flow. The fishers find it very difficult to operate their stake nets when jelly fishes proliferate in the lake. Within minutes of setting the net, it gets filled up with jelly fish. This often results in the net getting destroyed, stakes getting damaged, wastage of human effort and time, wastage of catch and other related economic losses. Fishers in the area are thus unable to operate the stake nets during the period. In order to help the fishers to operate the stake nets during this period, a Jelly Fish Excluder Device (JFED) was designed, developed and tested. The device could successfully exclude jelly fishes from the stake net. While there was about 99% exclusion of jelly fishes from the net fitted with the device, the control net got filled up with the jelly fish within minutes and hauling up of the net became extremely difficult. This simple cost effective and easy to operate device will be of help to fishers in operating stake nets round the year.

FS OR 16

Square mesh codends for selective trawling: An Indian perspective

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Bycatch, which includes non-target organisms that are caught during the capture process, is a major problem faced by fisheries, world over. Among the different strategies to reduce the incidence of bycatch, modifications made to the gear to reduce juveniles are very significant. The total bycatch in Indian fisheries was estimated at 58,000 tonnes, which formed about 2% of the total landings. Trawling, though contributes significantly to the marine production of India, about 56% of the total catch of trawlers is bycatch. This bycatch often comprises of juveniles of commercially important species targeted by trawls and other gears. A large number of bycatch reduction devices were designed and field tested in the Indian scenario, among which the square mesh codends were found to be very effective. ICAR-CIFT has successfully demonstrated the utility of square mesh codends in Gujarat, Maharashtra and Kerala and use of these codends are now mandatory in these states. Though selection parameters for different codends (shape, size etc.) are available, a meta-analysis on these results is lacking in India. Trawls, target many resources with varying lengths of capture and hence an optimal mesh size to be used will be a tradeoff between different factors like the length at first sexual maturity, the economic value of the targeted species group and the size and shape consideration of the codend itself. Deriving the best mesh size for the codends hence becomes complicated. This study attempts to optimize the codend mesh size/shape for trawl resources along the Indian coast. Results from 64 selectivity studies on codends carried out along the Indian waters were used. The different species for which selection parameters were available were grouped based on their shape, length-girth relation and the average economic value for the respective species was also considered. The comparative evaluation of L50 values showed that use of square mesh codends increased the L50 by 2-28%. Most of the fishes studied, belonged to the 'slender' category, for which square meshes are very effective. The only data available in the 'flat' category was for *Cynoglossus* sp. The study shows that rather than a single mesh size; codend mesh sizes should vary depending on seasons to sustainably and effectively capture trawl resources along the Indian coast. The method and the results of the

study and its implications are discussed in the paper.

FS OR 17

Role of artificial reefs in improving coastal productivity, conservation and energy efficient fisheries

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Artificial reefs are modified FADs set on the sea bed to promote habitat recovery or development and enhancement of the growth of marine benthic flora and fauna. Artificial reef technology has been used widely across the globe for both habitat and ecosystem enhancement and commercial fishery enhancement. The materials used for artificial reef construction are variable like concrete, steel and glass-reinforced plastic. In India, Tamil Nadu has, in recent years, become a major player in the practice of artificial reef deployment in coastal waters, under technical guidance from ICAR-CMFRI. Artificial reef modules made of concrete have been deployed in about 50 sites along the Tamil Nadu coast, under different schemes during the period 2009-2016. We present here, as a case study, the impact of artificial reef deployment in the coastal waters of Kovalam fishing village in Kancheepuram district of Tamil Nadu. Comparison of fish landings before and after reef deployment indicates improved catch of certain groups of fishes like perches and carangids. The direct beneficiaries are the artisanal hook & line fishers. Aggregation of breeding fishes and juvenile recruitment in the reef area is immense. The reefs also aggregate bait fishes which help the fishermen to carry out live bait fishing of economically valuable pelagic fishes slightly offshore. Underwater observations indicate aggregation of fish groups like groupers, pig-face breams, snappers, carangids, cardinal fishes, damsel fishes, angel fishes, scorpion fishes, rabbit fishes, and fusiliers. The reefs are also major settlement sites for benthic fauna including crinoids, urchins, starfishes, soft corals, acorn barnacles, mussels, giant clam, and oysters. On the economic front, while reef fishing has considerably reduced scouting and fishing time, as well as diesel consumption, the quality of the fishes caught from the reefs has induced higher demand and better price in local markets.

FS OR 18

Development of low drag trawls for energy efficient fishing

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Trawling is the most energy intensive fishing method and fuel cost alone constitute upto 75% of operational expenditure.It was reported that to catch one kilogram of fish, trawling requires 0.8 kg of fuel. Drag is the single most important factor contributing to the fuel consumption and thereby energy efficiency and profitability of trawl operations. Drag of trawl depends on factors like the design and rigging of the net and the operating conditions. According to Wileman (1984), the warp contributes 5%, sweeps-4%, otterboards-20%, floats-3%, foot rope-10% and netting- 58% to the total drag. Use of smaller otterboards, adoption of optimized towing speed, thinner twines and large mesh size to reduce twine surface area