MARSH BULLETIN 15(2) September (2020) 117–126

MARSH BULLETIN

Effect of electrofishing on some fish species in Qarmat Ali River and East Hammar marsh, Basrah, Iraq

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Abstract:

This study was conducted to show the effects of electrofishing on fish species caught by the electricity method widely common in Basrah province. The study was carried out in the Qarmat Ali River East Hammar marsh, which focused on the kinds of damages and injuries caused by this method to capture the fishes and based on the Reynolds Criteria (severity classification) divides the injuries into three ranks of the skeletal deformation and hemorrhagic injuries. Eight fish species were caught: *Poecilia latipinna*, *Carassius auratus* (Prussian carp), *Planiliza abu*, *P. subviridis* , *Silurus triostegus* (Catfish), and three species of Tilapia are *Coptodon zillii*, *Oreochromis aureus*, *O. niloticus*. The injuries varied depending on the species and the size and surface area of the fishes. It was noted that the *P. latipinna*, *P. abu*, *P. subviridis* in this way were not affected by electrofishing, while the first category injuries which include hemorrhage outside the spinal column and fusion or deformity of the vertebrae, and the second category injuries which included hemorrhage near the spinal column for one or two vertebrae or misalignment in the vertebrae or spine curvature distributed on Tilapia species and Prussian carp. The third degree of injuries, which included hemorrhage in the spine area of more than two vertebrae found in catfish only, while not seen any case of crashes or vertebrae separation of the spine of the third category of vertebral injury.

Keywords: electrofishing, fish, Basra, river, marsh

Introduction:

Electric fishing releases a high voltage current that moves from the positive pole to the negative pole through the water. When the fish within the electric path is subjected to sufficient voltage, they are affected by the electricity to be directed to the source of electricity and caught (Snyder, 2003). The Englishman Isham Baggs (Hartley 1990) first used the electric fishing method in 1863. Electric fishing has been widely used to collect aquatic organisms for scientific studies and control freshwater fish communities, especially in streams and rivers (Cowx, 1990). The efficiency of electric fishing depends on many factors, including fishing gear and other environmental factors surrounding fishes and the characteristics of fish themselves (Bohlin *et al*., 1989; Peterson *et al*., 2004). For example, water conductivity of electricity and fish lengths or sizes have a major impact on fishing (Bohlin *et al*., 1989). Fishing has many harmful effects on fishes, including side effects that increase the mortality rate, spinal injuries, and internal bleeding, a recurring injury that does not appear on the outer appearance of the fish (Kocovsky *et al*., 1997; Snyder, 2003). The continued incidence of electric-induced injuries has led to a decline in the growth rates of some species of fish (Gatz and Linder, 2008).

The basic principle of electric fishing is the transfer of electric current from the electrical device to the water and passing through the fish in the electric field with an amount of electrical efficiency that controls the behavior of the fish and allows its fishing (Mahoney et al., 1993). The movement of the fish in an electric field is believed to be the result of the rapid response of the central nervous system that controls the voluntary effectiveness of the animal and the central autonomic device that controls the involuntary actions of the animal and the muscles (Vibert, 1967). The stimuli move through the sensory nerve fibers to the brain and the nerve cord and also through the nerve fibers responsible for movement to the muscles. The electrical signal is transmitted as an electric polarization wave moving along the nerve cord resulting in an electric polarization that directs the fish to it. The movement of fish toward the electric power source is called galvanotaxis, an uncontrolled muscular spasm, resulting in the movement of fish towards the positive pole of the electric tool used in fishing. This movement is also believed to be the direct stimulation of the central nervous system of the fish that controls the voluntary and involuntary actions of the fish.

The impacts of electric fishing on fish take many assessments, including fish survival rates, injury rates, physical effects and effects on gametes. Many studies have examined the relationship between the electrical current characteristics of the type of electric current and the shape of the wave and its relation to mortality rates and injury rates in fishes. Electric fishing can be divided into two main types: Alternating current (AC), direct current (DC), which can also be classified as constant direct current (CDC) and pulsed direct current (PDC) (Reynolds, 1996). All types of electric currents can be used as long as they are efficient in hunting, but using an optimal kind of power to give high efficiency in fishing and less damage to fish is important (Allen-Gil, 2000). Most fish experiments have shown that the mortality rate is lower in direct current (DC) use.

Sources indicate that electricity was used as a means of observation during the 40s and became common during the 50s and 60s. Despite some precautionary studies, it was considered a benign technique for several years (Reynolds, 1996). Although some of the harmful effects of electrolysis on salmon were recorded in the early years (Hauck, 1949; Pratt1, 955; Hudy,1985), and subsequent studies found significant damage ranging from spinal destruction to internal hemorrhage (Sharber and Carother, 1988; Bohlin *et al*., 1989; Sharber *et al*.,1994) Neuropathy in the nerves, muscles, and tissues (McMichael, 1993; Hollender and Carline, 1994) as well as physiological and behavioral disorders (Schreck *et al*., 1976; Mesa and Schreck,1989; Mitton and McDonald, 1994). Electric fishing is a complex and dynamic structure between physics, physiology, and behavior (Snyder, 2003). The electric current interferes with or inhibits or activates the internal response to control the muscular effectiveness of the fishes (Kolz and Roynolds1989). Sharber and Carothers (1988) are one of the first studies to have recorded a high infection rate in a sample of rainbow trout (*Oncorhynchus mykiss*). Electrolytic fish may not seem to be affected after removed electricity source electricity. However, a major physiological imbalance in the fish's body may last for several hours or for a long time, and long-term effects may persist throughout the fish's life (Schreck *et al.*, 1976; Mitton and McDonald, 1994). Local studies were limited to the study of Al-Dubaikel *et al*. (1999), who study the physiological influences of electric current on the ionic balance of common carp(*Cyprinus carpio*) and mullet (*Liza abu*), as well as Al-Mukhtar *et al*. (2006), who focused on the physiological and anatomical effects on some species of fish due to electric fishing.

Unfortunately, electric fishing has become a widespread culture among many fishermen in Basrah because it is an easy, fast and non-selective way of fish, which is the reason for its danger. It affects all current aquatic animal groups as well as future generations. This study was conducted to show the effects of electrofishing on fish species caught by the electricity method widely common in Basrah province.

Materials and methods:

Description of the study area:

The study was conducted in Garmat Ali river and East Hammar Marsh in the province of Basrah in southern Iraq with three stations, the first station N: 30 ° 37 '56.39 "E: 47 ° 39' 45.69", the second station N: 30 ° 36 '11.12 "E: 47 ° 40 '41.42 ", third station N: 30 ° 34' 42.64" E: 47 ° 44 '19.77 ", for two months and for the period from November to December 2017 as shown in Figure (1).

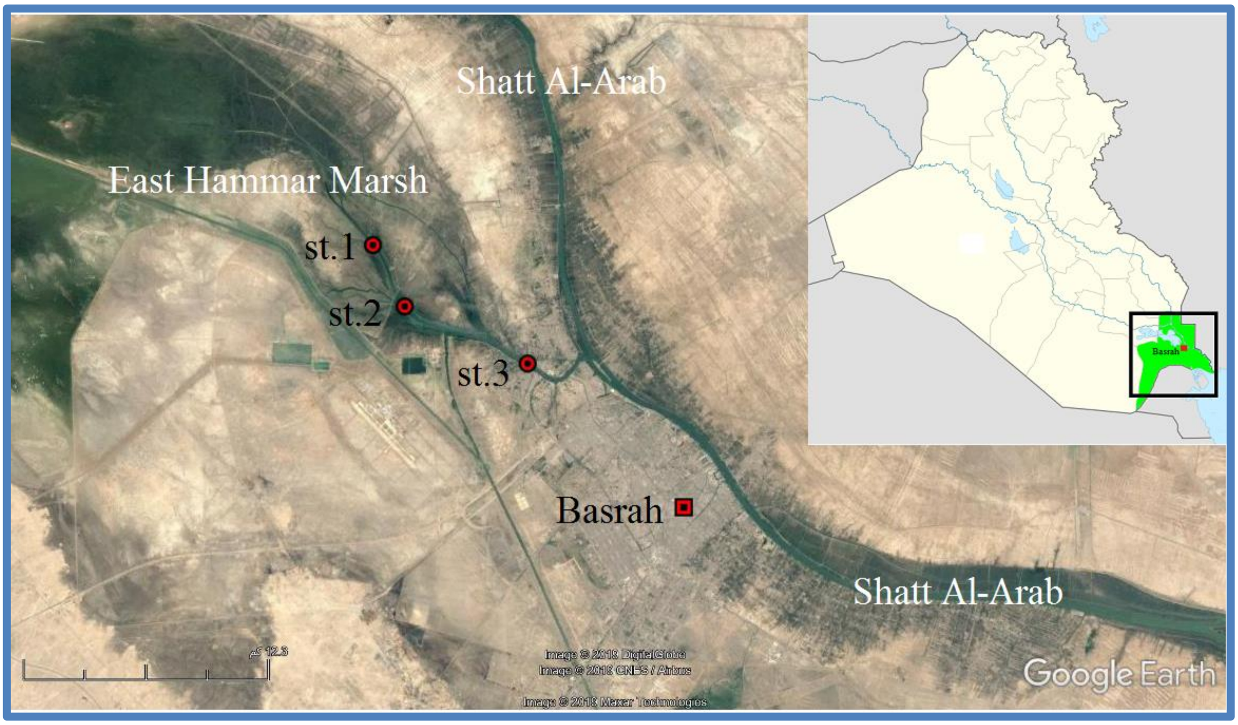

Figure 1. Map showing the study area.

In the process of collection, used a homemade device consisting of a benzene generator producing 10 amperes with 240 volts to feed an electric circuit that raises the voltages to the required level and outputs two poles: The anode is connected to a metal ring which is attached to the end of the long woody stick. The electrode is controlled by an electric button located on the other side of the stick holding the hunter's hand. The cathode is thrown into the water away from the anode. The Fiberglass boat (Fig.2) was moved near the aquatic plants on the area's banks. Most aquatic plants are *Phragmites australis*, *Typha domingensis*, and *Schoenoplectus* sp. The depth of dipping the electrode ring was only half a meter in the water among the aquatic plants. After the electrofishing process, which was estimated at 10 minutes for each station where the fishes were placed in the icebox and transferred directly to the laboratory for testing. Then the specimens were studied according to the method mentioned by Synder (2003), which begins by identifying the external damage on the fish, such as external bleeding, blood spots, and then removing the gill cover and watching the effects on the gills, the most important of which is haemorrhage. The muscles were then removed to show the spine to determine the damage to it and to the muscles surrounding it.The vertebral column of severe injuries was also removed to see the injury more precisely because some damage was not determined by longitudinal anatomy or even x-ray. X-ray technique was used to determine the damage in the vertebral column of all electrolytic fish species, and a number of injuries were identified.

Figure 2: The Fiberglass boat near the aquatic plants

Classification of severity of the damage:

According to severity classification criteria, damage and injures were classified using Reynolds (1996) for vertebral injuries and haemorrhagic injuries. A numerical value is given according to the severity of the injury shown in table (1).

Table (1) Reynolds Criteria used for vertebral and hemorrhagic injuries.

Standard degree of severity of injury	General specifications of the degree of injury	
	Vertebral injury	Muscular and haemorrhagic injuries
0	No vertebral damage	No bleeding
1	fusion or deformation of the vertebrae or both.	bleeding deformities in the muscles separated from the spine
2	Misalignment or curvature of vertebral column	Medium haemorrhage or haemorrhage on the spine (with less than two vertebrae)
3	Break in one or more vertebra or complete separation of one or more vertebra	multiple haemorrhages or one or more haemorrhages on the spine (displaying more than two vertebra)

Results:

The fishing process was carried out in the areas adjacent to the edge vegetation. The most important of the plans are *Phragmites australis*, *Typha domingensis* and the *Schoenoplectus sp*. Eight fishes species were caught: *P. latipinna*, *C. zillii*, *O. aureus*, *O. niloticus*, *C. auratus*, *P. abu*, *P. subviridis* and *S. triostegus*. The effects of the electricity upon fishes are immediate and permanent. During the fishing process and caught the fishes and transported into the boat, there is an immediate effect of electricity, including the total spasm of the fishes and their hardening, as well as the protruding of the eyes significantly (Fig. 3), especially in all Tilapia species, Prussian carp and catfsh, but in others e.g. *P. latipinna*, *P. abu* and *P. subviridis*, this phenomenon was not clear. There is no any external bleeding in all Fishes caught. Permanent and internal injuries have been identified in the laboratory through internal anatomy of fishes and through use of X-rays. Damage and injury are classified according to severity classification criteria using Reynolds criteria (Reynolds, 1996) for vertebral and hemorrhagic injuries, where a numerical value is given.

The study showed that the injuries to fish varied according to species and size, as many researchers, including Schreer *et al*. (2004), have confirmed. In this study, no injuries were recorded in *P. latipinna*, *P. abu* and *P.subviridis* fish in both vertebrae and hemorrhagic damage. In other species, 80% of all tilapian species and prussian carp had a specific injury and increased to 100% for catfish. When studying the effect of electrofishing on the species, we find that prussian carp and catfish are the most exposed of gills bleeding and body hemorrhage(Fig.4). The rate of haemorrhage severity in species showed that the proportion of first degree (Rank 1), one or more moderate haemorrhages in the muscles separated from the spine, was high in tilapian species and prussian carp (Fig.5). As for the second degree (Rank 2) also appeared in tilapia species and prussian carp. The prevalence of the third degree (Rank 3) of hemorrhage in catfish represent with strong bleeding along the spine of the fish (Fig.6).Spinal injuries also varies in severity depending on the species and length of the fish. Prussian carp, tilapian and catfish were the most vulnerable. The criteria for classifying the severity of vertebral injuries show that the first-degree injuries (Rank1) (Compression of vertebrae and fusion) were the highest percentage of injuries which found in prussian carp, tilapian species and catfish (Fig.7). The second-degree vertebral column injuries, (Rank 2) represented by misalignment of vertebrae (Fig.8) or vertebral column curvature (Fig.9), were found in a small proportion of injured fishes, particularly in prussian carp and tilapian species. The third degree (Rank 3) of broken vertebrae and the complete separation of the vertebrae did not show any case. The prevalence of vertebrate injuries, wounds, bleeding, and associated injuries are mostly visible in live fish than dead fish. The nature of these wounds is the compression, and misalignment of the vertebrae and the accompanying injuries, including separation or damage of the ribs, damage of the gas bladder and rupture of the spinal artery, the reason is due to the strong spasm of the body's muscles. The result also showed that damages of the vertebral column may occur anywhere on the column, but most of these damages occur near or behind the middle of the vertebral column in most of the fishes studied. The phenomenon of multiple injuries was also found in the vertebrae (multiple injuries).

Fig. (3) phenomenon of eye protruding.

Fig.(4) gills bleeding.

Fig. (5) haemorrhages of the muscles

Fig. (6) Bleeding along vertebral column

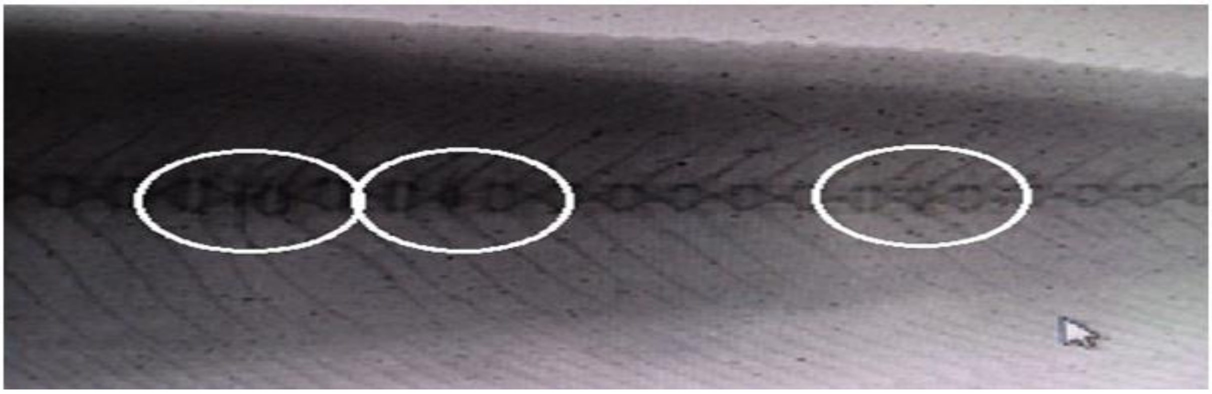

Fig. (7) Compression and fusion of vertberate

Fig. (8) misalignment of vertebrae

Fig. (9) vertebral column curvature.

Discussion:

The study showed that the first - degree of injury is internal bleeding or the fusion of the vertebrae are common among the injured fish but not in all fish caught as in tilapian species, prussian carp and catfish, it is also differed according to the size of the fish, and not appear in *P. latipinna*, *P. abu* and *P. subviridis*. The second - degree of injury, which is represented by bleeding associated with the spine or curvature or misalignment of vertebrae, were very few compared to the first degree and appeared only in large fish of tilapian species and Prussian carp did not appear in *P. latipinna*, *P. abu* and *P.subviridis*.

The present study showed that the species affectness by electrofishing were varied depend on many factors such as the size or surface area of the affected species compared with other species of non-affected species, which either have small size or small surface area. This variation in the incidence of small fish and large fishes is consistent with the concept that large fish show a stronger response to the electrical field than small fish, and this is confirmed by many studies (Adams *et al*., 1972; Stewart, 1975; Emery, 1984; Dalbey and Mcmahon, 1996; Dolan and Miranda, 2003). Depending on the probability of the shape of the fish, it is clear why certain species of fish are affected, in addition to the location of the nervous system and muscles.

Catfish showed a significant impact on electrofishing because this species of fish did not contain scales that reduce the impact of electric current. Emery (1984) explained that fishes containing scales such as common carp are more resistant and less affected by the electric field than the scaleless catfish. The mullet species have less effected with electrofishing due to they lack the poredsacles of lateral line.

The study also showed that the method of electrofishing is a non-selective method, that is, it catches all fish groups and all their commercial and non-commercial sizes. In contrast to the traditional methods of fishing nets, where they catch a certain size depending on the opening of the network used, as confirmed by Hubert (1996) and Hayes *et al*., (1996) in their investigations on the differences between the methods used to collect data on fish using different fishing methods, and this is reflected in the negative effects on other animal aquatic groups such as invertebrates, reptiles, amphibians and even fish larvae and eggs. This is confirmed by Snyder (2003) in his study on the negative effects of electrofishing on fish eggs and larvae and their long-term effects on fish communities.

Conclusions:

1- There is a relationship between fish species and electric fishing.

2- The extent of damage to which the fishes are affected also depends on the size, length or surface area of the fishes.

Recommendations:

1- Activating the laws related to fishing methods and restricted the phenomenon of electrofishing on scientific purpose.

2- Spreading awareness and educating fishing workers in electric methods about the grave risks this method poses to aquatic biodiversity and to humans.

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تأثير الصيد الكهربائي على بعض أنواع الأسماك في نهر كرمة علي وهور شرق الحمّار ، البصرة ، العراق

عادل فاضل عباس   رنا عبدالامير عيلان
قسم البيئة ، كلية العلوم ، جامعة البصرة

المستخلص:
أجريت هذه الدراسة لتوضيح آثار الصيد الكهربائي على أنواع الأسماك التي يتم اصطيادها بطريقة الكهرباء الشائعة على نطاق واسع في محافظة البصرة. أجريت الدراسة في مستنقع نهر كرمة علي شرق هور الحمّار . ركزت الدراسة على أنواع الأضرار والإصابات التي تسببها هذه الطريقة في صيد الأسماك ، واستناداً إلى معايير رينولدز (تصنيف الخطورة) ، قسمت الإصابات إلى ثلاث درجات من الهيكل العظمي إصابات التشوه والنزيف. تم اصطياد ثمانية أنواع من الأسماك *Poecilia latipinna* :، *Carassius auratus* (الكارب البروسي)، *Planiliza abu*، *P. subviridis*، (Catfish) *Silurus triostegus*، وثلاثة أنواع من البلطي هي *Coptodon zillii* ، *Oreochromis aureus*، *O. niloticus.* تباينت الإصابات حسب الأنواع وحجم ومساحة سطح الأسماك. لوحظ أن *P. latipinna, P. abu, P. subviridis* لم تتأثر بالصيد الكهربائي بهذه الطريقة ، بينما إصابات الفئة الأولى والتي تشمل نزيف خارج العمود الفقري واندماج أو تشوه في الفقرات ، وإصابات الفئة الثانية والتي تضمنت نزيفًا بالقرب من العمود الفقري لفقرة أو فقرتين أو اختلال في محاذاة الفقرات أو انحناء العمود الفقري الموزع على أنواع البلطي والكارب البروسي. أما الدرجة الثالثة من الإصابات والتي تضمنت نزيفًا في منطقة العمود الفقري لأكثر من فقرتين موجودتين في سمك السلور فقط ، بينما لم تشهد أي حالة اصطدام أو فصل فقرات العمود الفقري من الفئة الثالثة من إصابة العمود الفقري.