

Observations on large-scale destruction of fishing gear by the pufferfishes (family Tetraodontidae) along the south Konkan coast (west coast of India)

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The pufferfishes (family Tetraodontidae) have created havoc along the south Konkan coast of Maharashtra State since last twelve years by regularly resorting to large-scale destruction of fishing gear. Present work was initiated to analyse the causes for this strange phenomenon. Out of the seven species of puffers occurring in the area, *Lagocephalus spadiceus* seems to be largely responsible for destruction of gear. The extent of damage is observed to be more severe during September-November, which is the peak mackerel fishing season. They seem to be particularly severe on passive gear than active ones. Industrial fishing might have contributed to the increase in population of puffers in the recent years. A few practical remedial measures for counteracting puffer menace have been suggested based on experimental evidences. The menacing population of *L.spadiceus* can be appreciably curbed by fishing it out and exporting to several puffer-eating countries. Damage by puffers can be effectively controlled by treating the fishing nets in a mixture of liquid coal tar and diesel.

Sporadic reports of damage to fishing nets by pufferfishes (family Tetraodontidae) started appearing from 1980 onwards along the southern parts of Sindhudurg district of south Konkan coast (Fig. 1). Initially these reports did not attract much attention since no parallel instances were known or mentioned anywhere in the literature. In fact the puffers were known to be rather docile and harmless fishes possessing interesting ballooning behaviour and could be dangerous only if consumed due to their poisonous nature.

The first report of large-scale destruction of nets by puffers was on 26th October 1984 when a large shoal of puffers destroyed hundreds of fishing nets within a couple of hours off Ubhadanda and Kochera. Moving northwards towards Malvan and Devgad, it caused grave concern among the fishermen. In the fishing village of Surjekot (near Malvan) alone as many as 130 nets were reportedly damaged causing a huge loss. The situation further worsened in 1985 when the amount of loss from the three coastal talukas of the Sindhudurg district (viz. Vengurla Malvan and Devgad, Fig. 1, C) escalated. In 1986, the puffer shoals extended their destruction to the Ratnagiri district also (Fig.1, C). Since then the puffer menace was observed regularly once in February- March and again in September-November. The extent of damage was

always much greater during September- November period rather than in February-March. This created such an impact that the fishermen of the area developed a fear complex of puffers. Being the first postmonsoon month, September is the peak fishing season of the area. Unfortunately the puffer attacks coincided with this peak season causing a serious set-back to the entire fishing industry of the area. More pathetic was the condition of the poor fisher-folks like gillnetters and rampan operators who were hit to such an extent that their very livelihood of the season was at stake.

Any attempt to find out possible causes to this complex problem, necessarily required a thorough analysis of the entire fisheries system of the region in totality and therefore an attempt is made to cover some important aspects in the present investigation.

Detailed taxonomic and biological studies undertaken during the present investigation, have clearly revealed that out of seven species of puffers available along the Konkan coast, it is the green half-rough-back mackerel puffer *Lagocephalus spadiceus* (Richardson, 1845) which is mainly responsible for the large-scale destruction of fishing gear. It is the most dominant puffer species of the area which moves in large shoals and is available almost throughout the year. Another

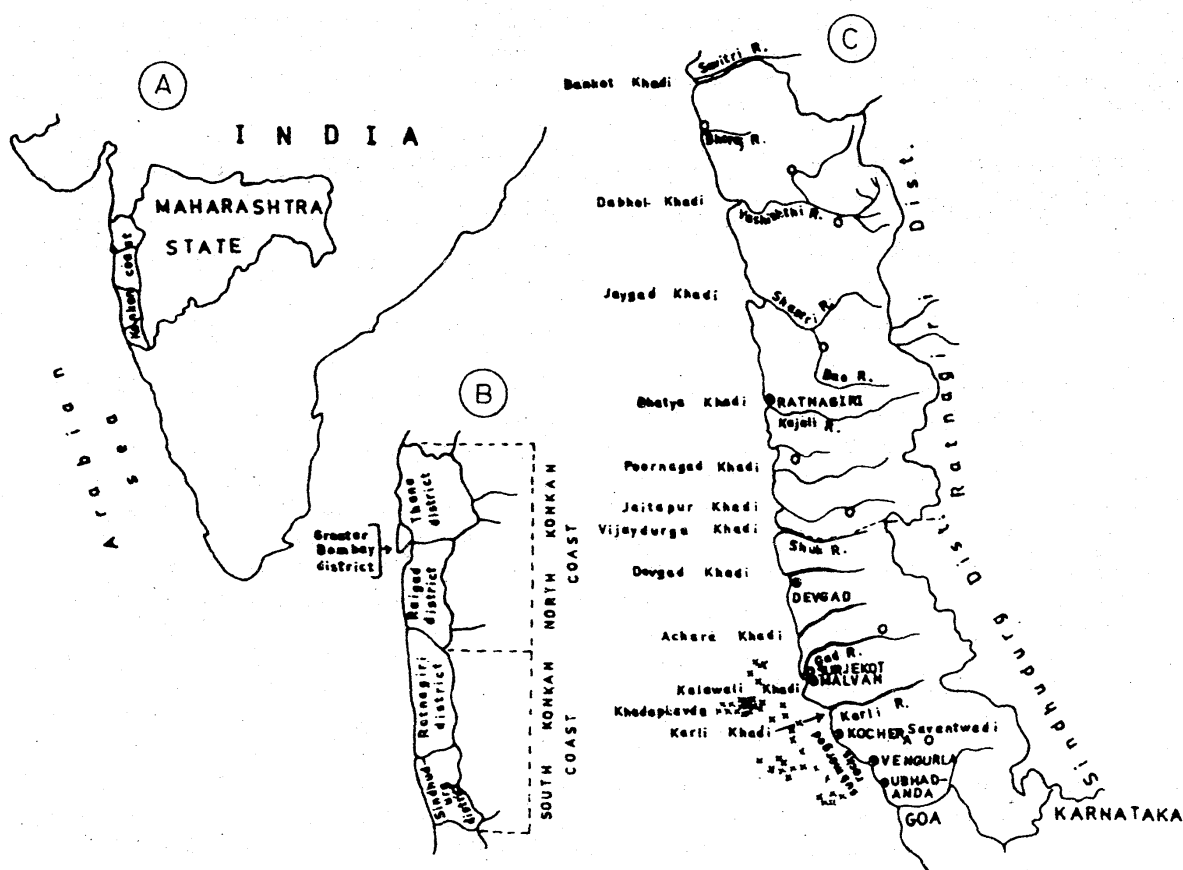


Fig. 1—Map showing: (A) location of Maharashtra state in southern part of India; (B) districts of north and south Konkan coast; (C) major fishing centres of Ratnagiri and Sindhudurg districts affected by puffer menace

species viz. *Lagocephalus lunaris* (Bloch & Schneider, 1801) although equally destructive occurs sparsely and that too occasionally so as to cause any serious concern. All the remaining five species are non-damaging even though they too are capable of biting the nets to certain extent. The net-damaging puffers can be easily distinguished from one another (Table 1)

Lagocephalus spadiceus seems to have a special liking for the Indian mackerel *Rastrelliger kanagurta* and that-is-why it apparently follows the schools of the latter species. Also in view of its overall morphological similarity with mackerel it is quite possible that its members easily intermingle with the mackerel shoals so that they can attack the mackerels without being seen by them. Also, they can prey upon the mackerels with greater ease when the latter get entangled in gill nets etc, thereby inadvertently damaging the nets.

According to Uno¹ the puffers seem to prefer

rocky areas for spawning. Visits to the affected areas almost invariably revealed the presence of either a rocky shore or large submerged rocky stretches near the shores (Fig.1,C) offering so called ideal grounds for puffer breeding. While there is a large submerged rocky stretch at 5 fathom line off Ubhadanda and Kochera, there is a huge rocky landmass about 5 km away from Surjekot viz. Khadapkawda (meaning a rocky patch in the local Marathi language). Even in Ratnagiri maximum number of *L.spadiceus* were found to occur along the rocky shore of Bhagwati Bunder and among tetrapods of Narmada as well as Mirkarwada jetties.

Biological studies undertaken for the biannual phenomenon showed that *L. spadiceus* breeds twice in a year i.e., during February - March as well as in September-November, besides undertaking spawning migrations to inshore waters (preferably near rocky patches). The extent of damage during

Table 1—Differences between net-damaging and non-damaging puffers of south Konkan coast

Sr no	Characters	Net - damaging puffers	Non -damaging puffers
1.	Swimming behaviour	Swim very fast forming large schools.	Essentially slow and solitary swimmers.
2.	Shape of body	Elongated light and streamlined.	Round heavy and blunt.
3.	Nature of dorsal and anal fins	Falcate; anal originating almost below anterior base of dorsal fin which has more than 12 rays.	Rounded ; anal originating distinctly behind anterior base of dorsal fin which has less than 12 rays.
4.	Nature of caudal fin	Lunate with distinct upper and lower lobes.	Mostly rounded at the most truncate but never lunate.
5.	Interorbital region	Flat or concave and shorter than snout.	Rounded or convex and longer than snout.
6.	Ventral spinulose portion	Stopping clearly ahead of anal aperture.	Atleast reaching upto anal aperture and mostly extending much behind it.
7.	Ventral skin fold	Present and extends along entire length of body.	Mostly absent ; if present mainly restricted to caudal peduncle only.
8.	Nasal organ	Represented as a pair of simple papillar apertures situated horizontally in front of eyes.	Mostly represented as bifid round and solid tentacles or flat flaps ; papillar apertures if present situated obliquely in front of eyes.
9.	Caudal peduncle	Short being less than 0.12 -- times standard length.	Longer being more than 0.12 -- times standard length.
10.	Nature of teeth	Slender inwardly bent, sharp canine-like and crossing each other like the cutting edges of a scissors when mouth is closed -- hence highly efficient not only in slicing cutting or tearing flesh of fish but also in easily cutting webbings.	Heavy stout straight, blunt molar - like and resting against each other when mouth is closed --- hence efficient in crushing hard molluscan shells by hammering action but rather inefficient in cutting webbings.
11.	Basal premaxillary denticles	Invariably present as well developed denticles clearly projecting out of skin surface.	Generally absent ; if present poorly developed and not projecting outside skin surface.
12.	Shape of pharyngeal pad	Globular.	Elliptical or rectangular.
13.	Alimentary canal	Shorter than standard length.	Longer than standard length.
14.	Feeding habit	Active predator feeding mainly on fast - swimming fishes like mackerel prawns and soft molluscs like squids etc.	Passive predator feeding mainly on sedentary and hard shelled bivalves and gastropods.

the first migration is quite less since the spawning shoals are mainly formed by smaller individuals ranging in size from 9 to 15 cm and having a body girth ranging from 6 to 12 cm. Most of these specimens can easily pass through the normal sized meshes of gill nets without damaging them since the webbings get damaged only when the gilled fishes are attacked directly. However this being non peak fishing season the catch by gill nets is also considerably poor and consequently there is less damage. The September - November spawning shoals, on the other hand, are considerably huge and are formed by specimens which are generally

larger than 18 cm and with body girth ranging from 13 to 20 cm. Puffers of this size normally cannot pass through the meshes of gill nets and as such find their migratory routes artificially obstructed by barriers formed by the gill nets. Thus besides indirectly destroying the nets by attacking the gilled fishes, these puffers directly bite, cut and damage the webbings. This being the peak fishing season the puffers encounter numerous gilled fishes and naturally the extent of damage tend to be much greater than those of February - March congregations.

It is also likely that comparatively high

fecundity of *L. spadiceus* might have contributed to the rampant increase in puffer population along the south Konkan coast. The observed egg number varied between 79, 000 and 3,36,000 in specimens ranging from 13 to 23 cm.

The gill net appears to be worst affected in the area as it is a static or passive (if allowed to drift) selective gear. The amount of destruction was found to be much higher in nets having smaller mesh sizes (i. e. ranging from 1 to 3 cm which is meant for catching silver bars, eels prawns baby tunas etc) than in nets with larger meshes (i. e. ranging from 4 to 10 cm meant for catching pomfrets etc). This might be possibly due to the fact that even bigger puffers can easily pass through such large meshes of pomfret nets. Whatever damage caused is mainly due to attack by puffers on the gilled fishes. Another possible reason for greater destruction in gill net is the obstruction it creates across the migratory routes of puffers in the form of a big ' wall of webbing ' and exposing itself to their cutting and biting.

In a rampan, the catch gets concentrated in the thick, small - meshed central 'bunt' portion as the net is being dragged on to the shore. This catch comprises puffers also which perhaps get entrapped as they expectantly follow shoals of pelagic fishes like mackerel etc and fail to damage the net since they get crammed into a moving net. Also the small mesh size (about 2 cm) at the ' bunt ' portion does not allow the puffers to force in their jaws through the webbing and damaging it. However the side wings of rampan which are made of larger meshes (about 5 cm) are more prone to puffer attack. It was interesting to note that the cotton rampan nets showed less damage than nylon ones possibly due to their thickness and also because of their periodical treatment and tanning by ' Kas ' or ' Vagal ' --- a decoction prepared from bark of ' ain ' tree (*Pentaptera tomentosa*). It was observed that while a direct relationship exists between the quality fish catch and amount of damage by puffers in gill nets the opposite seems to be true for the rampan.

Recently ' Disco - trawl ' with larger cod - end meshes is becoming more popular along the south Konkan coast². The portion which is susceptible to puffer attack in this net is its cod - end where the mesh-size varies from 5 to 7.5 cm. However, the

extent of damage is comparatively much low since this gear is essentially dynamic in nature.

Purse seine is a dynamic encircling gear. In order to minimise the attack, it is regularly tanned (at least once in a month) by the fishermen with a commercial dye having a coal tar / phenol base and the reported damage is comparatively less.

It is thus seen that puffers are capable of damaging almost all types of nets but seem to be particularly severe on passive gear possessing a mesh size ranging from 4 to 7.5 cm.

The net-damaging species *L. spadiceus* exhibits highly aggressive behaviour, attacking anything that comes in its way. Thus gill nets even without entangled fishes are often damaged and if there are gilled fishes, the puffers literally pounce upon them in a frenzy, tearing the webbing into pieces, besides devouring the fish within seconds and leaving only a few fragments / remnants of vertebrae or skull.

Occasional outbursts of puffer swarms are reported from Japan also which is known for its regular puffer fishery. Dense congregations of *Lagocephalus gloveri* were reported to appear all of a sudden along west coasts of Ojika and Kyushu islands during September - November 1983. These swarms were culled / thinned down using a novel and improvised fishing method. Special baskets made up of stainless steel wires, with mackerel meat placed as bait were lowered to a depth of about 70 m. Attracted by the mackerel bait the puffers surrounded these baskets which were gradually hauled up. The crowded puffers, which followed the baskets to the surface were scooped with dip nets. According to O. Tabeta of Nagasaki University Japan (pers. comm.) such swarms of *L. gloveri* and *L. wheeleri* tend to attack squid lines and culture nets of yellow - tail fish. So far however no published accounts of destruction of fishing gear by Japanese puffers are available. Nevertheless it is clear that the net damaging puffers show a special preference to mackerels and their spawning shoals seem to appear almost simultaneously both in Japan as well as in India. Although totally unaware of this Japanese innovation the local fisherboys and urchins have evolved their own ingenious technique for catching stranded puffer population. During the 1988-89 bumper season of mackerel, large congregations of puffers were noticed near Narmada and

Mirkarwada jetties of Ratnagiri. Perhaps realizing their frenzied behaviour towards fresh fish many small boys learnt to catch puffers with a single sweep of hand net using fresh mackerels as lure or bait.

It is thus seen that the aggressive behaviour of puffers and their weakness for fresh mackerels can be potentially utilised in effectively culling the menacing population of *L. spadiceus* by fishing them out and exporting to puffer eating countries like Japan etc. Larger than 30 cm individuals of *L. spadiceus* might have acceptance in countries like Japan where other poisonous species are banned.

The puffer menace coupled with advent and ascent of purse - seine fishery in the area since 1980 indicates the indirect role of this particular gear on the increasing puffer population. The purse - seine operations had a great negative impact on the shore - seines (= rampans) which used to keep puffer population in check and have thus contributed to increased puffer menace. In earlier days when there were no trawling or purse-seining along this coast rampan was the predominant gear for exploiting pelagic fishes like mackerels sardines etc. A few puffers always used to get caught in these rampans but they used to be immediately destroyed by fishermen away from the shore since they were / are considered to be highly poisonous and hence dangerous for human

consumption. Thus rampan operations almost throughout the year along the south Konkan coast were continuously culling the puffers. But with increased pressure of the modern gear the number of rampans has drastically reduced over the last few years³. This has possibly resulted in almost NO CONTROL over puffer population (and hence the menace) of the area.

Besides, both trawlers and purse-seiners mostly throw away the unwanted bycatches (which are on the increase due to reduced cod - end mesh size of trawi nets) back into the sea in nearshore waters. This perhaps offers ample and fresh food for puffers helping in thriving of their populations in an unchecked manner.

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