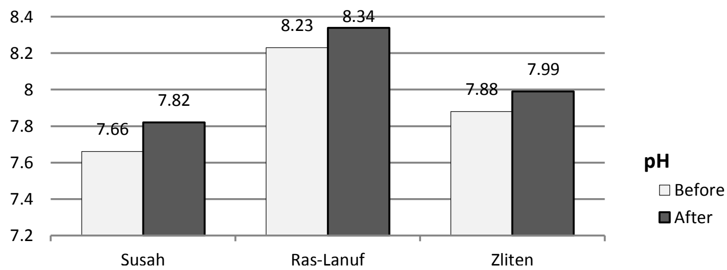
After blasting: A relative fluctuation appeared in the affected values of conductivity by the explosion, where it was decreased by a difference of 1.1129 mS/cm, to reach 50.2298 mS/cm in the coast of Ras-Lanuf in November, as a sharp subsidence, contrary to the coast of Susah in that month, with about (0.2185 mS/cm) as the lowest decline difference. On the other hand, an increase in connectivity value was recorded by 1.956 mS/cm, to approach 47.6668 mS/cm in Zliten in November (Table 1-Band Figure 1). This change up is observed by Ulas et al., (2014) as well. The averages varied in differences between 0.0369 in Zliten and 0.6195 in Ras-Lanuf shores as well.

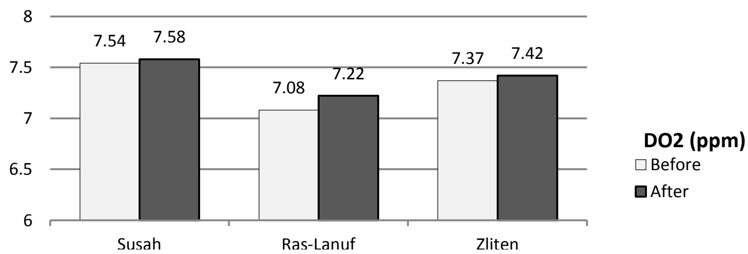
Table (1): Physicochemical parameter of the seawater between before and after the blasting experiment in coasts of Susah, Ras-Lanuf and Zliten in November 2021 and March 2022, with average, standard error ad significance test results.

		PARAMETERS (*A*)					
		Temperature C°		**pH**		**Salinity** (ppt)	
		Before	**After**	**Before**	**After**	**Before**	**After**
LOCATION	**Susah1 (Nov. 2021)**	20.62	20.24	7.43	7.51	32.92	33.04
	Susah2 (Mar. 2022)	19.18	18.93	7.89	8.12	31.88	31.23
	Average ± S.D.	19.90 ± *1.02*	19.59 ± *0.93*	7.66 ± *0.33*	7.82 ± *0.43*	32.40 ± *0.74*	32.14 ± *1.28*
	Significance	t=4.846 , P<0.05		t= 2.067 , P<0.05		t= 0.688 , P<0.05	
	Ras-Lanuf1 (Nov. 2021)	23.05	21.72	8.04	8.10	35.23	35.44
	Ras-Lanuf2 (Mar. 2022)	22.06	21.14	8.41	8.58	34.17	34.24
	Average ± S.D.	22.56 ± *0.70*	21.43 ± *0.41*	8.23 ± *0.26*	8.34 ± *0.34*	34.70 ± *0.75*	34.84 ± *0.85*
	Significance	t=5.488 , P<0.05		t= 2.091 , P<0.05		t= 2.00 P<0.05	
	Zliten 1 (Nov. 2021)	21.02	20.84	7.62	7.66	33.81	34.11
	Zliten 2 (Mar. 2022)	19.55	18.91	8.13	8.31	35.58	36.03
	Average ± S.D.	20.29 ± *1.04*	19.88 ± *1.36*	7.88 ± *0.36*	7.99 ± *0.46*	34.70 ± *1.25*	35.07 ± *1.36*
	Significance	t= 1.783 , P<0.05		t= 1.571 , P<0.05		t= 5.00 , P<0.05	

		PARAMETERS (*B*)			
		DO2 (ppm)		**Sp Conductivity (mS/cm)**	
		Before	**After**	**Before**	**After**
LOCATION	**Susah1 (Nov. 2021)**	7.42	7.45	45.9670	45.7485
	Susah2 (Mar. 2022)	7.65	7.71	43.3186	42.298
	Average ± *S.D.*	7.54 ± *0.16*	7.58 ± *0.18*	44.6428 ± *1.87270*	44.02325 ± *2.43987*
	Significance	t= 3.00 , P<0.05		t= 1.545 , P<0.05	
	Ras-Lanuf1 (Nov. 2021)	6.99	7.15	51.3427	50.2298
	Ras-Lanuf2 (Mar. 2022)	7.16	7.28	48.0419	49.0553
	Average ± *S.D.*	7.08 ± 0.09	7.22 ± *0.01*	49.6923 ± *2.33402*	49.64255 ± *0.83050*
	Significance	t= 7.00 , P<0.05		t= 0.047 , P<0.05	
	Zliten1 (Nov. 2021)	7.31	7.32	47.4712	47.6668
	Zliten2 (Mar. 2022)	7.43	7.51	48.1615	48.0397
	Average ± *S.D.*	7.37 ± *0.08*	7.42 ± *0.13*	47.81635 ± *0.48812*	42.85325 ± *6.80739*
	Significance	t= 1.286 , P<0.05		t= 0.233 , P<0.05	







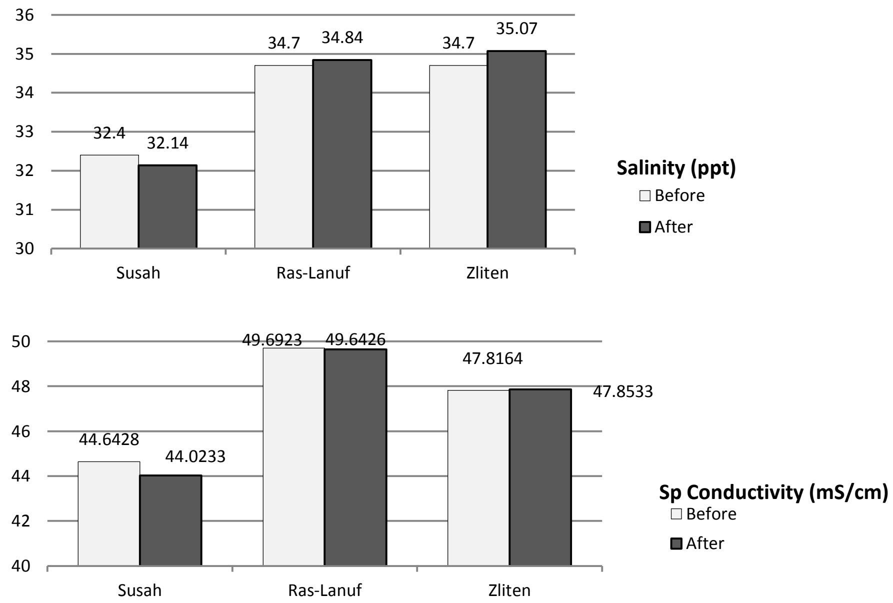


Figure (1): Changes in physicochemical parameters between before and after the blasting experiment in coasts of Susah, Ras-Lanuf and Zliten in November 2021 and March 2022, with average and standard error. [A: Temperature (◦C), B: Sp Conductivity (µS/cm), C: Salinity (p.p.t.), D: Dissolve oxygen (mg/L), and E: pH].

Looking at the correlation in Table (1), it was perfect between (before) and (after) for each factor separately. As well as, the (T) values were significant, from (0.047) Conductivity, till (7.00) in the dissolved oxygen averages at the water column of Ras-Lanuf waters, the correlation of these factors was determined at less than 0.05 in all factors in all experimental locations, Ulas et al., (2014) as well found that the significant differences between the mean of the same parameters in the Turkish waters. This indicates the clear impact, resulting from this fishing method on the marine environment.

3.2. Fish composition:

In Susah, Ras-Lanuf and Zliten, the composition of fishes that captured using the explosives are determined in table (2) and figure (2). It is noticed that the majority of these bony fish families belong to Sparids, Carangids , Grey mugils (Mugilidae) and Rabbit fishes (fam. Siganidae). Meanwhile the minors were counted in Picarels (fam. Centracanthidae), Drum fishes (fam. Sciaenidae) and Triggerfishes (fam. Balistidae). Regionally, Susah's yield had about 11 species, which had major portions; starting *Seriola dumerilli* (81 specimens), were rated into 39.3%, followed by *Trachurus* *meditrranus* , *Pagrus pagrus* and *Sarpa sarpa* by around 11.0% for each, then *Sphyraena sphyraena* (8.3%), and *Umbina cirrosa* with specimens of *Spicara maena* had 3.9% for each. Meanwhile the minors had been recorded in ratios of *Epinephelus marginatus* and *Trachinotus ovatus* by 1.5 and 0.5%, respectively (Table 2& figure 2).

Going to describe the large trenches of yield of Ras-Lanuf (Table 2 & figure 2); Amberjacks were sized from 60.4 to 85.2 cm, and rated with 41.3%, followed by Red sea breams *P. pagrus* with 16.5% (8.7 – 19.6 cm), then *Trachurus mediterraneus* and *Spondyliosoma cantharus* by 10.1% for each. To see the smaller values in this location were for *Siganus luridus* (5.5%), *Caranx crysus* (4.6%) and *Umbrina canariensis* (2.8%).

Ending on Zliten's shores; the young ambers (called locally: Bremah) have been collected in smaller than 80.3 cm, with 40.3% of the harvest of the experiment, followed with *T. meditrranus* (13.8%), *Mullus surmuletus* (12.3%), then *P. pagrus* and *Scomber joponicus* which rated by 8.5% for each (Table 2 & figure 2).

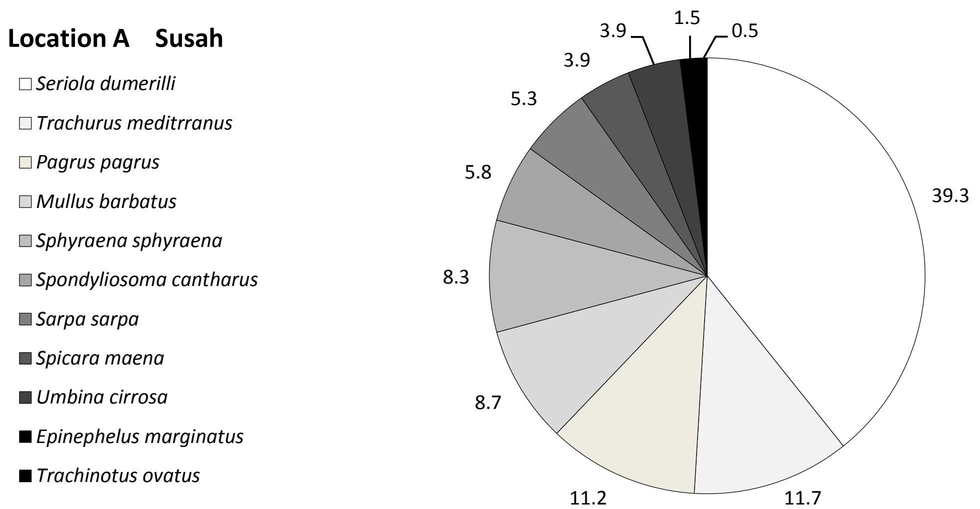
These records are mainly close to Pet-Soede *et al*., (1999); Abdallah, (2002); Buzaid, (2008 & 2021), and Ulas *et al*., (2014). Regarding the geographic distribution and the environmental conditions.

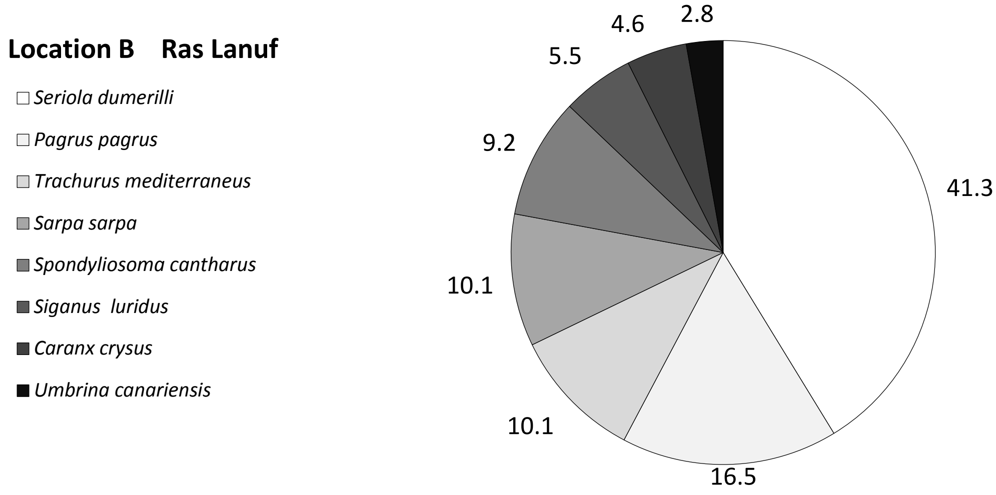
Table 2. Composition of captured fishes after the blasting experiment in coasts of Susah, Ras-Lanuf and Zliten in November 2021 and March 2022.

	Family	Species	Count	%	Length (cm.)	Weight (gm.) [Aver ± S. D.]
Susah	Carangidae	*Serioladumerilli*	81	39.3	75.3 - 108.8	3852.00 ± *610.00*
		Trachurusmeditrranus	24	11.7	8.8 - 14.4	72.22 ± *9.52*
		Trachinotusovatus	1	0.5	9.4 - 13.1	69.52 ± *43.18*
	Sparidae	*Paguspagrus*	23	11.2	7.7 - 16.1	51.13 ± *13.94*
		Spondyliosomacantharus	12	5.8	5.4 - 13.6	60.53 ± *12.91*
		Sarpasarpa	11	5.3	12.4 - 25.2	70.43 ± *22.47*
	Mullidae	*Mullusbarbatus*	18	8.7	6.9 - 17.1	40.44 ± *24.1*
	Centracanthidae	*Spicaramaena*	8	3.9	10.4 - 14.9	64.85 ± *61.23*
	Sphyraenidae	*Sphyraenasphyraena*	17	8.3	27.3 - 45.1	181.89 ± *79.24*
	Sciaenidae	*Umbinacirrosa*	8	3.9	9.7 - 15.6	62.33 ± *34.11*
	Serranidae	*Epinephelusmarginatus*	3	1.5	25.3 - 43.3	210.33 ± *85.22*
			206	**100.1**		

	Family	Species	Count	%	Length (cm.)	Weight (gm.) [Aver ± S. D.]
Ras-Lanuf	Carangidae	*Serioladumerilli*	45	41.3	66.4 - 85.2	1355.45 ± *150.62*
		Trachurusmediterraneus	11	10.1	7.6 - 17.7	72.61 ± *16.61*
		Caranxcrysus	5	4.6	6.5 - 13.5	63.12 ± *22.44*
	Sparidae	*Pagruspagrus*	18	16.5	8.7 - 19.6	40.12 ± *11.32*
		Sarpasarpa	11	10.1	5.7 - 15.6	27.77 ± *9.2*
		Spondyliosomacantharus	10	9.2	7.6 - 14.5	77.43 ± *11.53*
	Siganidae	*Siganusluridus*	6	5.5	8.9 - 13.6	64.22 ± *9.16*
	Sciaenidae	*Umbrinacanariensis*	3	2.8	11.6 - 16.5	74.63 ± *12.75*
			109	**100.1**		

	Family	Species	Count	%	Length (cm.)	Weight (gm.) [Aver. ± S. D.]
Zliten	Carangidae	*Serioladumerilli*	53	40.8	26.9 - 80.3	1888.43 ± *422.22*
		Trachurusmeditrranus	18	13.8	8.9- 12.1	64.32 ± *13.11*
		Lichiaamia	4	3.1	7.6 - 14.8	91.64 ± *15.19*
	Sparidae	*Pagruspagrus*	11	8.5	11.3 - 27.6	63.22 ± *18.71*
		Sarpasarpa	5	3.8	12.4 - 21.1	88.23 ± *35.12*
		Sparusaurata	2	1.5	11.3 - 31.0	91.33 ± *21.13*
		Pagelluserythrinus	2	1.5	8.9 - 19.7	72.55 ± *22.34*
		Spondyliosomacantharus	3	2.3	11.8 - 15.1	66.33 ± *12.81*
	Mullidae	*Mullussurmuletus*	16	12.3	7.7 - 16.4	30.23 ± *12.82*
	Scombridae	*Scomberjoponicus*	11	8.5	18.3 - 39.6	320.66 ± *191.22*
	Siganidae	*Siganusluridus*	3	2.3	5.8 - 17.6	74.53 ± *22.37*
	Balistidae	*Balistiscarolinases*	2	1.5	22.1 - 28.3	116.43 ± *27.11*
			130	**100**		





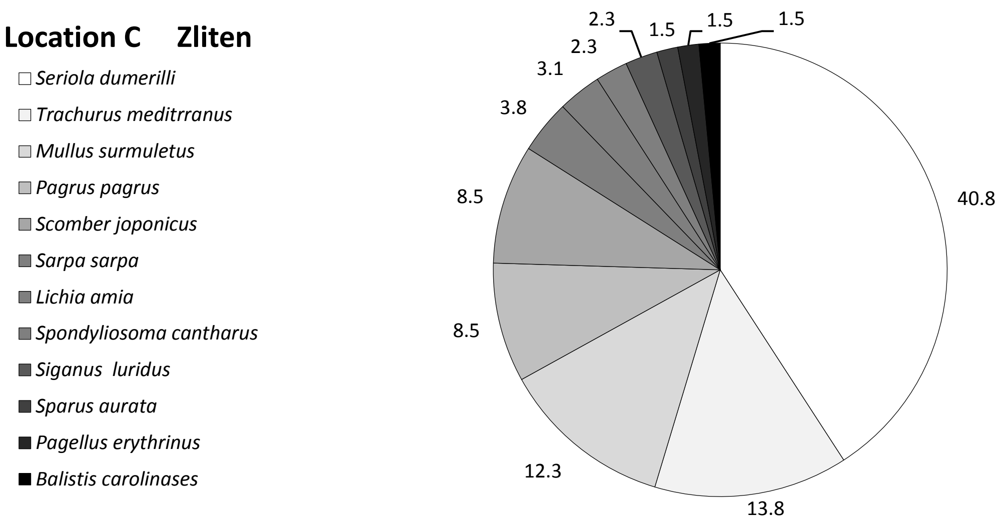


Figure 2. Composition of captured fishes after the blasting experiment in coasts of Susah, Ras-Lanuf and Zliten in November 2021 and March 2022.

4. CONCLUSION

Blast fishing, as an illegal fishing method, cause of using explosives, to kill fish stocks easily, has been banned globally, even in Libya; according to item No. (7), (14), and (15) of Law No. 14 of 1989. However, this practice is still carried out on Libyan shores, especially since it has flourished in it with impunity, due to the recent local wars, that have left the country overwhelmed with weapons and explosives since 2011. This fishing method has become popular among fishermen; cause of the abundance of its main equipment, and based on factors that enable the operation of this fishing method on the coast: (i) easy availability of cheap materials for making explosive devices, (ii) well-connected businessmen who supply the operation and market, (iii) lack of local marine resource the ownership, such as the power-men, (iv) ineffective law enforcement at the local level, and (v) a lack of political will at all levels. The motive for the fishermen to violate the laws and use this technique is the fast and sufficient financial gain for their families, due to the yield of this method in two days; it might equal a harvest of several weeks using traditional fishing methods. Latterly, the practice of this fishing method is considered an environmental disaster. It does not lead to the killing of large amounts of marine organisms in an immediate decline in the richness and species diversity, but also to the destruction of their habitats and nursery grounds as well.

As well as, it causes loss of lives or limbs for the fishermen as a result of the bombing incidents, with another long-term effect; causes as a lack of a permanent and renewable source of livelihood for them; resulting from the destruction of successive generations of fish stocks in their habitat. Unfortunately, without tackling the key enabling factors, in order to be able to provide alternative solutions and methods, the use of explosives will continue to flourish in the Libyan coastal waters to the detriment of its environment, its tourism industry, and its reputation as a safe destination. It has been considered that the damaged areas, as a result of this fishing method, these areas need a long duration to start recovery. In order to reduce this duration to facilitate this recovery; we need human intervention widely, if recovery is required, indeed, that was first. Secondly, an action plan of fisheries management must be developed, which includes a temporary or permanent ban or suspension of fishing in the affected areas, hopefully, to achieve the restoration of the ecological and economic value of, and the coastal ecosystem therein, with the involvement of government institutions, organizations and local administrations (particularly fishermen’s unions, coast guards, marine wealth offices, and civil society institutions ..etc), in order to extend control and enforce the law on these areas where these violations occur.

Finally, the most crucial point is raising "community awareness" to reflect the light on the risks and harmful effects of this act, which should be criminalized by religious, moral, and tribal aspects of the local community, due to its effectiveness and permeability, compared to the legal prosecution.

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