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Mudskipper fishing in the coast of Bhavnagar, Gulf of Khambhat, Gujarat, India

Jignesh Kanejiya • Devendra Solanki • Imtiyaz Beleem • Bharatsinh Gohil

Department of Life Sciences, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar, Gujarat, India.

Correspondence
Dr Bharatsinh Gohil; Department of Life Sciences, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar, Gujarat, India
Email: bharatsinhmgohil@gmail.com

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Abstract

Coastal areas of Bhavnagar district harbors wide range of ichthyofaunal diversity and diverse fisheries resources. The fishermen in this area use wide range of fishing methods and gears, which evolved traditionally and being adept extensively in Bhavnagar coastline. Livelihood of these fishermen is almost entirely depends on mudskipper fishing and they employ three types of fishing methods to catch them i.e. direct catch through digging the burrow, stick traps around mudskipper holes, and by nylon net. Fishing by using nylon net is the most commonly used method compared to others.

Keywords: Mudskippers; fishing methods; lunar cycle; Bhavnagar Coast

1 | INTRODUCTION

Mudskipper flesh has high nutritive value (Misra *et al.* 1989; Clayton 1993). They belong to family Gobiidae from subfamily Oxudercinae and 34 species of mudskippers were reported worldwide (Murdy 1989). Nine species of mudskippers are available in India of which five species were reported from the Gujarat Coast (Pilo *et al.* 1996; Barman *et al.* 2000). Two species of mudskippers were also reported from the mudflats of Nada and Gandhar; hence, seven species were available in the Gulf of Khambhat, Gujarat, India (Shukla *et al.* 2014). In 800 AD, people used cormorant fishing in Asia, later it became well-known as a sports fishing method in European countries (von Brandt 1964). Three types of fishing nets are being used by the fishermen of Gujarat, *i.e.* nylon multifilament net, HDPE (high-density polyethylene) net and nylon monofilament net. Dol net (hands woven nets) and trawlers are the famous traditional fishing methods in Maharashtra (Ulman *et al.* 2008). Fishing methods are being employed depending on the nature of the habitats, types of target fish, indigenous knowledge of fishermen, previous experience on fishing and economic status of fishermen (Gurumayum and Choudhury 2009). The success of these fishing techniques depends on various factors like the selection of fishing site, time, the efficiency of materials used and availability of fish (Lalthanzara and Lalthanpuii 2010). In the fishing activity, other kinds of methods used like netting, angling, spearing, rock striking, hammering, dynamiting, electro-fishing and poisoning (Manik 2010). Diversified fishing gears and methods are being used in fresh and estuarine waters in Indian subcontinent to catch different types of fishes (e.g. Galib *et al.* 2009, 2010; Lalthanzara and Lalthanpuii 2010; Pravin *et al.* 2011; Shaji 2013; Sultana and Islam 2016). People living in the Bhavnagar coastal area prefer to have *Boleophthalmus dussumeiri* (Valenciennes 1837) while other available species mudskippers are distasteful to them. In this study, we describe different types of mudskipper fishing methods in the Bhavnagar Coast, Gujarat, India.

2 | METHODOLOGY

2.1 | Study site

Gujarat having the longest coastline about 1600 km in India, it bestowed with two Gulfs, the Gulf of Kutch and Gulf of Khambhat. Gulf of Khambhat characterized by having several inlets and creeks with the confluence of rivers like the Shetrunji, Narmada, Mahi, Dhadhar and Tapi. The coastal region of Bhavnagar region has a mixture of habitats including sandy supratidal zone, muddy (and somewhere rocky) middle intertidal zone and highly muddy lower intertidal zone with sparse mangrove patches.

2.2 | Methods

The field survey was carried out during the period of July 2014 to June 2015. Mudskipper catching methods were noted down by observing the fishing events directly in the field and through personal communication with the fishermen. Each method (except impaling of mudskipper in plant root) was evaluated based on two complete Hindu *Tithi* calendar (lunar cycle) for each of the three seasons (winter, summer, and monsoon). The lunar cycle is the phase of the moon that includes 15-day waxing (locally called *Shukla Paksha*) and 15-day waning (locally called *Krishna Paksha*) of the moon and each of the day is called *Tithi* or lunar day.

3 | RESULTS

The present study describe three types of mudskipper catching methods i.e. harvesting by using net, direct catch through digging the burrow (hand catching) and stick traps around mudskipper holes. Three species of mudskippers *B. dussumeiri*, *Periopthalmus waltoni* and *Scartelaos histophorus* were commonly harvested in the study area of which *B. dussumeiri* was widely caught for consumption.

3.1 | Harvesting by using net

Vernacular name of this method is '*Kandari*' at Gulf of Khambhat (Figure 1A). At the time of fishing operation the net lay down in vertical position surrounding the area where good numbers of mudskipper holes appeared, mudskippers entangle in the net mesh when they come out of their nests. Fishermen collect the mudskippers from the net into a basket (Shukla 2014). Net catch method is more widely used throughout the Gulf of Khambhat for mudskipper catching, as it is efficient in collecting good numbers of mudskippers. In this method, maximum and minimum daily catch per net in winter were 6 kg and 3 kg respectively whereas in summer the maximum and minimum amount of catch were 5 kg and 2 kg respectively. In the monsoon the mean daily catch was less than 3 kg (Figures 2–4).

3.2 | Direct catch through digging the burrow (hand catching)

This method categorizes into two subtypes (a) collecting of mudskipper in a basket and (b) collection of mudskipper by impaling them in flexible plant root (*Acacia* sp.) or clutch wire.

3.2.1 | Collecting of mudskipper in basket

In this method, collection of mudskipper is done by hand (Figure 1B). Fishermen dig the mudskipper burrow by hands to catch them. This method is quite painstaking and it takes much time about 2 to 3 hours for fishermen, as the person has to move to each burrow. Collected mudskipper transferred to the basket (Shukla 2014). Mudskippers captured by this method are less susceptible to physical injury and thus can survive for a long time (1–2 days) after collection. This method used during the winter season when the population of mudskippers is much denser than other season. In this method the maximum daily catch is made during winter, varied from 2.5–4.5 kg per fisherman. In the summer season, the amount is 1–3 kg while in monsoon it is below 2 kg.

3.2.2 | collection of mudskipper by impaling them in flexible plant root or clutch wire

It is an indigenous method for mudskipper catching in the study area. In this method, fishermen dig out the mudskipper burrow by hands to collect the mudskipper. After collection, fishermen penetrate one end of the clutch wire or slender flexible plant root at the neck region of mudskipper (Figure 1C). They add more and more mudskipper to the wire or plant root to form a long chain. Normally plant root or clutch wire of one meter in length is used. The main limitation of this method is that mudskipper will die immediately after catching, and thus allow fishermen to fish for a shorter time in order to avoid decomposition of the catch. In this method a single fisherman can add 86 to 110 mudskippers in a single wire or plant root. This method might not be used by all the fishermen in the Bhavnagar coastal area but commonly practiced in Hathab, Sartanpar, Alang and Gadhula areas. This method is used during winter season only.

3.3 | Stick-traps around mudskipper holes

Locally, in a vernacular language, this method is known as '*Fando*' or '*Fansi*' (Shukla 2014). In this method, a wooden stick-trap is being inserted near the burrows (Figure 1D). A trap of nylon string having a typical node is prepared at the top of the thin sticks, which placed at the mouth of the mudskippers hole. When mudskipper comes out of the hole it gets entangle in nylon stick trap. Fishermen unwound the nylon to remove mudskipper from the stick-trap. In this method mudskipper caught at certain points

like pectoral fin or mouth region making mudskippers less vulnerable to physical injury. In this method, large holes are preferred. Most of the fishermen do not prefer this method as it needs more skill to make a trap for fishing in order to catch mudskipper efficiently. It is a time-consuming method as it traps around 25–30 mudskippers from 45–50 holes per hour. Some fishermen use a colored stick that easily visible in mud. In this method, the maximum daily catch (3.2 kg) was recorded in winter season and minimum was 1.5 kg. During summer it was 0.5–2.2 kg and in monsoon it ranges between 0 and 1 kg.

FIGURE 1 Different types of mudskipper fishing: net catching (A), by digging the burrow (B), by impaling the mudskipper (C) and stick-trap method (D).

3.4 | Overall comparison

Comparison among three methods (Figures 2–4) reveals that the highest fishing recorded in net catching method and the lowest was in the stick-trap method. The lunar cycle also plays an important role on mudskipper fishing. The highest catch was made during *Amas* to *Agiyarus*, and from *Pacham* to *Punam*, of *Shukla Paksha* (bright fortnight) and from *Chhath* to *Ekam* of *Krishna Paksha* (dark fortnight). Moreover, the catch was lower during *Dasham* to *Chhath* of *Shukla Paksha* and during *Dasham* to *Pacham* of *Krishna Paksha*. By and large, the highest catch was made during the winter season as compared to summer and monsoon. Mudskipper catching was the lowest in monsoon.

4 | DISCUSSION

Fishermen as well as local people use traditional fishing methods for catching mudskippers in the study area. Several of them who are comparatively richer have developed their own methods for mudskipper fishing by modifying the existing methods. For example, one of the subtypes of hand catching method- impaling of mudskipper in clutch wire or flexible plant root, in which longer chain (than normal length) is used for the mudskippers. But, being poor majority of them cannot afford this modification. Poor status of livelihood of the fishing communities is common and already reported by some other researchers (e.g. Flowra *et al.* 2009; Islam *et al.* 2013).

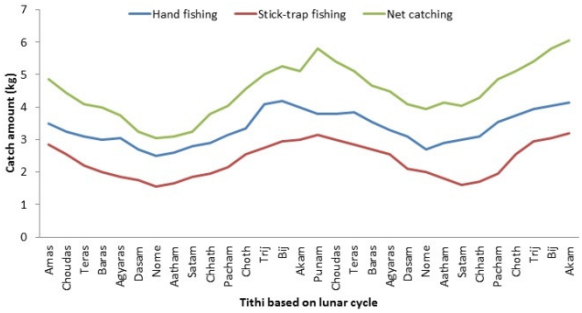

FIGURE 2 Amount of mudskipper catch in winter season in relation to lunar cycle.

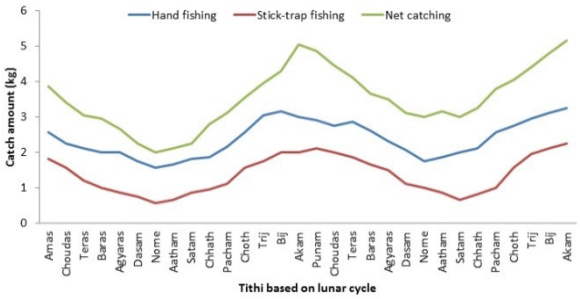

FIGURE 3 Amount of mudskipper catch in summer season in relation to lunar cycle.

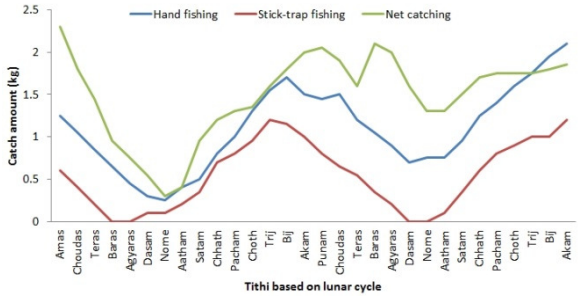

FIGURE 4 Amount of mudskipper catch in monsoon season in relation to lunar cycle.

This method is commonly practiced in the Bhavnagar coast but it may not be the case in other parts of the Gulf of Khambhat. Fishing of mudskipper is more during the winter season, while less during monsoon, as mud shifted away to lower intertidal zone due to rainfall in monsoon (Figure 5). Net catching method is widely used for mudskipper as well as for other fishes in the entire Gulf of Khambhat, while stick-trap and hand catching method primarily used for mudskippers. The study shows that net

catching is the most commonly used and also the preferred method in the study area as large number of fishes can be obtained by this method. The stick-trap method and hand catching methods are mainly being using by the poor fishermen as they cannot afford the net. Depending on the lunar cycle the catch can be varied and more catch can be made during *Amas* to *Agiyarus*, *Pacham* to *Punam* of *Shukla Paksha*; and also during *Chhath* to *Ekam* of *Krishna Paksha*. However, less amount of catch could be expected during *Dasham* to *Chhath* of *Shukla Paksha* and *Dasham* to *Pacham* of *Krishna Paksha*.

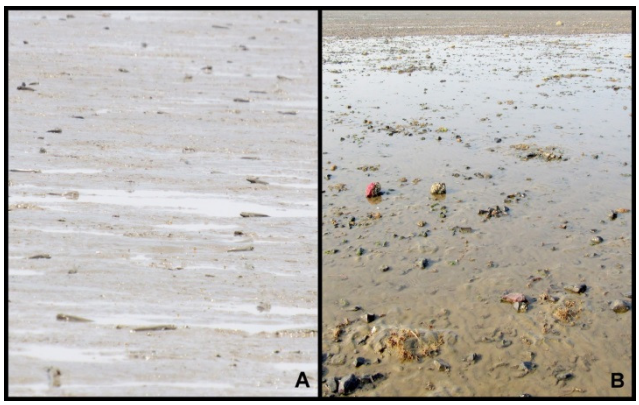

FIGURE 5 Mudskippers are in mudflat during winter season (A) and erosion of mud layer showing during monsoon (B).

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CONTRIBUTION OF THE AUTHORS

JK, DS & IB primary data collection; **DS** photography; **JK** data analysis; **JK, IB & BG** manuscript preparation.