Co-management and Livelihood Enhancement Planning in Coastal Artisanal Fisheries

Report on Status of Artisanal Fisheries

Food and Agriculture Organisation of the United Nations
Apex Towers, 4th floor,
54, 2nd Main Road, R.A.Puram,
Chennai - 600 028, India

Foundation for Ecological Research,
Advocacy and Learning
P.O.Box 28,
Puducherry - 605 012

Report of surveys of artisanal fish landings in Villupuram, Pondicherry and Cuddalore Dt. of Tamil Nadu

Status of Artisanal Fisheries

Tara N. Lawrence, S. Kumaran and R.S.Bhalla

September 30th 2008

Submitted to the FAO/UNTRS as part of the project entitled
Co-management and Livelihood Enhancement in Coastal Artisanal Fisheries

Food and Agriculture Organisation of the United Nations/ United Nations Team for Recovery Support
Apex Towers, 4th Floor,
54, 2nd Main Road, R.A.Puram
Chennai, 600 028, India
and
Foundation for Ecological Research, Advocacy and Learning
P.O. Box 28, Puducherry, 605 001, India
Email: feral@feralindia.org
Home Page: http://www.feralindia.org

Contents

List of Figures

Executive Summary

This report presents the findings of a six month survey of the status of fisheries along a portion of the Coromandel coast in Tamil Nadu covering a 100km stretch between Villupuram and Cuddalore Districts, including the Union Territory of Pondicherry. The survey was conducted in three cycles, each two months apart, at 17 artisanal village landing centres. Only artisanal craft and gear were covered during the survey.

Results show a high degree of over capacity and an increasing use of large destructive nets such as the ring seine and "periyavalai" which target low value-high volume species. Findings suggest that a high proportion of catch is from the lower age classes across all the species recorded. We also found that the bulk of the fishing effort was restricted to a depth of 20 metres across different types of motorised craft. While this points to the high productivity of these shallow waters, it also indicates the level of pressure on the resource base.

While most of the artisanal gear is species specific by nomenclature, the majority of nets used were gill nets. Often the same net had a range of mesh sizes and consequently trapped different species. Seasonality in gear use and targeted species could not be covered as the sampling period for this study was six months.

Incomes in artisanal fishing vary a great deal with types of gear used and season. This may explain the present shift towards ring-seining operations which appear to provide the best option for both crew and gear owners. Our finding also suggest that although line fishing is more remunerative than most other gear (second to the ring seine), line fishing alone is unlikely to sustain large increases in fishing capacity as the targeted species are showing signs of depletion.

Chapter 1 Introduction

The present study was a result of an earlier investigation on the impact of tsunami relief on artisanal fishing capacities along the Coromandel coast. The earlier study[6] found a significant increase in the number of craft, crew and outboard engines since before the tsunami and indicated that artisanal fishing had undergone a major change as a result of relief efforts. One of the lacunae of the earlier investigation was the lack of ecological data and quantitative information on fishing capacities and gear/catch associations. This study was an attempt to fill some of these gaps and feed the results into the ongoing discussions on fisheries co-management.

The present study was part of a larger effort in fisheries management and livelihoods of fishing communities launched by the Food and Agriculture Organisation of the United Nations under the UNDP-UNTRS programme. It is one of the four components of an action research project awarded to the Foundation for Ecological Research, Advocacy and Learning (FERAL).

Note: The data on which this report is based is limited both in terms of seasons as well as regions in which the surveys were conducted. Findings here therefore need to be taken as initial results which will be refined as more field surveys are conducted.

Study area

The findings presented here are based on 6 months of field surveys taken up in 17 settlements along the Villupuram, Pondicherry and Cuddalore coast (Figure 1.1). Three cycles of surveys were done which included fish landing surveys and "sea surveys". The former involved documentation of gear/catch composition and details of fishing practices such as depth, substratum and targeted species. The latter was a survey taken on hired boats where fishing was observed in situ. Visual observations of types of gear and targeted species were recorded and a GPS/Sonar unit was used to record information on location, depth and substratum. An additional observation made during the landing survey was a record of the number of craft that were used or not used on that particular day of fishing.

Objectives

The primary goal of the study was to build an ecological and taxonomic baseline on artisanal fishing and fishing practices. Its objectives were:

1. To build a taxonomic baseline of fish landings from artisanal gear and craft.
2. To document details of gear use including depth, substratum and targeted species.
3. To determine associations between catch, gear and fishing methods.

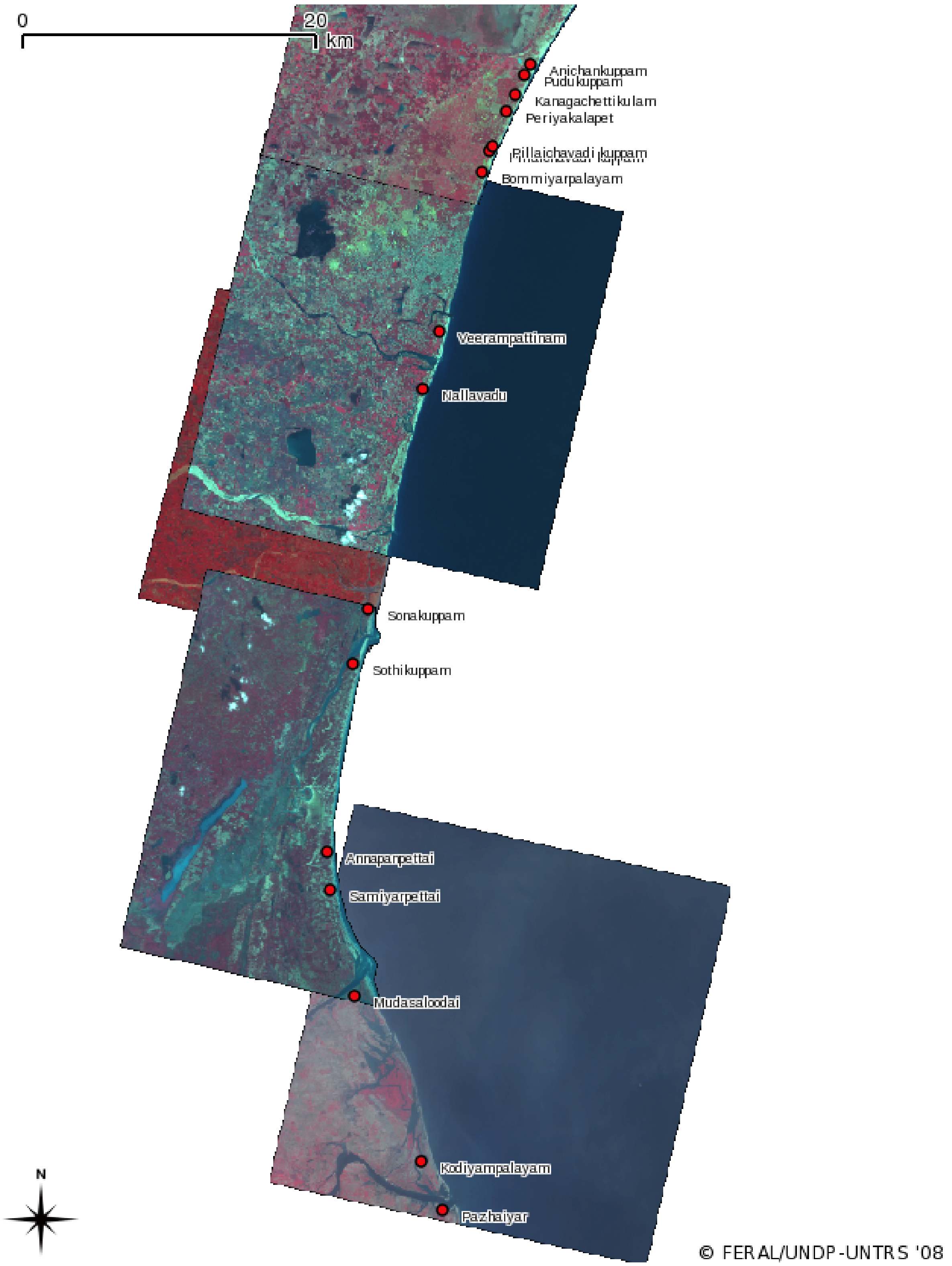


Figure 1.1: Study area.

4. To determine whether there were any signs of over-fishing and if so, for which taxonomic group.

Methods and Activities

Given the wide range of objectives, the methods and activities adopted for data collection were varied and essentially comprised of the following.

Landing surveys

The survey consisted of fishery related questions which dealt with the type of gear and craft used, the effort involved in terms of time, manpower, quantity of catch landed, average earnings per day as opposed to the total amount invested per fishing trip. Three visits to each of the fishing villages were made in an attempt to track the seasonality of the fishery for the period of the project.

Fishermen were interviewed at the time of landing (i.e., when the day's catch is brought in). Photographic samples of the catch were collected as actual collection of specimens (in a multi species and multi gear fishery) spread across a study area of two districts was un-feasible. Identification of specimens from photographs was attempted up to species level using the FAO identification sheets for fishery purposes (Area 57, 51 and Sri Lanka) along with Fishbase[44].

Measurements as well as counts of specimens (species wise) were obtained from the photographs which contained a standard point of reference, using the ImageJ software package which enabled measurements of photographed specimens. The number of specimens were enumerated to determine species proportion within a total catch at a given time and place. Thus we overcame the practical limitations on physical measurement of the landed catch and were able to cover a large number of landings without undue disturbance to the fishermen.

Measurements were used to categorise the fish into size classes or class intervals which were generated based on data available from FAO and Fishbase. The total length for most species was used and wherever unavailable,standard length was used as a substitute. While the smaller class intervals corresponded to juveniles or even younger fish species, the larger class intervals represented mature/adult groups which were caught.

Sea surveys

Boats were hired from four locations corresponding to the clusters used for the landing surveys. Trips were timed along with the fishing activity and all visible boats engaged in fishing were surveyed. Data collected through direct observation and questions to the fishers included type of craft, nets and mesh size and targeted fish species. Additionally a GPS cum sonar unit was used to note down the depth of fishing, coordinates of the boat and type of substratum above which the fishing was taking place.

Transect walks and resource maps

Discussions were held with the fishermen on the nature of infrastructural resources related to fishing available at the settlements and regions of the settlement that were earmarked for specific activities. This was followed by a walk along the boat parking area where the number and type of boat used for the days fishing were recorded as well as those which did not go out to sea. The survey was repeated three times through the six month study.

Review of literature

International Status

Small scale fisheries in developing countries act as a safety net for the poor as it provides an important seasonal livelihood for many communities. Some fishers even follow migratory species and seasonal variations in fisheries altering their target species and area accordingly and hence are referred to as the “nomads” of the sea. Unfortunately, ineffective management of fishing capacities has caused drastic depletion of resources contributing to overfishing- both biological and economical and this has seriously affected the coastal fisheries sector. Also, the difficulty in monitoring these fisheries was mostly due to the large number of vessels and landing areas as well.[36] Historically, areas on the continental shelf have been victimized by trawling and dredging gears incurring severe damage to deep water corals and sponge formations which has become widespread. Lacunae in studying species biodiversity and habitat damage, renders environmental reporting as vague and incomplete. Sporong (2004)[35] cites the Mediterranean fisheries as a typical multi species, multi gear industry, with a high number of species being marketed. Some of the trawls discard about 20-70% of their catches depending on the depth of fishing and the targetted species. The gear used usually determines the quality and quantity of bycatch and discards and this is highly variable. Artisanal gill netting incurs up to 9 per cent discards which maybe as high as 80% of their total catch. Research is fundamental to our understanding of the impacts of fisheries bycatch on the ecosystem as well as on the fishery. The charismatic marine megafauna seem to be the highlight and focus of the marine bycatch groups with little attention paid to the smaller less “charismatic” groups and this has serious ecological implications. Deep sea corals and sponges are destroyed by bottom trawling fisheries worldwide. According to Lewison (2004),[22] if the target species of the fishery can sustain intense fishing effort and the bycatch is proportional to that effort, bycatch mortality levels will increase as fishing effort intensifies, irrespective of the amount of target species caught.

Methods for analyzing Ecological Data:

According to Garces et al. (2006),[14] managing the fisheries requires an understanding of the biological assemblage structure. As defined by the authors, an assemblage refers to the species available in the same place at the same time. Ecological analysis of assemblage structure has become increasingly important in the management of marine resources. Identification of conservation areas for species or stocks based on their spatial distribution and abundances was suggested as a method of management of marine resources and biodiversity conservation. The need to detect population densities of selected species is also a crucial requirement of biodiversity, conservation and environmental impact studies in a select habitat[5] . Gascuel et al. (2005),[15] were of the opinion that focussing on the trophic level seems promising in analyzing and modeling marine ecosystems and their associated fisheries. Length, size spectra and the trophic levels are linked at community levels, with length, crucial in determining the dynamics of an ecosystem and trophic level emerging as a result of these dynamics. For the trophic level approach, trophic spectra are essential as spectra can be plotted for biomass, catches, exploitation rate, etc., and thus serves as an explanatory variable for both ecological and fisheries assessments. Sibert et al.,(2006)[34] analyzed the fishery impacts on population biomass, size structure, and trophic status of major top-level predator stocks in the Pacific ocean. They reported that long line fishing (selective gear known for removing the larger and older individuals) was the primary method used for the first 25 years of the tuna fishery except in some coastal areas while the purse seine fishery in the 1980s began the removal of smaller fish and hence, spread the exploitation to earlier life history stages. They utilized an ontogenic model which related size to trophic level, applying it to the size structure of the catch, exploited population, and unexploited population to estimate trophic levels.Their results seem to have differed from widely accepted theories concerning the status of large predatory stocks and the impacts of fishing the same. Being realistic extensions of previous work, an appraisal of the impacts of fishing on the pelagic ecosystem was done, with the concept of aggregating abundance across species by summing biomass according to length across species. Also stated was that although some predator populations have decreased severely in response to fishing, others have increased. This extends the notion of examining the impact of fisheries on the trophic level of the catch by also examining the trophic level of the population at large, concluding that there is no impact on the trophic level of the population and that the apparent reduction in the trophic level of the catch is caused by "fishing through the food web".[12] This essentially means expansion of the fisheries to include species it previously did not (applying to the Indian scenario), also stating that top trophic level fisheries are sustained as newer and lower trophic levels are exploited even though on the whole the overall catches seem to have declined. Trophic interactions are of concern to fisheries for two reasons. One is the decline in food resources which would cause the respective predator populations to move elsewhere and hence decline in that given area and the other reason would be in causing regime shifts in the ecosystem by decreasing biomass.[9] Daskalov, et al. (2007)[10] provided evidence that over fishing can bring about regime shifts within an ecosystem that result in fisheries collapses and blooms of algae and gelatinous plankton. They examined the long term changes over several trophic levels in the marine ecosystem of the Black Sea. They pointed out that when the structure of the food web is altered, the complex systems will not return to their original state but will adapt to the immediate prevailing local conditions. Trophic cascades, rarely occurring in the open ocean, are a consequence of overfishing which result in one or two trophic levels being altered severely which would have serious implications on the ecosystem itself in addition to affecting productivity and water chemistry of the region as well. According to the authors, predation and fishing are significant in the dynamics of an ecosystem. Aside from climate, predation and fishing, changes in the ecosystem could also result from eutrophication and invasion of alien species. Overfishing and collapses occur when the decline of stocks which is a relatively fast process is confronted with overcapacity or growing fishing effort which is a relatively slow process.

Impacts of Gear used on Fishing Resources

Watson et al., (2004)[43] developed a database mapping the gear associated with the various fisheries world over, the taxon harvested by the respective region, along with the distribution of trawling and dredging grounds, describing the effects trawling has on the marine habitat and therefore on the dependent species. The obvious primary impact of fishing gear is to kill and harvest living organisms for human use, and the authors in this work have stated that impacts of fishing gear on the marine environment are far more severe than those caused by climate or by pollution. Such type of databases allow further understanding of the impacts of gear on sensitive ecosystems such as sea grass beds, coral reefs etc, and thus will be useful in informing policies regarding fisheries management. As Hjermann et al., (2004)[18] points out: the switching of a predator-target prey species is not within our control, however, switching to a different fishing method depending on the management strategy is within our control. Watson et al., (2004)[43] found that catch increased dramatically from seine and trawl gears, as early as 1950. Fluctuations were seen in catch from seines apparently caused by the El Nino effect (eg:Peru's anchovy fishery suffered due to this effect) whereas the catch from trawl and dredge gears steadily increased. Hook and line seemed to override the catchability of gill nets, the latter still being the fifth most important general gear type in terms of contribution to the total catch. They have also reported a recent review of different fishing gears used in the US and their consequent impacts on the marine ecosystem, which confirmed that bottom trawling rigs, bottom gill nets and dredges have the worst ecological impacts. Trophic and size composition of catch by gear type was examined by Watson, et al., (2006)[42] as part of the importance of a database which co related the quantity and type of catch with the gear used. It introduces the importance of such work commenting that global statistics are poor as far as the identification of species is concerned as well as the location of the same. The "gear effect" was mentioned by Rouyer et al., (2008)[32] where in their study they found that the long liners were distinct from the other gears, even if they were more numerous and concerned species with very different life histories. Although baitboat and purse seiner fleets also formed distinct groups, no grouping was found according to any of the species. In other words, the CPUE of different species fished with the same gear displayed more common fluctuations than the CPUE of a given species fished with different gears.

National Status

The issue of increased anthropogenic activity in addition to climatic influences particularly in inshore waters, has been raised by those concerned about the consequential impacts on the marine environment which in turn would affect the carrying capacity of the sea and thus potential fish harvests. Many workers have hypothesized the link between environmental deterioration and declining catch rates or the changing catch composition, but the evidence to support this needs to be carefully examined. The available data on landings of marine fish in India tend to be controversial with considerable disagreement as to what the reality of the situation is. Fishermen unanimously agree that catches have declined overtime and that there also has been a shift in the species composition in many areas. Changes in the seasonal availability of fish has also been observed. The study points out that a targeted approach to fishing (especially for high value species), may have also resulted in a decline in biodiversity. However a doubtful observation pointed out by the study was the decline of discards/bycatch being landed by the shrimp trawling industry.[7] A collaborative effort of a few workers under this project summarized the trends in the fisheries sector of India following scoping studies in the five states of Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Orissa. Subramanian, (2003)[37] observed that the role of community in conservation has been particularly striking in Kanyakumari, where a unanimous consensus among the artisanal fishermen against trawling allowed for timely interventions for conserving marine resources and regulating trawler activity. He reports that The National Fishworkers' Forum constituted by artisanal fisher unions, equated trawling with destruction and not production and identified artisanal fishing as the only means to a sustainable future. Increasing concern on destruction of marine habitats, bioinvasions and alterations to the diversity of various life forms make it necessary now for the management to understand the relation between biodiversity and ecosystem functioning in our coastal and offshore waters. Vencatesan, (2006)[40] stresses on the need to reassess the biodiversity of the Indian seas and also felt that India should and probably needs to revitalize its 200-year tradition of marine biodiversity inventorying. She reports that inadequate documentation and taxonomic studies due to insufficient explorations and resources are limitations in this field. According to the author, recent taxonomic research has brought to light the higher number of species in each group and the many unidentified ones that are being collected from the marine ecosystem. Also the diversity seen in the life history stages of marine organisms suggests that works classifying these organisms into ecological species which are then used in ecological valuation is the better way to evaluate marine biodiversity. She attributes all loss of biodiversity at the various levels of species, communities and habitats to the lack of awareness,institutional coordination and effective implementation of existing laws. The marine environment of India consists of unique ecosystems known for their aesthetic beauty as well as for providing numerous habitats for biological species. Venkataraman et al., (2005),[21] stated that the inventory of coastal and marine biodiversity in India could be more than what is already known estimating that only about 2/3 of the marine habitat has been studied, though not completely. They are in agreement with Seshagiri et al, (2003)[33] who talks about the need to understand the dynamics of an ecosystem by considering biodiversity as the crucial component of the same. Some of the aspects or questions examined by many (as reported by the same study) were the effects of biodiversity on the environment, ecological succession of communities, the relationship between biodiversity and the food web and their overall importance in community stability and productivity. India has had a long tradition on the subject of taxonomic diversity which shows that the need to document diversity within/of a given region was realized a long time ago. One of the earliest works was that of Francis Day, (1889)[11] whose contribution was significant to Indian Zoology. His account on the marine fishes in India, especially, included those of non economic value as well and served as a landmark in species identification in India. Other workers, whose efforts cannot be ignored in this field are Jhingran, (1975)[20] and Talwar and Kacker, (1984),[38] whose work on commercial fish species of India, are crucial tools in taxonomy and systematics of marine fisheries of India. Undoubtedly there were more who endeavored to improvise upon previously published works and one of these is the Food and Agriculture Organization itself, which undertook the massive and monumental task of documenting the marine resources(for one) of the world, painstakingly recording the data region wise. The FAO began keeping fisheries records in 1960s with the objective to improve catch statistics through accurate species identification. Species identification is a major fisheries issue. The Species Identification and Data Program (SIDP) was initiated in the early 1970s to improve the quality of fisheries data collection by species through reliable species identifications in the field, particularly in developing areas and countries.[24] The authors discussed the various tools made available by the FAO for the purpose of identification ranging from published catalogs to the internet based information technology of today1. The FAO series of species identification sheets for fishery purposes are the current and more complete catalogues which has made taxonomy far less complicated and intimidating as it once seemed. Fischer et al., (1974)[2] and Fischer and Bianchi, (1984)[13] worked on the Indian Ocean, (with reference to the Areas 57 and 51 respectively) and Sri Lanka[8] providing information on the commercial species of the region. Young, (2006)[4] discussed the status of the fisheries in the Indian Ocean and the various countries affected by it, listing the common species as well. Contributions in species identification or just the compilation of species of common economic interest has been done by the Fishery Survey of India, 2004. CMFRI has been conducting fishery surveys along the Indian coasts and has reported the species composition of the catch, gear wise and state wise landing and this information can be obtained from the data page of the Organization.(1962-2006).[1] The small scale fisheries of Tamil Nadu were reviewed by the BOBP2 in 1983, which documented all aspects of the fishery from craft, gear, markets, infrastructure etc., to the abundant species with emphasis on those with economic value. This report serves as the baseline for comparative studies of the trends within the fisheries sector. An account of the diversity of Tamil Nadu and Puducherry was given by Jerald, (1994),[19] covering mangroves, corals, pelagic and demersal fishery resources including fish, molluscans and crustaceans. An appraisal of the trawl fishery of Tamil Nadu from 1985-2000 was done by Mini and Srinath, (2003)[27] with an account of the constituent groups stating that silverbellies were the dominant species, which comprised the trawler catch during the given period. Mohanty et al.,(in press) reviewed the sardine and anchovy fishery along the Indian coasts including that of Tamil Nadu and Puducherry. Magesh, (2004)[25] pointed out that jellyfish blooms are quite common along the coast of Tamil Nadu which was then welcomed by the fishing community in view of the dwindling resources. This initial enthusiasm has now died and all jellyfish processing units that were set up are now idle. Jelly fish blooms indicate overfishing within the given area and also suppress fish populations by preying on their larvae and eggs. Mantri, (2004)[26] documented the sea weed diversity along the tsunami affected coasts of India, reporting Tamil Nadu to have a considerable species diversity after Kerala; Radhakrishnan et al., (2005)[31] reports on the major lobster fishery in India, stating that in the South East coast of India, gill nets are the dominant gear used as opposed to trawl nets used widely in the northern region with a mention on the peak seasons for lobsters as well. These efforts contibuted to the sporadic works on single species groups within India. Vijayan, et al., (2000)[41] reviewed the status of the fishery of Kerala providing suggestions for conservation and management of Kerala's marine resources. While the suggestions and recommendations are not new and are common to the universal fishery crisis, the extent of implementation regionwise, however, differs. A clear lack of taxonomic information regarding the non target species or by catch was seen in his report.

Applications of Fishery Research in Management

The problem with a multi species situation is taxonomic. The multiple synonyms for a given species, the morphological differences between adult and juvenile, the response of a population (as a whole) or species specific to the pressures of overfishing and natural selection alter the catch considerably over time. Without such knowledge, the basic knowledge of what is being caught and where, how are the resources to be managed? How does the existing fishery adapt to the changing trends of this natural resource? The scientific aspect to this fisheries project deals with the taxonomic status of species being harvested, the age groups which are caught (determined by their total lengths and weights at the given size) and assessing the proportion of each species within a given catch at a given time. It also examines the ecological and economic aspect of fisheries within the proposed study area. Such studies will aid in determining the status of the fishery itself. And how sustainable the actual resources are, thus being able to inform management strategies for sustainable fishing. Hjermann et al., (2004)[18] examined the collapse of the capelin fishery of the Barents sea, occurring thrice due to predation and fishing. Cod and herring thrive on capelin which is required in rebuilding its fat reserves required for its spawning migration and to produce the eggs while the fishermen pursue capelin as a target fishery. This results in a depensating effect as the predation(natural and anthropogenic) occurs faster than the population can recover therefore causing a spiralling effect on the given species population. The dependancy of cod or herring on capelin signify the link in the food web, a collapse in which would result in an ultimate decline in their population. Hence in cases like this, a multi species approach is required for successful management. Total catch and trophic level of the catch provide information about the potential to disrupt predator/ prey relationships through introduction of non native species or fishing down the food web by fishing out predator populations.[30] Measures of diversity can also indicate the possible impacts of fishing. Bycatch trends of non target species are also used as indicators of possible impacts. Significance thresholds for species diversity impacts are catch removals sufficiently high to cause the population of one or more target or non target species to fall below the minimum biologically acceptable limit such that the population or species cannot recover.[23] According to Seshagiri et al., (2003),[33] the diversity of a region serves as indicators of numerous happenings within an ecosystem and can recount its history, account for the present situations and possibly even predict the future as consequences of the past and present. The importance of trophodynamic indicators were also discussed by Cury et al., (2005)[9] as being crucial to understand ecosystem changes and fisheries. Such indicators are sensitive to the trophic level of a given species and also take long to respond to large structural changes in an ecosystem. Also examined was the usefulness of such indicators in the ecosystem based approach to fisheries and how they can be applied in minimizing the adverse effects of fishing. Removing biomass from a complex of species feeding on each other is bound to have serious implications on the ecosystem as well as for fishing, the latter being indirectly affected by the long term viability of other fisheries. Pauly et al., (2000)[29] critically examined the use of Ecopath suite of software including Ecosim and Ecospace as well, as tools for evaluating the ecosystem impacts of fisheries, where the models not only attempt to predict trophic flows and biomass flows but confirm trophic levels as functional entities and not just concepts to segregate species. Hillborn et al., (2003)[17] states the importance of the role of biocomplexity of stock structure in providing stability and sustainability. They provided evidence for the effects of biocomplexity within fish stocks as important for maintaining their resilience to future environmental change, using the success of the sockeye salmon fisheries of the Bristol Bay, Alaska as an example. Blanchard, 2001 further confirms that, interspecific interactions are significant to the species dynamics and spatial segregation would result in a decrease in species richness and both these factors would be influenced by fishing which are consistent with the hypothesis that harvesting alters the inter relationships between species to a level of co existence not expected under “unfished” conditions. In view of the depleting resources, Livingston et al., (2005),[23] discussed of a scientific framework providing ecosystem based advice. This assesses the dynamics of the ecosystem and the resident biodiversity and the effects each have on the other, relating it to target species and impacts of the fishing techniques. Ecological indicators are useful in giving away the status of the ecosystem with appropriate justification. Hence this approach is also being used to advise fishery managers. Identification of sensitive and meaningful ecosystem indicators is also required before a more formalized decision making process, one that includes ecosystem considerations, can be developed. Recent approaches being considered are oriented around the ecosystem itself and this includes marine protected areas as well. This approach is said to address several issues such as conserving marine biodiversity,supporting fisheries, protecting natural and cultural heritage values, and maintaining economic viability.[3] However, emphasis needs to be given to the methods implemented and management strategies need to be evaluated. According to the authors,the diversity of the various approaches implemented across different regions of the world, and their successes or failures can inform future conservation efforts. Successful marine conservation requires practical ways to integrate ecological, social, cultural, political and economic objectives. Current management strategies are concerned with conservation of “parts of the system” as opposed to the inter-relationships among them stating the limitation of such systems is that considerations about bycatch and impacts of fishing gear and habitats are qualitative mostly. The symptoms of overfishing in an ecosystem are decrease in biodiversity, decline in abundance of populations of exploitable resources, increase in bycatch and discards, greater variability in abundance of species, greater anthropogenic modifications to the habitat and in extreme cases, shifts in ecosystem regimes.[28] Management will always be considered with a subset of species of overriding economic, ecological and social value. Rather than substituting the current management strategies, ecosystem considerations may increasingly expand so as to address the issue of bycatch, predator prey demand and the side effects of fishing effort, in addition with conservation of the target species. Incorporation of these factors into the existing approaches will stress on the need to manage the fishing capacity so as to avoid sequential depletion and trophic imbalances caused by species and size selective harvesting. MPAs and restriction on use and design of fishing gears will constantly be advocated to address impacts on the habitat by fishing and other anthropogenic activity. Unfortunately, as pointed out by Gewin, (2004),[16] an enormous amount of data comes directly from each country’s fishing industry, which is often biased as a result of unreported discarding, illegal fishing and the misreporting of harvests. Fisheries science has taken steps to increase the quality of data in recent years. One consequence of fishing down the food web, is that overall reproduction rates can potentially suffer. Fish size, gender, and age at maturity have a substantial impact on individual species’ reproduction rates. Since larger fish are the most susceptible to fishing, the population’s age structure can shift as individuals, particularly females are fished out. On the whole, “unreported discarding, illegal fishing and misreporting of harvests”, contributes to the dearth of information on the biological attributes of the fisheries in the region, as also indicated by Haastrecht et al., (2003)[39] who investigated the usefulness of the the ban enforced on the east coast of India. Their study revealed that the ban was mostly implemented rather for reasons of incentives than for those based on biological grounds. Interestingly enough, they reported that artisanal fisherfolk benefitted most from this ban. However, due to the lack of biological data to support the supposed benefit of the ban, they suggested that it continue, till further enough research can support or reject it.

Chapter 2 Observations

Fishing Craft and Gear

Nets used are mostly gill nets, drift nets, whose classification is based on the mesh size and also according to the species they are supposedly targetting. The diversity of species caught exhibit the multi species nature of this fishery and nearly all are marketed mostly locally, with only the “high value species” being marketed commercially. In other words, a fishery existed for nearly all groups and this is seen in the nomenclature of the nets. Whether this fishery has evolved and adapted to the available resources overtime can be gleaned from the existing records.

Figure 2.1a presents the total number of boats recorded from the coastal survey i.e., these boats were recorded as landed or bringing in their catch for the day while Figure 2.1b presents the number of boats recorded while fishing at sea. The high number of small FRPs include those required for ring seine operations.

The other two crafts which were associated only with the ring seine operations were the Vallams and the big FRPs. The thonis, kattumarams and a proportion of the small FRPs were involved in the regular fishing activity utilising mostly gill nets with different mesh sizes. The lesser number of Kattumarams recorded while operating can be accounted by their extent of fishing grounds as well their inability to access deeper and further areas.

Figure 2.2 shows the total number and type of craft, which were active in each of the villages surveyed. The big FRPs and the Vallams were active during ring seine operations alone. Sothikuppam was the only village where Vallams and small FRPs were used for ring seine operations. Thonis were recorded only in the Mudasaloodai region and in the Nagapattinam district.

Big FRPs were observed in Kalapet and Nallavadu while Kattumarams and the small FRPs were the most common craft and were recorded at every landing site.

Figure 2.4 shows the cumulative status of craft use at the respective landing sites summed across three cycles of data collection. The graph shows that the number of used craft is generally less than those used. The number of unused FRPs and kattumarams as well as thonis(from Mudasalodai to Pazhayar) is considerably higher than that of the used craft. The number of damaged craft in each of the landing sites were approximately around the same number with exceptions of Pazhayar and Nallavadu(higher number of damaged FRPs) and Bomayarapalyam(damaged kattumarams). Mudasalodai, Pazhayar and Kodiyampalyam also had damaged thonis. Data was collected for Sothikuppam only during the first cycle. They followed the 45 day ban period so data could not be collected during the second cycle and the third cycle consisted exclusively of ring seine landings which were occurring at the Cuddalore jetty. Hence data could not be collected at this time as well.

Figure 2.3 provides information on the average length of crafts as well as the average horsepower of the engines used by the various craft of the region. Vallams were the largest craft, used for the ring seine operations with an avg length of 75 feet and an average horsepower of 450[1].The big FRPs followed with an average length of 30 feet and powered by two 10 HP[2] motors. Big FRPs, are crafts designed specifically for ring seining operations, mainly to carry the bulky nets. The small FRPs were of 24 feet average length and 10 HP. The thonis were larger than the kattumarams with the latter measuring only about 12 feet. Maruti Kattumarams were not seen during the surveys.

The gear employed in the region are mostly gill nets, drift nets and trammel nets (see Table 2.2 for Tamil and English names of nets).

Tamil Name	English Name	Mesh sizes (mm)	Weight (kg)	Height (ft)	Length (ft)	Season used	Species targeted
Kanankaruthai	Gill net	38, 40, 42, 46, 52, 54, 55, 56	100, 75, 150	3	600	Summer	Mackerel
Paranda	Gill net	34	75, 100	2	100	All months	Mullet
Mani	Trammel net	18, 40, 42, 44, 70	75, 100, 150	2	200	Nov, Dec	Prawn
Pantha	Varies	40, 44, 48, 50, 56	50, 100	30	600	Summer	Sardine
Kavalai	Gill net	16, 26, 27,28, 32, 56	75, 100, 200, 250, 300, 150	4	600	Jan, Feb	Sardine
Athula	Gill net	38,40, 43, 45, 46, 50, 60, 65, 75, 80, 85, 90, 110	40, 50, 60, 75, 100	3	200	Oct, Nov	Solefish
Surukku	Ring seine	18, 24, 28, 32, 76	1000, 1500	30	1000	Summer	Sardine, carangids
Kolaa	Gill net	24, 28, 32, 52	75, 150, 200	2	1000	Summer	Flying fish
Salanka	Gill net	20, 38, 45, 50, 54, 65	50, 75, 100, 150	2	200	Nov, Dec	Mullet
Mathee	Gill net	28, 36, 38, 40	75, 100	4	600	Summer	Sardine
Mathappuvalai	Gill net	40, 45, 48, 50, 54, 60, 120	50, 75, 100	4	600	All months	Mullet
Kanavaa	Gill net	60	150	3	600	All months	Squid
Disko	Gill net	22, 30, 32, 34, 35, 36, 38, 40, 42, 44, 45, 46, 50	40, 50, 60, 75, 100	4	600	Summer	Sardine
Singe	Gill net	60, 85	100, 200, 300	3	250	Oct, Nov	Slipper lobster
Sannavalai	Gill net	40	75	3	300	All months	Mullet

[1]This is an inboard (Leyland) engine.
[2]Long tailed outboard motor.

Nakku	Gill net	47, 90, 180	75, 100	3	200	Oct, Nov	Solefish
Nandu	Gill net	28, 30, 40, 45, 50, 55, 56, 60, 70, 75, 80, 85, 90, 95, 100, 110, 120, 62, 54, 135	30, 50, 75, 80, 100, 150	3	200	Oct, Nov, Dec	Crab
10.Number	Gill net	26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 45, 48, 50	50, 75, 100, 150	2	200	All months	Sardine
Madavai	Gill net	50, 54, 70	75, 100	2	200	All months	Mullet
Kezhanga	Gill net	36	75	2	200	All months	Whiting
Pannu	Gill net	26, 28, 30, 32, 38, 40, 42, 44, 45, 50, 52, 53, 54, 55, 56, 85, 100	50, 60, 75, 100, 150, 200	3	600	Summer	Sardine
kolaa	Gill net	16, 17, 18, 27, 28, 30, 32, 34, 36, 38	75, 100, 150, 300	2	1000	Summer	Flying fish
Valaa	Gill net	50	150	2	1000	Summer	Sardine
Pas	Gill net	54, 56, 60	100, 150, 200	2	600	Summer	Mullet
Periya	Shore seine	16, 28, 38, 60, 80, 85	500, 1000, 1500	4	500	Summer	Anchovy
Nethilee	Gill net	14, 16, 18, 38	75, 100	4	100	Summer	Anchovy
Izhou	Trawl net	25	100, 400, 500	15	500	All months	Prawn
Aadha	Gill net	28	50, 100	3	200	Summer	Mullet
eraal	Trammel net	30, 38, 18, 60	75, 100	2	200	Summer	Prawn
Kenda	Gill net	48, 65, 80, 90	75, 150	2	200	All months	Mullet
Pothu	Gill net	45	75	3	300	Summer	Mullet
Maappu	Gill net	40, 60	75, 150	2	200	All months	Sardine
Sanghu	Gill net	80	100	3	200	Oct, Nov, Dec	Shell
Line	Line				3000	All months	Seer
Valaa	Gill net	52	100	2	1000	All months	Sardine
Malappu	Gill net	56	1000	2	200	All months	Mullet
Thavukola	Gill net	44	150	2	500	All months	Flying fish
Othaadukku	Gill net	54	50	5	100	Summer	Mullet

Vanjiram	Gill net	24	150	5	100	Summer	Seer
Nall	Gill net	38	100	2	100	Summer	Mullet
Rettaivalai	Trawl net			6	600	All months	Prawn
Adantha	Varies	32	50, 75	30	600	Summer	Sardine

Table 2.2: Tamil and English names of nets. The two nets Adantha(small) and Pantha(big) valai are names given based on mesh sizes and can be given to any net just based on this one criteria. During the surveys, many fishermen used these names instead of the gear's specific name. So ring seines, gill nets with small mesh size are also called adantha valai like those with bigger mesh sizes are called panthavalai.

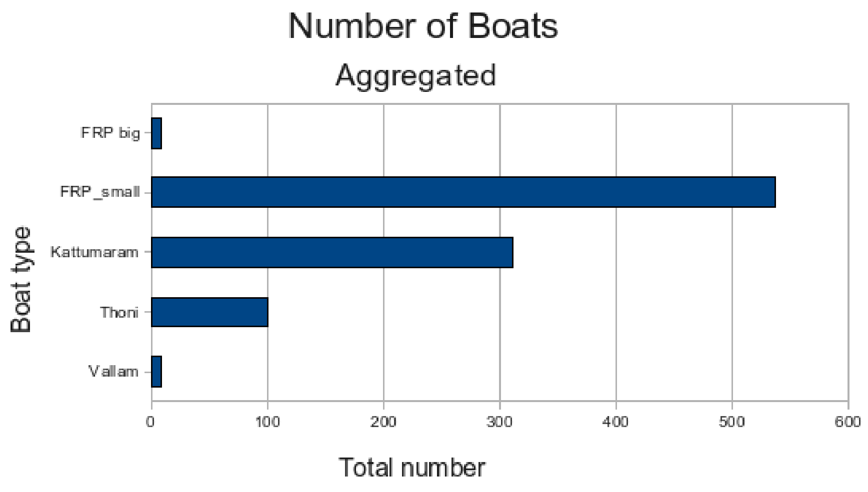
These are classified and named locally based on their mesh size as well as the species they are meant to capture. Due to this reason there is a considerable diversity within fishing gear. During the coastal surveys, the Kolaavalai, Kavalaivalai and the Diskovalai were recorded to be used the maximum, while during the sea surveys Surukkuvalais were recorded the most i.e., in operation. There were not many observations of the ring seines during the landing surveys. The few observations made did not yield desired data as the fishermen were not forthcoming with responses. Especially after the Veerampattinam incident ring seine fishermen refused to co operate; photographs of the catch were managed on one occasion. The ring seine data collection was also problematic because of the uncertainty in landing time. Many were operating one net more than once on a single day and also many were in search of fish shoals, so even landing time could not be estimated as it depended on when they found a considerably large shoal. Those landed at the regular times (the regular fishing time per village) were recorded. Nine shore seines were also recorded during the landing surveys.

Figure 2.6a shows the number of nets being used with the average mesh size in mm observed at the time of landing and during the sea surveys. Observations for the landing surveys show that Izhou Valai is the net used by trawls in the Mudasaloodai region; these were surveyed only in the first cycle of data collection, with a mesh size of 25 mm at the cod end. The minimum mesh size that was recorded was 14-18; seen in the shore seines, ring seines and a few gill nets as well. The nethileevalai however has mesh sizes between 14-20, with one exception of 38 mm.

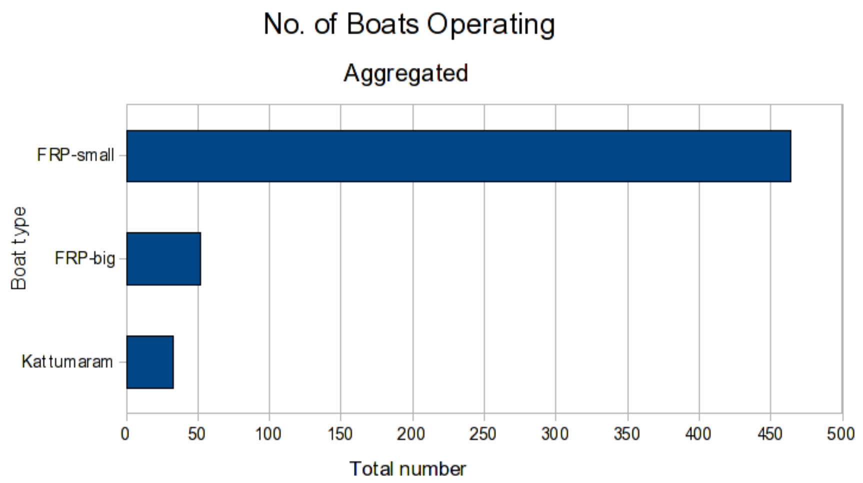
The sea survey observations, shown in Figure 2.6b present the average mesh sizes of the gear being operated in the region. A number of gear with mesh sizes below 30 mm were/ are being operated in the region. Ring seines in particular exhibited a range of mesh sizes from 14mm to 80mm. The most commonly used was that of 25mm (13 nets). Also seen were mesh sizes of 14mm(4 nets) and 16mm (9 nets). The kavalai valai and the kolaa valai were the next most often sighted gear in operation.

Figure 2.7 presents the total number and types of nets recorded on a settlement basis. Pazhayar and Veerampattinam, both large villages and major landing centres, exhibited the maximum diversity in nets being operated while the latter also accounted for the highest number of nets being used followed by the former. Sothikuppam had the least diversity of nets and also happened to own the maximum number of ring seines. Annapanpettai and Pudhukuppam had the fewest number of nets.

Figure 2.8 indicates the type and number of craft that were operated with different nets. Usually not more than one net was used by a single craft. However, in the case of larger gear like the ring seine, 1 net was operated by 1 big FRP and 9-10 smaller FRPs or 1 Vallam with 10 FRPs as carrier boats. This combined with the manpower represents the fishing unit of the given region. Some of the gear were common to all craft types with the dominant craft being the small FRPs followed by the kattumarams.



(a) Craft observed during landing surveys.



(b) Craft observed during sea surveys.

Figure 2.1: Boats in active use.

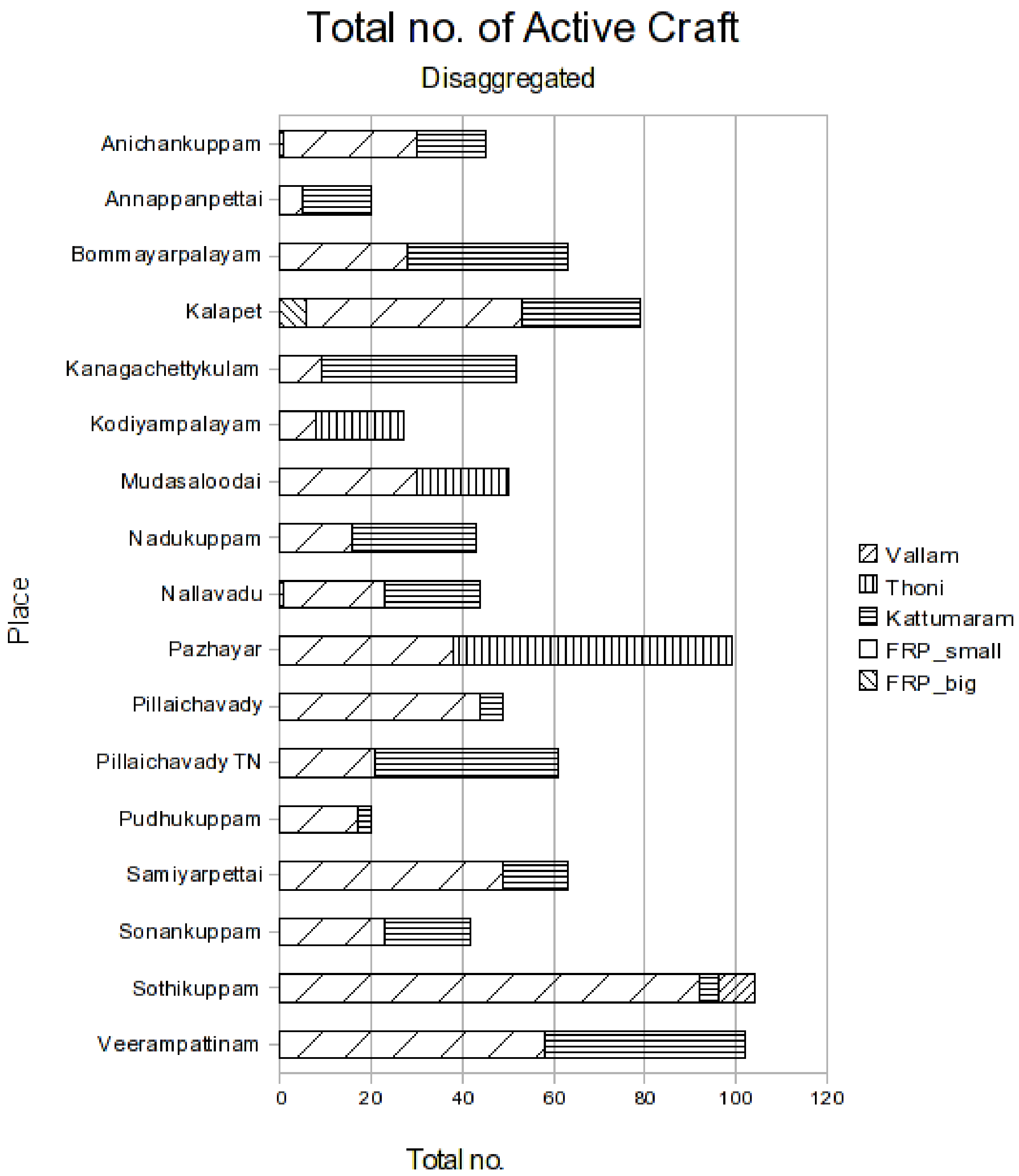
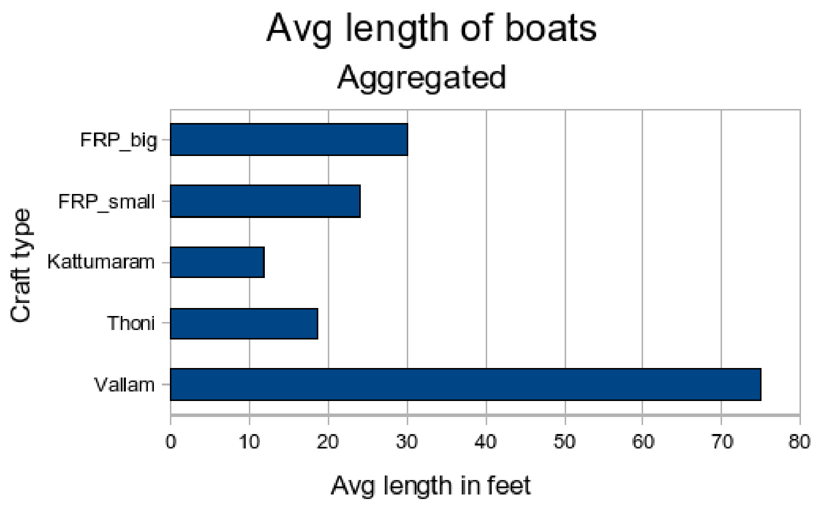


Figure 2.2: Types of craft.



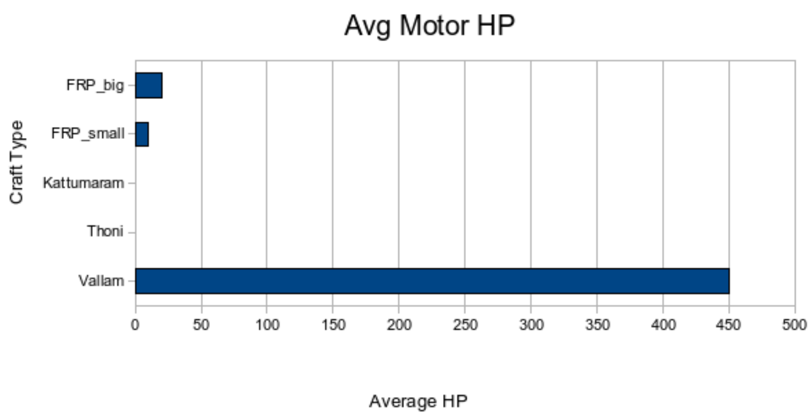


Figure 2.3: Average length of craft and power of OBM.

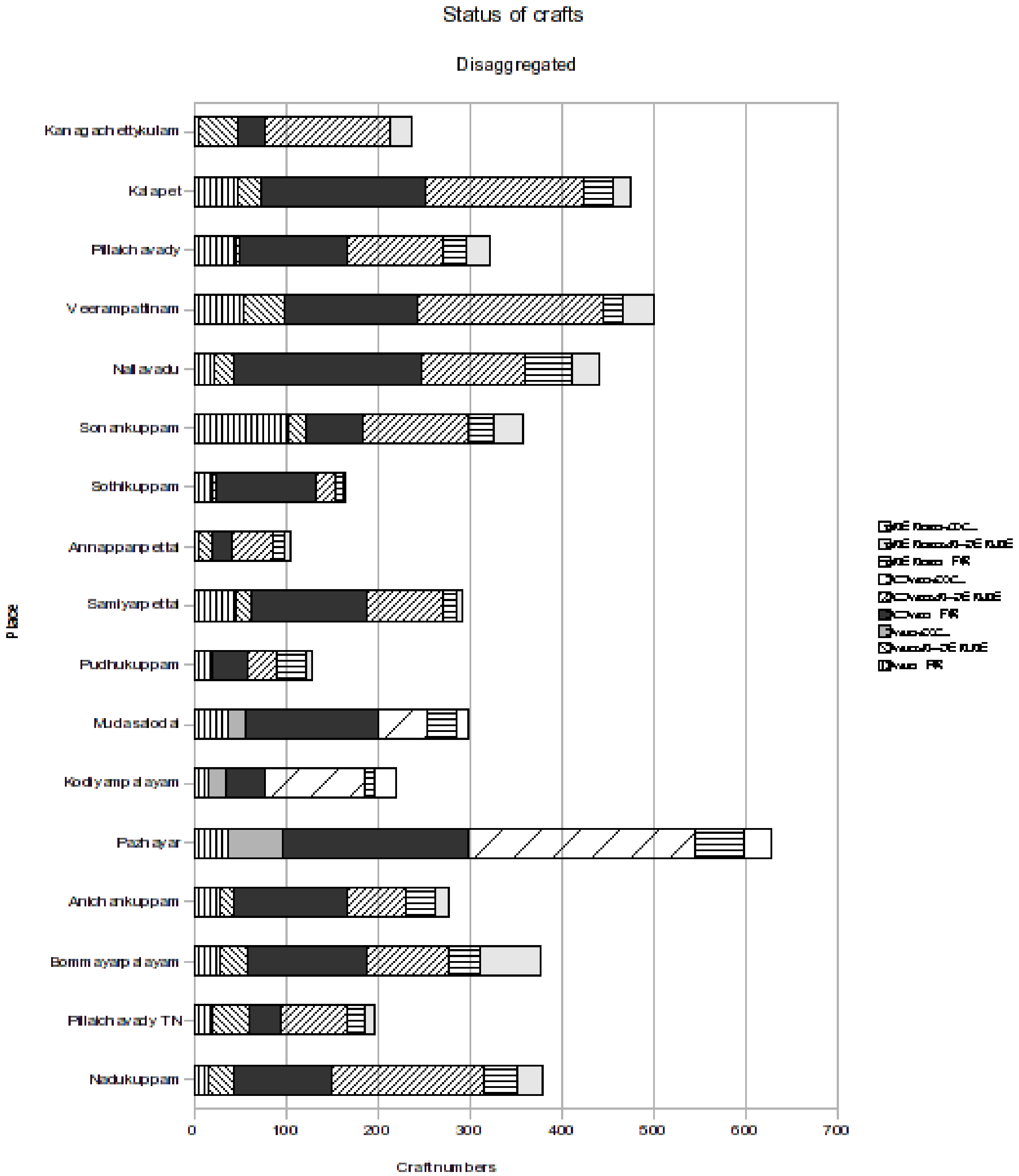
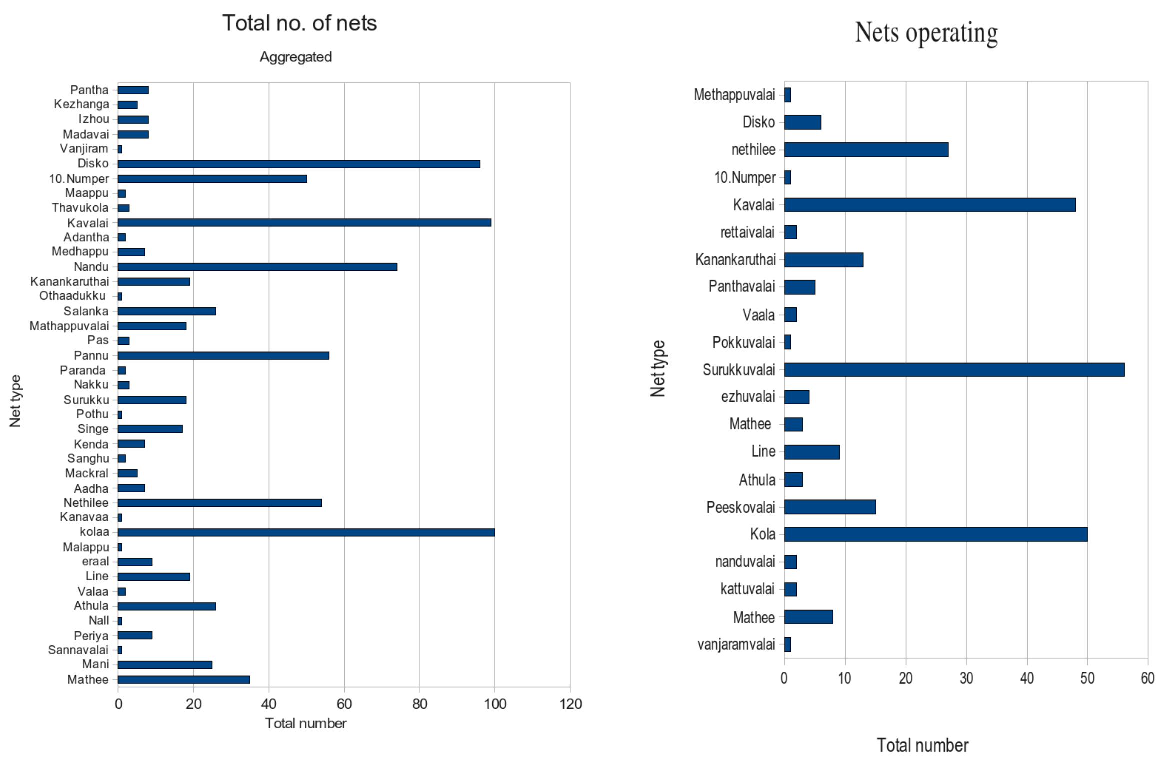
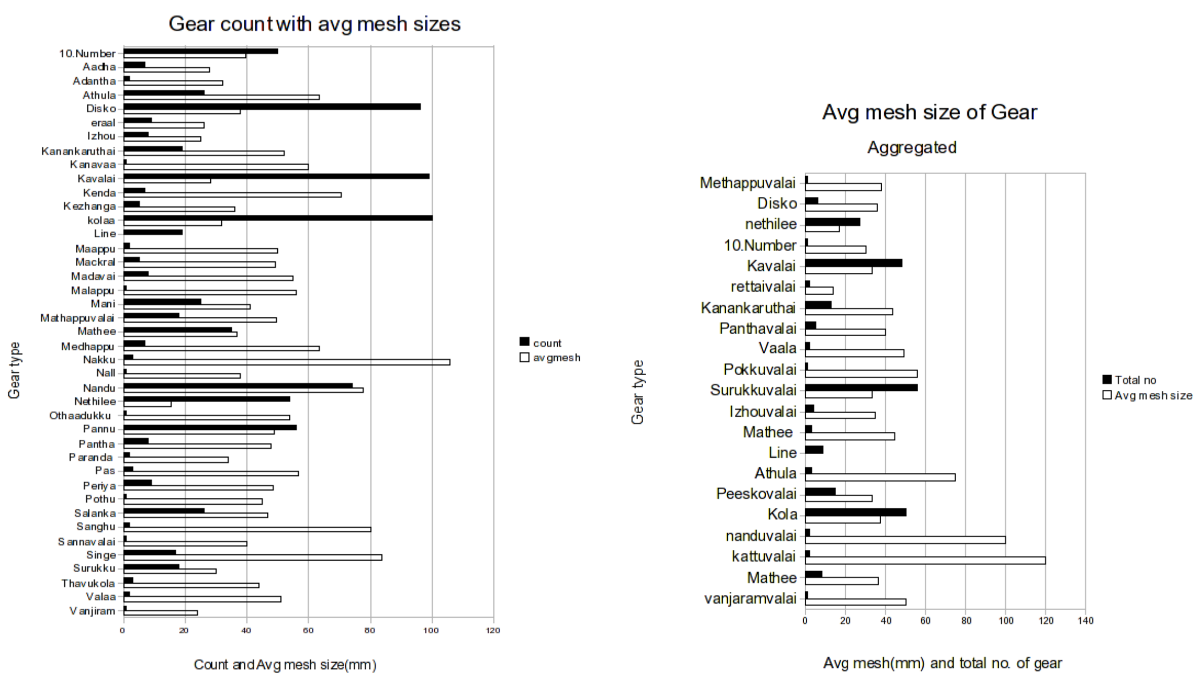


Figure 2.4: Status of craft use.



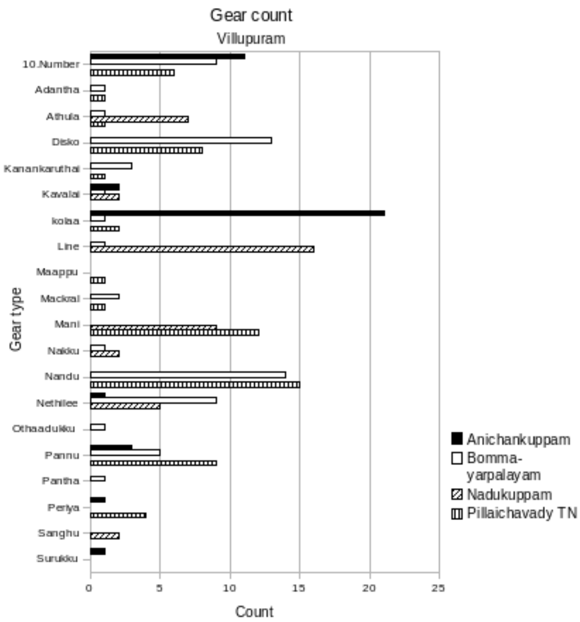
(a) Nets observed during the landing survey. (b) Nets observed during the sea survey.

Figure 2.5: Use of nets.

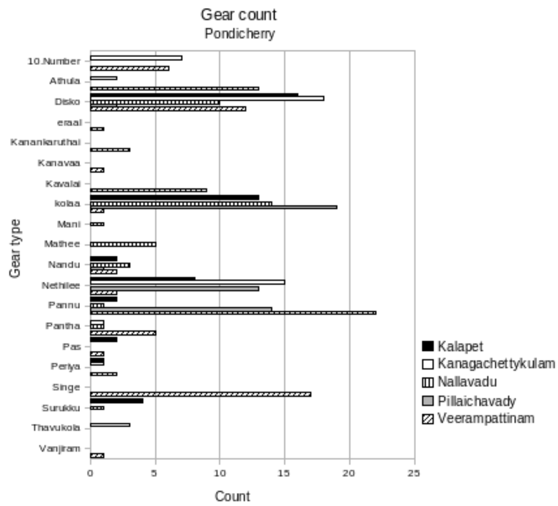


(a) Observations during landing surveys. (b) Observations during sea-surveys.

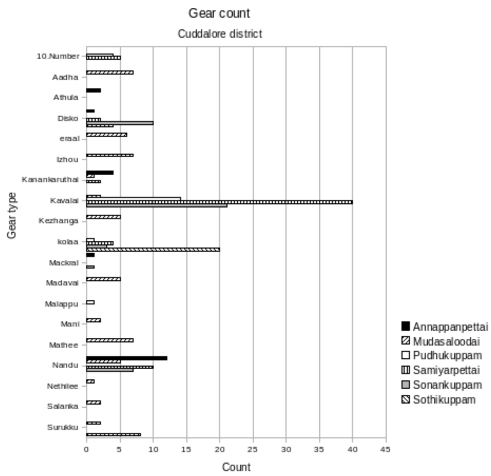
Figure 2.6: Observations of nets and mesh sizes.



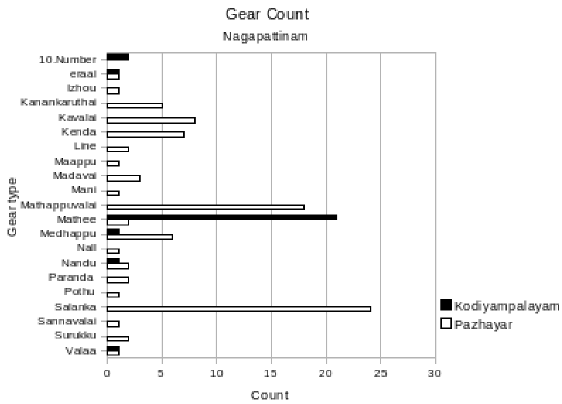
(a) Villupuram.



(b) Pondicherry.



(c) Cuddalore



(d) Nagapattinam

Figure 2.7: Settlement wise net count.

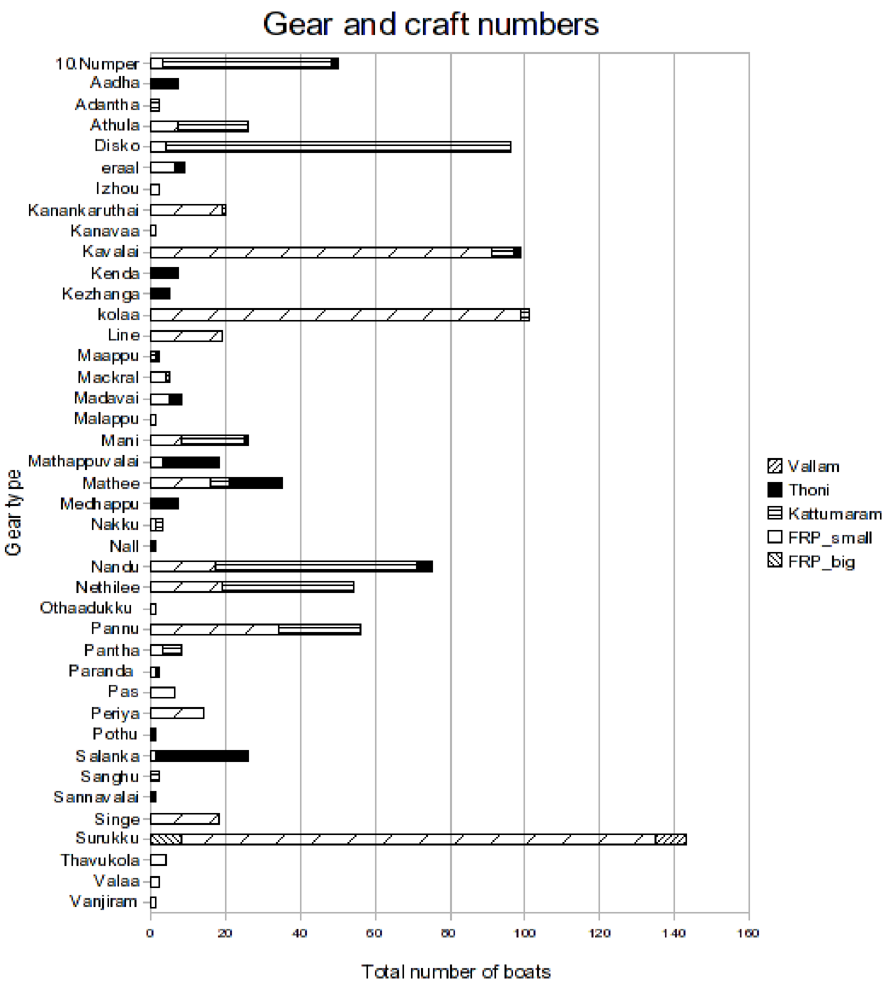


Figure 2.8: Craft and net association.

Depth of operations and substratum

Figure 2.9 presents the observations of the type of substratum above which different nets were used. The maximum number of gear were operated over a sandy, clayey or just clayey substrata, which dominate the continental shelf. Very few gear were operated over a rocky and clayey or sandy substrata.

Figure 2.10 shows the depth at which the gear were operated. As the figure shows, the substratum over which fishing was done also affected the depth at which the gear was operated. The depth of most operations is restricted to an average of 18m and less, with very few operations extending to greater depths. Line fishing was recorded to occur at depths greater than 50m on more than one occasion. Most of the other types of gear fall below the 20m range.

Figure 2.11a presents the depth of the substrate as recorded by the echosounder during the sea surveys, in addition to noting the position of the boats which were operating in the same region. It shows that the rocky, clayey substrata is the deepest while the sandy, clayey substrata are in the shallower regions. Figure 2.11b indicates the depth of fishing. This depth can also represent the height of the nets in some cases. Here also, the rocky, clayey substrata was recorded to be the deepest and were recorded on a few occasions when the fisherfolk ventured out to deeper waters.

Figure 2.12 presents the depth at which different craft were observed during the sea surveys. Small FRP boats were used as carrier boats during the ring seining operations and were associated with either the big FRPs or the Vallams which were used as the main boat during these trips. Thoni's were used in the most shallow waters, normally backwater regions. Kattumarams were used at an average depth of 8m while independent FRPs fished at depths of 17m. Ring seining operations through Vallams operated at nearly 24m while the big FRP boat operations were in shallower waters averaging 14m.

The depth of the substratum at which nets were found to be operated during the sea surveys are presented in figure 2.13. The ring seine was operated at an average depth of 32m. making it the deepest operated net, while the nandu valai or crab net was the shallowest operated net at an average of 2.1 m. Note that the total number of ring seine operations noted during the surveys was 56 which is also the highest number of observed nets.

Figure 2.14 presents the depths at which fishermen said they had operated their nets during the fishing trip. It needs to be noted that the relationship between the craft and depth of fishing also have bearing on the depth at which the nets were operated. Thus crafts like kattumarams and thonis have limitations as far as access to deeper waters is concerned and nets operated from them would be in shallow waters. The total number of such craft is restricted to a particular depth, which is also utilised by the motorised and mechanised craft. 56 ring seines were operated at a depth of 30m, also indicating the number of craft operating in that zone. Combinations of small FRPs with either vallams or big FRPs indicate ring seine operations at a common depth. 100 thonis and 311 kattumarams fished at a depth of 8.5m.

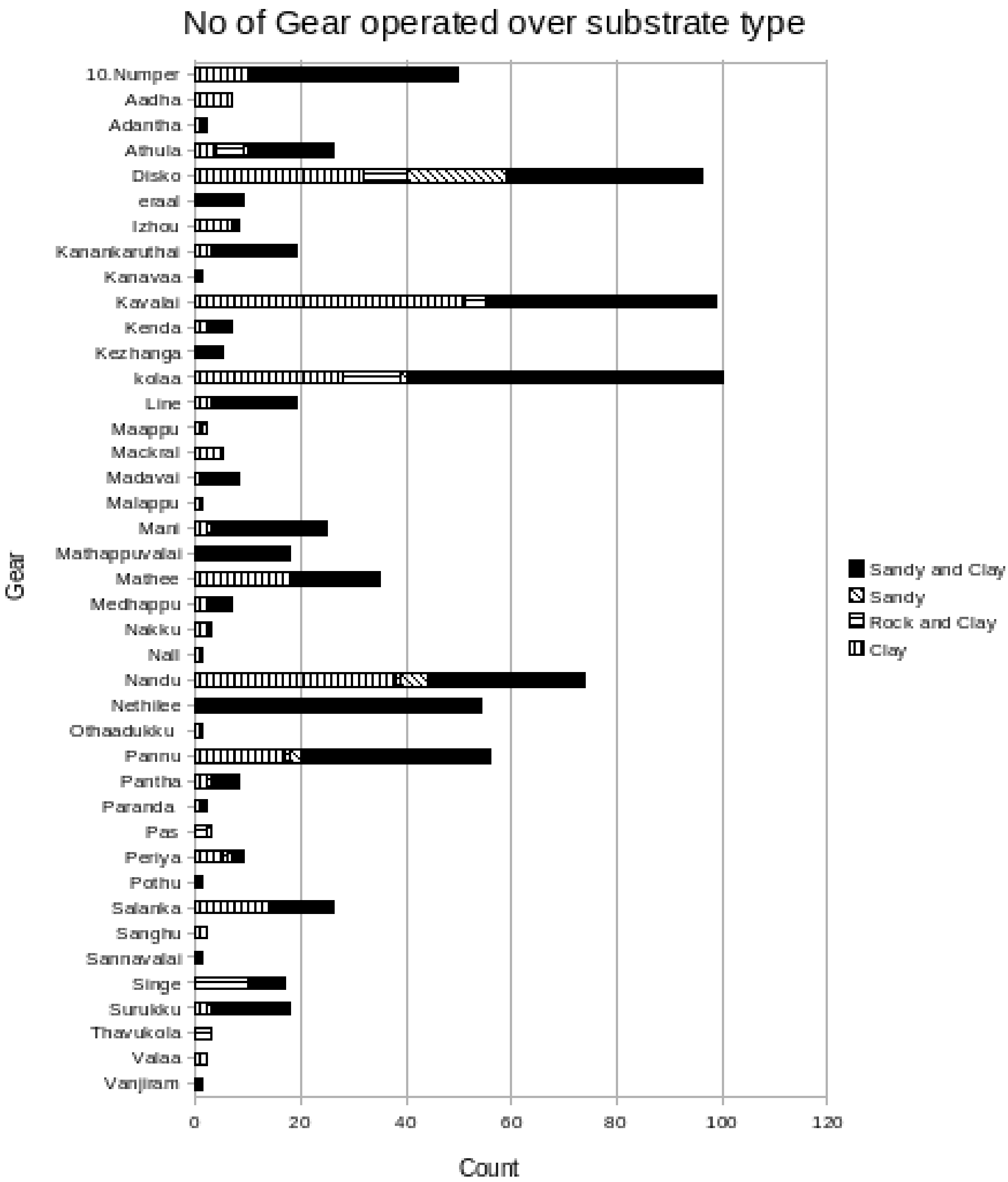


Figure 2.9: Net and substratum association.

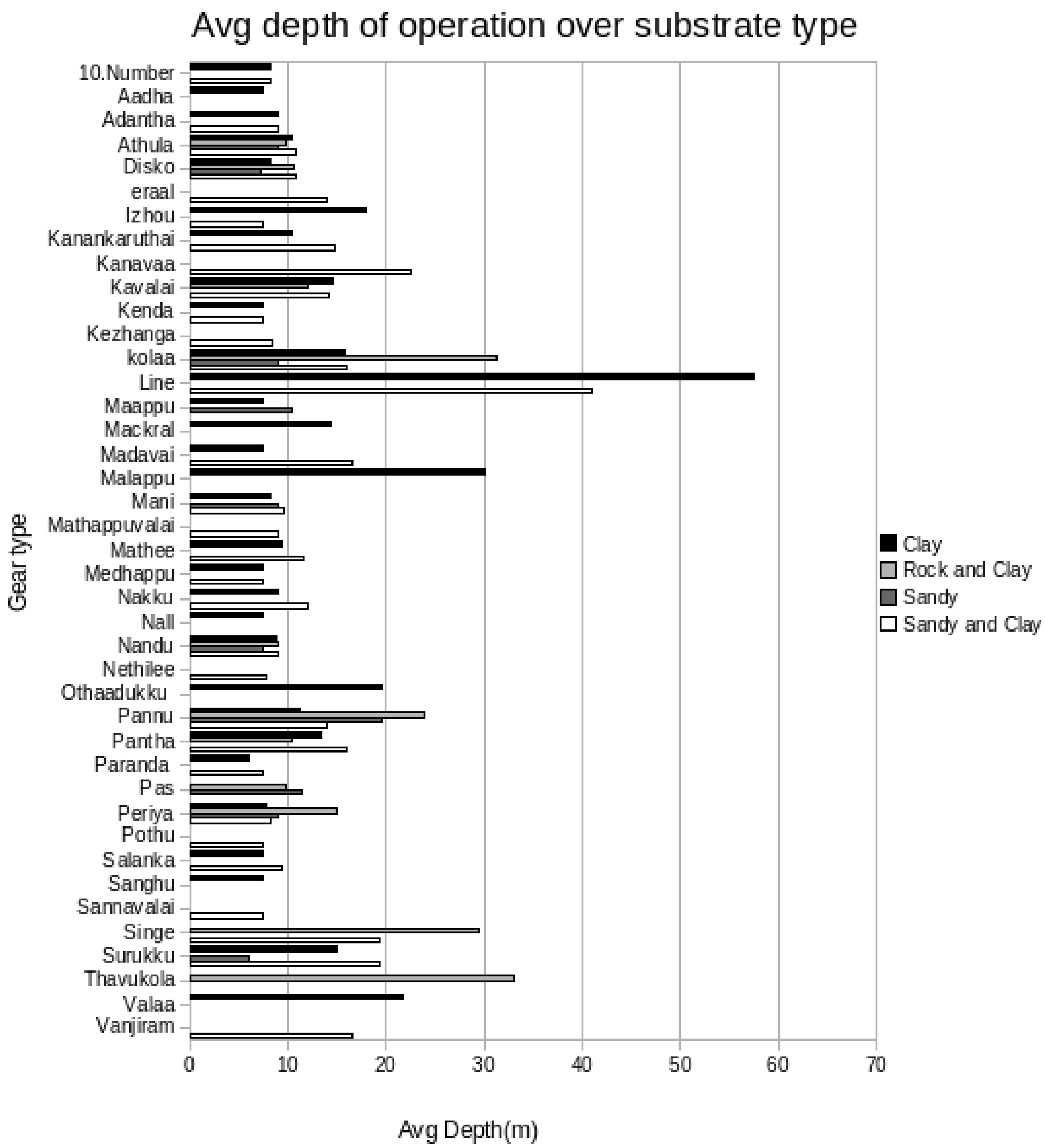
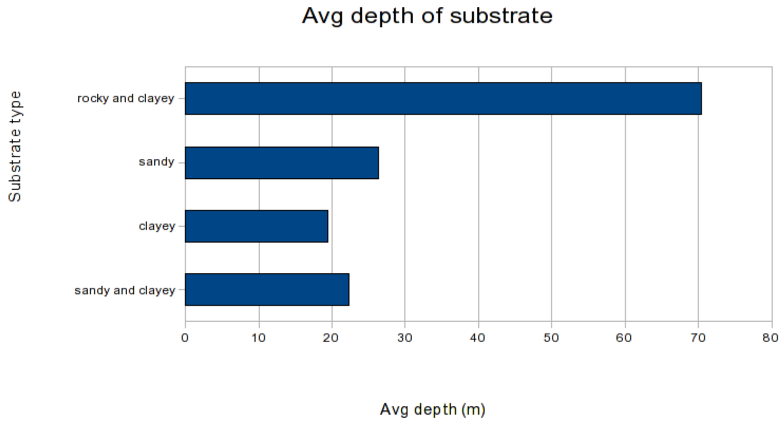
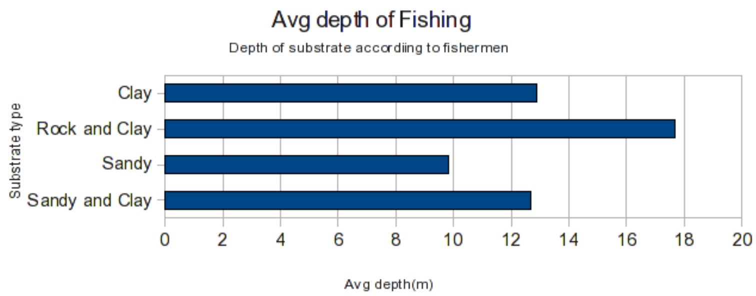


Figure 2.10: Depth of operations.



(a) Depth of substrate.



(b) Depth of the region where the fishermen set their nets (their perception)

Figure 2.11: Depth of substrate and fishing operations.

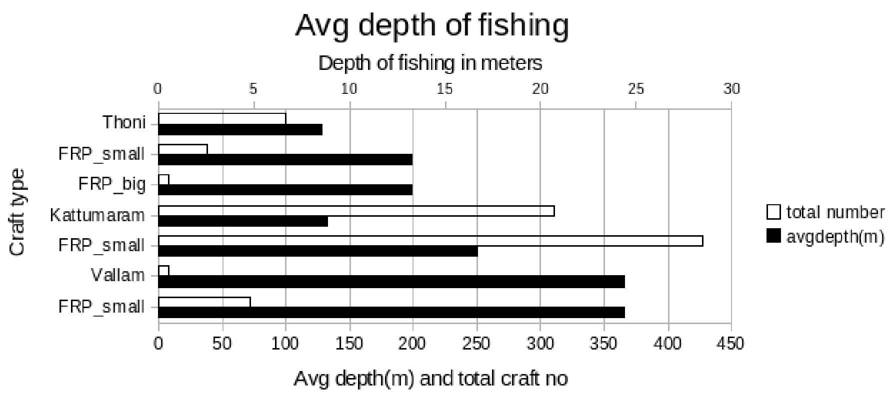


Figure 2.12: Craftwise depth of fishing.

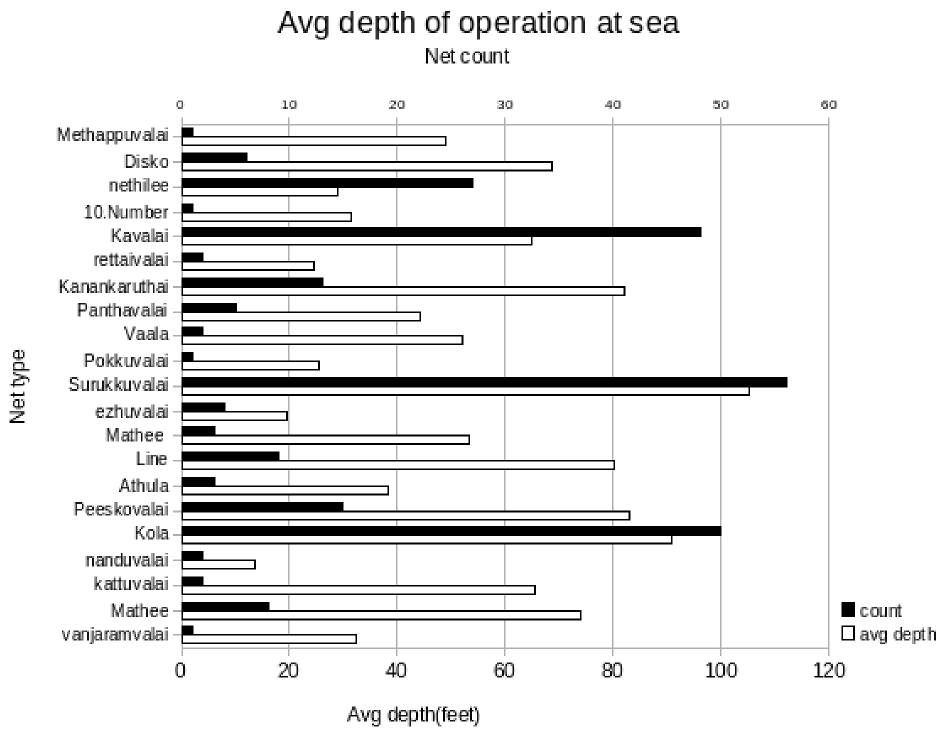


Figure 2.13: Depth of net operations.

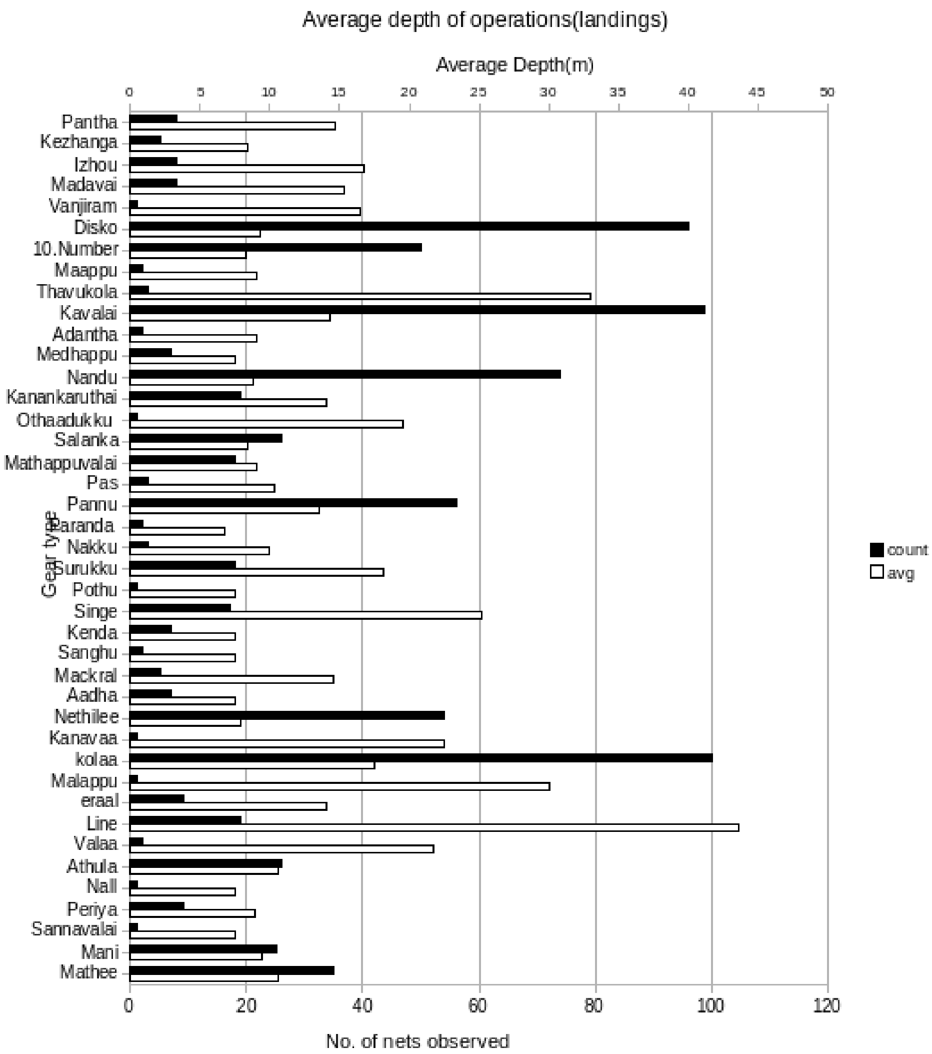


Figure 2.14: Depth of net operations during landing surveys.

Seasonality of gear use

Figure 2.15 shows that most of the nets are operated throughout the year with the exception of nethilee valai and suruku valai which had distinct seasonality and which are also species specific. 9 nets were operated only in particular months like the vanjiram valai, valaa valai, thavukola valai, etc. The nets operated the most were the kolaa, kavalai, disko and the nandu valai.

Figure 2.16 presents the total number of gear in operation per month as observed during the sea surveys, which were undertaken following each cycle of data collection for the coastal surveys. April accounts for the highest number of gear being operated followed by June. Most of the data for April was collected before the ban i.e., before April 15th. Noteworthy are the number of ring seines that were operated in April (over a period of four days, each day covering one cluster or district).

Figure 2.17 presents the cumulative use of gear based on the landing surveys. The highest number of gear were operated in the months of January, February and June. The lesser number of nets observed in July was due to the completion of the 3rd cycle of data collection around the same time. February shows the highest diversity in gear operated i.e., 26 different gear operated in a single month, followed by March and June (20 different nets).

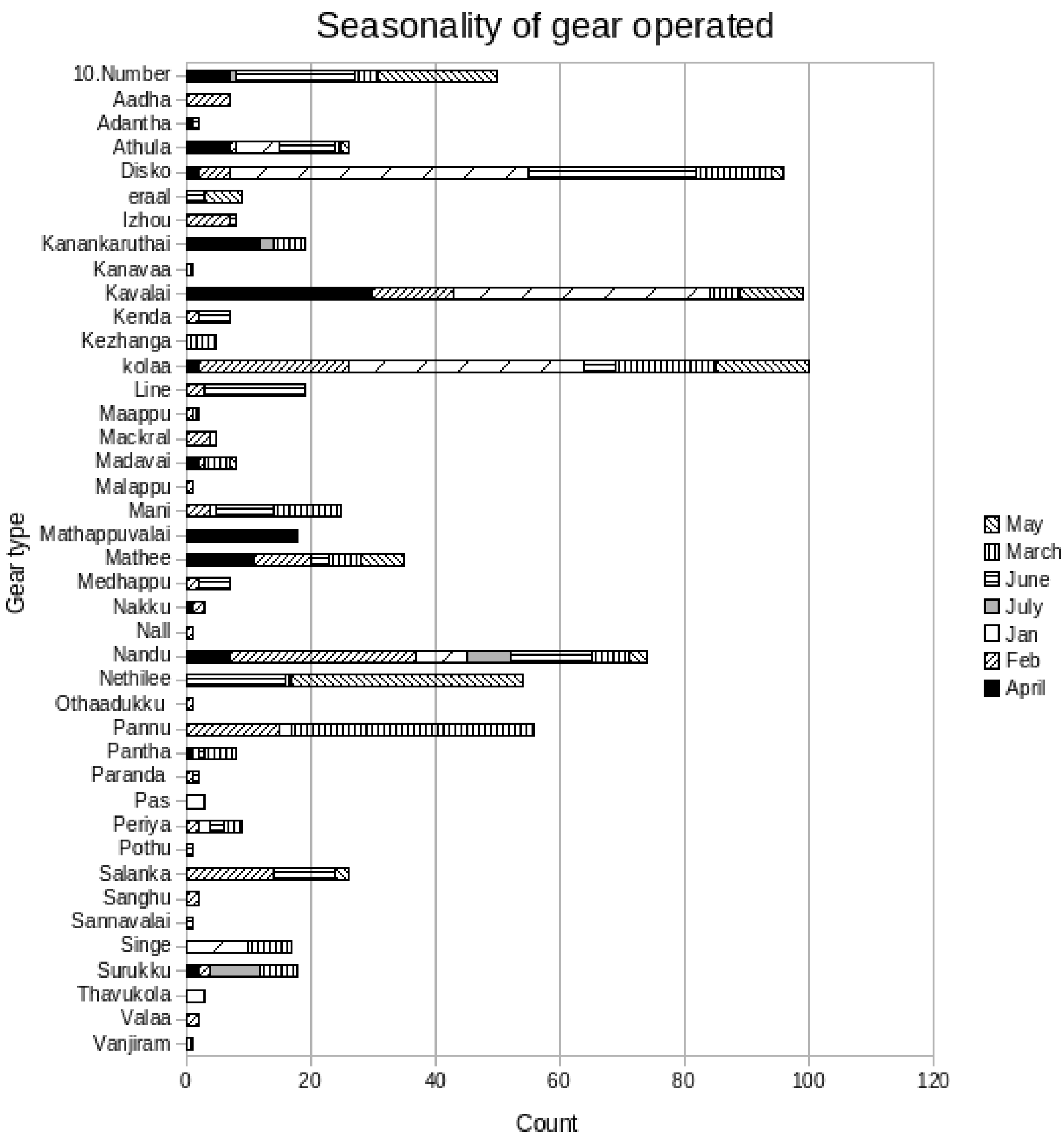


Figure 2.15: Seasonality of gear use (landing survey).

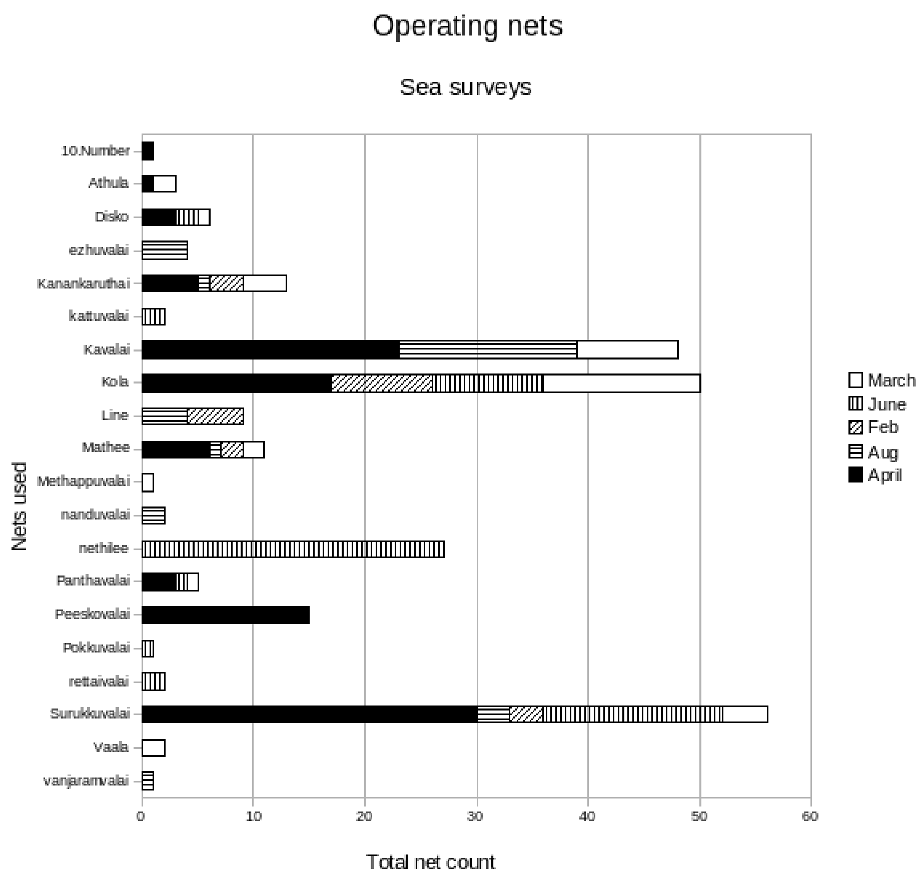
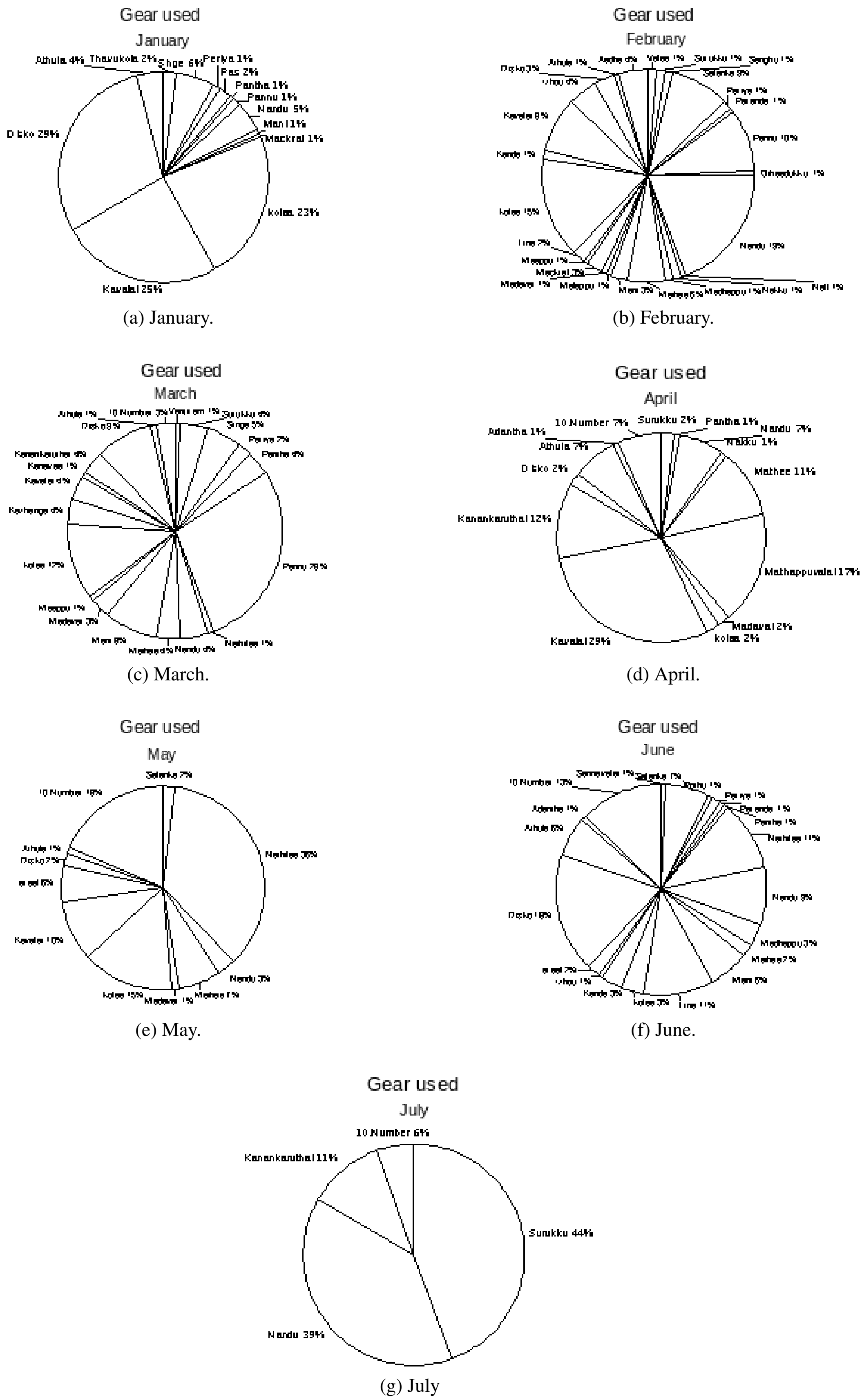


Figure 2.16: Seasonality of gear use (sea survey).



(a) January. (b) February.

(c) March. (d) April.

(e) May. (f) June.

(g) July

Figure 2.17: Monthly cumulative gear use (landing surveys).

Fishing effort

Figure 2.18 presents the average crew size per craft type which ranges from two for thonis to over 45 for vallams. The number of crew required per type of net was also recorded and has been presented in Figure 2.19. This represents the actual manpower involved in a single operation of the respective gear. Gear like the shore seine(Periyavalai) and the ring seine (Surukuvalai) employ a large number of fishermen as opposed to the gill nets/trammel nets operated by a kattumaram or FRP where the maximum crew required could be anywhere from 1 to 5 respectively.

Figure 2.20 presents the time spent fishing per craft type. The average time spent is about 3 to 4 hours for kattumarams and FRPs respectively. As in ring seine operations, which can last till the catch is exhausted, vallams were reported to fish for about 6 hours. Many gear are set in the night, and brought back the next morning. For such type of overnight operations, the hauling time was considered. This kind of fishing was mostly done using thonis. However thonis also did the regular fishing for about 2 to 3 hours per day.

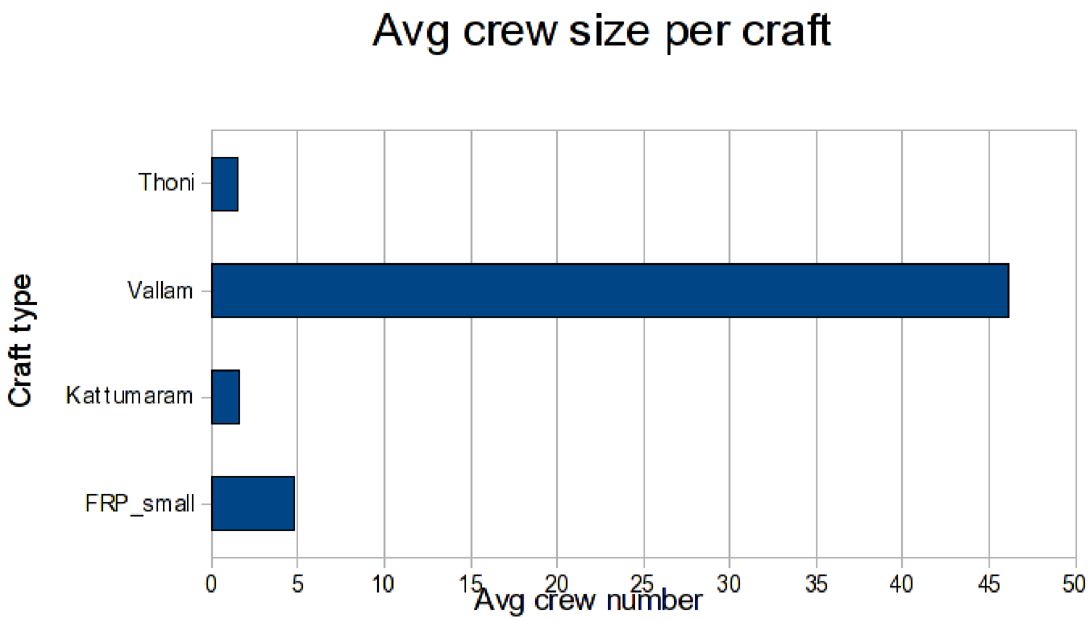


Figure 2.18: Average crew per type of craft.

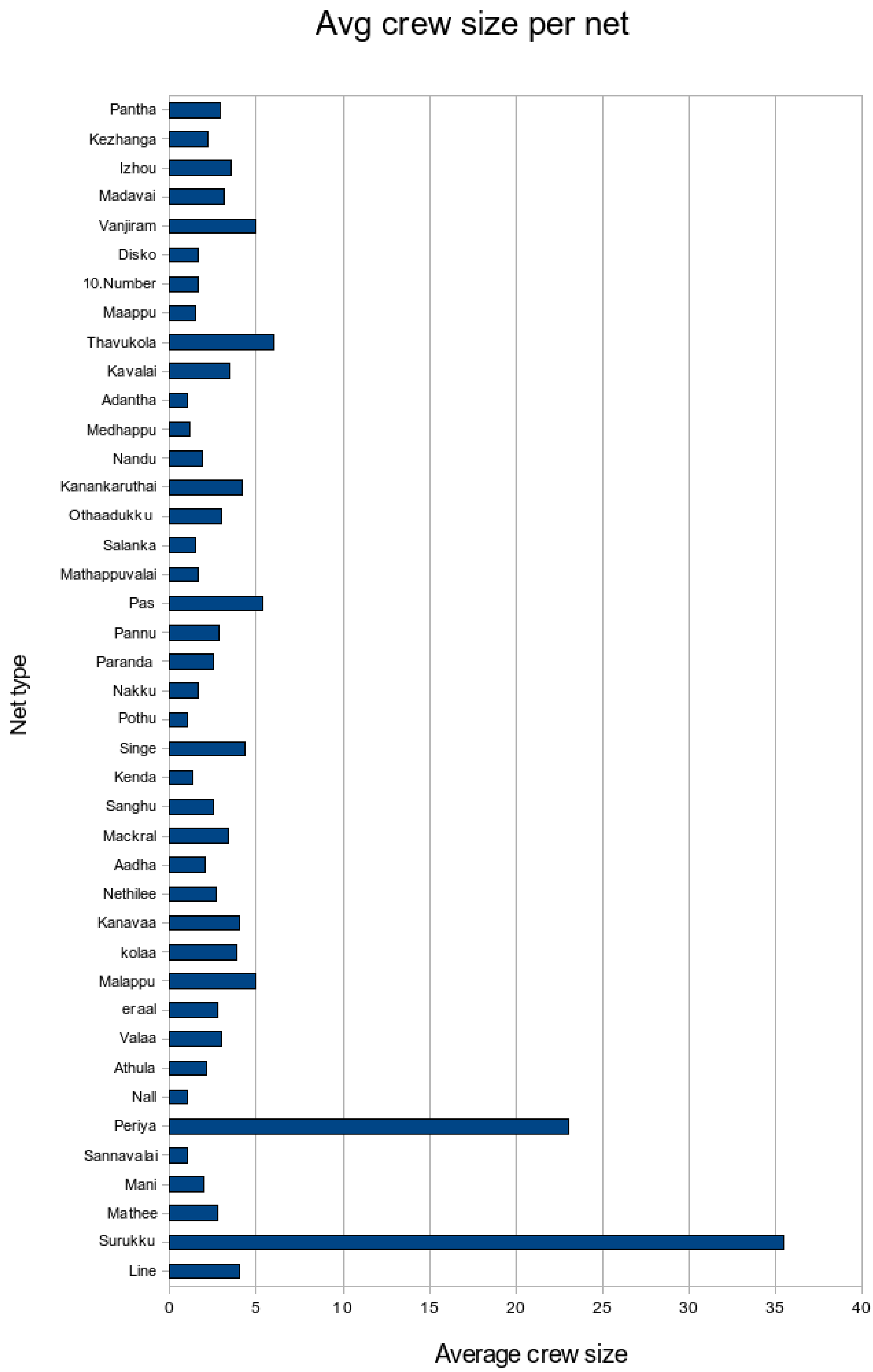


Figure 2.19: Average crew size per net type.

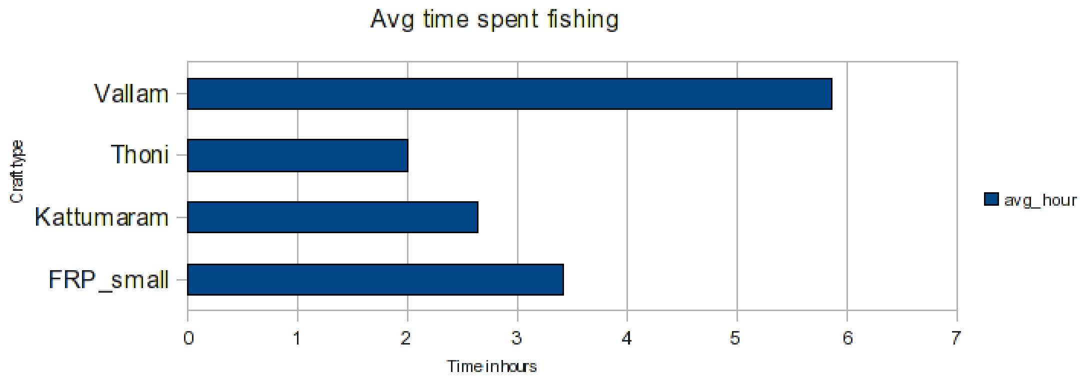


Figure 2.20: Average time spent fishing.

Catch weight and earning

Figure 2.21 presents the total catch weight and the total earnings generated accordingly. The average catch weight by the Surukkuvalai was the highest, followed by that of the Periyavalai and Line. The average earnings generated by the ring seine catch is by far the highest of all catches, followed by line catches and then the shore seine catches. Line catches comprise the economically important groups like seerfish, tuna etc., which would account for the higher earnings when compared to that of the shoreseine. There were many instances where fishing was not successful for the day in which case there would be no income, as in the case of the Kezhanga valai. All other gear rarely yielded catches with average weights above 500 kg, and was well below this mark which in turn directly corresponds to the low average income resulting due to the low catch weight.

High earnings from nets like the ring seines and anchovy nets are seasonal. And neither are high earnings guaranteed irrespective of the gear employed for fishing. Refer to figure 2.23 and Figure 2.21; with the catch weight and the earnings summed across all gear. The graph indicates that most of the gear rarely exceed catch weights of 500 kg thereby preventing earnings from exceeding and rarely crossing Rs.1000. The only exceptions to this occasionally are the Line gear, kavalai and kolaa valai, mani valai etc where depending on the quality of catch in addition to the quantity, earnings may exceed a sum of Rs.25000. The ring seine stands out significantly from the graph as being the only net yielding high quantities as well as obtaining high returns. It must be kept in mind that the earnings reported here are figures given by the fishermen themselves. The graph representing the total earnings per net versus the total crew operating that net gives an idea of the average earnings made by the respective fishermen (crew and owners).

The number of the crew men indicate the number required for operation of the respective gear. Figure 2.24 and 2.25 present the earnings per head. Earnings from any catch are usually divided between the owners and the crew at a 60% and 40% arrangement respectively. The arrangement for the ring seines however is 75% and 25%. About 10% is required for the craft and diesel cost and 45% is taken towards the gear. While a part of it includes the gear maintenance costs, the remainder is considered as a profit for the owners of the net, who require it in recovering their investment in the net. The remaining 45% is divided equally among the owners and the crew members.

The owners of the craft and gear earn more than the crew though a part of their earnings goes towards maintenance of their gear and craft (Figure 2.26). While the owners are few except in cases of the Surukkuvalai where they exceed 15 people, the minimum number of owners for most gear is 1 person. The Periyavalai have about 3-4 owners and has been observed to generate the lowest income. As this does not require operation at sea this net is usually operated by the older fishermen. The percentage is relaxed on days when the crew's earnings are very low (once recorded to be Rs.10 per head!) in which case the arrangement is reversed. A net with no earnings at all during the data collection was the kezhanga net contributing to the instances when fishermen returned with no fish catch. Line fishermen were the next significant group earning better than the other fishermen. This is mostly due to the target fish which are characteristic of hook and line/ long lining. The economic value of these fish therefore result in high returns if and when caught in considerable quantities.

Earnings of fishermen often range through extremes from nothing to a thousand or several thousands.

The figures reported are the earnings from a single operation and a single catch. The average earnings of a crew member is Rs.200 or less while that of the owners is Rs.1000 (not including the ring seine operators). The ring seine owners can earn a maximum of Rs.30000 to about Rs 5000 per catch while the crew members can earn from Rs.2500 to Rs.500. The higher figures occurring on good catch days. Also the earnings are divided among those who participate in that day's fishing. The ring seine owners are large in number and not all participate in a single operation. They fish on alternate days and earn accordingly. These high earnings from a single ring seine operation explains why most of the kattumaram and FRP owners using other gear are now participating as crew in ring seine operations. They fish for a period of 250 days in a year while the remainder 115 days includes sporadic bad weather and the monsoons, the 45 day ban, various village functions and ceremonies.

While most of the fish caught are sold fresh those of small sizes are dried and sold as dry fish. Additionally most of the bycatch and discards contribute to fish meal/ poultry feed wherever discarded and dried for this purpose. Figure 2.27a represents the mode of marketing into the respective destination/market while Figure 2.27b represents the mode of marketing from the landing site. The former indicates the major mode of marketing is the auction system which also agrees with Figure 2.27b. The auction system at the community level is an interesting marketing strategy which has existed overtime with the main auctioneer appointed by the village and from the village. Wherever the auction system is followed the market is formed at the landing site from where after the purchase of a portion of the catch, the fisherwomen sell it either door to door (local and distant places) or at a common fish market. Trading is also seen but not on a large scale. This mostly occurs with catches from line gear as well as the ring seines. Few instances where catch was sold to traders from Kerala and Veloore were recorded. Pondicherry and Cuddalore OT featured as important trading destinations. Figure 2.27b indicates as already mentioned, the auction system to dominate the mode of marketing. Self marketing is also followed considerably. Most of the landing sites in Pondicherry were trading within Pondicherry with a similar situation in Cuddalore to Cuddalore OT. Veerampattinam follows the Auction system which was set up by SIFFS. Fish of small sizes were used as dry fish. Most of the bycatch and discards contribute to fish meal/ poultry feed wherever discarded and dried for this purpose.

The Auctioning system proved to be a unanimous marketing strategy prevailing throughout the study region. Wherever the catches were sold at an auction, the market was formed at the village itself, thereby becoming the local marketing system. This system is the only mode of marketing seen in Pazhayar. Traders figured predominantly where bulk catches like that from ring seines or shore seines with either sardines or anchovies respectively, were available. In addition to this many of the economically important groups especially tuna, sharks, seers etc were marketed through traders and sent to either Chennai or Kerala from where they would be exported. Tiger prawn catches also called for traders through whom live catches were sold to the nearby hatcheries. The highest number of traders were seen in Kalapet. Pondicherry also is the market for many of the traders to sell their load. The Self mode of marketing involved either the wife or a family member of the fisherman's family, where the catch was sold door to door in a headload/basket. Due to various limitations, this mode of marketing was restricted to local areas. This appears to be the only form of marketing in the village Annapannpettai.

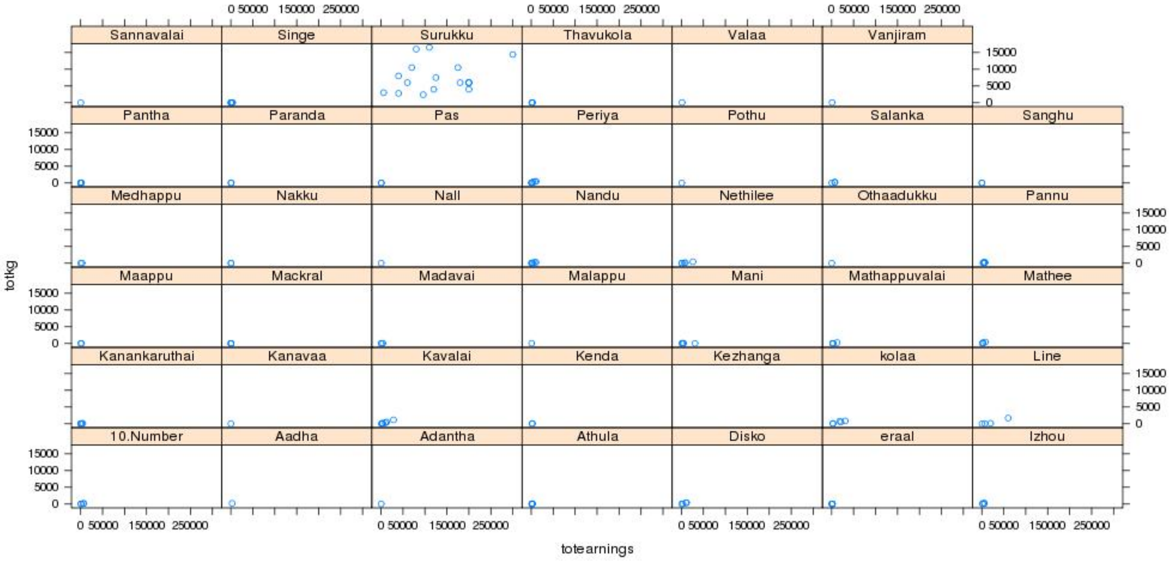


Figure 2.21: Total earning and catch weight.

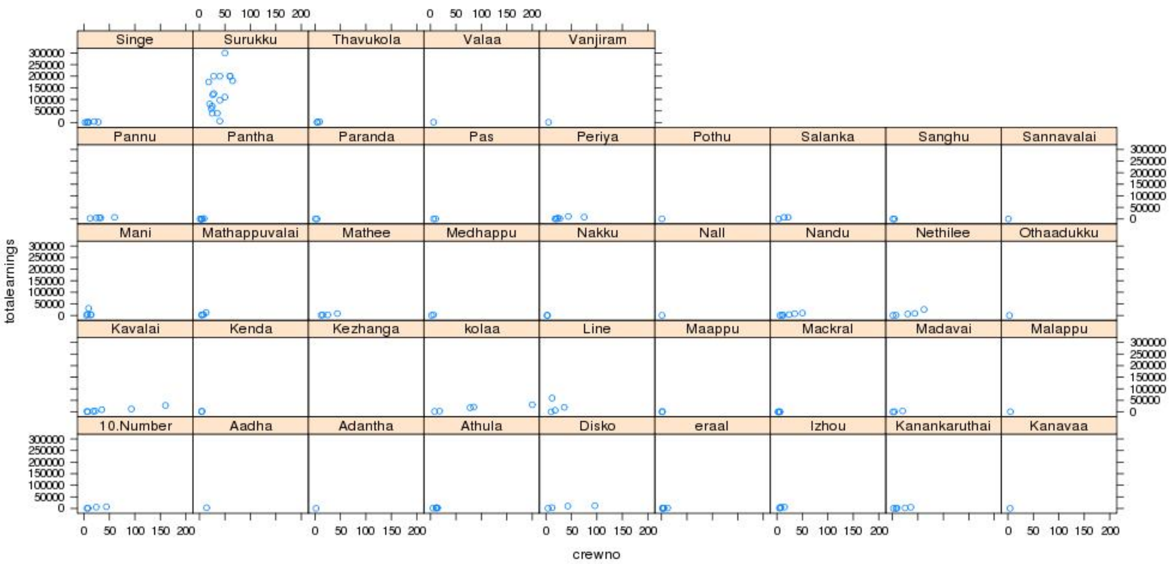


Figure 2.22: Per capita earning per gear.

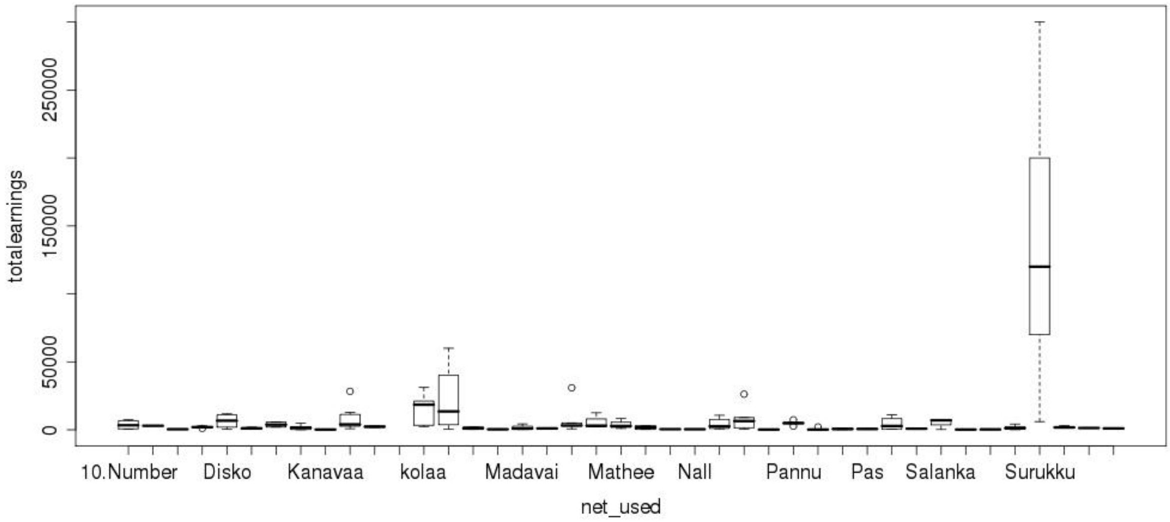


Figure 2.23: Net earning from gear.

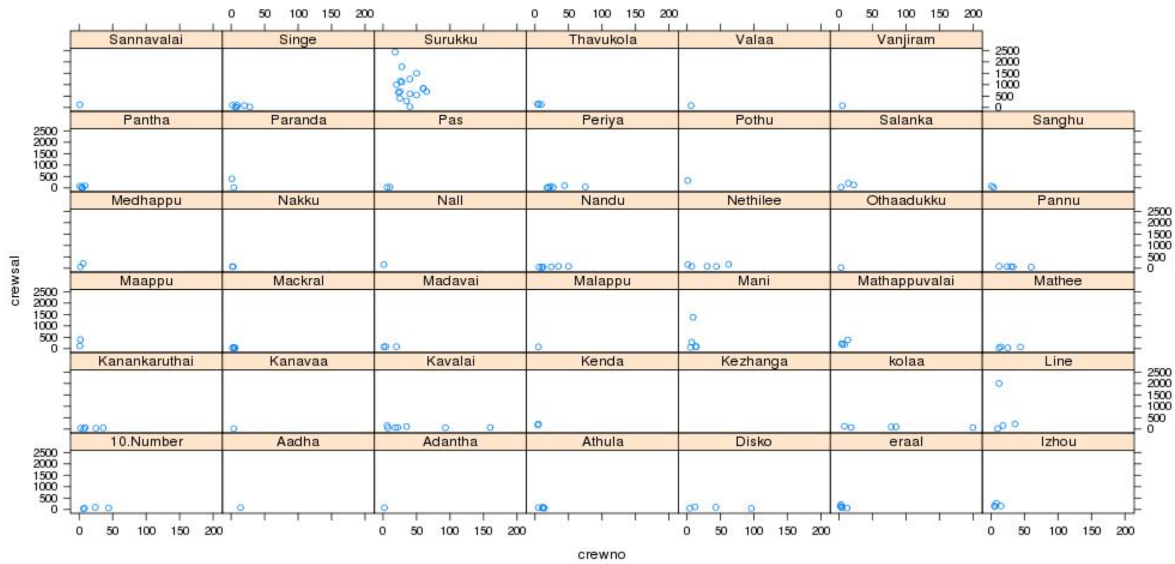


Figure 2.24: Earning of crew members.

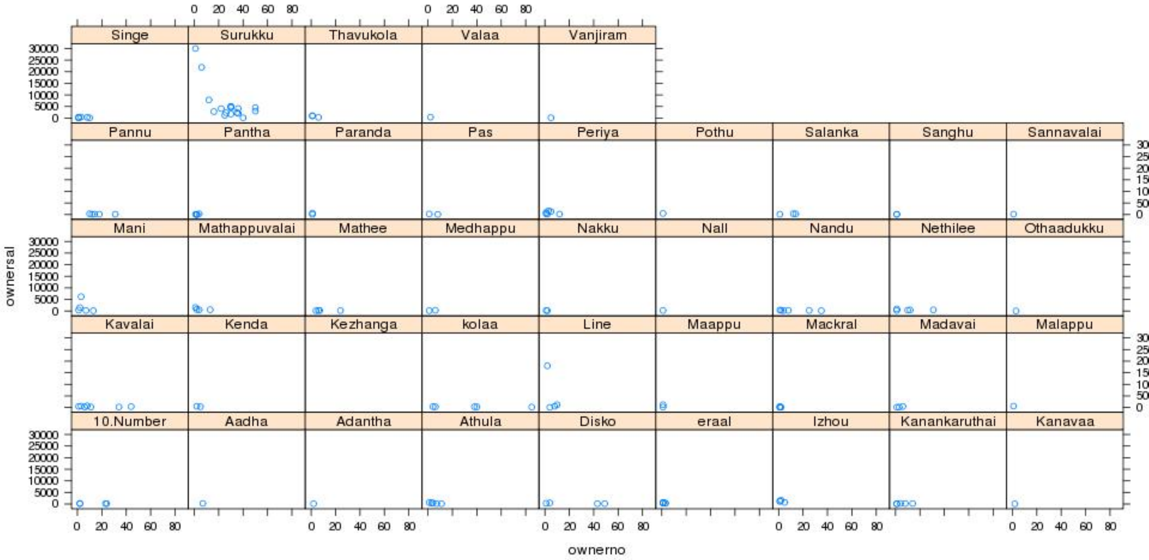


Figure 2.25: Earning of craft and gear owner.

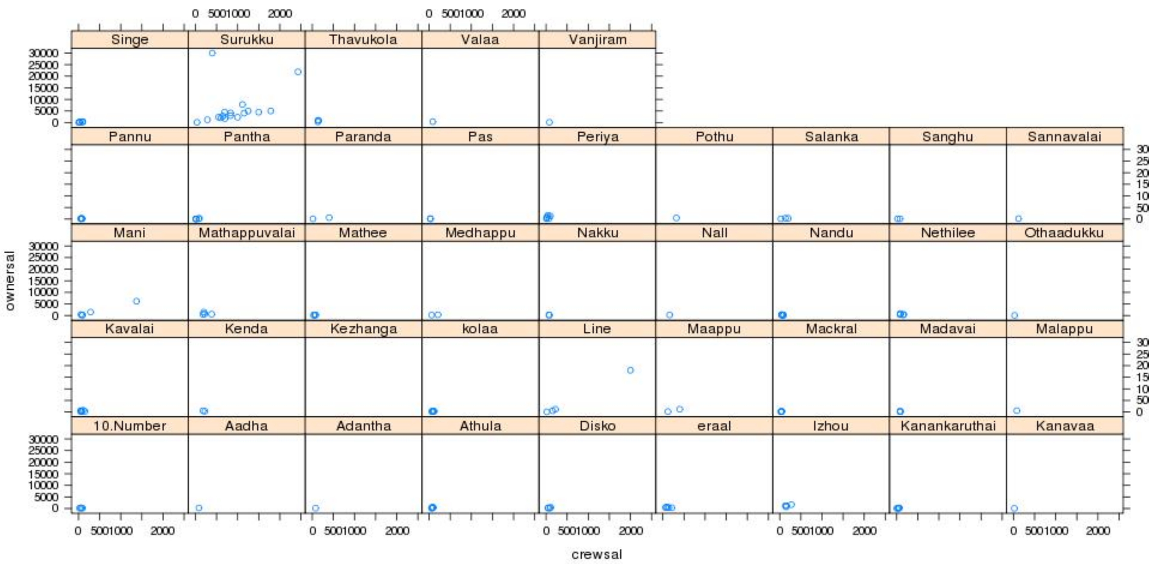
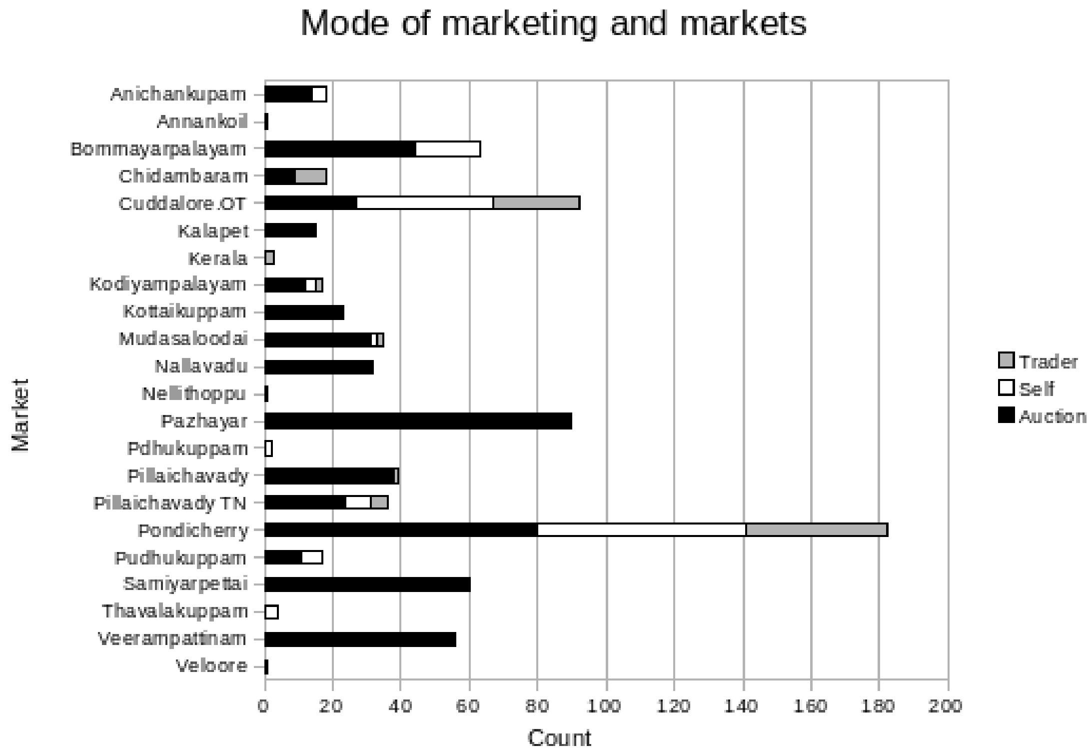
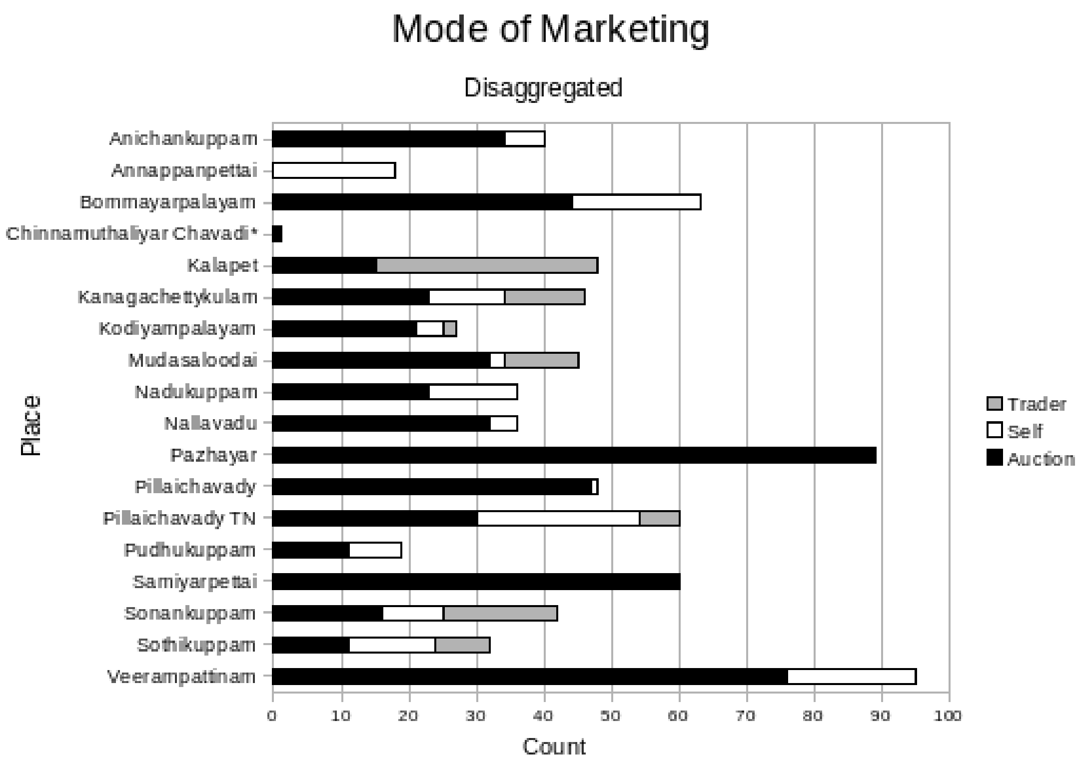


Figure 2.26: Relative salaries of owner and crew members.



(a) Market to which the catch is headed.



(b) Mode of marketing from landing site

Figure 2.27: Marketing.

Abundance, distribution and gear association of catch

Figure 2.28 represents only those groups where more than 100 individuals were come across, of the 83 families sighted from the region (Refer to Annexure A for details of species composition). Clupeoids and Engraulids stand out among all other groups mentioned, the former owing mostly due to the ring seine catches and the latter due to the anchovy fishery. However these two groups were most commonly sighted in almost every catch along with Carangids and Mullids. A variety of Penaeid shrimps and Portunid crabs were also sighted in almost all catches. The families Tetradontidae and Calappidae were often discarded thus significantly contributing to the by catch and discards. The not distinguishable group comprised those fish which were damaged, still entangled in the nets or covered extensively by beach sand. All other families rarely crossed the 100 mark.

Of the 83 families (excluding the unknown and not distinguishable categories), Figure 2.29 represents the remaining families where less than 100 individuals were come across. The unknown group comprises those where identification was not possible though with an inclination towards a new species. The Families represent those contributing to the by catch of the region.

The gear employed in a multi species fishery is quite diverse and even though many are named according to their target species, the graph (Figure 2.30)shows that almost all Families are caught by virtually every gear. One type of specific gear with a very distinct target group is the Nethilee net and the graph shows that most of the Engraulids (anchovies) were captured by the same. Due to its small mesh size, other groups also happen to get caught particularly other Engraulid species as well as the Clupeoids. A considerable portion of the Clupeoids were also caught by the Surukkuvalai in addition to the 16 other different nets used. Majority of the groups were caught in very small numbers (less than 100) by the variety of gear being operated within the region. Those caught in significantly larger numbers were also harvested by a variety of nets, these also formed the most common groups sighted in almost every catch.

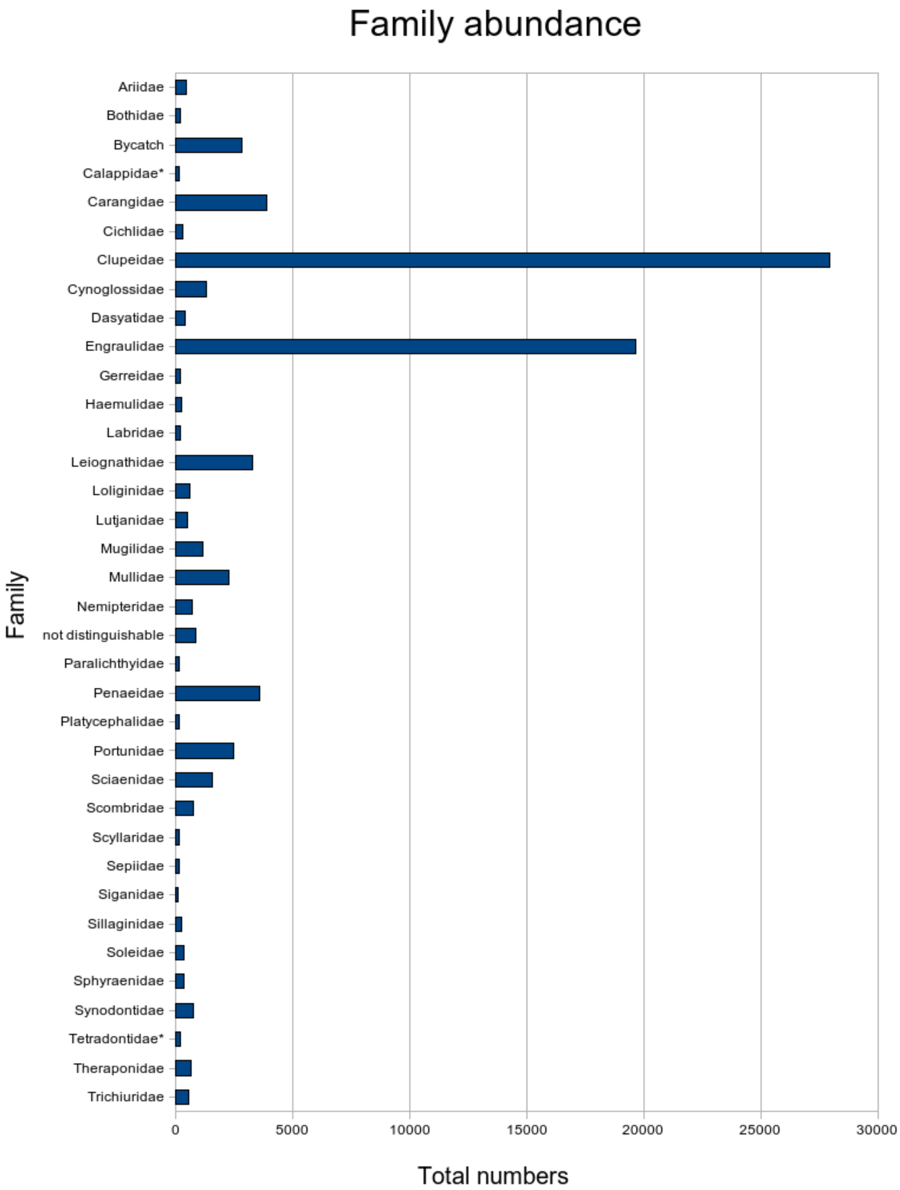


Figure 2.28: Family abundance.

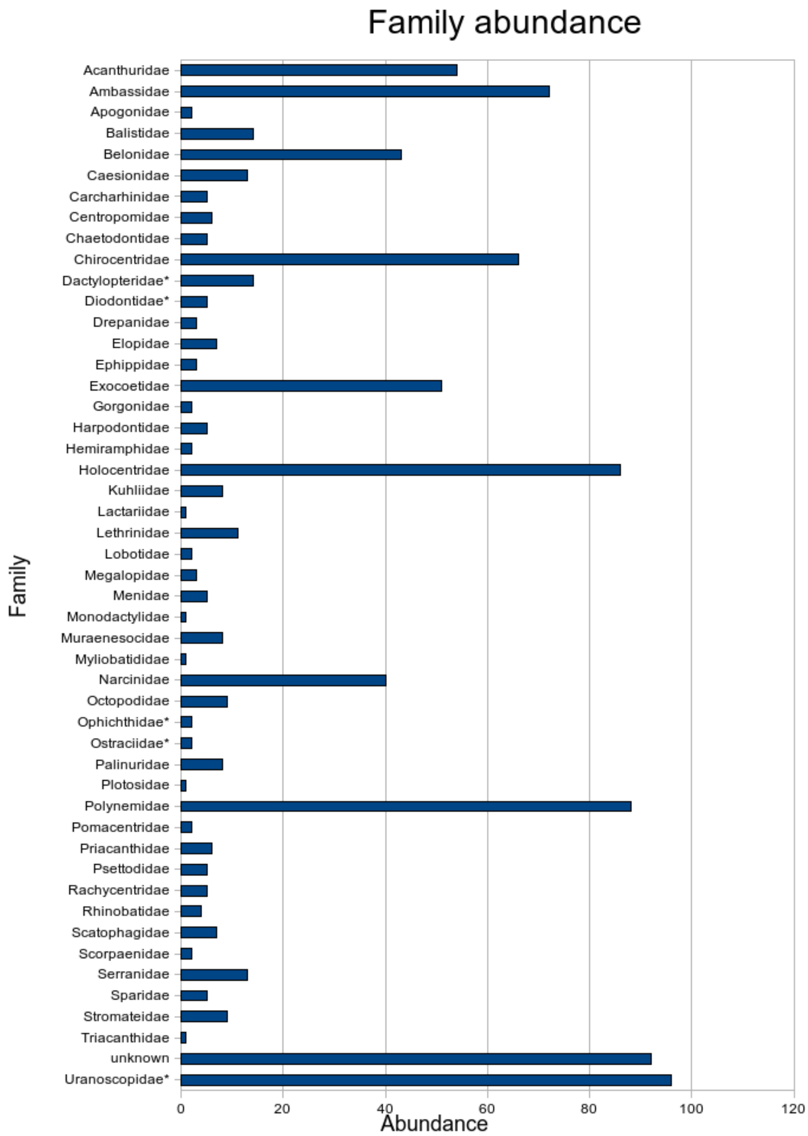


Figure 2.29: Family abundance, rare species.

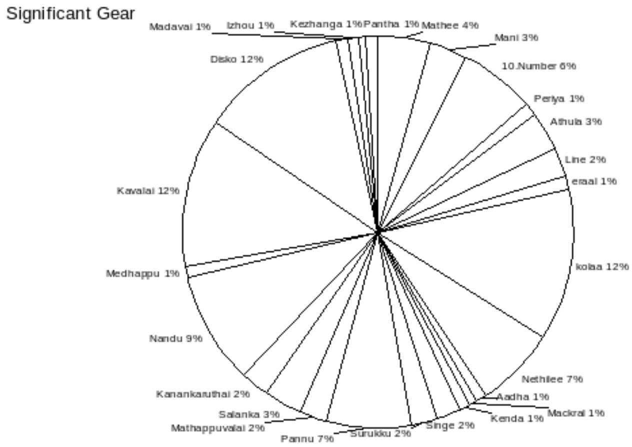


Figure 2.30: The figure above represents the gear which contributed to 1% and above of the total number and types of gear being operated in the given region. No significant relationship was seen within gear type and species caught. There were significant differences in the species caught between different kinds of gear e.g. ring seines versus gill nets vs line.

Substrate association of catch

Figure 2.31 presents the species abundance over the 4 substrate types that have been come across in this region excluding the Clupeoids and Engraulids as they were the only groups to be caught in large numbers. Since most of the fishing occurs over a sandy and clayey substratum, majority of the catch naturally occurs over the same. It can also be assumed that the species caught from these substrates need not necessarily live only in that particular environment and could also have been in transit at that point in time. The rocky and clayey substratum has been indicated to be deeper and the species caught over the same are rocky or reef inhabitants, the only families to be caught at that depth (>25m) like the fusiliers (Caesionids), emperors (Lethrinids) and groupers (Serranids). Fewer species from these depths also indicted a lower effort as fewer boats fished at these depths (Figure 2.33). The shallower substrata were of the sandy, clayey type where most of the groups have been caught. It can be assumed that most of the species are shallow water dwellers; Clupeoids and Engraulids are pelagic shoaling species, as well as planktivorous feeders. Due to the nutrient influx from the landmass, plankton blooms usually occur more in inshore waters than farther from the shelf. This fact explains the abundance of a large number of species in the nearshore waters. Also, predatory groups tend to be found wherever there is availability of prey species.

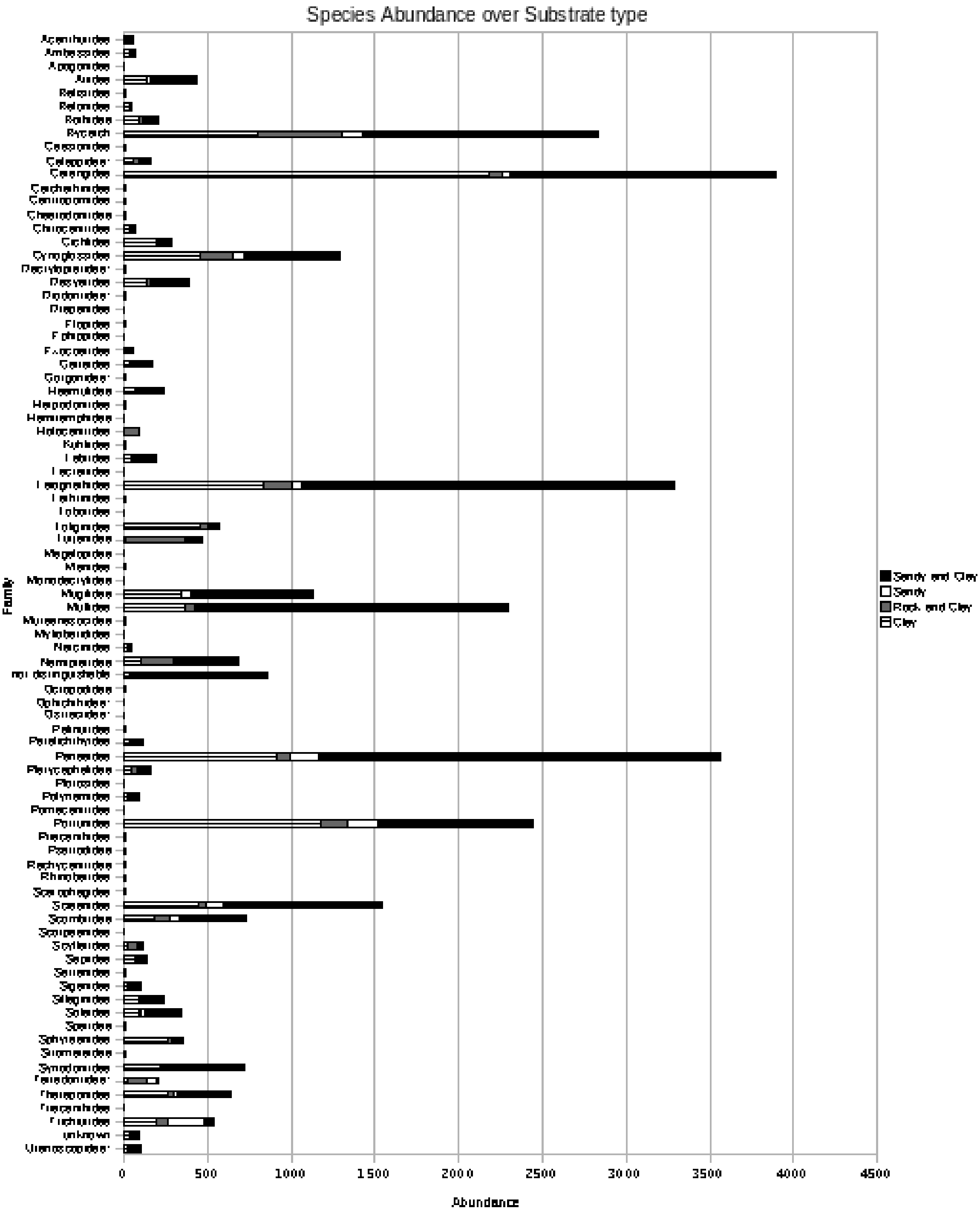


Figure 2.31: Species abundance over substrate type.

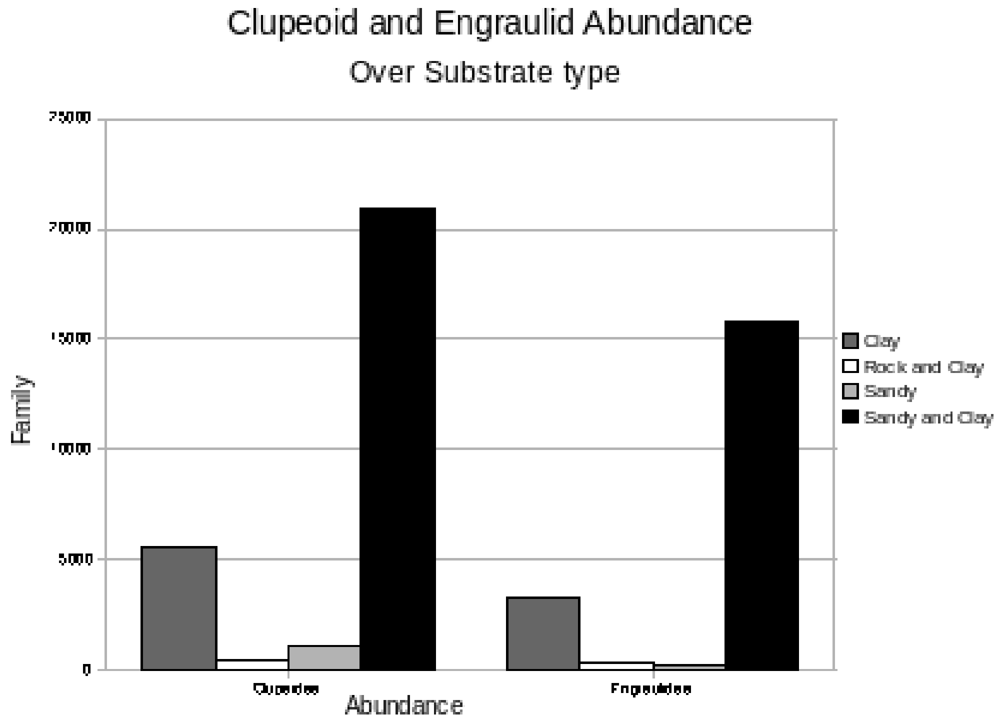


Figure 2.32: Clupeoid and Engraulid abundance over substratum.

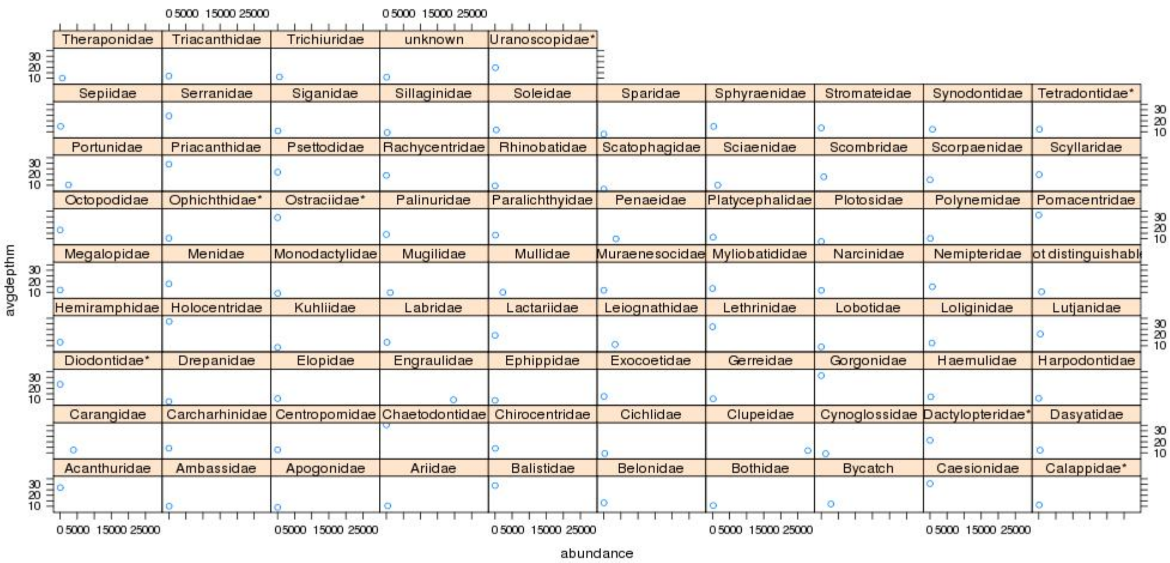


Figure 2.33: Abundance and depth of fishing.

Seasonal patterns in catch composition and abundance

Figure 2.34 presents the type and abundance of species monthwise with an attempt to examine the seasonality of the existing fishery. However few groups were only sighted in a particular month, for example Caesionids (fusiliers) or the Balistids (triggerfish) or Gorgonidae (sea fans) which were observed in the month of January. Again, these these groups were located over a rocky, clayey substrate at a depth greater than 25m and very few boats fished at these depths.

Figure 2.35 shows that the highest number of individuals (summed across all families) were caught in the months of April closely followed by May. These are the months when the 45 day ban is in practice, mostly applicable to the trawl sector as well as FRPs powered with engines > 16 HP, thus the FRPs with engine power < 16 HP, the thonis and Kattumarams are exempt from this. The maximum abundance seen in April can be assumed to be a reason why the artisanal fishers feel the ban is useful essentially because no trawling takes place during that specified period reducing the competition for resources. The lowest abundance is seen in July because the field data collection came to an end mid July.

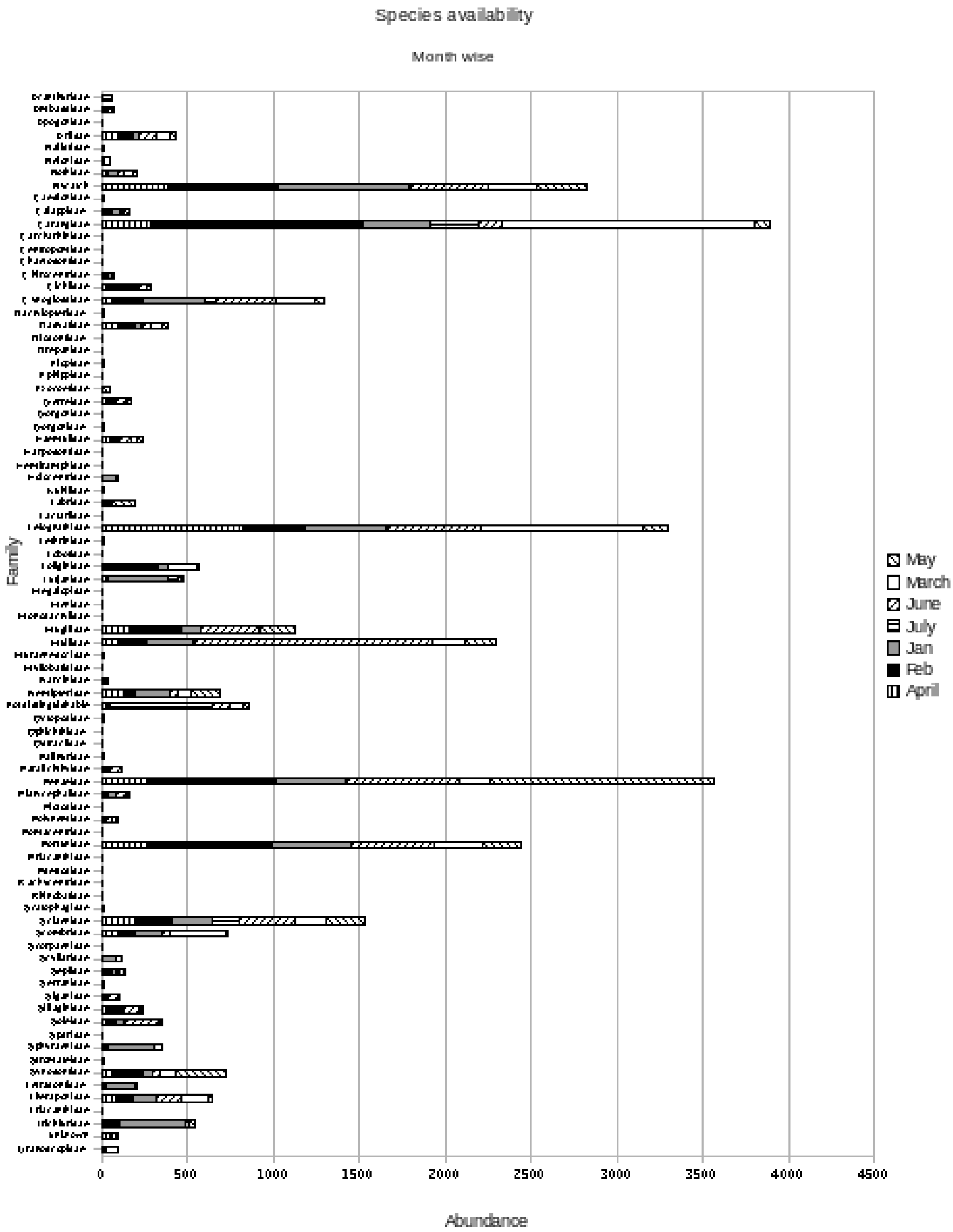


Figure 2.34: Monthwise abundance of species.

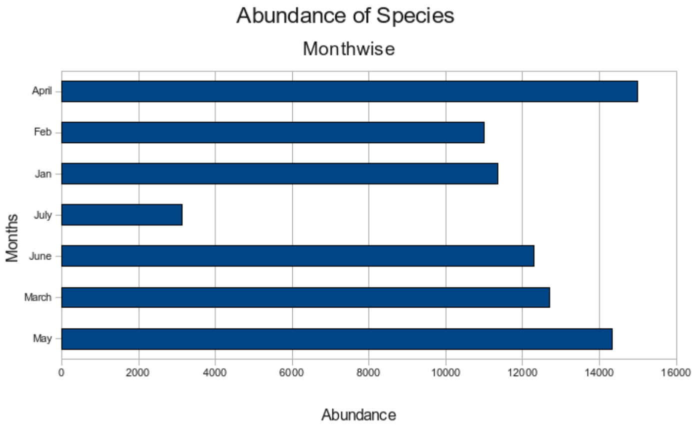


Figure 2.35: Monthwise cumulative abundance.

Size classes of catch

Figure 2.36 shows the size, substrate and depth association of the catch. Based on the large number of juveniles and sub adults caught from the given depth as well as substrate, it can be assumed that the inshore waters are highly productive and serve as feeding grounds. More research is required to ascertain if they serve as breeding and maturing grounds as well.

Figure 2.37 presents the proportion of catch in different age classes. The graph shows a comparatively fewer adults, larger specimens as well as fingerlings or smaller classes. While size classes differ for each species, the highest number of individuals belonged to the sub adult class which also represents the average sized number of individuals. More research would be required to ascertain if lengths or size classes can also indicate stages of maturity in the life history of fish.

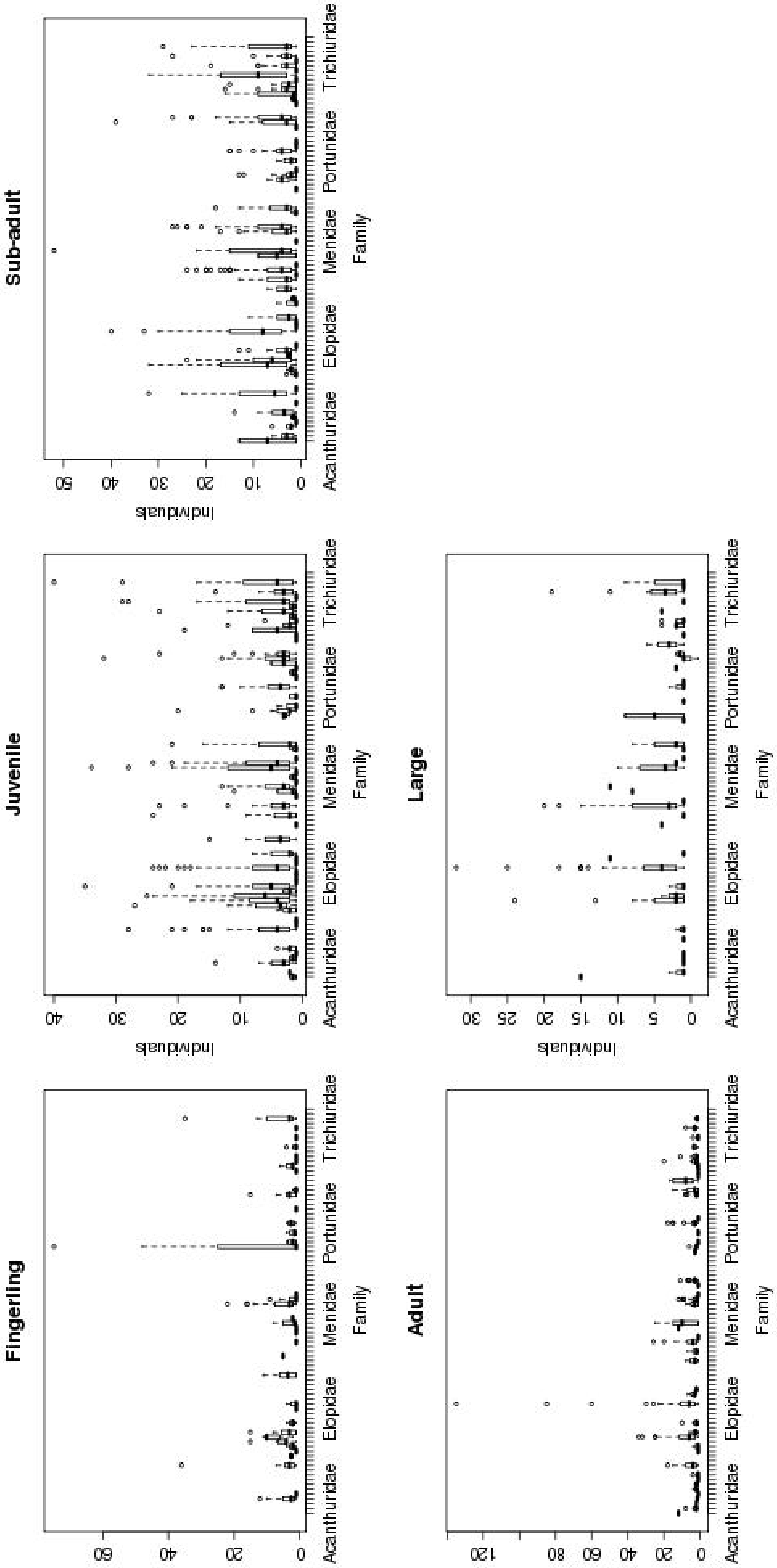


Figure 2.36: Size, substrate and depth association of catch.

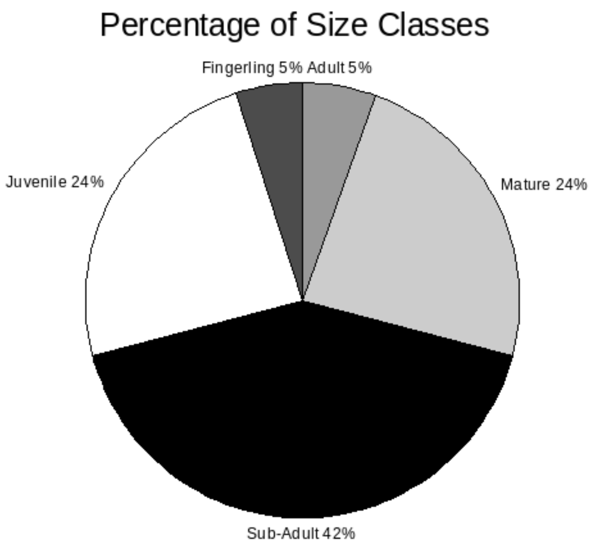


Figure 2.37: Size class proportions.

Chapter 3 Discussions and Conclusions

There is a great deal of diversity in the kinds of nets and mesh sizes as well as the kind of craft and the OBMs in use within the artisanal sector. Earlier studies suggest that the dominance of FRP boats is at least in part due to post tsunami relief.[6] It appears that the preference for OBM powered FRPs continued and the Kattumarams have been replaced by them as the most popular craft, which has demonstrated its versatility as it is being used both for deep sea line fishing as well as a carrier boat for ring seine operations. However, fishing has continued more or less in the same regions and larger motorised craft have not ventured into deeper waters. Thus there is increased fishing effort in the same region, approximately up to 20 metres depth.

We also have numerous observations of near-shore trawling and pair trawling in the same shallow zones. Many of the artisanal gear also caught non-target species including a variety of crabs, including gravid individuals, gastropods, sponges and soft corals and sea grass and sea weeds. The vast majority of the species included juveniles, especially of the economically important groups such as seers, sharks, mullets and snappers.

The entire spectrum of available species are being harvested, either through targeted efforts or as incidental catches, many being discarded as they are of little or no economic value. At least part of this is explained by the range of mesh sizes being used across different net types. Further, some of the larger nets such as the ring seine have mesh sizes ranging from 14 to 80mm. Mesh sizes used in the majority of the observations were smaller than those specified in the marine fishing regulation act. Thus the fishing of the smaller size classes is likely to continue, which is likely to further jeopardise the resource base. The predominant size classes observed were sub-adults and juveniles which support this hypothesis.

Available data did not show any relationship between gear and catch composition, probably because the nets are largely non-species specific and were all be operated in the same or similar areas. The seasonality of gear use is also not particularly well defined[1]. The important exceptions to this are the the ring seine and anchovy net. Thus the pressure for extraction of non-shoaling and non-pelagic species is constant through the season, apparently regardless of species. Pressure on pelagic is also constant as some of the nets also target pelagic species.

The only significant substrate/catch association was species associated with rocky bottoms. The catch, observed in January comprised of Gorgonidae, Caesionidae and Balistidae. These are fish characteristic of a rocky/reef environment.

The average earning for a crew member on a fishing trip is Rs.120.90 while that of the owners was

[1]Not including nets sighted less frequently (<20 sightings).

Rs.565.50 for nets other than the ring seine. For ring seine nets, available data suggested that the crew earned an average of Rs.930.30 while the owners earned Rs. 6028.50. Even though these figures are indicative, they give a clear explanation for the growing popularity of the ring seine.

In conclusion, it appears that overfishing is a real issue which needs to be dealt with at the earliest, however not necessarily due to ring seining alone. The combination of gear, fishing zones and destructive fishing practices are three areas that need to be tackled simultaneously if pressure on the resource base is to be reduced. Given that many of the destructive practices and gear are already banned by the MFRA it would seem logical that the involvement of the community in its implimentation would itself be a major step in the right direction.

Bibliography

[1] Central marine fisheries research institute, kochi, india.

[2] Fao species identification sheets for fishery purposes. eastern indian ocean (fishing area 57) and western central pacific (fishing area 71), 1974.

[3] Implementation and management of marine protected areas. *Conservation Biology*, 19:1699–1700, December 2005.

[4] Review of the state of world marine capture fisheries management: Indian ocean. *FAO Fisheries Technical Paper*, page 458, 2006.

[5] Gerald J. Bakus, Gregory Nishiyama, Eduardo Hajdu, Hetal Mehta, Mahadi Mohammad, Ulisses dos S. Pinheiro, Stephen A. Sohn, Thaddeus K. Pham, ZulWgar bin Yasin, Tan Shau-Hwai, Abraham Karam, and Erin Hanan. A comparison of some population density sampling techniques for biodiversity, conservation and environmental impact studies. *Biodiversity Conservation*, pages 2445–2455, 2007.

[6] R.S Bhalla. Policy analysis of tsunami-impacted areas in india, 2006.

[7] Ramachandra Bhattha and Venkatesh Salagrama. Major trends in the utilization of fish in india and their impact on the poor, 2001.

[8] G.H.P. De Bruin, B.C. Russell, and A. Bogusch. Fao species identification field guide for fishery purposes. the marine fishery resources of sri lanka., 1995.

[9] P. M. Cury, L. J. Shannon, J-P. Roux, G. M. Daskalov, A. Jarre, C. L. Moloney, and D. Pauly. Trophodynamic indicators for an ecosystem approach to fisheries. *ICES Journal of Marine Science*, 62:430–442, 2005.

[10] Georgi M. Daskalov, Alexander N. Grishin, Sergei Rodionov, and Vesselina Mihneva. Trophic cascades triggered by overfishing reveal possible mechanisms of ecosystem regime shifts. *Proceedings of the National Academy of Sciences*, 104:10518–10523, June 2007.

[11] Francis Day, C.I.E., and L.L.D. *The Fauna of British India, including Ceylon and Burma*, volume 1 and 2. Calcutta: Thacker, spink, & Co., 1889.

[12] Timothy E. Essington, Anne H. Beaudreau, and John Wiedenmann. Fishing through marine food webs. *Proceedings of the National Academy of Sciences*, 103:3171–3175, February 2006.

[13] W. Fischer and G. Bianchi. Fao species identification sheets for fishery purposes, western indian odean, fishing area 51, 1984.

[14] L.R. Garces, I. Stobutzki, M. Alias, W. Campos, N. Koongchai, L. Lachica-Alino, G. Mustafa, S. Nurhakim, M. Srinath, and G. Silvestre. Spatial structure of demersal fish assemblages in south and southeast asia and implications for fisheries management. *Fisheries Research*, 78:143–157, 2006.

[15] Didier Gascuel, Yves-Marie Bozec, Emmanuel Chassot, Audrey Colomb, and Martial Laurans. The trophic spectrum: theory and application as an ecosystem indicator. *ICES Journal of Marine Science*, 62:443–452, 2005.

[16] Virginia Gewin. Troubled waters: The future of global fisheries. *PLoS Biology*, 2:e113 EP –, April 2004.

[17] Ray Hillborn. Faith-based fisheries. *Fisheries*, 31:554–555, November 2006.

[18] Dag O. Hjermann, Geir Ottersen, and Nils Chr. Stenseth. Competition among fishermen and fish causes the collapse of barents sea capelin. *Proceedings of the National Academy of Sciences*, 101:11679–11684, August 2004.

[19] Joseph.A. Jerald. *Tamil Nadu and Pondicherry, Indian East Coast*, pages 183–203. BOBP/REP/67. Bay of Bengal Programme, 1994.

[20] V.G. Jhingran. *Fish and Fisheries of India / Delhi (India)*. Hindustan Pub, Delhi (India), 1975.

[21] K.Venkataraman and Mohideen Wafar. Coastal and marine biodiversity of india. *Indian Journal of Marine Sciences*, 34:57–75, March 2005.

[22] Rebecca L. Lewison, Larry B. Crowder, Andrew J. Read, and Sloan A. Freeman. Understanding impacts of fisheries bycatch on marine megafauna. *Trends in Ecology and Evolution*, 19:598–604, November 2004.

[23] P.A. Livingston, K. Aydin, J. Boldt, J. Ianelli, and J. Jurado-Molina. A framework for ecosystem impacts assessment using an indicator approach. *ICES J. Mar. Sci.*, 62:592–597, 2005.

[24] Jordi Lleonart, Marc Taconet, and Michael Lamboeuf. Integrating information on marine species identification for fishery purposes. *Marine Ecology Progress Series*, 316:231–238, July 2006.

[25] S. Jacob Magesh and Sarah Coulthard. Jellyfish exports: Bloom or bust, November 2004.

[26] Vaibhav A Mantri. Seaweed floristic studies along tsunami affected indian coast: A litmus test scenario after 26th december 2004. *Journal of Earth System Science*, 115:371–378, June 2006.

[27] K.G. Mini and M Srinath. Trawl fishery of tamil nadu (1985-2000): An appraisal, 2003.

[28] Steven A. Murawski. Definitions of overfishing from an ecosystem perspective. *ICES J. Mar. Sci.*, 57:649–658, June 2000.

[29] D Pauly, V Christensen, and C Walters. Ecopath, ecosim, and ecospace as tools for evaluating ecosystem impact of fisheries. *ICES Journal of Marine Science*, 57:697–706, 2000.

[30] D. Pauly, A. W. Trites, E. Capuli, and V. Christensen. Diet composition and trophic levels of marine mammals. *ICES Journal of Marine Science*, 55:467–481, 1998.

[31] E. V. Radhakrishnana, V. D. Deshmukh, Mary K. Manisseri, M. Rajamani, Joe K. Kizhakudan, and R. Thangaraja. Status of the major lobster fisheries in india. *New Zealand Journal of Marine and Fresh Water Research*, 39:723–732, 2005.

[32] T. Rouyer, J. M. Fromentin, F. Menard, B. Cazelles, K. Briand, R. Pianet, B. Planque, and N. C. Stenseth. Complex interplays among population dynamics, environmental forcing, and exploitation in fisheries. *Proceedings of the National Academy of Sciences*, 105:5420–5425, April 2008.

[33] Raghukumar Seshagiri and A.C. Anil. Marine biodiversity and ecosystem functioning: A perspective. *Current Science*, 84:884–892, April 2003.

[34] John Sibert, John Hampton, Pierre Kleiber, and Mark Maunder. Biomass, size, and trophic status of top predators in the pacific ocean. *Science*, 314:1773–1776, December 2006.

[35] N Sporong, C Coffey, J Brown, and D Reyntjens. Sustainable eu fisheries: facing the environmental challenges., November 2004.

[36] Illona C. Stobutzki, Geronimo T.Silvestre, and Len R.Garces. Key issues in coastal fisheries in south and southeast asia, outcomes of a regional initiative. *Fisheries Research*, 78:109–118, 2006.

[37] Ajantha Subramanian. Community, class, conservation development politics on the kanyakumari coast. *Conservation and Society*, 1:177–208, 2003.

[38] P.K. Talwar and R.K. Kacker. *Commercial sea fishes of India.* Zoological Survey of India, Calcutta, 1984.

[39] Eline van Haastrecht and Marjanka Schaap. *A critical look at fisheries management practices:the 45-day ban in Tuticorin District,Tamil Nadu, India.* PhD thesis, University of Amsterdam, December 2003.

[40] Jayshree Vencatesan. Key issues in the conservation of marine biodiversity. *Current Science*, 90:1310–1311, May 2006.

[41] V. Vijayan, L. Edwin, and K. Ravindran. Conservation and management of marine fishery resources of kerala state, india. *Naga, The ICLARM Quarterly*, 23:6–9, September 2000.

[42] R. Watson, C. Revenga, and Y. Kura. Fishing gear associated with global marine catches i.database development. *Fisheries Research*, 79:97–102, 2006.

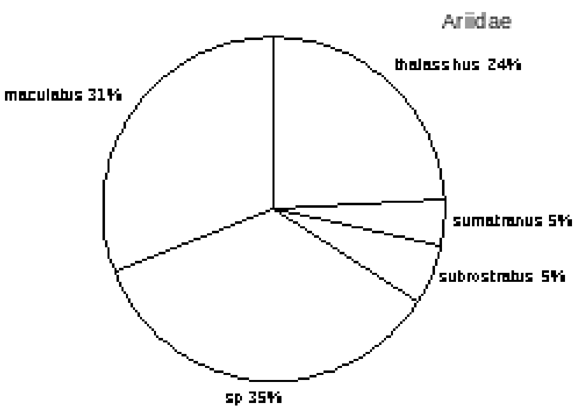
[43] Reg Watson, Eriko Hoshino, Jordan Beblow, Carmen Revenga, Yumiko Kura, and Adrian Kitchingman. Fishing gear associated with global marine catches, 2004.

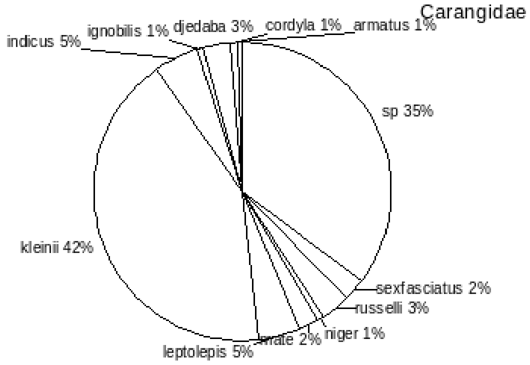
[44] WorldFish Centre and FAO. Fishbase : A global information system on fishes, 2008.

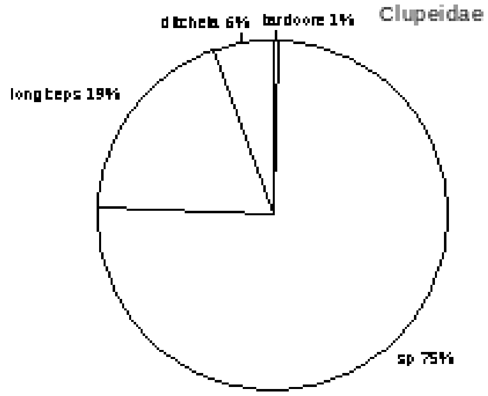
Appendix A Proportion of species in common families

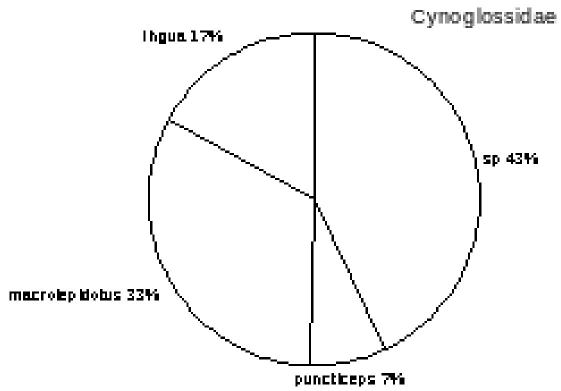
The graphs presented below provide information on the proportion of different species that comprise the most common of the families observed during the landing surveys. The selected families contributed over 1% of the total catch.

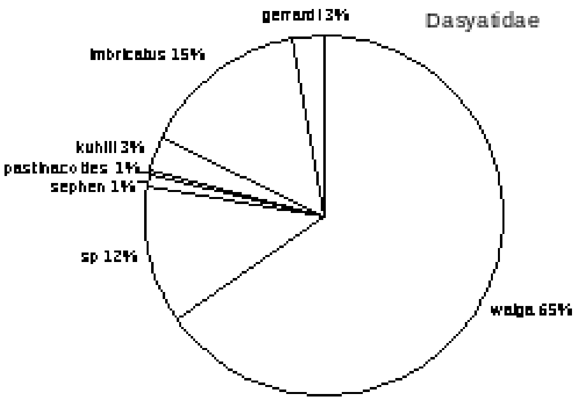
For all groups, wherever identification upto species level was not possible it is denoted as ’sp’. It has been identified as belonging to the respective family however. Identification was not possible if the specimen was not distinct in the photograph. This could be for several reasons such as if only a part was visible, or only the ventral surface, or was damaged, etc., For Families like Clupeidae where all species look similar, identification was not possible when the groups were mixed (more than one species). This applies to other families too when present in large numbers or within a shoal of assorted species. Bycatch groups were diverse as it included all marine invertebrates and a few fish species. Taxonomy was easiest for fish as the resources available are plenty when compared to the smaller organisms and due to the time consuming nature of the task, keeping in mind the limitations of time, identification of other organisms other than fish was not attempted. This applies to Penaeidae as well but most are denoted as ’sp’.

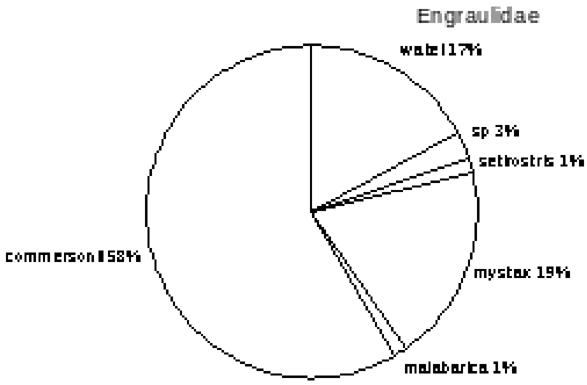


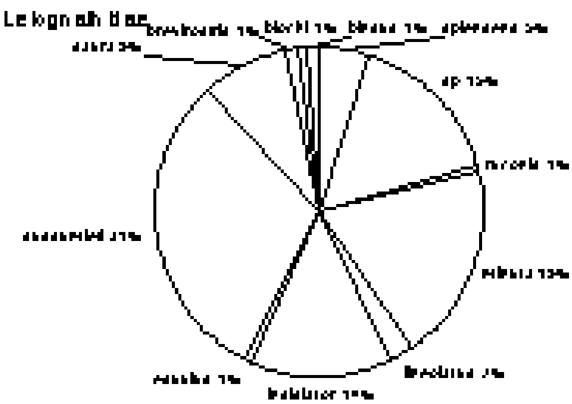


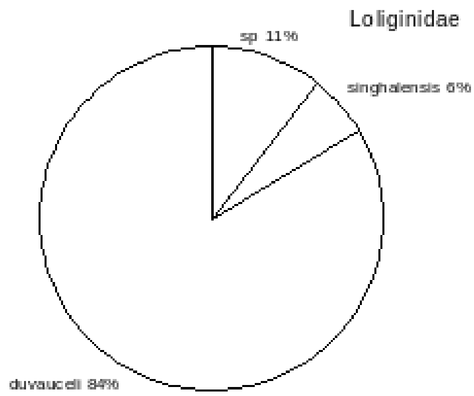

Clupeidae
ditchela 6%
tardoore 1%
longiceps 19%
sp 75%

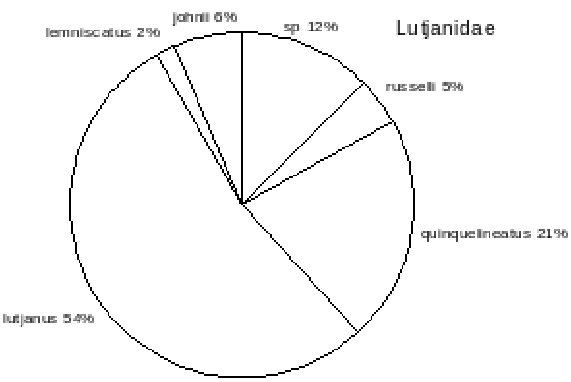

Cynoglossidae
lingua 17%
sp 43%
macrolepidotus 33%
puncticeps 7%

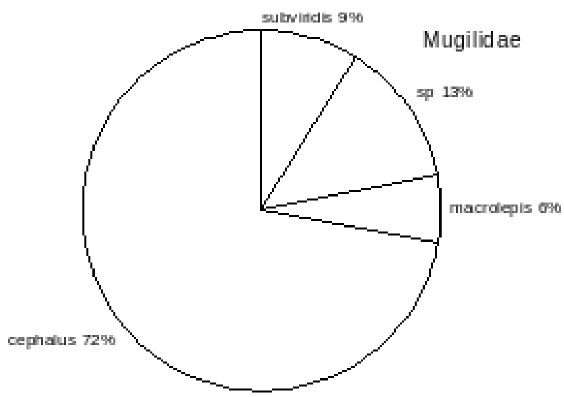

Dasyatidae
gerrardi 3%
imbricatus 15%
kuhlii 3%
pastinacoides 1%
sephen 1%
sp 12%
walga 65%

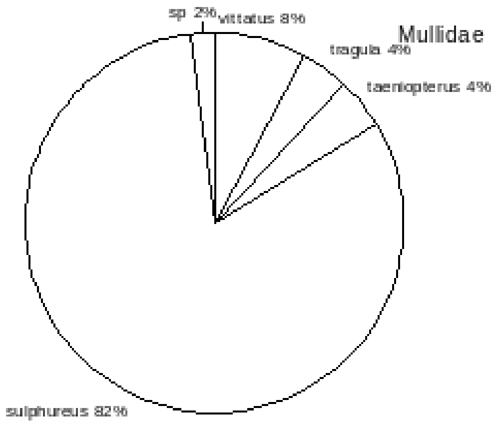

Engraulidae
waite1 17%
sp 3%
setirostris 1%
commersonii 58%
mystax 19%
malabarica 1%

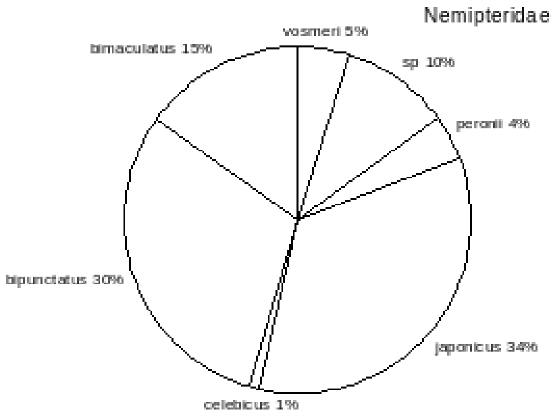

Leiognathidae

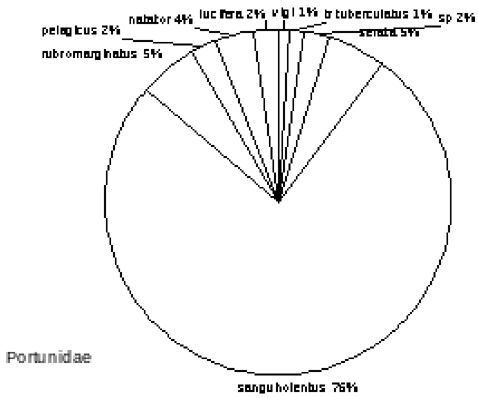

Loliginidae
sp 11%
singhalensis 6%
duvauceli 84%

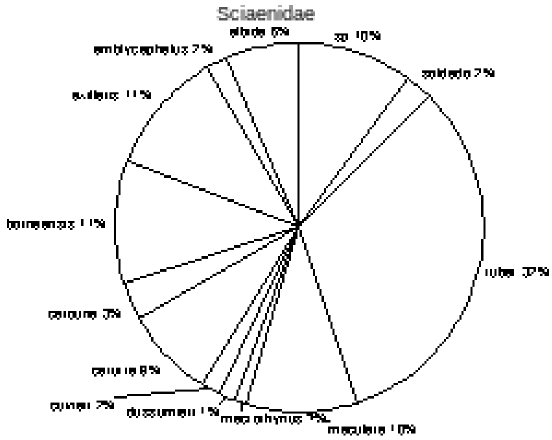

Lutjanidae
johnii 6%
lemniscatus 2%
sp 12%
russelli 5%
quinquelineatus 21%
lutjanus 54%

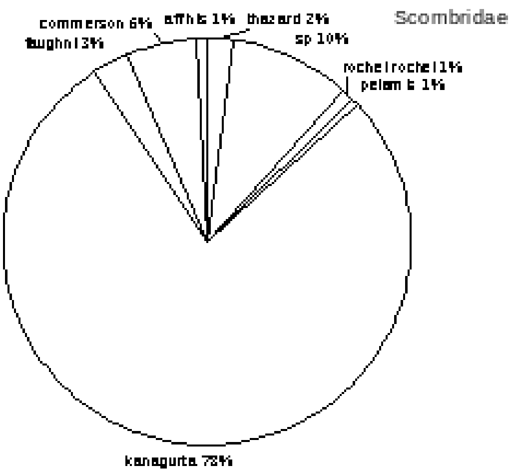

Mugilidae
subviridis 9%
sp 13%
macrolepis 6%
cephalus 72%

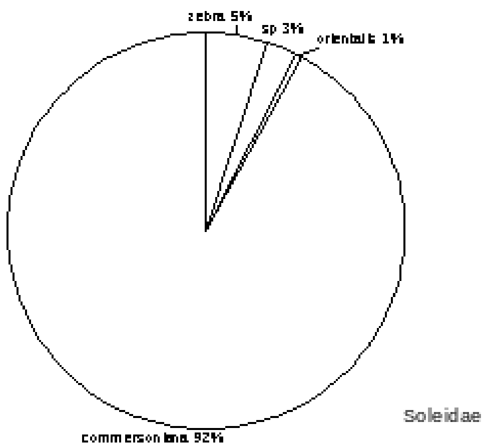

Mullidae
sp 2%
vittatus 8%
tragula 4%
taeniopterus 4%
sulphureus 82%

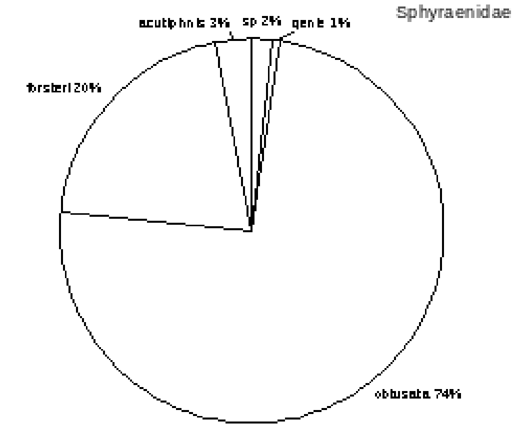

Nemipteridae
vosmeri 5%
bimaculatus 15%
sp 10%
peronii 4%
bipunctatus 30%
japonicus 34%
celebicus 1%

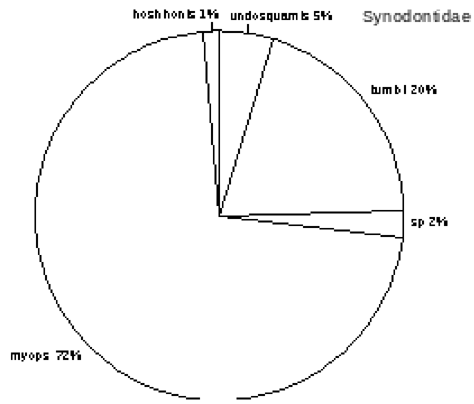

natator 4%
vigil 1%
tuberculatus 1%
sp 2%
pelagicus 2%
rubromarginatus 5%
Portunidae
sanguinolentus 76%

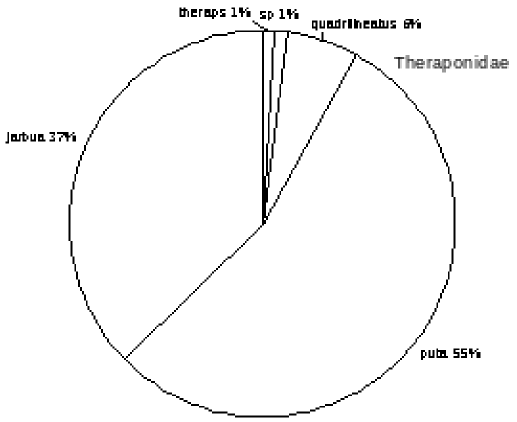

Sciaenidae
sp 10%

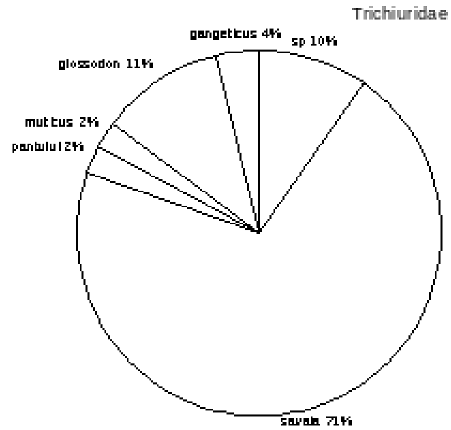

commerson 6%
thazard 2%
Scombridae
sp 10%
pelamis 1%
kanagurta 73%


zebra 5%
sp 3%
orientalis 1%
Soleidae


Sphyraenidae
acutipinnis 3%
sp 2%
genie 1%
forsteri 20%
obtusata 74%


Synodontidae
hoshinonis 1%
undosquamis 5%
tumbil 20%
sp 2%
myops 72%


Theraponidae
theraps 1%
sp 1%
quadrilineatus 6%
jarbua 37%
puta 55%


Trichiuridae
gangeticus 4%
sp 10%
glossodon 11%
muticus 2%
pantului 2%
savala 71%

Appendix B Abbreviations and Definitions

Given that the document contains a number of scientific terms and definitions we have tried to summarise the same in the section below. Kindly note that this is not meant to be an exhaustive list. Kindly refer to the following sites for additional information.

1. FAO Fish Base. A database for fishery related information, includes colour pictures and keys for identification of all families across regions.
2. ENVIS. Information on marine faunal diversity of India.
3. Coral Reef Network. Identification guide for fish enabling classification up to Family level.
4. CephBase. Aid in identification of cephalopods on the basis of morphology enabling classification at the family, genus and sometimes to species level.
5. Southeastern regional taxonomic centre. Aids in identification of marine invertebrates on the basis of morphology enabling classification at the Family and Genus level.
6. Digital Taxonomy. Biodiversity Search Engines: A search engine containing all links to websites providing information on taxonomy and biodiversity of the world.

Nomenclature

Balistidae Trigger fish.

Balistids Tiggerfish

Caesionidae Fusiliers.

Caesionids Fusiliers

Clupeoids Sardines, Hilsas and Shads

Drift nets A type of gill net which is allowed to drift with the current.

Engraulids Anchovies

FAO Food and Agriculture Organisation of the United Nations.

FERAL Foundation for Ecological Research, Advocacy and Learning.

Fishbase A global information system on fishes.

FRP Fibre reinforced plastic boats.

Gastropods Molluscs.

Gill nets Walls of netting which may be set at or below the surface, on the seabed, or at any depth inbetween.

Gorgonidae Sea fans.

Kattumarams Kattu - to tie, maram - tree. The traditional fishing craft of the Coromandel coast.

Maruti Kattumarams A kattumaram fitted with an outboard engine.

Thoni Traditional canoe used in backwater areas. Thonins can be dug-outs or plank constructed.

Trammel nets A wall of net divided into three layers. An inner fine-meshed net is sandwiched between two outer, larger meshed nets.

UNTRS United Nations team for Tsunami Recovery Support.

Vallams Large sea faring canoes, traditionally manufactured in Kerala and very popular for ring seine operations.