The Effect of Electric Current on the Survival and Behavior of Several Species of Fish

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Abstract

Different sizes and ages of common carp (*Cyprinus carpio*), tilapia (*Oreochromis niloticus*), *Aphanius dispar* and grass carp (*Ctenopharyngodon idella*) were exposed to different voltages of alternating current (AC). The small sizes of all types of fish were found to be more resistant to different voltages and more tolerant to the electric current than the large ones. The current study showed a positive relationship between the period of exposure to different voltages with the recovery time of the first fish and the total recovery of all fish. No fish mortality was recorded at voltage 150 for all types of fish. In contrast, the highest percentage of fish mortality was recorded using voltage 220, especially common carp with an average length of (3.3 cm).

Keyword: Fish, Electric fishing, Basrah, Recovery time, Stunning time.

Introduction

Fish respond differently to electric currents, and skin and size affect that response (Nikolsky, 1963). Electric current is used at different frequencies for catching fish in fresh water. It is also used in anesthetizing fish, and its cost is lower than other methods (Sehramm *et al.* 2002). Electric current was used for fishing in freshwater to attract fish or stun them. Vibert (1967) stated that several factors affect fishing using electricity, such as electrical conductivity, the water surface's dimensions, and water quality. Dolan (2002) mentioned that the information available about the most negligible electric current required to anesthetize fish needs to be more comprehensive. However, it mainly depends on the type of fish, its weight, and the body water content (Wilson, 2005).

Studies that included the effect of electricity on fish in Iraq were limited to a limited number of studies, including the study of Al-Dubaikel, *et al.* (1999) on the effect of electric current on osmotic regulation in fish *C. carpio* and *Planliza abu*, and the study of Al-Mhnawi (2006) on the effect of electric current Alternating chemical composition of four species of fish *P. abu*, *C. carpio*, *Acanthopagrus arabicus*, and *C. idella*. Mohsen (1987) stated that the effect of the chemical composition of fish caught by electric current, especially its suitability for preservation due to the lack of acid accumulation lactic acid in muscles due to stress. Al-Mukhtar, *et al*. (2006) studied the effect of commercial fishing by electrocution on some species of fish in the marshes of Basrah governorate. It was found that the fish were severely damaged by bleeding in the gills, muscles, and spine twisting. The study of Abbas and Aylan (2020) on the effect of electric fishing on eight species of fish (*Poecilia latipinna, Carassius auratus, P. abu, P. subviridis, Silurus triostegus, Coptodon zillii, O.aureus,* and *O. niloticus*) caught from Karmat Ali River. The study showed a difference in the severity of injuries resulting from this type of fishing depending on the fish's species, size, and surface area.

The current study aims to know the effect of electric current on the survival rates, the behavior of fish exposed to it at different lengths, and the recovery period required to return the fish to its normal position after removing the effect.

Material and Methods

Different lengths of the common carp (*C. carpio*) were used (0.8, 3, 14 cm), the variable bream (*A. dispar*) with an average length of (3.5 cm) and the Nile tilapia *O. niloticus* with an average length of (14.7 cm) and grass carp *C. idella* with an average length of (9.5 cm). The fish were collected from the ponds of the Marine Sciences Center, University of Basrah. They were exposed to an alternating electric current through a locally manufactured device with an electrical capacity of 0-250 volts and periods of 15-, 30-, and 45-seconds Picture (1). Its electrodes are made of electric wires. The electrodes are made in rings to simulate the electric fishing used in the inland waters in Basrah governorate. They are suspended inside a basin made of fiberglass, the size of which is 1 m, and the distance between the two poles is 1 m^3. fifty larvae of the common carp (*C. carpio*) and ten fish were placed. The fish were exposed to an electric current for each basin and the rest of the species. The time of appearance of exposure to different voltages (150, 220 volts), the time of electrocution, and the time of recovery for all fish was recorded, the number of dead fish was recorded, and the behavior of the fish as a result of being affected by electric shock was recorded. The water temperature (C^o), salinity and pH of the experimental pond water were measured using the YSI 556 MPS device after it was calibrated, as the water temperature was (25 C^o), salinity (1.2 psu), and pH (7.6).

Picture (1): The electricity-generating device used in the experiment

Results

Cyprinus carpio larvae

The results of the current study showed that the larvae of common carp with lengths (0.8, 0.7, 0.6, and 0.9 cm) and an average length of (0.75 cm) were not affected under the influence of voltages 150 and 220 for 15 seconds, while it showed an unclear effect except for a few numbers of them (3-4). A larva under the influence of a voltage of 150 for 30 seconds and larvae under a voltage of 220 volts for 30 seconds showed a direct effect by ascending to the surface and floating. The full awakening is after 2 minutes without any case of mortality after the cessation of the effect. The larvae showed a rapid movement in a specific place similar to the vibration movement under a voltage of 150 for 45 seconds. When the power is cut off, this effect disappears, and it begins to be quiet for a while, and after about 30 seconds, it returns to normal. The larvae showed a behavior represented by rising to the surface when using a voltage of 220 for 45 seconds and returning to normal after 2 minutes of the stimulus disappearing, and three mortality larvae were recorded.

Fingerlings of *Cyprinus carpio*

Fingerlings of common carp *C. carpio* were used, with lengths of 3.0, 2.5 and 3.5cm, an average length of (3.3 cm), and an age of about two months. These sizes of common carp showed an apparent effect when using different voltages and for the periods used, as the first effect was recorded after about five seconds and the total wake-up period ranged between 165 seconds and 325 seconds. No case of fish mortality was recorded when using a voltage (150). In contrast 3, 9 and 7 cases of fish death were recorded under the influence of a voltage (220) and for 15, 30 and 45 seconds, respectively (Table, 1).

Table (1): The effect of electric current on common carp fish with an average length of (3.3 cm).

No. of fish	Average length (cm)	Voltage	Time of stunning (sec)	The beginning time of the first fish affected (sec)	The recovery time of the first fish (sec)	The total recovery time of all fish (sec)	No.of mortality fish
10	3.3	150	15	5	25	165	-
10	3.3	150	30	5	45	165	-
10	3.3	150	45	5	70	285	-
10	3.3	220	15	5	75	170	3
10	3.3	220	30	5	90	285	9
10	3.3	220	45	5	105	320	7

***Cyprinus carpio* fishes**

The common carp with lengths (16.5, 14.0, 16.0, 18.0, 9.5 and 10.0) and an average length of (14.7 cm) showed its effect after 5 seconds when exposed to 150 and 7 seconds at a voltage of 220 for all periods. The duration of the first awakening ranged between (10-80). seconds, while the total recovery period for all fish and their return to normal ranged between (75-300) seconds for a voltage of 150 and all periods, and one death case was recorded at this voltage, while the duration of the first recovery ranged between (30-110) seconds and a period of the total recovery of all fish was between (180-360) seconds for a voltage of 220 and all periods. One death case was also recorded at this voltage (Table 2).

Table (2): The effect of electric current on common carp fish with an average length of (14.7 cm).

No. of fish	Average length (cm)	Voltage	Time of stunning (sec)	The beginning time of the first fish affected (sec)	The recovery time of the first fish (sec)	The total recovery time of all fish (sec)	No. of mortality fish
10	14.7	150	15	5	10	75	-
10	14.7	150	30	5	25	130	-
10	14.7	150	45	5	80	300	-
10	14.7	220	15	7	30	180	1
10	14.7	220	30	7	35	220	-
10	14.7	220	45	7	110	360	1

Grass carp fishes *Ctenopharyngodon idella,*

The length of the grass carp *C. idella* ranged from (7.5-10.5 cm) with an average length of (8.8 cm), as its first impact was recorded after 7 seconds for 150 effort and 3 seconds for 220 efforts. The recovery period for the first fish for 150 efforts ranged between (80-255 seconds), (80-255 sec) and (80-240 seconds) for effort 220 for periods 15, 30, and 45 seconds, while the total recovery period for all fish was (100-180 seconds) and (230-400 seconds) for efforts 150 and 220 and periods. 15, 30 and 45 seconds, respectively. No fish mortality occurred during the experiment using this species (Table 3).

Table (3): The effect of electric current on grass carp fish with an average length of (8.8 cm).

No. of fish	Average length	Voltage	Time of stunning (sec)	The beginning time of the first fish affected (sec)	The recovery time of the first fish (sec)	The total recovery time of all fish (sec)	No. of mortality fish
10	8.8	150	15	7	15	80	-
10	8.8	150	30	7	140	80	-
10	8.8	150	45	7	241	400	-
10	8.8	220	15	3	20	80	-
10	8.8	220	30	3	170	230	-
10	8.8	220	45	3	255	485	-

Tilapia fish *Oreochromis aureus*

The tilapia fish *O. aureus lengths* used in the experiment ranged from (7-24.5 cm) with an average of (14.7 cm). The fish exposed to the electric current was affected after 5 seconds for voltages 150 and 220, respectively, and different periods. The recovery of the first fish after the cessation of the stimulus using voltage 150 was 40 seconds for the duration. The periods are 15 seconds, 80 seconds, and 210 seconds for the period of 30 and 45 seconds, respectively, while the wake-up time of the first fish was at a voltage of 220 at the periods of 15, 30, 45 seconds, 70, 130 and 375 seconds, respectively. The total wake-up time of all fish for voltages was 150 And 220 for different periods (90, 210, 300 seconds) and (300, 480 and 1020 seconds). Small sizes of this species (7 and 8 cm) showed that they were not affected by voltages 150 and 220 for different periods, and no mortality was recorded for fish of this species (Table 4)

Table (4): The effect of electric current on Tilapia fish *O. aureus* with an average length of (14.7 cm).

No. of fish	Average length (cm)	Voltage	Time of stunning (sec)	The beginning time of the first fish affected (sec)	The recovery time of the first fish (sec)	The total recovery time of all fish (sec)	No. of mortality fish
10	**14.7**	**150**	**15**	**5**	**40**	**90**	**-**
10	**14.7**	**150**	**30**	**5**	**80**	**210**	**-**
10	**14.7**	**150**	**45**	**5**	**210**	**300**	**-**
10	**14.7**	**220**	**15**	**5**	**70**	**300**	**-**
10	**14.7**	**220**	**30**	**5**	**130**	**480**	**-**
10	**14.7**	**220**	**45**	**5**	**375**	**1020**	**-**

Aphanius dispar

The lengths of the *A. dispar* fish ranged from (2.5 to 4.5 cm) at a rate of (3.5 cm). The period for the fish to be affected by voltages was 150 and 220 for different periods (3-4) seconds, while the recovery of the first fish reached voltages 150 and 220 at periods 15 and 30., 45 seconds 25, 90, 165 seconds, and 30, 160, and 250 seconds, respectively, and the total wake-up time for all fish was for voltages 150 and 220 for different periods (180, 300, 720 seconds) and (420, 440 and 825 seconds) on respectively (Table 5). No cases of fish mortality were recorded at different voltages and durations.

Table (5): The effect of electric current on *A. dispar* with an average length of (3.5 cm).

No.of fish	Average length (cm)	Voltage	Time of stunning (sec)	The beginning time of the first fish affected (sec)	The recovery time of the first fish (sec)	The total recovery time of all fish (sec)	No. of mortality fish
10	3.5	150	15	4	25	180	-
10	3.5	150	30	4	90	300	-
10	3.5	150	45	4	165	720	-
10	3.5	220	15	3	30	420	-
10	3.5	220	30	3	160	440	-
10	3.5	220	45	3	250	825	-

Discussion

Recently electric fishing has spread in the inland waters of Basrah, whether in the internal rivers or the marshes, through electric shock using an electric generator in a small boat. This method causes the fish to lose consciousness, so it floats above the water's surface and is easy to catch, and after a few minutes, it returns to life again.

Abbas and Aylan (2020) indicated that the first degree of injuries in fish from fishing using electricity is internal bleeding or fusion of the vertebrae, which is common among fish exposed to electricity. These injuries vary according to the size of the fish. In contrast, second-degree injuries caused by bleeding associated with the spine or misalignment of vertebrate are considered very few compared to first-degree infection and appears only in large fish of tilapia and Prussian carp species and does not appear in *p. abu* and p. *subviridids*. Among the negatives recorded on fishing using electricity is that it is a non-selective method, meaning that it catches all fish and all sizes, whether commercial or non-commercial, in addition to its adverse effects on other aquatic animal groups such as invertebrates, reptiles, amphibians, and even fish larvae and eggs (Snyder, 2003).

Many studies indicated the effect of direct electric current on many freshwater fish, such as bighead carp, gizzard shad *Dorosoma cepedianum* (Lesueur, 1818), grass carp, rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792), juvenile and adult sea lamprey, silver carp, and walleye *Sander vitreus* (Mitchill, 1818) (Verrill and Berry 1995; Maceina *et al*. 1999; Holliman, 2011; Johnson and Miehls 2014; Johnson *et al*. 2014; Parker *et al*. 2015; Weber *et al.* 2016).

The current study showed a difference in the effect of species on electricity (150 and 220 volts) and according to the duration of electrocution (15, 30 and 45 seconds), as the species showed different responses depending on the type and age of the fish, whether large or small in size or surface area and this coincides with many studies that show the large fish show a more robust response to the electric field than the small fish, as well as the shape of the fish, in addition to the location of the nervous system and muscles, as well as the fact that the fish is injured or not (Emery,1984; Dalbey, *et al.*, 1996; Kim & Mandrak, 2017 and Abbas & Aylan, 2020).

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تأثير التيار الكهربائي على بقاء وسلوك عدة أنواع من الأسماك

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الملخص

تم تعريض أحجام وأعمار مختلفة من أسماك الكارب الشائع*Cyprinus carpio*، والبلطي النيلي *Oreochromis niloticus*، والبطريخ المتغير *Aphanius dispar*، والكارب العشبي *Ctenopharyngodon idella* لجهود مختلفة من التيار المتناوب (AC) وقد وجد أن الأحجام الصغيرة لجميع أنواع الأسماك أكثر مقاومة للجهود الكهربائية المختلفة وأكثر تحملاً للتيار الكهربائي من الأسماك الكبيرة. أظهرت الدراسة الحالية وجود علاقة إيجابية بين فترة التعرض لجهود مختلفة مع زمن التعافي للأسماك الأولى والاسترداد الكلي لجميع الأسماك. لم يتم تسجيل أي نفوق للأسماك عند الجهد 150 لجميع أنواع الأسماك. وفي المقابل تم تسجيل أعلى نسبة نفوق للأسماك عند استخدام الجهد 220، وخاصة الكارب الشائع بمتوسط طول (3.3 سم).

الكلمات المفتاحية: أسماك، الصيد بالكهرباء، البصرة، زمن التعافي، زمن، الاسترداد.