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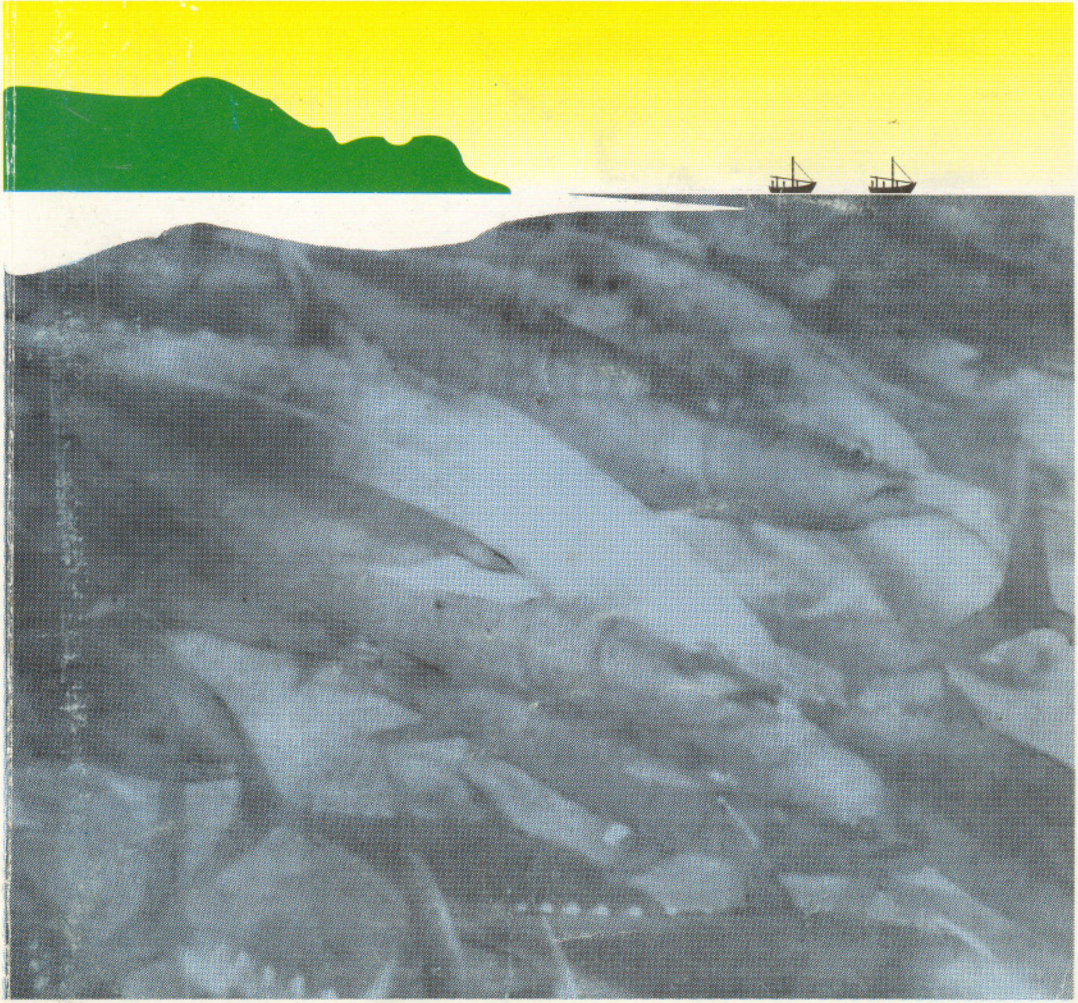

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The Maldives Marine Research Bulletin is published twice a year by the Marine Research Section of the Ministry of Fisheries and Agriculture. The Bulletin aims to improve understanding of the Maldivian marine environment and to promote the sustainable utilization of marine resources by providing a means of dissemination of relevant information. Each issue will be dedicated to a single theme, on any marine topic, but with particular emphasis on fisheries and marine life. Bulletins will include original research results, reviews, and manuals. The Maldives Marine Research Bulletin will be published in English with a Dhivehi summary. Information published in any Bulletin may be freely used, but the source should be acknowledged. All enquiries should be addressed to:

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THE MALDIVIAN TUNA FISHERY:

A COLLECTION OF TUNA RESOURCE RESEARCH PAPERS

MARINE RESEARCH SECTION
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EDITORIAL

It is with great pleasure that we are publishing the second issue of the Maldivian Marine Research Bulletin on the occasion of Fishermen's Day 1996. This issue of the Bulletin focuses on the most important area of the Maldivian fishery namely the tuna fishery, an area to which the Government always accords a very high priority.

For centuries tuna fishing was the only fishery that existed in the Maldives, and was the main source of protein and employment for the Maldivian people. It is clear that Maldives was historically the biggest tuna fishing nation in the Indian Ocean. Although recent years have witnessed the introduction of other fisheries in the Maldives, tuna fishing still remains the key component of the country's fishing industry. Due to the importance of this fishery to the country's economy, and to the great increase in tuna fishing by other countries in the Indian Ocean, the importance of proper management of tuna resources has never been greater.

The Marine Research Section of the Ministry of Fisheries and Agriculture has statutory responsibility for the rational and sustainable management of all living marine resources in the EEZ of the Maldives. MRS has carried out much work aimed at the assessment of local tuna resources. In particular MRS has implemented several successful research projects, both at regional and local levels, towards understanding the tuna fishery. The papers that appear in this volume present the results of some of these research efforts. These papers have already been presented at the meeting of the Indo-Pacific Tuna Programme Expert Consultation on Indian Ocean Tunas which was held in Colombo, Sri Lanka in September 1995. They are printed again here to make them more widely available to interested parties within the Maldives.

Finally I owe a debt of gratitude to my colleagues for their assistance in publishing this issue. Special thanks to Dr. Charles Anderson, who has found time to help in compiling all the papers that appear in this issue. Thanks to Mr. Ahmed Hafiz for writing the Dhivehi text. All the staff of MRS have helped in one way or the other in bringing this issue out in time, and their assistance is gratefully acknowledged. We are also most grateful to the staff of EPCS for their help in the provision of fisheries statistics.

Mohamed Faiz
Editor

INTRODUCTION

The tuna fishery is of central importance to the Maldives, and has been for centuries. The great Arab traveler Ibn Battuta gave a clear account of this importance at the time of his visits in 1343-44 and 1346. There is also evidence that tuna fishing was an important activity in the Maldives before the conversion to Islam in AH548 (AD1153-4). Even today, the tuna fishery remains a major source of employment, of export earnings and of food for the Maldivian people.

Thus, it seems likely that Maldivian fishermen have exploited the seasonal ebb and flow of tuna schools for at least one thousand years. This exploitation has been sustained for such a long time because the size of the Maldivian catch was always small in comparison to the size of the resource. This fortunate situation is now changing. There are only five main tuna species involved in the Maldivian fishery, and all of them are considered to be highly migratory:

Dhivehi Name	English Name	Scientific Name	1994 Catch
Kalhubilamas	Skipjack tuna	*Katsuwonus pelamis*	69,411t
Kanneli	Yellowfin tuna	*Thunnus albacares*	12,620t
Raagondi	Frigate tuna	*Auxis thazard*	4,019t
Latti	Kawakawa	*Euthynnus affinis*	2,656t
Loabodu kanneli	Bigeye tuna	*Thunnus obesus*	506t

Because these tunas are highly migratory, they cannot be considered to be a solely Maldivian resource. They are part of wider Indian Ocean stocks. These stocks are being subjected to increasing fishing pressure elsewhere in the Indian Ocean, not only by other coastal countries but also by distant water fleets. The total reported Indian Ocean catch of tunas increased 430% in the 20 years between 1974 and 1993, from 195,000t to 839,000t. It is continuing to increase.

The long-term prospects for the Maldivian tuna fishery do not appear good. The past two decades have seen fishery after fishery around the World collapse as a result of overexploitation. Indian Ocean tunas are not immune from the same fate. The latest scientific estimates suggest that Indian Ocean yellowfin and bigeye tuna stocks are already being exploited at close to or even in excess of their maximum sustainable yields. With international demand increasing, pressure on these and other stocks can only increase too.

The Ministry of Fisheries and Agriculture (MOFA) has legal responsibility for the rational and sustainable management of all living marine resources within the Maldivian Exclusive Economic Zone (EEZ). The Marine Research Section (MRS) of MOFA has responsibility for carrying out the research necessary for the Ministry to fulfill that mandate. The Economic, Coordination and Planning Section (EPCS) of MOFA has responsibility for the collection and compilation of fishery statistics.

In view of the importance of the tuna fishery to the Maldivian economy and society, MRS has devoted a large part of its efforts towards gaining an understanding of the complex population dynamics of Maldivian tuna resources. In this endeavour, MRS has worked closely with EPCS and with the Indo-Pacific Tuna Development and Management Programme (IPTP), a regional tuna fisheries body of the Food and Agriculture Organization of the United Nations (FAO), based in Colombo.

A particularly valuable service provided by IPTP has been to bring together tuna fishery scientists from around the Indian Ocean every two years to review the status of regional tuna fisheries and stocks. The last such 'Expert Consultation' was held in Colombo in September 1995. At that meeting, a total of seven technical papers mostly relating to the status of tuna resources were presented by the Maldivian delegation from MRS. Those seven papers are reproduced here in order to make their findings more widely available to interested parties in the Maldives. The seven papers provide:

- an overview of the Maldivian tuna fishery;
- reviews of information on the yellowfin, bigeye and skipjack tuna resources;
- results of a study of skipjack otoliths aimed at determining growth rates;
- results of recent tuna tagging activities (updated); and
- an overview of tuna research and data collection activities in the Maldives.

In addition, in this volume the first Maldivian tuna fishery bibliography is included, to provide interested researchers with a point of entry to the fascinating but often hard to find literature.

Although all of the topics covered in this volume are of interest in the Maldives, of special concern is the status of the skipjack tuna resource within the Maldivian EEZ. Roughly two thirds of the total fish catch of the Maldives is of skipjack tuna. A collapse of the skipjack fishery would have catastrophic consequences for the Maldives. In recent years Maldivian skipjack catches have stagnated, catch rates have declined, and sizes have decreased. These are serious developments which have already had deleterious economic effects. There are at least three possible explanations for these changes:

1. Competition between masdhonis and/or local overfishing, resulting in reduced local abundance of skipjack. (The Maldives has by far the highest catch per unit area of skipjack in the World).
2. Heavy fishing of skipjack by the western Indian Ocean purse seine fishery, resulting in reduced numbers of skipjack migrating into Maldivian waters. (The western Indian Ocean purse seine fishery now catches about 250,000t of skipjack per year, and an inverse relationship between those catches and Maldivian skipjack catch rates is demonstrated in this volume).
3. Oceanographic changes causing natural variations in apparent abundance of skipjack in the waters around Maldives. (Studies by MRS have shown that Maldivian tuna abundance is affected by both El Niño Southern Oscillation events and by decadal scale oceanographic variations).

There are very different implications for the Maldivian tuna fishery, depending on which explanation is the correct one. Unfortunately it is not yet possible to distinguish between them. Recognizing the importance of the skipjack fishery, MRS is now devoting a large part of its limited research capability to addressing this particular problem.

We live in interesting times. The resources on which the Maldivian tuna fishery has flourished for so long are under threat as never before, as a result of external fishing activities. At the same time, socio-economic changes within the Maldives are resulting in fewer young men entering the fishery, with grave long-term implications. Decisions made during the next few years by the Government of Maldives, and by the Indian Ocean fishing community, will have profound and perhaps irreversible effects on the Maldivian tuna fishery, a fishery that until recently had survived unchanged for centuries.

REVIEW OF THE MALDIVIAN TUNA FISHERY

R. Charles ANDERSON, Ahmed HAFIZ and M. Shiham ADAM

ABSTRACT

The tuna fishery is of prime importance to the Maldives. Skipjack tuna (*Katsuwonus pelamis*) is the most important species, averaging 68% of the total national catch. Other important species are yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), frigate tuna (*Auxis thazard*) and kawakawa (*Euthynnus affinis*). Catches of all these species are known to be affected by oceanographic changes, particularly those associated with El Niño Southern Oscillation events. Significant quantities of rainbow runner (*Elagatis bipinnulata*) and silky shark (*Carcharhinus falciformis*) are taken by the pole and line fishery. Livebait pole and line is by far the most important fishing method. the size of the livebait catch was estimated at 11,100t in 1993, making this the largest reef fishery in the country. Traditional trolling has decreased in importance in recent years. In contrast, sports fishing is becoming increasingly popular. Recent infrastructure developments include FAD deployment, and improved freezing capacity.

INTRODUCTION

The Maldives is a tuna fishing nation. The Maldivian tuna fishery has been in existence for centuries, and is still of central importance. In 1994 the total recorded fish catch reached a record of 104,000t, of which 89,600t (86%) was of tunas. The great majority of the tuna catch is landed by livebait pole and line vessels, known as *masdhonis*. There is also a significant but declining troll fishery. This is carried out from vessels known as *vadhu dhonis*, most of which are still sail powered. In addition, some tuna longlining has been permitted under licence in the outer waters of the Maldivian EEZ during recent years. At the last two Expert Consultations the Maldivian tuna fishery was reviewed by Hafiz (1991) and Hafiz and Anderson (1994).

SKIPJACK, YELLOWFIN AND BIGEYE

Skipjack tuna (*Katsuwonus pelamis*) is caught mainly by pole and line. It is the most important fish species caught in the Maldives. Skipjack catches averaged 68% of the total national fish catch in 1992-94. Recorded catches had stagnated at about 58,000t/yr from 1988-1993, although they did increase in 1994. This recent increase may, however, be largely the result of a change in the fishery statistics system (Anderson and Hafiz, 1996). Catch rates declined during 1988-1993. There is also evidence from commercial data that average sizes may have decreased over the last few years. There is therefore some concern about the status of skipjack resources.

Yellowfin tuna (*Thunnus albacares*) is the second most important species caught in Maldives. Catches have been increasing in recent years to a record high of 13,100t in 1994, which was 12.6% of the total recorded fish catch. The great majority of the yellowfin tunas landed in Maldives are juveniles, caught by the pole and line fleet. However, increasing numbers of subadults and adults are being caught by handliners and longliners.

Relatively small quantities of bigeye tuna (*Thunnus obesus*) are landed among yellowfin catches. Most are juveniles, caught by pole and line. Separate catch statistics are not collected for bigeye tuna, but it has been roughly estimated that something of the order of 500t per year of this species is currently being landed in the Maldives. This is about 0.5% of the total recorded catch.

Total estimated annual catches for skipjack and yellowfin tuna are summarized in Table 1. Further details of the fisheries and biology of these two species, and also of bigeye tuna, are presented in separate papers (Adam and Anderson, 1996a&b; Anderson, 1996), so they are not considered any further here.

FRIGATE TUNA

Frigate tuna (*Auxis thazard*) known locally as *raagondi*, is the third most important fish species caught in the Maldives. Catches have increased in recent years, to an average of 4300t during 1992-94 (Table 1). This amounts to about 4.7% of all fish, and about 5.4% of all tunas caught in the country. The majority of the frigate tuna caught in the Maldives is taken by livebait pole and line (Table 2).

Catch per unit effort (CPUE) as well as catch has increased recently (Fig.1). This is believed to be due to the effects of oceanographic changes, particularly those associated with El Niño Southern Oscillation (ENSO) events (Anderson, 1987 & 1993; Hafiz and Anderson, 1994). Note the relatively high CPUEs during the El Niño years of 1982-83, 1987 and 1992-

94 (Fig.1), and also the record catch during the earlier El Niño year of 1973 (Table 2).

The size range of frigate tuna caught in the Maldives is rather limited (Fig.2). The great majority of the frigate tuna caught in 1994 were within the range 30-40cm FL, with a mode at about 36cm. This is consistent with lengths reported in earlier years (Anderson, 1987; Hafiz and Anderson, 1988; Rochepeau and Hafiz, 1990).

KAWAKAWA

Kawakawa or eastern little tuna (*Euthynnus affinis*), is the fourth most important species caught in the Maldives. Catches have increased in recent years, to an average of 2900t during 1992-94 (Table 1). This amounts to about 3.1% of all fish, and about 3.6% of all tunas caught in the country. The recent increase in kawakawa catches was achieved by the pole and line (*masdhoni*) fleet (Table 3). The trolling (*vadhu dhoni*) fleet traditionally landed the bulk of kawakawa in the Maldives. However, over the last decade the *vadhu dhoni* fleet has declined in size, and consequently catches have declined too.

In addition to catch, CPUE has also increased recently, to a record level of nearly 14kg/day by mechanized pole and line vessels in 1993. As with frigate tuna, the CPUE of kawakawa in Maldivian waters is known to be affected by ENSO events (Anderson, 1987 & 1993; Hafiz and Anderson, 1994). Note the high CPUEs during the El Niño years of 1982-83 and 1992-94 (Fig.3), and also the high catches during the earlier El Niño years of 1973 and 1977 (Table 3).

Kawakawa is relatively uncommon in the south of Maldives. A combined length frequency histogram for kawakawa sampled on three islands in the north and centre of the Maldives is presented in Fig. 4. The majority of kawakawa caught were within the size range 26-50cm FL, which is consistent with previous reports (Anderson, 1987; Hafiz and Anderson, 1988; Rochepeau and Hafiz, 1990).

TUNA FISHERY BY-CATCH

The Maldivian pole and line fishery is a highly directed one, specifically targeting tunas. The quantity of other species caught is relatively small, probably less than 5% of the total catch. Data presented by MOFA (1995) suggests that nearly 10% of catch by pole and line is of species other than tunas. Despite the fact that "other species" tend to be underreported in Maldivian catch statistics, this may be an overestimate as a result of misreporting of fishing method. The main by-catch species caught by the pole and line fishery are rainbow runner (*Elagatis bipinnulata*), silky shark (*Carcharhinus falciformis*) and to a lesser extent dolphinfish (*Coryphaena hippurus*). Species taken in minimal quantities include ocean triggerfish (*Canthidermis maculatus*), tripletail (*Lobotes surinamensis*), and oceanic whitetip shark (*Carcharhinus longimanus*).

Silky sharks are of particular interest for both economic and ecological reasons. The association of silky sharks with tunas is well known (e.g. Au, 1991; Anderson and Ahmed, 1993). In Maldives the adults are known as *ainu miyaru* (school shark) because of their close association with tuna schools. The juveniles are known as *oivaali miyaru* (drifting object / flotsam shark) because of their association with such objects. Drifting objects, and their associated fishes, are carried to the Maldives by the monsoon currents, so tend to appear off the west coast during the southwest monsoon (May to October) and off the east coast during the northeast monsoon (December to March). Maldivian tuna fishermen search for flotsam, in order to catch the fish associated with them. The most commonly associated variety is juvenile yellowfin tuna, but other target and by-catch species can also be found, including juvenile silky sharks. Fishermen occasionally catch these sharks by pole and line, but they are more commonly taken by handline or by hand. The majority are juveniles within the length range 90-150cm. Adult silky sharks are caught in Maldives by pelagic longline. Virtually all Maldivian tuna fishermen report that tunas follow silky sharks, and that catching silky sharks reduces tuna catches. Despite this many Maldivian tuna fishermen catch silky sharks because "everybody else does" and because of the economic incentives. On the fishing island of B. Thulaadhoo in August 1995, local processors were paying fishermen MRf100 (about US$8.45) per piece for whole juvenile silky sharks. The meat is salt dried for export to Sri Lanka, and the fins are dried for export to the Far Eastern Chinese markets. Rising demand for shark fins, combined with increasing longlining activity in the Indian Ocean (IPTP,1995) will undoubtedly have a major impact on Indian Ocean pelagic shark stocks. The effect this will have on tuna stocks and/or catches is unknown.

OTHER TUNAS AND RELATED SPECIES

Dogtooth tuna (*Gymnosarda unicolor*) is a reef associated species. Catches are made mainly by trolling along reefs. Total recorded catches are summarized in Table 1; these undoubtedly underestimate actual landings due to under-reporting of reef fish catches. Wahoo (*Acanthocybium solandri*) is the only seerfish of any importance caught in the Maldives. Most are caught by trolling, although some are still taken by a traditional lure-and-harpoon fishery (known as *heymas helun*). Separate catch statistics are not maintained for this species. The narrow-barred Spanish mackerel (*Scomberomorus commerson*) does occur in Maldives, but is very rare.

The billfish species caught most commonly in the Maldives is the sailfish (*Istiophorus platypterus*). As with wahoo, this species is caught mainly by trolling, although some are still taken by the traditional lure-and-harpoon fishery. Separate catch statistics are not maintained for billfishes. At Malé market nearly all the billfishes landed are sailfishes, with only occasional landings of black marlin (*Makaira indica*) and even rarer landings of blue marlin (*Makaira mazara*) and striped marlin (*Tetrapterus audax*). The scarcity of marlins on Malé market is believed to be a result of local fishermen not targeting these species, rather than a reflection of real scarcity. Marlins appear regularly in game fishing and longlining catches. Longliners also catch quantities of broadbill swordfish (*Xiphias gladius*).

FLEET TRENDS

Details of the numbers of both pole and line vessels and trolling vessels actively engaged in fishing are presented in Table 4. The amount of fishing carried out by these vessels is shown in Table 5. Mechanization of the traditional sailing pole and line (*masdhoni*) fleet started in 1974-75. By 1982 the great majority of the tuna catch was being landed by mechanized vessels. The number of mechanized pole and line vessels grew steadily from 1974 to 1993. 1994 was the first year in which there was a decline in the number of pole and line vessels actively engaged in fishing. The reasons for this probably include the rising costs of such vessels; the increasing difficulty of finding crews; and the expansion of other investment opportunities within the country.

During the period of transition during the mechanization of the pole and line fleet (1975-1982) the trolling (*vadhu dhoni*) fleet increased its fishing activity (Table 5). Since then, however, mechanized pole and line vessels have dominated the fishery and trolling vessels have been marginalized. As a result the number of active trolling vessels, and the number of days that they fish have both decreased in recent years (Tables 4 & 5).

The decline of the troll fishery, and the apparent cessation of growth in the mechanized pole and line fleet are indicative of the changing socio-economic conditions within the Maldives. Of particular importance are changing attitudes to fishing as an occupation. Fishing is not seen as a desirable occupation, even though income can be relatively high. The great expansion and diversification of the economy over the last two decades has created many employment opportunities in other sectors. The number of fishermen in the Maldives reached a peak in 1984, and has stagnated or even declined since then (Table 5). With an increasing population the net result is that the percentage of fishermen has dropped from its historical level of about 15% to a current level of about 8-9% of the population. These trends are likely to have serious implications for the Maldives.

SPORTS FISHING

Sports fishing is becoming increasingly popular with foreign tourists visiting the Maldives. There are at present about 6 dedicated game fishing boats based at resorts in the country. In addition, an unknown number of local boats (*dhonis*) carry out sports fishing on a part-time basis. Most vessels target sailfish and wahoo, and also catch occasional dogtooth tuna, yellowfin tuna, marlins, jacks (Fam. Carangidae) etc. At present there is no national licencing scheme or data collection system for sports fishing boats. All the vessels involved in this fishery are Maldivian registry.

One vessel specifically targets billfish, and has carried out some tagging under the aegis of the International Billfish Foundation, Florida, USA. About 100+ releases of billfish have been made since 1993. There has been one reported recovery - a saifish, recaptured in the Maldives, 34 days after release in 1993.

BAITFISH

The Maldivian tuna fishery is based to a very large extent on the livebait pole and line technique. In 1994 an estimated 93% of the total recorded fish catch of the Maldives was caught by pole and line (MOFA, 1995). A wide range of livebait species are used, but the main varieties, in order of importance, are:

- Sprats, particularly the silver sprat, *Spratelloides gracilis* (fam. Clupeidae).
- Juvenile fusiliers (fam. Caesionidae).
- Cardinalfishes (fam. Apogonidae).
- Anchovies, notably the Indian anchovy, *Encrasicholina heteroloba* (fam. Engraulididae).

The total annual catches of livebait in the Maldives have been roughly estimated for three different time periods by Anderson and Hafiz (1988) and Anderson (1994) as follows:

1978-1981	3000-3500t
1985-1987	5800 ± 1300t
1993	11100 ± 2800t

It should be noted that there are considerable uncertainties associated with these estimates. Despite this it is clear that there has been a major increase in livebait catches in recent years. In part this can be explained by the steady increase in fishing effort over the last 15 years (Table 5). The period 1978-81 marked the low point of pole and line fishing effort, and therefore of livebait utilization, during the transition from an entirely sailing fleet to an essentially mechanized one. There also seems to have been an increase in the quantity of bait used per day. This appears to be largely a result of the increase in average size and associated fishing power of pole and line vessels (*masdhonis*) in recent years.

Tuna catch per unit bait (CPUB) has been estimated at about 10kg/kg (range 7-13) in 1985-87 (Anderson and Hafiz, 1988), and at about 7kg/kg (range 5-9) in 1993 (Anderson, 1994). This is rather low compared to CPUB rates from the western Pacific (e.g. Sakagawa, 1987) and very low compared with estimated rates in Lakshadweep (Pillai, 1991). There are several possible explanations for the apparently low CPUB in the Maldives. These include:

- The Maldivian fishermen's profligate use of livebait when it is available in abundance.
- Total catch has been estimated in the Maldives, not the quantity of bait used (excluding losses during capture and holding) as may be the case elsewhere (Sakagawa, 1987).

- A possible overestimation of total Maldives bait catch, as a result of poor estimation of the frequency of reuse from one day to the next of unused bait. Sampling has been initiated to estimate this factor more accurately.

With an estimated catch of 11,100 ± 2800t in 1993, the Maldivian livebait fishery is much larger than the livebait fisheries of the south Pacific (cf. Blaber and Copland, 1993; Dalzell, 1993). It is certainly the largest reef fishery in the Maldives, and by far the most important since it supports the 80,000t per year pole and line tuna fishery.

FAD PROGRAMME

The Maldives carried out initial experiments with fish aggregating devices (FADs) for tunas in 1981. Numerous trials were carried out over the following years to develop a design that was suitable for Maldivian conditions (Naeem, 1988). A suitable design has now been evolved, and is proving very successful in aggregating tunas (Naeem and Latheefa, 1994). The latest model FADs typically last for about two years after deployment. Thirty two sites around the Maldives have been identified as appropriate locations for FADs, taking into account bottom topography, proximity of fishing islands and local tuna abundance. MOFA aims to maintain FADs at all of these sites, with 28-30 FADs in place at any one time.

INFRASTRUCTURE DEVELOPMENT

The Maldivian tuna fishery has traditionally been carried out by privately owned pole and line vessels. Government development efforts over the last decade have concentrated on the development of infrastructure for the collection and export of tuna. The government agency responsible for these activities is the Maldives Industrial Fisheries Company (MIFCO). MIFCO maintains a fleet currently comprising 22 collector (ice carrying) vessels and 12 mother (freezer) vessels. This includes 4 new refrigerated seawater collector vessels commissioned during 1995 (Anon, 1995). MIFCO runs the tuna cannery at Felivaru in Lhaviyani Atoll (north of Malé). MIFCO has also commissioned two new cold storage facilities, both in the south of the country. One at Maandhoo in Laamu Atoll is already operational, having commenced operations in April 1994. The other is at Koodhoo in Gaafu Alifu Atoll, which started operations in 1996.

EXPORTS

Tunas in general and skipjack in particular form a major part of the Maldivian diet. Nevertheless, tuna has been a major export of the Maldives for centuries. The traditional export was smoke dried tuna, known as 'Maldive fish', and the traditional export market was Sri Lanka. This market collapsed in the early 1970s. The Maldives then diversified into canned and frozen tuna exports. A byproduct of canning operations is fish meal, which is also exported. In the last few years the market for Maldive fish has opened up again, and exports of this commodity have increased. Details of tuna and tuna product exports over the last few years are presented in (Table 6).

EEZ FISHERY

The Maldives declared a 200 mile EEZ in 1976. From 1985 fishing by foreign or joint venture longliners has been permitted under licence in the outer waters of the EEZ (i.e. from 75-200 nautical miles offshore). The inner waters, up to 75 miles offshore are reserved for local fishermen. No purse seining or gillnetting is permitted in the Maldivian EEZ.

During 1994 a total of 20 foreign longliners (14 Korean and 6 of central/south American registry) were licenced to fish in the Maldivian EEZ, by the Ministry of Trade and Industries. As a condition of licencing vessels were supposed to submit full catch and effort data on a regular basis. In practice, three vessels submitted full data; three submitted partial data; twelve submitted only total catch and number of days fished; and two submitted no data, perhaps because they did not fish in the Maldivian EEZ. Partly because of their non-compliance with the requirement to submit data, licences of all foreign vessels were terminated from August 1994. Total reported effort, total reported catch, estimates of catch composition, and estimates of catch per unit effort for 1994 are summarized in Table 7.

It is emphasized that these estimates are based on vessel reports; they have not been independently verified. By way of comparison, one Maldivian vessel (a highseas longliner owned and operated by MIFCO) operated in the same outer waters of the Maldivian EEZ from May 1993 to July 1996. This vessel had a Japanese masterfisherman on board, but was operated on a trial basis with a Maldivian crew. It might therefore have been expected to achieve lower catch rates than those of the licenced vessels. In fact the Maldivian vessel reported higher catch rates than the foreign, licenced vessels (Table 7), strongly suggesting that they had been underreporting.

PURSE SEINE TRANSHIPMENTS

In recent years purse seiners based in Seychelles have fished in the region of the Chagos Archipelago (i.e. just south of Maldives) during the first half of the northeast monsoon (i.e. November to January). In November 1994 Spanish purse seiners started transshipment in Addu Atoll (the southernmost Maldivian atoll), under a licencing agreement with the Maldivian government State Trading Organization (STO). The numbers of vessels involved, and the quantities of fish transshipped are summarized below (source: STO, Malé):

Date	No. Purse Seiners	No. Reefers Arrived	Tuna Transshipped (t)
11. 94	2	3	1561
12. 94	4	4	4147
01. 95	6	2	5778
Total	12	9	11486

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Table 4. Numbers of active fishing vessels operating in Maldives, 1985-94.
Source: MOFA/EPCS.
Note: P/L = pole and line *masdhoni*

Year	Sailing P/L	Mech. P/L	Total P/L	Trolling	Total
1985	43	988	1031	963	1994
1986	32	1009	1041	753	1794
1987	21	1044	1065	655	1720
1988	16	1096	1112	505	1617
1989	14	1114	1128	414	1542
1990	11	1151	1162	343	1505
1991	6	1252	1258	352	1610
1992	38	1347	1385	270	1655
1993	15	1434	1449	299	1748
1994	42	1410	1452	324	1776

Table 1. Recorded catches (t) of tunas in the Maldives by species, 1970-94.
Source: Ministry of Fisheries and Agriculture / Economic Planning and Coordination Section.

Year	Skipjack	Yellowfin	Frigate	Kawakawa	Dogtooth	Total
1970	27,684	1,989	3,023	644	n/a	33,340
1971	28,709	1,227	3,015	473	n/a	33,424
1972	17,971	2,076	3,186	596	n/a	23,829
1973	19,195	5,475	6,626	1088	n/a	32,384
1974	22,160	4,128	6,006	830	n/a	33,124
1975	14,858	3,774	4,057	415	n/a	23,104
1976	20,092	4,891	2,707	953	n/a	28,643
1977	14,342	4,473	3,080	927	n/a	22,822
1978	13,824	3,584	1,661	768	n/a	19,837
1979	18,136	4,289	1,701	721	n/a	24,847
1980	23,561	4,229	1,595	1063	n/a	30,448
1981	20,617	5,284	1,606	1274	n/a	28,781
1982	15,881	4,005	2,061	1887	n/a	23,834
1983	19,701	6,241	3,540	2087	n/a	31,569
1984	32,048	7,124	3,105	1714	376	44,367
1985	42,602	6,066	2,824	2177	182	53,851
1986	45,445	5,321	1,778	1071	136	53,751
1987	42,111	6,668	1,921	1232	105	52,037
1988	58,546	6,535	1,629	1257	84	68,051
1989	58,145	6,082	2,146	1322	108	67,803
1990	59,899	5,279	3,013	1891	281	70,363
1991	58,898	7,711	2,582	1677	234	71,102
1992	58,577	8,697	3,389	2451	337	73,451
1993	58,740	10,110	5,456	3569	628	78,503
1994	69,411	13,126	4,019	2656	387	89,599

Naeem A. (1988) Fish aggregation devices (FADs) in the Maldives. Rasain 8: 179-200.

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1992	58,577	8,697	3,389	2451	337	73,451
1993	58,740	10,110	5,456	3569	628	78,503
1994	69,411	13,126	4,019	2656	387	89,599

Table 2. Annual Maldives catch (t) of Frigate Tuna by vessel type, 1970-94.
Source: MOFA/EPCS.
Note: minor catches by other categories are included under trolling.

Year	Sailing P/L	Mech. P/L	Total P/L	Trolling	Total
1970	2775	--	2775	248	3023
1971	2849	--	2849	166	3015
1972	3004	--	3004	182	3186
1973	6440	--	6440	186	6626
1974	5804	--	5804	202	6006
1975	3713	181	3894	163	4057
1976	1971	448	2419	289	2707
1977	1863	953	2816	264	3080
1978	720	735	1455	206	1661
1979	435	994	1429	272	1701
1980	207	1084	1291	304	1595
1981	141	1156	1297	309	1606
1982	80	1750	1830	231	2061
1983	141	3048	3189	351	3540
1984	66	2701	2767	338	3105
1985	70	2071	2141	683	2824
1986	130	1309	1439	339	1778
1987	25	1580	1605	316	1921
1988	14	1373	1387	242	1629
1989	5	1944	1954	197	2146
1990	21	2760	2781	232	3013
1991	2	2421	2423	159	2582
1992	32	3220	3252	137	3389
1993	34	5216	5250	206	5456
1994	12	3764	3776	243	4019

Table 3. Annual Maldivian catches (t) of Kawakawa by vessel type, 1970-94.
Source: MOFA/EPCS.
Note: minor catches by other categories are included under trolling.

Year	Sailing P/L	Mech. P/L	Total P/L	Trolling	Total
1970	242	--	242	402	644
1971	220	--	220	253	473
1972	253	--	253	343	596
1973	574	--	574	514	1088
1974	397	--	397	433	830
1975	140	7	147	268	415
1976	157	34	191	762	953
1977	112	48	160	767	927
1978	78	55	133	634	768
1979	94	79	173	548	721
1980	104	191	295	768	1063
1981	119	284	403	871	1274
1982	172	671	843	1044	1887
1983	98	895	993	1094	2087
1984	49	646	695	1019	1714
1985	99	811	910	1267	2177
1986	23	476	499	572	1071
1987	18	548	566	666	1232
1988	11	690	701	556	1257
1989	13	811	824	498	1322
1990	15	1238	1253	638	1891
1991	4	1244	1248	429	1677
1992	65	1998	2063	388	2451
1993	20	3061	3081	488	3569
1994	11	2217	2228	428	2656

Table 5. Annual fishing effort (nos. boat days) by vessel type, and numbers of fishermen, 1970-94.
Source: MOFA/EPCS.

Year	Sailing P/L	Mech. P/L	Total P/L	Trolling	No. Fishers
1970	191,421	--	191,421	104,482	17,094
1971	169,237	--	169,237	67,378	18,075
1972	158,544	--	158,544	76,136	18,535
1973	215,278	--	215,278	90,461	18,807
1974	203,362	--	203,362	93,504	19,362
1975	171,808	4,200	176,008	90,100	19,666
1976	153,539	21,800	175,339	135,031	21,381
1977	104,943	41,300	146,243	157,949	21,594
1978	53,739	54,800	108,539	176,878	22,683
1979	24,615	74,904	99,519	132,903	23,924
1980	16,877	83,134	100,011	136,934	24,330
1981	13,852	83,731	97,583	130,362	22,301
1982	10,036	97,085	107,121	132,342	21,727
1983	6,339	117,172	123,511	118,639	22,262
1984	6,220	153,460	159,680	108,314	21,028
1985	4,681	162,430	167,111	110,061	19,671
1986	3,354	161,910	165,264	79,139	22,245
1987	2,355	158,785	161,140	69,380	22,387
1988	1,242	184,353	185,595	51,460	21,880
1989	911	183,944	184,855	39,725	22,025
1990	1,317	193,045	194,362	37,933	21,725
1991	424	198,320	198,744	35,814	21,432
1992	3,602	204,808	208,410	28,137	21,195
1993	1,057	222,548	223,605	34,507	19,995
1994	1,138	223,095	224,233	31,687	22,268

Table 6. Exports (t) of tunas and tuna products from the Maldives, 1990-94.
Source: Customs data compiled by MOFA/EPCS.
Note: Weights are actual weights not live weights.

Commodity	1990	1991	1992	1993	1994
Frozen	17,056	10,085	5,540	9,869	7,439
Smoke dried	2,418	3,285	3,093	3,578	4,102
Salt dried	2,084	2,298	1,323	1,657	2,394
Canned	6,931	7,188	7,478	4,877	6,849
Fish meal	1,971	3,110	2,150	2,450	2,350

Table 7. Catch, effort and catch per unit effort of foreign and Maldivian registry vessels operating in the Maldivian EEZ.
Source: Ministry of Trade and Industries and MIFCO data compiled by MOFA/EPCS/MRS.

	Licenced Vessels	Maldivian Vessel
Period of Operation	1/94 - 8/94	5/93 - 1/95
Fishing Effort		
No. vessels fished	18	1
No. reported days fished	985	279
Average no. hooks per day	2403[a]	1768
Total hooks used	2,366,955	493,343
Catch (t)		
Total catch	790.9t (100%)	273.2t (100%)
Bigeye tuna catch	538.6t[b] (68.1%)	118.2t (43.2%)
Yellowfin tuna catch	136.0t[b] (17.2%)	77.1t (28.2%)
'Other' catch	116.3t[b] (14.7%)	77.9t (28.5%)
Catch per unit effort		
Bigeye tuna CPUE	228 kg/1000 hooks	240 kg/1000 hooks
Yellowfin tuna CPUE	57 kg/1000 hooks	156 kg/1000 hooks
'Other' CPUE	49 kg/1000 hooks	158 kg/1000 hooks
Total CPUE	334 kg/1000 hooks	554 kg/1000 hooks

Notes: a. Based on reports for 192 days.
b. Based on reports for 256t

Fig 1. Mechanized pole and line CPUE for frigate tuna, 1979-1994 for the entire Maldives (Kg/day)

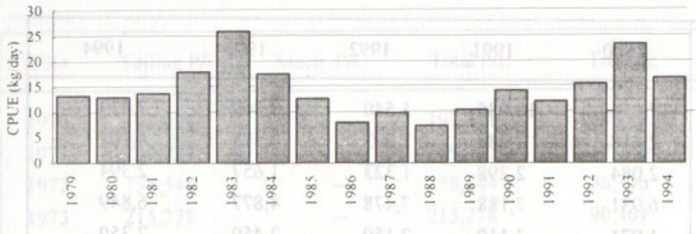


Fig 2. Length frequency distribution of frigate tuna in the Maldives, 1994 (H.Dh.Kulhudhufushi, R.Alifushi and G.Dh.Thinadhoo)

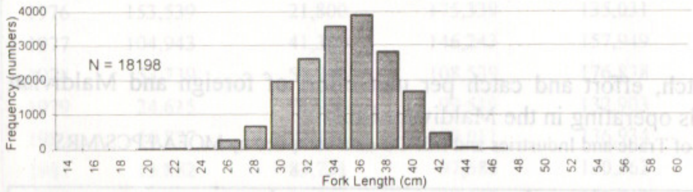


Fig. 3. Mechanized pole and line CPUE for kawakawa, 1979-1994 for the entire Maldives (Kg/Day)

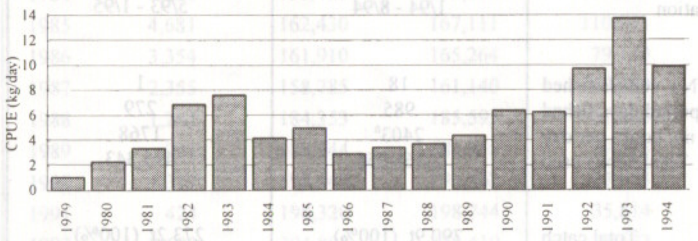
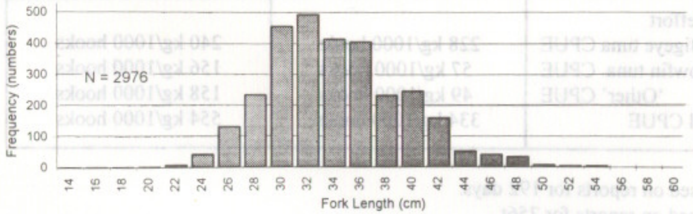


Fig 2. Length frequency distribution of kawaawa in the Maldives, 1994 (H.Dh.Kulhudhufushi, R.Alifushi and G.Dh.Thinadhoo)



YELLOWFIN TUNA (*THUNNUS ALBACARES*) IN THE MALDIVES

M. Shiham ADAM and R. Charles ANDERSON

ABSTRACT

Yellowfin (*Thunnus albacares*) is the second most important species of fish caught in the Maldives. Catches have increased in recent years, to a total of over 13,000t in 1994. The majority of the catch is of juveniles, caught by pole and line, for which there are two seasonal fisheries: off the west coast during the southwest monsoon and off the east coast during the northeast monsoon. The relative importance of the southwest season fishery has declined in recent years; it is speculated that this may be the result of high catches by other nations in the western Indian Ocean adversely affecting recruitment to the Maldivian fishery. Otherwise Maldivian yellowfin tuna catches are known to be affected by oceanographic variations, including medium term (decadal scale) variations, and El Niño Southern Oscillation events.

INTRODUCTION

Yellowfin (*Thunnus albacares*) is the second most important species of fish caught in the Maldives, after skipjack tuna (*Katsuwonus pelamis*). Yellowfin catches have increased dramatically in recent years. In 1994 the total Maldives catch of yellowfin was over 13,000t (Anon, 1995), which was 12.6% of the total national fish landings.

The Maldivian yellowfin fishery is essentially a livebait pole and line fishery. Catches from traditional (but now mechanized) pole and line vessels account over 95% of the total yellowfin catch. The yellowfin caught are mainly surface swimming juveniles within the size range 30-60cm FL. Yellowfin are also caught regularly, but in smaller quantities, by hand lining and trolling. These methods generally catch large sized yellowfins of more than 70cm FL. In addition, longliners operating in the waters around the Maldives take deep swimming adults.

The Maldives "yellowfin" catch includes a small number of bigeye tuna (*Thunnus obesus*). No separate statistics are kept for this species. However, preliminary studies suggest that bigeye tuna may account about up to 5% of the total yellowfin catch (Anderson and Hafiz 1991; Anderson 1996).

This report summarises current knowledge of the biology of yellowfin tuna in the Maldives, and presents new information about the Maldivian yellowfin fishery.

CATCH TRENDS

Recorded catches of yellowfin tuna for the years 1970-1994 are given in Table 1 and Figure 1. Figure 2 illustrates the relative contributions of the main vessel types to annual catches. Pole and line is clearly the most important fishing method for yellowfin tuna in the Maldives. The pole and line fleet is a traditional one, but mechanization (which started in 1974-75) effectively transformed the entire fleet from sail to engine power in less than ten years. The contribution of the trolling fleet to the total yellowfin catch is relatively small. Trolling catches peaked at about 590t/yr (i.e. about 14% of the total yellowfin catch) in 1979-80. Since then trolling catches have declined, reflecting the general decline of the whole troll fishery as a result of changing socio-economic conditions within the Maldives.

During the period 1970-1994 total yellowfin catches have increased substantially, but somewhat erratically (Fig. 1). Catches from 1973-1982 averaged about 4400t/yr. From 1983-1990 yellowfin catches averaged about 6200t/yr. Since 1990 yellowfin catches have more than doubled to a record of 13,126t in 1994. This is an increase of roughly 2000t/yr during the period 1990-94. Explanations for this dramatic increase in yellowfin include:

1. An increase in crude fishing effort. The number of active fishing vessels engaged in pole and line fishing increased about 23% from about 1100 in 1990 to over 1400 vessels in 1994. A more useful index of fishing effort is the number of days fished by mechanised pole and line vessels, which increased 13% from about 198,000 days in 1990 to over 223,000 days in 1994 (see Anderson, Hafiz and Adam (1996) for details of fishing effort statistics).

2. An increase in fishing power of the pole and line vessels. In recent years boat owners have tended to build bigger pole and line vessels and to install larger engines, with the aim of increasing fishing power and attracting better crews. The introduction of mechanical pumps for water spraying during pole and line fishing, the more frequent use of radios between vessels, the more frequent use of binoculars for spotting seabirds, and an increase in the number of FADs have all increased the effective fishing power of the vessels (Hafiz and Anderson, 1994). These increases are, however, difficult if not impossible to quantify.

3. A change in catchability and/or abundance. The abundance and/or catchability of yellowfin and other tuna species is known to be affected by changes in oceanographic conditions, both within the Maldives (Anderson, 1987 & 1993; Hafiz and Anderson, 1994) and within the wider western Indian Ocean (Marsac and Hallier, 1990; Marsac, 1992). It seems possible that oceanographic conditions during the years 1992-94 were particularly favourable for yellowfin tuna in Maldivian waters. These points are discussed further below.

CATCH PER UNIT EFFORT (CPUE) TRENDS

The Maldivian yellowfin fishery is dominated by mechanized pole and line vessels. Annual average catches per unit effort (CPUE) for the years 1979-1994 for mechanized pole and line vessels are given in the Table 2 and Figure 3. The best available measure of fishing effort, and the one used here, is the number of fishing days. The problems associated with using number of fishing days as a measure of pole and line fishing effort are well known (e.g. Anderson, 1993; Hafiz and Anderson, 1994). They include problems of variations in bait availability, seabird abundance, vessel interactions, etc. These difficulties mean that individual annual estimates of Maldivian CPUE may not be too accurate, but the timeseries is believed to give a very useful picture of major trends.

Annual average yellowfin CPUE decreased from a high of 63kg/day in 1981 to a low of about 27kg/day in 1990. This decline has been noted before (Anderson, 1993; Anderson and Hafiz, 1991; Hafiz and Anderson, 1994; IPTP, 1992; Nishida, 1991). Possible reasons for this decline are noted by IPTP (1992, p.49).

Since 1990 annual average yellowfin CPUE has more than doubled, rising steadily from about 27 kg/day in 1990 to 59kg/day in 1994. Part of this increase in CPUE can be explained by an increase in fishing power of the pole and line vessels, as noted above. Although the change in vessel fishing power has not been quantified, it seems unlikely to be able to account for more than about 10-20% of the increase in yellowfin CPUE over the last 5 years. The most likely explanation for the remaining increase in Maldivian yellowfin catch and CPUE is changes in the oceanographic conditions in the Indian Ocean, which are discussed below.

The Maldivian pole and line fishery for yellowfin is highly seasonal. Peak catches are made off the west coast of the Maldives during the southwest monsoon (June to October), and off the east coast during the northeast monsoon (December to April) (Adam, 1993; Anderson, 1985 &1988; Hafiz and Anderson, 1991; Rochepeau and Hafiz, 1990). Particularly high catches are made off Raa and Baa Atolls during the southwest monsoon, and off Kaafu and Lhaviyani Atolls during the northeast monsoon. As simple indices of CPUE for these two seasonal fisheries, pole and line catches and effort have been compiled for the following two areas and time periods:

1. Southwest monsoon fishery:
   Raa and Baa Atolls, for June, July, August and September.
2. Northeast monsoon fishery:
   Lhaviyani and Kaafu Atolls and Malé town, for December January, February and March.

The complete time series for both fisheries are presented in Table 3 and Figs.4a&b. Note that fishing effort in these time series has been standardized to "number of days fished by mechanized pole and vessels." This has been done for years prior to 1979 by assuming that sailing vessels caught half the yellowfin that mechanized vessels did, following Anderson (1985).

Historically, the southwest monsoon fishery has always been more important than the northeast monsoon fishery. The average CPUE for the southwest monsoon fishery during the period 1970-1994 was 165kg yellowfin per mechanized pole and line vessel day. For the northeast monsoon fishery the average CPUE was 81kg/day. Both fisheries show similar recent trends in CPUE: a rapid decline from 1983/85-1990; and an increase since 1990. While there are a number of possible explanations for this pattern of changes, the most likely is believed to be changes in oceanographic conditions, which are discussed below.

Since 1990, CPUE in the southwest monsoon fishery has increased only slowly. In contrast the increase in CPUE in the northeast monsoon fishery has been very rapid. During 1970-90 the southwest monsoon fishery CPUE was greater than that of the northeast monsoon fishery in 20 out of 21 years. During 1991-94, the northeast monsoon fishery CPUE was greater than that

of the southwest monsoon fishery in three out of four years. One possible explanation for this change is the increasing catch of yellowfin tunas by other nations in the western Indian Ocean, adversely affecting recruitment to the southwest monsoon fishery in the Maldives.

OCEANOGRAPHIC VARIATIONS AND YELLOWFIN CATCHES

As noted by Marsac (1992), a traditional approach to population dynamics based upon an assumption of environmental stability is no longer tenable. In the Maldives the abundance of juvenile yellowfin is known to be affected by variations in oceanographic conditions of at least three types:

Seasonal variations. As already mentioned above, the fishery for juvenile yellowfin tunas in the Maldives is highly seasonal. In fact there are essentially two fisheries, one off the west coast during the southwest monsoon and one off the east coast during the northeast monsoon (Adam, 1993; Anderson, 1985 & 1988; Anderson and Hafiz, 1991; Rochepeau and Hafiz, 1990). In both seasons the juvenile yellowfins are strongly associated with drifting objects.

Medium term variations. As noted above, there are medium term trends in yellowfin CPUE in recent years. Since the same pattern of variation in CPUE is seen in Maldivian frigate tuna and kawakawa, while the opposite pattern is seen in skipjack, these trends are believed to be related in some way to medium term variations in oceanographic conditions (Anderson, 1993; Hafiz and Anderson, 1994).

Variations associated with ENSO events. Maldivian yellowfin CPUE increases during El Niño years (Anderson, 1987 & 1993; Hafiz and Anderson, 1994; Rochepeau and Hafiz, 1990). Note the elevated yellowfin CPUEs during the El Niño years of 1972-73 (Figs. 1&4), 1976 (Figs. 1&4b), 1982-83 (Fig. 4b), 1987 (Figs. 1,3&4b), and 1992-94 (Figs. 1,3&4). In the western Indian Ocean, ENSO events are characterized by high sea surface temperatures, low wind mixing, and strong vertical gradients in the thermocline. These conditions appear to promote yellowfin larval survival (Marsac and Hallier, 1990; Marsac, 1992) and hence presumably also recruitment to the Maldivian fishery.

It appears that oceanographic conditions during the years 1992-94 were particularly favourable for juvenile yellowfin tuna in Maldivian waters. This is reflected in the high total catch (Fig.1) and national CPUE (Fig.3). However, the relatively low CPUE for juvenile yellowfin off Raa and Baa Atolls during the southwest monsoon is a cause for concern. There is clearly a need for further study into both the effects of oceanographic variability on yellowfin tuna distribution and abundance, and of fisheries interactions, within the Indian Ocean.

LARGE YELLOWFIN FISHERY

The great majority of yellowfin landed in the Maldives are surface swimming juveniles, caught by livebait pole and line. A traditional trolling and handlining fishery for large yellowfin also exists in the Maldives. The yellowfin caught in this fishery are generally subadults and adults of more than 70cm FL. Large yellowfin are also caught occasionally by pole and line, using double poles. There are a number of well-established local fisheries for large yellowfins, including ones off:

- Haa Alifu Atoll in the far north, during January-April.
- Malé in the centre of the country, during March-September.
- Fuvah Mulaku and Addu Atoll in the far south, during April and November.

The Fuvah Mulaku fishery has been briefly described by Anderson, Adam and Waheed (1993). However, the overall seasonal distribution of large yellowfin tunas within Maldivian waters has not been well documented. A survey has therefore been initiated of all fishing islands in the country, to obtain information from experienced fishermen on the seasonal occurrence of large yellowfin. At present there is considerable business interest about large yellowfin within the Maldives: exports of chilled fish to the Japanese sashimi market and of tuna loins to Europe have recently started.

In additional to the "inshore" fishery for large yellowfin, some tuna longlining has been and is being carried out in the outer waters of the Maldivian EEZ (i.e. 75-200 miles offshore). Further details are given by Anderson, Hafiz and Adam (1996).

SIZE DISTRIBUTION OF YELLOWFIN CATCHES

From 1993 Maldives initiated a regional tuna length frequency sampling program. Active pole and line skippers were employed to measure their tuna

catches at seven islands, representing all regions of the Maldives. In addition, sampling at Malé market, which was initiated in 1983 has been continued. 1994 data are summarized in Figure 5 and in Table 4. Among over 74,000 yellowfins measured in 1994, the commonest sizes in the pole and line fishery were 38-50cm FL. The great majority of the yellowfin sampled fell within the size range of 30-60cm FL. There was no obvious trend in yellowfin size between regions. Yellowfin sampled at one location (Dh. Kudahuvadhoo) were on average smaller than at other locations. The median size of yellowfin sampled there was 39cm FL, compared with 44-47cm FL at the other seven sampling locations. As Dh. Kudahuvadhoo is a central location this observation is difficult to explain; returns for 1995 are currently being compiled and may shed some light on this apparent anomaly.

The regional length frequency sampling programme concentrates on pole and line catches, with the exception of Malé market sampling which covers all gears. As a result, large yellowfin catches are not particularly well represented. Some sampling of large yellowfin catches has been carried out in Haa Alifu, Raa and Baa Atolls in the north and at Fuvah Mulaku in the south. The combined length frequency distribution of hand line catches of large yellowfin from these two locations is presented in Figure 6. Sampling at Malé does not separate pole and line and handline catches, and so Malé data have been excluded from Fig. 6. In both Fig. 5c (Malé) and Fig. 6 there is a clear mode at 82-84cm FL. The 108cm FL mode in Fig. 6 is mainly due to fish from Fuvah Mulaku.

OTHER BIOLOGICAL INFORMATION

Growth. Because the Maldivian yellowfin tuna fishery mainly targets juveniles, it has not been possible to develop growth models for the full size range of yellowfin tuna found in Maldivian waters. Two studies so far have concentrated on growth rates of juveniles. From analysis of length frequency data, Anderson (1988) estimated a linear growth rate of 2.9±0.4cm/mo between 30-70cm FL (although growth at half this rate could not be discounted). From tagging data, Yesaki and Waheed (1992) estimated an average growth rate of 2.4cm/mo at 70cm FL.

Migration. Anderson (1988) proposed a model of juvenile yellowfin tuna migration in the central Indian Ocean in which a broad band of young fish in the equatorial waters moves east and west in phase with the seasonally changing monsoon currents. Anderson (1988) and Adam (1992) suggest that intermediate sized fish migrate northwards from the Maldives into the north of the Arabian Sea. Length frequency data from pole and line catches presented here shows no evidence of increase in size with latitude within the Maldives. From a tagging study of juvenile yellowfin tuna in Maldives, Yesaki and Waheed (1992) confirmed the east-west movement in phase with the monsoons, but did not present evidence for a net northward movement. It may be therefore that if there is a northward migration it does not start until the yellowfin have grow to a size greater than that at which they are normally taken by pole and line (i.e. greater than 60cm FL). For western Indian Ocean yellowfin, a change in body proportions determined by detailed analyses of length-weight relationships has been noted at about 64-68cm FL, and this has been interpreted as reflecting a "turning point ... in the life of this fish" (Montaudouin, Hallier and Hassani, 1990; Hallier, 1991). Maldeniya and Joseph (1988) demonstrated a northward movement of yellowfin along the west coast of Sri Lanka, mainly on the basis of changes in relative abundance of 60-80cm FL fish.

Regarding adult yellowfin, Morita and Koto (1971) suggested that there is a movement of fish from the equatorial western Indian Ocean, through the southern Maldives and up past Sri Lanka into the Bay of Bengal every year between October and March. The seasonal fishery for large yellowfin at Fuvah Mulaku every November may be targeting these fish (Anderson, Shiham and Waheed, 1993). Some tagging of large yellowfin at Fuvah Mulaku has been carried out (Anderson, Adam and Waheed, 1996), but no overseas recoveries have been received to date.

Stock relationships. Nishida (1992) proposed that there are two major stocks of yellowfin tuna in the Indian Ocean: a western and an eastern stock, with an area of overlap between about 70° - 90°E. If this is the case it is possible that the juvenile yellowfin that are caught off the west coast of the Maldives during the southwest monsoon could come from the western stock, while those caught off the east coast of the Maldives during the northeast monsoon could come from the eastern stock. A scatter plot of southwest monsoon fishery CPUE against northeast monsoon fishery CPUE shows no obvious correlation. The same applied when southwest monsoon fishery CPUE was plotted against northeast monsoon fishery CPUE for previous and following years. This finding would tend to support the two stock hypothesis. If this is the case, the similarity in CPUE trends over the period 1970-94 for the two fisheries, as noted above, might still be attributed to large scale changes in oceanographic conditions affecting local abundance or catchability in Maldivian waters of juvenile yellowfin tunas from different sources.

Length-weight relationship. Anderson et al. (1995) have calculated the following length-weight relationship (cm - kg) for Maldivian yellowfin tuna landings, within the size range 25-145cm FL:

$$W = 0.00002863\ FL^{2.897} \qquad (N = 875;\ r = 0.990)$$

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Table 1. Maldivian yellowfin tuna catches by vessel type (1970-1994).
Source: Ministry of Fisheries & Agriculture / EPCS

Year	Sailing P/L	Mech. P/L	Total P/L vessels	Trolling	Grand Total
1970	1799	--	1799	190	1989
1971	1081	--	1081	146	1227
1972	1940	--	1940	136	2076
1973	5234	--	5234	241	5475
1974	3868	--	3868	260	4128
1975	3348	164	3512	262	3774
1976	3569	912	4481	410	4891
1977	2530	1593	4123	350	4473
1978	1324	1890	3214	370	3584
1979	733	2959	3692	597	4289
1980	471	3176	3647	582	4229
1981	273	4467	4740	544	5284
1982	167	3603	3770	234	4004
1983	112	5872	5984	257	6241
1984	76	6818	6894	230	7124
1985	82	5715	5797	269	6066
1986	22	5178	5200	121	5321
1987	9	6522	6531	137	6668
1988	12	6366	6378	157	6535
1989	6	5972	5978	104	6082
1990	5	5225	5230	50	5280
1991	5	7649	7654	57	7711
1992	11	8628	8639	58	8697
1993	17	10006	10023	87	10110
1994	8	12859	12867	259	13126

Table 2. Catches and catch per unit effort (CPUE) of yellowfin tuna for mechanized pole and line vessels, 1979-1994.

Year	Catch (t)	Effort (days)	CPUE (kg/day)
1979	4289	79904	54
1980	4229	83134	51
1981	5284	83731	63
1982	4004	97085	41
1983	6241	117172	53
1984	7124	153460	46
1985	6066	162430	37
1986	5321	161910	33
1987	6668	158785	42
1988	6535	184353	35
1989	6082	183944	33
1990	5280	193045	27
1991	7711	198320	39
1992	8697	204808	42
1993	10110	222548	45
1994	13126	223095	59

Table 4. Average lengths and size ranges (cm) of yellowfin tuna samples in Maldives during 1994.

Sample Number	*Sample Location*	*Mean*	*Mode*	*Median*	*Size Range 5-95%*	*Smallest*	*Largest*	*Total in Sample*
1	H.Dh. Kulhudhufus	46	48	47	33-57	25	82	11730
2	R. Alifushi	46	??	47	30-60	20	84	10063
3	K. Malé*	53	44	45	31-112	22	164	2749
4	M. Maduvvari	44	47	47	33-51	29	154	2269
5	Dh. Kudahuvadhoo	39	38	39	31-49	23	66	9984
6	L. Maamendhoo	47	46	47	37-53	20	118	6826
7	G. A.Villingili	43	43	44	32-55	17	87	12283
8	G.Dh. Thinadhoo	47	47	47	35-58	20	98	18563
	TOTAL							74467

**Malé sample includes catches from hand line and trolling*

Table 3. Indices of Maldivian yellowfin CPUE (kg/mech. P/L vessel day) for two seasonal yellowfin fisheries, 1970-1994. *Data source: Ministry of Fisheries and Agriculture.*

a: NORTH EAST MONSOON
Location: Kaafu, Malé town and Lhaviyani
Months: Dec, Jan, Feb and March

Year	Catch (t)	Effort (d)	CPUE
1969-70	132	3967	33
1970-71	68	4558	15
1971-72	147	4682	31
1972-73	430	6227	69
1973-74	327	6555	50
1974-75	776	5674	137
1975-76	296	5954	50
1976-77	688	5787	119
1977-78	418	6255	67
1978-79	278	4045	69
1979-80	396	6807	58
1980-81	539	7037	77
1981-82	186	6463	29
1982-83	517	7947	65
1983-84	1234	12373	100
1984-85	1108	11183	99
1985-86	1516	11571	131
1986-87	1165	11219	104
1987-88	984	11800	83
1988-89	571	12360	46
1989-90	261	8164	32
1990-91	952	11416	83
1991-92	892	10705	83
1992-93	1228	12545	98
1993-94	1818	12544	145

b: SOUTH WEST MONSOON
Location: Raa and Baa Atolls
Months: June, July Aug and Sept.

Year	Catch (t)	Effort(d)	CPUE
1970	827	6345	130
1971	376	4976	76
1972	1022	5535	185
1973	1814	6671	272
1974	1294	5555	233
1975	1644	12393	133
1976	1909	11420	167
1977	1358	9336	145
1978	1131	9079	125
1979	1075	6449	167
1980	1378	6313	218
1981	1160	5047	230
1982	1898	5897	322
1983	2175	6706	324
1984	1527	8805	173
1985	1591	7820	203
1986	1053	8804	120
1987	2226	8244	270
1988	1062	7513	141
1989	917	10403	88
1990	550	12483	44
1991	778	9597	81
1992	994	10048	99
1993	1183	12807	92
1994	1438	13115	110

__Note:__ To standardize sailing pole and line vessel effort to "number of mechanized pole and line vessels days" it was assumed that sailing vessels caught half the yellowfin caught by mechanized vessels. For the years 1970-1978 sailing vessel effort was halved. For the years since 1979 sailing vessels effort was small and has been ignored. Also note that data for Dec. 1969 have not been included.

***Figure 1.** Maldives yellowfin catch by vessel type, 1970-1994.*

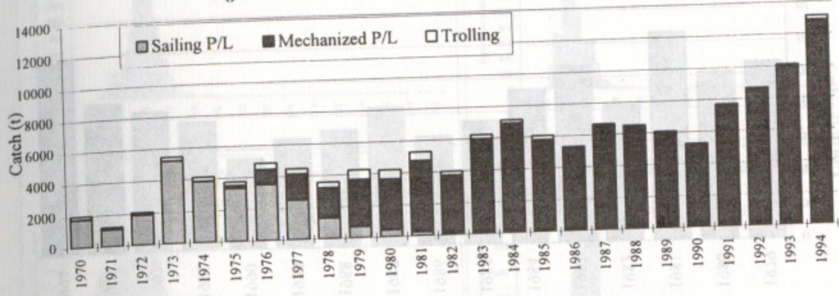


Figure 2. *Percentage yellowfin catch by vessel type, 1970-1994*

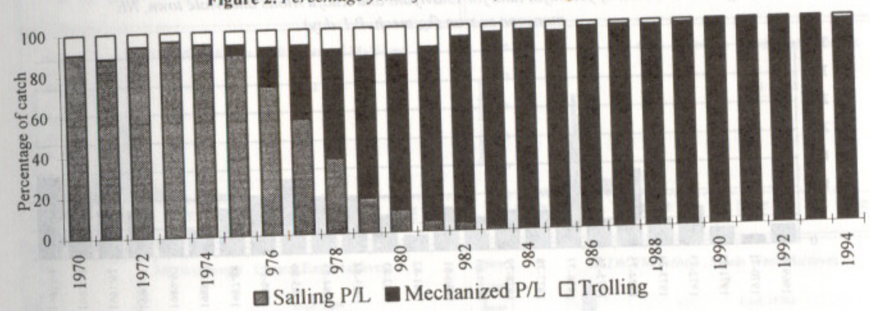


Figure 3. Mechanized pole and line CPUE for yellowfin tuna, 1979-1994, for the entire Maldives (kg/day)

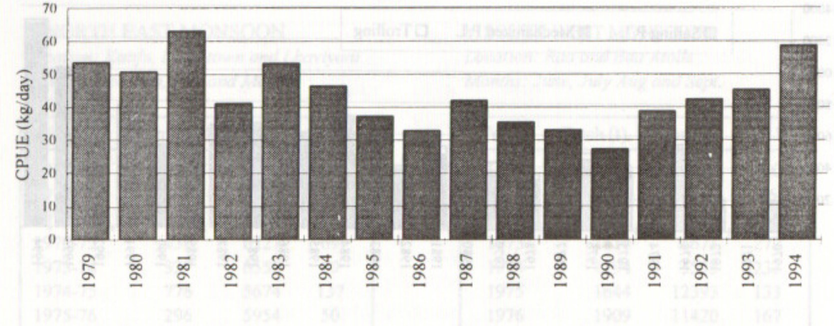


Figure 4a. CPUE of yellowfin tuna for Lhaviyani and Kaafu Atolls and Malé town, NE monsoon season (kg/mech. P/L day)

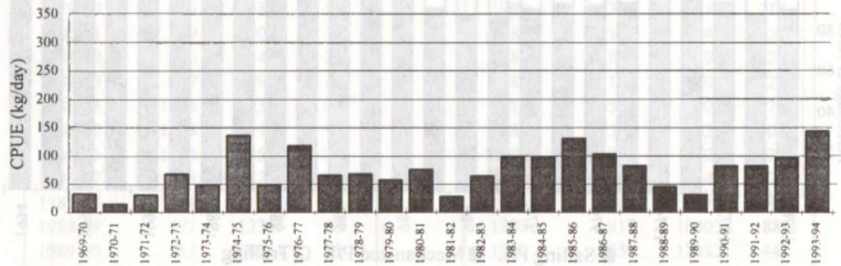


Figure 4b. CPUE of yellowfin tuna for Raa and Baa Atolls, SW monsoon season (kg/mech. P/L day)

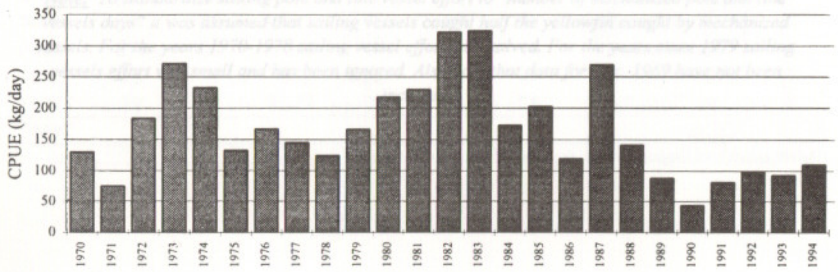


Figure 5. Length frequency distribution of yellowfin tuna from the Maldives, 1994.

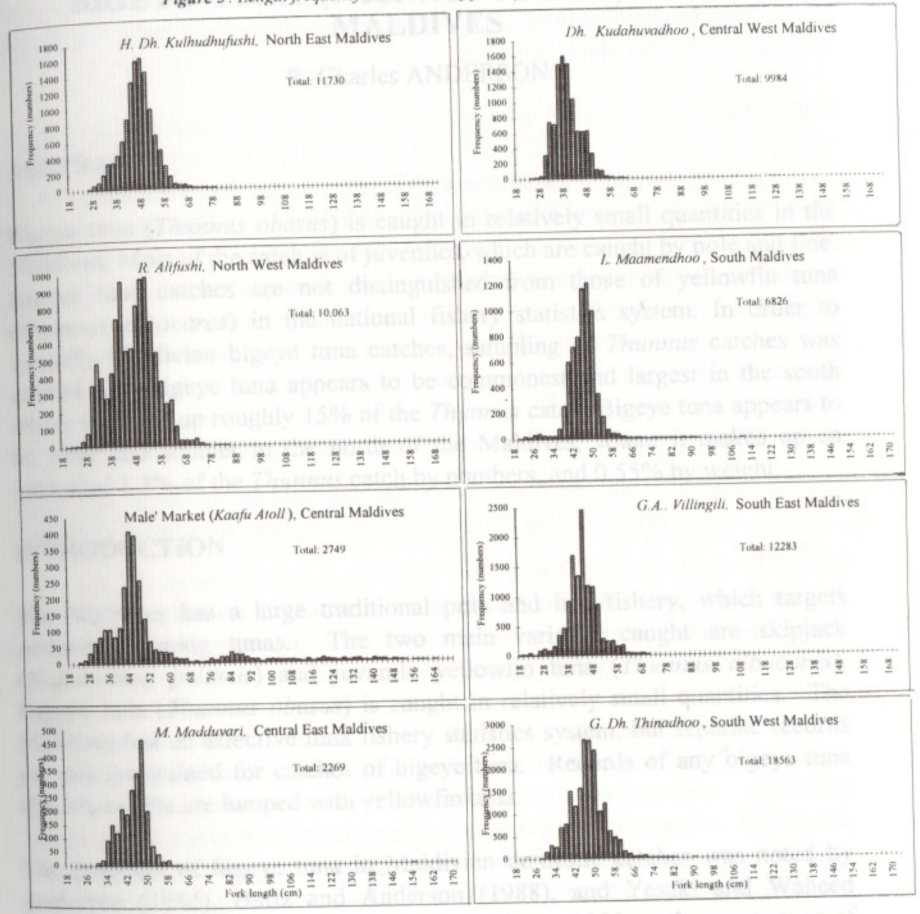
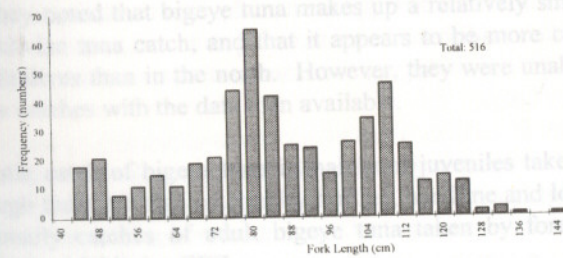


Figure 6. Length frequency distribution of "Large Yellowfin Tuna" caught in the Maldives by handline and troll.



BIGEYE TUNA (*THUNNUS OBESUS*) IN THE MALDIVES

R. Charles ANDERSON

ABSTRACT

Bigeye tuna (*Thunnus obesus*) is caught in relatively small quantities in the Maldives. Most of the catch is of juveniles, which are caught by pole and line. Bigeye tuna catches are not distinguished from those of yellowfin tuna (*Thunnus albacares*) in the national fishery statistics system. In order to quantify Maldivian bigeye tuna catches, sampling of *Thunnus* catches was carried out. Bigeye tuna appears to be commonest and largest in the south where it makes up roughly 15% of the *Thunnus* catch. Bigeye tuna appears to be rarer and smaller in the north of the Maldives, where it makes up an estimated 1.3% of the *Thunnus* catch by numbers, and 0.55% by weight.

INTRODUCTION

The Maldives has a large traditional pole and line fishery, which targets surface-swimming tunas. The two main varieties caught are skipjack (*Katsuwonus pelamis*) and juvenile yellowfin tuna (*Thunnus albacares*). Bigeye tuna (*Thunnus obesus*) is caught in relatively small quantities. The Maldives has an effective tuna fishery statistics system, but separate records are not maintained for catches of bigeye tuna. Records of any bigeye tuna that are caught are lumped with yellowfin tuna.

The presence of bigeye tuna in Maldivian domestic catches was noted by Anderson (1986), Hafiz and Anderson (1988), and Yesaki and Waheed (1991). Information available up to and including 1990 on the occurrence of bigeye tuna in Maldivian catches was reviewed by Anderson and Hafiz (1991). They noted that bigeye tuna makes up a relatively small proportion of the Maldivian tuna catch, and that it appears to be more common in the south of Maldives than in the north. However, they were unable to quantify total bigeye catches with the data then available.

The domestic catch of bigeye tuna is mainly of juveniles taken by pole and line, although there are also catches by trolling, handline and longline. There are additionally catches of adult bigeye tuna taken by foreign longliners operating in the Maldivian EEZ.

The aims of this report are to review new information on the occurrence of bigeye tuna in the Maldives, and to present preliminary estimates of bigeye tuna catches by the Maldivian fleet.

METHODS

Thunnus catch sample data for the Maldivian pole and line fleet from before 1991 are taken directly from Anderson and Hafiz (1991). Note that the November 1990 sample from Laamu Atoll and the January-February 1990 sample from Lhaviyani Atoll have been corrected to include all *Thunnus* caught and recorded by reliable observers, not just those tagged. These alterations make minimal differences to the estimated percentage of bigeye tuna in the samples.

Since 1991, particular emphasis has been placed on sampling two regions:

1. The south of Maldives, which was under-sampled by Anderson and Hafiz (1991), but which was believed to have the highest abundance of bigeye tuna.
2. The northwest of Maldives during the southwest monsoon, when by far the highest seasonal catches of yellowfin tuna are made (Anderson, 1985 and 1988; Rochepeau and Hafiz, 1990).

Bigeye tunas are not always easy to identify from external characteristics, particularly when the fish are small and boat-worn. Therefore the preferred method of sampling was to examine the livers. However, this was only possible on a large scale at the tuna cannery on Felivaru island in Lhaviyani Atoll. The next best method was to examine the external characteristics of live or fresh-dead specimens. This was possible on a number of tuna-tagging trips, particularly in the south of the Maldives. The least satisfactory sampling method was to examine the external characteristics of landings. Whenever possible this was supplemented by liver sampling of contentious individuals. Such additional liver sampling was not possible at Malé fish market, so estimates of bigeye occurrence there must be considered as minimum values only.

Most *Thunnus* fork lengths were measured with a measuring board, to the full centimeter below. *Thunnus* from Malé market in 1993-95 and those from Baa and Raa Atolls in August 1992 were measured with tapes. Tape lengths were converted to board lengths following the procedures outlined in Anderson *et al.* (1995). Length-weight conversion factors used were those of Poreeyanond (1994) for bigeye tuna and Anderson *et al.* (1995) for yellowfin tuna.

Catches of *Thunnus* have been recorded by the Ministry of Fisheries and Agriculture (MOFA) by atoll and by month since 1970. Total annual catches, and catches from the north and centre (referred to hereafter as the north) and south of Maldives are summarized in Table 3. For the purposes of this report the Kudahuvadhoo Channel at about 02° 40' N is considered to be the dividing line between the north and south of Maldives (see Discussion below, and Figure 1 for location map).

Available catch data for longliners operating in the Maldivian EEZ have been compiled by Klawe (1980) and by the Ministry of Fisheries and Agriculture (MOFA), and are summarized in Table 4.

RESULTS

A total of 26 samples of *Thunnus* were inspected for the presence of bigeye tuna (Tables 1 and 2). The great majority of these fish were caught by pole and line; a few were caught by trolling or handline. In every case the majority of the fish sampled were yellowfin tuna. Bigeye tuna made up 0-24% of the samples. Among the total of 14672 *Thunnus* sampled, 680 (4.6%) were bigeye tuna. A single longtail tuna (*Thunnus tonggol*) was present in the sample from Gaafu Alifu Atoll taken in February 1994.

There is a tendency for bigeye tuna to be more common in samples from the south of Maldives than in samples from the north of the country. The data from these two regions are therefore presented separately (Tables 1 and 2). In the north and centre of Maldives bigeye tuna made up an average of 1.3% of the *Thunnus* catches by number (1.1% excluding Malé market samples, in which the proportion of bigeye is most likely to have been underestimated). In the south of the Maldives bigeye tuna made up an average of 14.7% of *Thunnus* catches sampled, by numbers.

Length-frequency distributions of bigeye tuna catches from the north of Maldives and from the south are presented separately in Figure 2. For comparison, length-frequency distributions of yellowfin tunas caught at the same times and in the same locations are also presented. It is possible that some bigeye may have been present in Malé market samples during months when none were recorded. To minimize this potential source of bias, only those yellowfin sampled in months during which bigeye tuna were recorded at Malé market are included.

Bigeye tuna sampled in the north of Maldives were much smaller than those sampled in the south (Figure 2). In the north the modal length was about 36 cm, and the estimated mean weight 1.1 kg. In contrast, in the south the modal length of bigeye tuna was about 58 cm, and the mean weight 3.6 kg. Although there was a difference between the average sizes of yellowfin tuna taken in the north and in the south at the same time as the bigeye, it was much less marked. In the northern yellowfin sample the modal length was about 44 cm, and the average weight 2.6 kg. In the southern yellowfin sample the modal length was about 46 cm, and the average weight 3.3 kg.

DISCUSSION

Anderson and Hafiz (1991) and Anderson (1992 and 1993) suggested that bigeye tuna may be more abundant in the south of Maldives than in the north. The results presented here support this idea. Bigeye tuna makes up an estimated 1.3% of the *Thunnus* catch by numbers in the north of the Maldives, and an estimated 14.7% in the south. Excluding Malé market samples, the estimated contribution of bigeye tuna to the *Thunnus* catch in the north of the Maldives is 1.1%.

Because of the differences in average size of bigeye tuna sampled in the north and south of the Maldives, the contribution of bigeye tuna by weight to total *Thunnus* catch is very much greater in the south than it is in the north. Assuming that the samples taken are representative, and given the average weights and percentages noted above, the contribution of bigeye tuna by weight to the *Thunnus* catch is estimated to be 0.55% in the north (including Malé) and 15.8% in the south.

Anderson (1992) demonstrated that many fish species, including tunas, show variations in abundance from north to south along the Maldivian atoll chain. In particular, for many fishes the Kudahuvadhoo Channel seems to mark a significant boundary. This channel, at about 02° 40' N, divides the north-central double chain atolls from the southern single chain atolls. As a first approximation, in order to quantify catches, it is assumed that this channel also marks something of a boundary for bigeye tuna. The recorded catches of *Thunnus* in the two regions north and south of the channel over the 25-year

period 1970-94 are presented in Table 3. Note that discrepancies between the IPTP and the MOFA databases may have led to minor errors in the years 1984-87. Using the estimated percentage contribution of bigeye tuna by weight to the *Thunnus* catch in the two regions given above, the total Maldivian catch of bigeye tuna by year was estimated (Table 3 and Figure 3).

The total bigeye tuna catch of the Maldivian fleet (mainly by pole and line) is estimated to have increased from about 100 t/yr in the 1970s about 500 t/yr at present. This increase is a reflection of the increase in Maldivian tuna catches in general, and of yellowfin catches in particular. The estimated contribution of bigeye to the total Maldivian catch of *Thunnus* increased from about 3% during the 1970s to about 5% over the last few years. This reflects the increasing proportion of *Thunnus* caught in the south of Maldives over the last couple of decades (about 16% during the 1970s, and about 28% during 1990-94). The estimated contribution of bigeye to the total Maldivian catch of all tunas was about 0.4% in the 1970s and 0.6% during 1990-94.

The presence of juvenile bigeye tunas in Maldivian catches has been previously documented, but this paper presents the first catch estimates. The estimated domestic Maldivian catch is relatively small in terms of weight: 500t, compared with a total Indian Ocean catch of 68,000 t in 1993 (IPTP, 1995). Nevertheless, because the bigeye caught in Maldives are small juveniles this catch may not be insignificant in terms of numbers of fish taken. The status of the Indian Ocean stock of bigeye tuna is not well known, but the stock is thought to be heavily exploited (IPTP, 1994). Attempts should be made to refine the current estimates of Maldivian bigeye catches, so that they can be incorporated in future stock assessments.

It is emphasized that the present estimates of bigeye tuna catches in Maldives are first approximations only. For example, these estimates are based on rather limited sampling during 1986-95, which may not be applicable to the years 1970-85. Even within the period 1986-95 there may have been intra-annual and interannual variations in bigeye tuna abundance that have not been adequately accounted for (particularly taking into account the great variation in frequency of occurrence of bigeye between *Thunnus* samples). Other potential sources of error include:

1. Variations in abundance associated with El Niño events, which are known to affect other tuna species in Maldivian waters (Anderson, 1993).

2. Mechanization of the Maldivian pole-and-line fleet, which took place during the second half of the 1970s, and may have changed bigeye catchability, for example by increasing ability to fish offshore.

3. Increased fishing pressure on the Indian Ocean bigeye stock, which may have adversely affected recruitment to the Maldivian fishery.

4. The great increase in the use of FADs in Maldivian waters in the last few years, which might have some influence on the catchability of juvenile bigeye (18 out of the 29 bigeye tunas recorded from Baa Atoll in August 1995 were caught on a FAD, even though most fishing was on schools not associated with FADs).

In the western Indian Ocean purse-seine fishery, bigeye tuna make up 17% of *Thunnus* catches from log sets, but less than 3% from sets on free schools (Hallier, 1994). Maldivian fishermen search for floating objects, particularly during the juvenile yellowfin tuna fishing seasons (Anderson, 1985). It is not known to what extent regional and seasonal variations in the occurrence of floating objects within Maldivian waters will effect bigeye tuna catches.

Maldeniya *et al.* (1991) sampled gillnet and troll landings for bigeye tuna on the southwest coast of Sri Lanka. They found an incidence of 0.7% bigeye tuna among 2018 small *Thunnus*, the remainder being yellowfin tuna. The bigeye tunas in that sample were on average smaller than the yellowfin, and were within the range 36-56 cm FL. These results are similar to those obtained from the north Maldives. Overall, there is a suggestion of a cline in bigeye tuna abundance, increasing from north to south:

Beruwala, Sri Lanka	(6°27' N)	0.7%
North Maldives	(7°00' N - 4°50' N,	1.1%
(excluding Malé)	but mostly S of 6°N)	
Malé, Maldives	(4°10' N)	1.4%
South Maldives	(1°55' N - 0°25'S)	14.7%

There appears to be an abrupt increase in the frequency of bigeye occurrence between Malé and the south of Maldives. It is not known to what extent this is a true reflection of the actual situation, or a result of inadequate sampling in the intermediate area. It is therefore recommended that further sampling in the region between Malé and Laamu Atoll should be carried out.

Large quantities of bigeye tuna are caught by longliners in the central Indian Ocean (*e.g.* IPTP, 1988; Yang and Park, 1988), including the area of the Maldivian EEZ. Prior to the declaration of the Maldivian EEZ in 1976, Far Eastern longliners fished in this area. Some records of their catches are given by Klawe (1980). For some of the time since then licensed joint-venture longlining in the outer zone (i.e. 75-200 miles offshore) has been permitted. In addition, a commercial longliner has been operated in the same area by the Maldives Industrial Fisheries Company (MIFCO) since 1993. Available catch data have been compiled by the Ministry of Fisheries and Agriculture (MOFA), and are summarized in Table 4. The quantity of bigeye caught by longliners in the Maldivian EEZ is usually more than that of yellowfin tuna, with an average of 57% of the total recorded longline catch of these two species being bigeye tuna. The particularly high incidence of bigeye in the 1994 licenced longliner catch can be attributed to the fact that most of these vessels were Korean, and were presumably targeting bigeye tuna with deep longlines (*e.g.* Yang and Park, 1988).

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Table 1. Summary of results of bigeye tuna catch sampling activities in the north and centre of the Maldives.

Date	Sampling location	Fishing location	No. *Thunnus* sampled	Size range (cm)	No. of bigeye	Purpose of sampling
12.86-4.87	Malé	Near Malé	1337	24-135	1	Market samp.
12.87-2.88	Malé	Near Malé	1030	23-150	0	Market samp.
11.88	"Matha Hari"	E. of Lhaviyani	22	45-84	0	BET (liver)
2.89	Felivaru	Lhaviyani	909	30-84	5	BET (liver)
2.89	Haa Alifu	Haa Alifu	10	104-147	0	BET (liver)
2.89	Haa Alifu	Haa Alifu	200	53-147	0	BET (external)
1.90-2.90	Lhaviyani	Lhaviyani	322	24-78	0	Tagging
3.90	Lhaviyani	Lhaviyani	25	54-72	0	Tagging
7.90	Felivaru	Raa & Baa	675	NA	2	BET (liver)
10.90	Raa	Raa	82	37-56	0	Tagging
8.92	Baa	Baa	194	36-54	8	BET (external)
8.92	Raa	Raa	231	38-124	0	BET (external)
7.93-12.93	Malé	Near Malé	650	29-156	0	Market samp.
1.94-12.94	Malé	Near Malé	1758	23-162	76	Market samp.
1.95-6.95	Malé	Near Malé	2048	25-157	18	Market samp.
6.95	Raa	Raa	230	28-43	0	BET (external)
8.95	Baa	Baa	1268		29	Tagging
Subtotal 1	Malé	Near Malé	6823	23-162	95	Market samp.
Subtotal 2	Without Malé	North	4168	24-147	44	-
TOTAL	-	-	10991	23-162	139	-

Table 2. Summary of results of bigeye tuna catch sampling activities in the south of the Maldives

Date	Sampling location	Fishing location	No. *Thunnus* sampled	Size range (cm)	No. of bigeye	Purpose
5.90	Laamu	Laamu	53	58-81	0	Tagging
11.90	Laamu	L. & Satoraha	782	36-108	103	Tagging
12.92	Gnaviyani	Gnaviyani	152	40-131	33	BET (liver)
9.93	Laamu	Laamu	336	39-97	7	Tagging
11.93	Gnaviyani	Gnaviyani	64	45-139	0	Tagging
2.94	Gaafu Alifu	G.A.& Satoraha	836	29-55	89	Tagging
4.94	Laamu	L. & Satoraha	123	25-53	1	Tagging
8.94	Gaafu Alifu	G.A.& Satoraha	1285	33-147	308	Tagging
4.95-5.95	Gnaviyani	Gnaviyani	50	42-116	0	Tagging
TOTAL	South	South	3681	25-147	541	

Table 3. Summary of reported yellowfin and bigeye tuna catches by longliners operating in the Maldivian EEZ.

Year	Yellowfin catch (t)	Bigeye catch (t)	% Bigeye	Source
1972	401	374	48	Klawe (1980)
1973	119	146	55	Klawe (1980)
1974	53	54	50	Klawe (1980)
1975	718	1436	67	Klawe (1980)
1976	447	366	45	Klawe (1980)
1977	636	498	44	Klawe (1980)
1986	157.5	83	35	MOFA, Malé
1989	103.0	136	57	MOFA, Malé
1990	126.5	168	57	MOFA, Malé
1995	136.0	538.6	79	MOFA, Malé
1993-5	77.1	118.2	61	MIFCO, Malé
TOTAL	2974.1	3917.8	57	-

Table 4. Estimation of bigeye tuna catches (t) in the Maldives by the domestic fleet.

Year	Total *Thunnus* catch			Estimated bigeye catch		
	North	South	Total	North	South	Total
1970	1,530	459	1,989	8	73	81
1971	940	287	1,227	5	45	51
1972	1770	306	2,076	10	48	58
1973	4,822	653	5,475	27	103	130
1974	3,462	666	4,128	19	105	124
1975	3,257	517	3,774	18	82	100
1976	4,135	756	4,891	23	119	142
1977	3,584	889	4,473	20	140	160
1978	2,935	649	3,584	16	103	119
1979	3,579	710	4,289	20	112	132
1980	3,696	533	4,229	20	84	105
1981	3,965	1,319	5,284	22	208	230
1982	3,505	500	4,005	19	79	98
1983	5,383	858	6,241	30	136	165
1984	4,965	2,159	7,124	27	341	368
1985	4,208	1,858	6,066	23	294	317
1986	4,113	1,208	5,321	23	191	213
1987	4,824	1,844	6,668	27	291	318
1988	4,691	1,844	6,535	26	291	317
1989	4,296	1,786	6,082	24	282	306
1990	3,544	1,735	5,279	19	274	294
1991	4,817	2,894	7,711	26	457	484
1992	6,469	2,228	8,697	36	352	388
1993	7,163	2,947	10,110	39	466	505
1994	10,281	2,845	13,126	57	450	506

Fig 1. Location Map

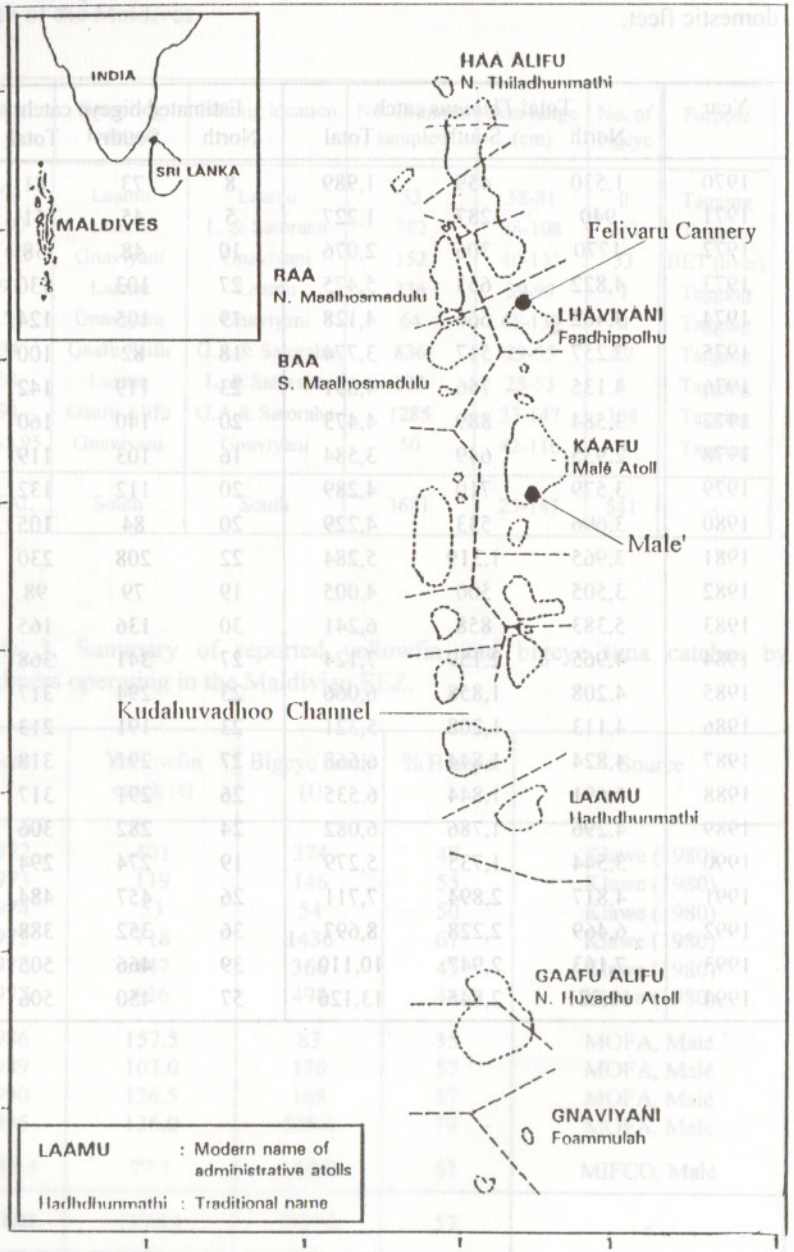


Fig 2. Length Frequencies of Bigeye Tuna and Yellowfin Tuna from the North and South of Maldives

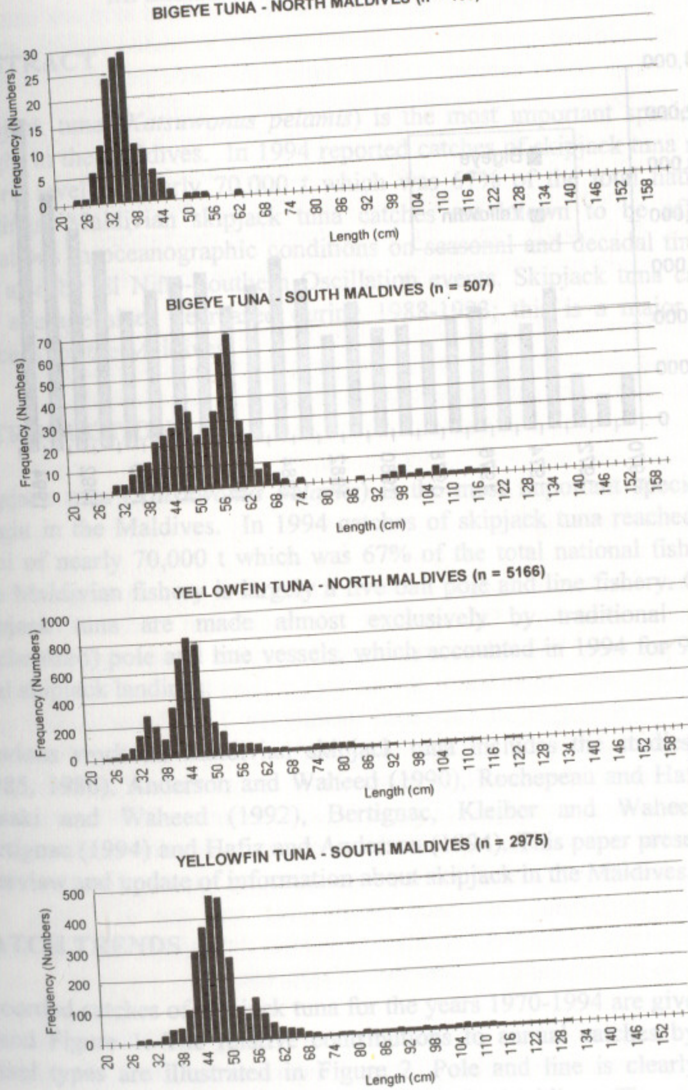
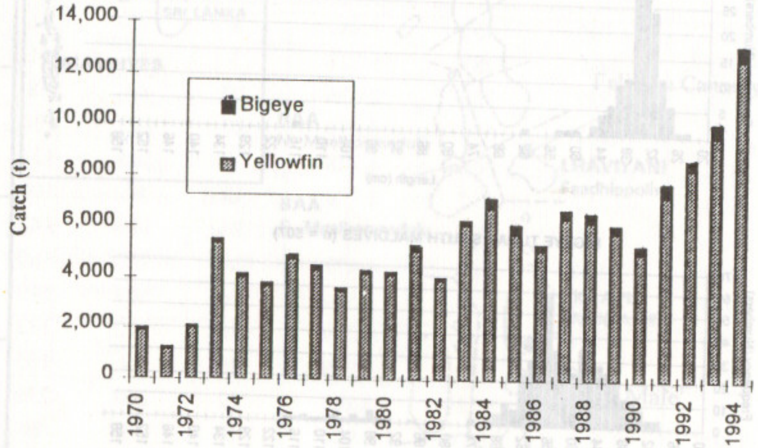


Fig. 3. Estimated Annual Catches of Yellowfin and Bigeye Tunas by the Maldivian fleet, 1970-94



SKIPJACK TUNA (*KATSUWONUS PELAMIS*) IN THE MALDIVES

M. Shiham ADAM and R. Charles ANDERSON

ABSTRACT

Skipjack tuna (*Katsuwonus pelamis*) is the most important species of fish caught in the Maldives. In 1994 reported catches of skipjack tuna reached a record level of nearly 70,000 t which was 67% of the total national fish landings. Maldivian skipjack tuna catches are known to be affected by variations in oceanographic conditions on seasonal and decadal time scales, and also by El Niño-Southern Oscillation events. Skipjack tuna catch rates and average sizes decreased during 1988-1993; this is a major cause of concern for the Maldives.

INTRODUCTION

Skipjack tuna (*Katsuwonus pelamis*) is the most important species of fish caught in the Maldives. In 1994 catches of skipjack tuna reached a record level of nearly 70,000 t which was 67% of the total national fish landings. The Maldivian fishery is largely a live bait pole and line fishery. Catches of skipjack tuna are made almost exclusively by traditional (but now mechanized) pole and line vessels, which accounted in 1994 for 99% of the total skipjack landings.

Previous work on Maldivian skipjack tuna includes the studies of Hafiz (1985, 1986), Anderson and Waheed (1990), Rochepeau and Hafiz (1990), Yesaki and Waheed (1992), Bertignac, Kleiber and Waheed (1994), Bertignac (1994) and Hafiz and Anderson (1994). This paper presents a brief overview and update of information about skipjack in the Maldives.

CATCH TRENDS

Recorded catches of skipjack tuna for the years 1970-1994 are given in Table 1 and Figure 1. The relative contributions to annual catches by the main vessel types are illustrated in Figure 2. Pole and line is clearly the most important fishing method for skipjack tuna the Maldives. The pole and line fishery in the Maldives is a traditional one dating back hundreds of years, but the fleet was mechanized starting in 1974. By the beginning of 1980 the active component of the pole and line fleet had been almost entirely mechanized.

Mechanization did not bring an immediate increase in total skipjack catches. Although mechanized pole and line vessel catches increased rapidly during 1975-80, sailing vessel catches crashed during the same period (Figure 2). This partly reflected the decrease in the number of sailing vessels as some were mechanized, but was also partly due to the fact that it was the oldest and least productive sailing vessels that were not mechanized. These vessels eventually dropped out of the fishery altogether resulting in a net loss to the fleet. Also, in the early years, the full potential of mechanized vessels was not realised due to problems with fuel distribution and engine maintenance.

As a result of these difficulties the full benefits of mechanization, in terms of increased skipjack catch, were not seen until the mid- to late 1980s, when total recorded skipjack catch soared from a low of 16,000 t in 1982 to 58,500 t in 1988. From 1988-93 skipjack catches stagnated at about 59,000 t. The recorded catch did increase in 1994 to 69,000 t, but this is thought to be largely the result of a change in the method of compiling the statistics (Anderson and Hafiz, 1996).

The increase in skipjack catch between 1982-1988 may in large part be attributed to an increase in fishing effort. The number of mechanized vessels engaged in pole and line fishing increased during this period (by 34%, from 1166 to 1558). More importantly the number of days fished, which is a more useful index of fishing effort, increased steadily (by 73%, from 107,000 total pole and line vessel days in 1982 to 185,500 days in 1988). The increase in the fishing power of pole-and-line vessels (over and above that attributable to mechanization) was also significant (Hafiz and Anderson, 1994). Increased size of vessels and engines, increased use of binoculars for spotting birds, widespread use of inter-vessel radio communication, improved bait catching and holding techniques, increased deployment and use of FADs, and increased capacity of the freezer/collector vessels throughout the country all contributed to this increase in production of skipjack.

However, the increase in skipjack catches during 1982-88 cannot be explained by increases in fishing effort and fishing power alone. During this period crude fishing effort increased by an estimated 73%. Taking rough account of increases in fishing power, effective fishing effort may have

increased by something of the order of 100%, but skipjack catch increased by an estimated 260%. This suggests that there was a substantial increase in apparent abundance of skipjack over the same period.

From 1988 to 1993 there was a continued increase in fishing effort (by 21%, from 185,500 pole and line vessel days in 1988 to 223,600 days in 1993) and fishing power. The decrease in catch during this period was a result of a decrease in skipjack CPUE.

CATCH PER UNIT EFFORT (CPUE) TRENDS

The Maldivian skipjack fishery is dominated by mechanized pole and line vessels. The best available measure of fishing effort, and the one used here, is the number of fishing days. Annual average catches per unit effort (CPUE) for 1979-1994 are given in Table 2 and Figure 3. The problems associated with using number of fishing days as a measure of pole and line fishing effort are well known (*e.g.* Anderson, 1993; Hafiz and Anderson, 1994). These include the problems of variation in bait availability, sea bird abundance, vessel interaction, *etc.* These difficulties mean that individual annual estimates of Maldivian CPUE may not be too accurate. Nevertheless, these factors may to some extent average out on an annual basis, and the time series is believed to give a useful picture of major trends.

The average annual skipjack CPUE for mechanized pole-and-line vessels decreased from a high of about 260 kg day^{-1} in 1980 to a low of about 160 kg day^{-1} in 1982-83. From 1982-83 to 1988 the annual average CPUE increased steadily (except for a dip in 1987) to over 310 kg day^{-1} in 1988-89. From 1989 CPUE gradually decreased at a rate of about 4% annually to about 260 kg day^{-1} in 1993. In 1994 reported CPUE increased to about 305 kg day^{-1}.

The relatively low estimated skipjack CPUEs during 1982-83 and 1987 could be due to a decrease in apparent skipjack abundance as a result of unfavourable oceanographic conditions in Maldivian waters during these years. 1982-83 and 1987 were all El Niño years. This point is discussed further below.

The increase in skipjack CPUE during the period 1983-1988 may be due to a combination of factors, including increased apparent abundance of skipjack and increased fishing power of pole-and-line vessels. The increase is also due in part to an increase in the proportion of large skipjack reported during this period (Hafiz and Anderson, 1988; Rochepeau and Hafiz, 1990). This in turn may have resulted from a real increase in abundance of large skipjack, the greater ability of mechanized vessels to catch large skipjack (Hafiz and Anderson, 1988) and/or a decrease in the accuracy of Maldivian fishery statistics (Rochepeau and Hafiz, 1990; Anderson and Hafiz, 1996).

The gradual decrease in CPUE in 1988-1993 may be due to a decrease in the apparent abundance of skipjack around Maldives. Possible explanations for this include:

1. A change in oceanographic conditions in the area. Tunas are known to be affected by changes in oceanographic conditions, both within the Maldives (Anderson, 1987 & 1993; Hafiz and Anderson, 1994) and within the wider western Indian Ocean (Hallier and Marsac, 1990; Marsac, 1992). In particular, the decline in Maldivian skipjack CPUE during 1988-1993 might be due to decadal scale changes in the oceanographic conditions in the region.
2. Increased catches of skipjack elsewhere in the western Indian Ocean, notably by the purse-seine fishery, adversely affecting abundance in the Maldivian fishery. Figure 4 illustrates an apparent inverse relationship between Maldivian skipjack CPUE and total skipjack catches from the western Indian Ocean (FAO Statistical Area 51). This relationship is not strong ($r = -0.343$), and there is no proof of cause and effect. Nevertheless, this is a source of concern to the Maldives. Two tagging experiments carried out in the Maldives (Yesaki and Waheed, 1992; Anderson, Adam and Waheed, this volume) have demonstrated that there is movement of skipjack tuna from Maldivian waters to the western Indian Ocean purse-seine grounds. There is a need for skipjack tagging to be carried out in the western Indian Ocean to quantify skipjack movements towards the Maldives.

It is possible that Maldivian CPUE is not a reliable index of skipjack abundance. For example, local competition between pole-and-line vessels at high levels of fishing effort might tend to reduce CPUE. However, the fact that Maldivian pole-and-line CPUE data for all tuna target species (skipjack, yellowfin, frigate tuna, and also kawakawa) show consistent responses to oceanographic variations suggest that this is not the case.

OCEANOGRAPHIC VARIATIONS AND SKIPJACK CATCHES

Perhaps the most obvious oceanographic variations in Maldivian waters are those associated with the seasonal monsoons. The seasonal movements of skipjack within Maldivian waters have not yet been well worked out. However, Hafiz (1986) and Rochepeau and Hafiz (1990) have described some regular seasonal changes in the abundance of skipjack. Anderson (1991) noted that small skipjack tended to be most abundant in Vaavu and Meemu Atolls (east central Maldives) during the southwest monsoon and early northeast monsoon (May-December), while large skipjack were most abundant during the northeast monsoon (November-April). Yesaki and Waheed (1992) noted a general northward movement of tagged skipjack released at the end of the northeast monsoon (May). In contrast, tagged skipjack released at the end of the southwest monsoon (October and November) showed a net southerly movement.

Catches of skipjack tuna in Maldivian waters are affected by ENSO (El Niño-Southern Oscillation) events (Anderson, 1987&1993; Hafiz and Anderson, 1994; Rochepeau and Hafiz, 1990). 1972-73, 1976, 1982-83, 1987, 1992-94 were all El Niño years. During those years (with the exception of 1994) recorded skipjack catches and catch rates were noticeably depressed (Figures 1 and 3). El Niño years bring increased sea surface temperatures, low wind mixing and strong vertical gradients in the thermocline to the western Indian Ocean (Marsac and Hallier, 1990). It is not known how these conditions affect skipjack in Maldivian waters. One possibility is that increased sea surface temperatures may reduce larval survival and hence recruitment to the Maldivian fishery. Forsbergh (1989) noted a decrease in skipjack larval abundance at temperatures above 29ºC in the eastern Pacific Ocean.

Anderson (1993) and Hafiz and Anderson (1994) have suggested that apparent medium-term or decadal-scale changes in Maldivian tuna CPUE indices, including that of skipjack tuna, may be related to decadal-scale cyclical changes in oceanographic conditions around Maldives. If such oceanographic variations have occured in the Indian Ocean they might explain part of the variation in skipjack CPUE noted above (*i.e.* the increase during 1983-88 and decrease during 1988-93). There is clearly a need for much more research on the effects of oceanographic variations on skipjack in the central Indian Ocean.

SIZE DISTRIBUTION OF SKIPJACK CATCHES

A regional tuna sampling program involving active pole-and-line fishing skippers was initiated in 1993 (Anderson and Hafiz, 1994). Data are collected from 8 islands, representing all regions of the country. Skipjack data have been compiled, and some summary length frequency histograms are presented in Figure 5. At Malé market fish are measured with tapes, not boards as elsewhere. These data have been converted to board lengths using a board length-tape length conversion factor (Marine Research Section, unpublished data).

The great majority of the skipjack caught in the Maldives are within the size range of 35-65 cm FL. This confirms previous work (Hafiz, 1985 & 1986; Anderson and Waheed, 1990; Rochepeau and Hafiz, 1990; Anderson, 1991). The size distribution of skipjack caught in the Maldives is often bimodal (note the length-frequency histogram for H.Dh. Kulhudhufushi, Figure 5a; see also Hafiz, 1985 & 1986; Hafiz and Anderson, 1988; Anderson and Waheed, 1990; Rochepeau and Hafiz, 1990). Maldivians classify skipjack into two size classes: small (*mas*) and large (*godhaa*). The typically bimodal size distribution of skipjack catches in the Maldives is believed to provide a biological basis for this division (Hafiz and Anderson, 1988). Traditionally, a large skipjack is one which when carried by the tail will have its snout touching the ground. Large-scale commercial purchasing of skipjack throughout the Maldives under two different size categories has led to some blurring of this traditional classification (Rochepeau and Hafiz, 1990; Anderson and Hafiz, 1996). It is interesting to speculate on what further changes to this traditional classification might occur as improved nutrition in the Maldives causes the average height of the population to increase.

The cause of the bimodal distribution often seen in Maldivian skipjack catches is the relative under-representation of 50-60 cm skipjack in the catch. This again is apparent from these length samples. Of particular note is the dramatic decrease in numbers of skipjack above about 50 cm caught in the islands of M. Maduvvari and L. Maamendhoo. It is possible that these fish move offshore, away from the Maldives, for example towards Sri Lanka (Anderson and Waheed, 1990). 50+cm skipjack certainly appear in quantity in the catches of Sri Lankan offshore vessels (*e.g.* Maldeniya and Dayaratne, 1994). Many of these vessels fish right up to, and even inside, the boundary of the Maldivian EEZ. This suggestion is discussed further by Anderson, Adam and Waheed (1996).

It has been reported previously, on the basis of analysis of catch data (Hafiz, 1985 & 1986; Rochepeau and Hafiz, 1990; Anderson, 1992, 1993) that the proportion of large skipjack in the catch is greater in the north of Maldives than in the south. The length data presented here support this contention. Large skipjack are more abundant in catches in the two northernmost islands sampled (Kulhudhufushi and Malé) than in the three islands further south. However, the overall proportion of large skipjack in the samples appears to be somewhat less than that noted in previous years (cf. Hafiz, 1985&1986; Rochepeau and Hafiz, 1990). Note, however, that because of the possibility of sampling bias the differences between years may not be as great as they seem.

Cook (1995) reported a decrease in average weight of skipjack purchased by the Maldives Industrial and Commercial Fisheries Company (MIFCO) during 1990-94. The weighted mean weight of skipjack purchased in 1990 was about 4 kg, but this dropped to about 2.7 kg in 1993. During this period MIFCO purchased 36% of the total recorded catch of skipjack and yellowfin (data source: MIFCO, compiled by MOFA/EPCS). Note that MIFCO started buying smaller-size fish than before in December 1993, so data from 1994 are not considered here.

STOCK STATUS

The Indian Ocean skipjack stock is generally believed to be very large. Furthermore, natural oceanographic variations are likely to cause considerable variations in local abundance. Nevertheless, the possible decrease in the proportion of large skipjack in the catch, the definite decrease in the average weight of a very substantial sample of the skipjack catch during 1990-93/4, and the drop in skipjack catch rates over the period 1988-93, all suggest the possibility of overfishing. This is a major cause for concern in the Maldives.

SKIPJACK GROWTH

Hafiz (1985&1996) estimated von Bertalanffy growth parameters for skipjack tuna from analysis of length frequency samples from two locations in

Maldives. His results were:

Sample 1	Baa Atoll	$L_\infty = 78cm$	$K = 0.625y^{-1}$	(Hafiz, 1985)
Sample 2	Malé	$L_\infty = 82cm$	$K = 0.45\ y^{-1}$	(Hafiz, 1986)

The differences between growth parameters estimated from the two samples by Hafiz (1985 &1986) are indicative of the differences in estimated growth rates for the two locations (Table 3). This, combined with the frequent observation of stationary modes in Maldivian skipjack tuna catches (*e.g.* Anderson and Hafiz, 1986) suggests that analysis of modal progression in samples from one location should not be relied upon to yield accurate estimates of skipjack growth rates.

Estimates of skipjack growth rates from tagging studies were made by Yesaki and Waheed (1992) and by Anderson, Adam and Waheed (1996). These estimates are summarized in Table 3. The authors of both studies had considerable reservations about their growth rate estimates on account the great variation in their tag recovery data. This, combined with the fact that the two studies, using almost identical methods, produced such different growth rate estimates suggests that tagging should not be relied upon to yield precise estimates of growth rates.

Adam, Stéquert and Anderson (1996) used tetracycline marking of tagged skipjack to determine the periodicity of microincrement deposition in the otoliths of Maldivian skipjack. They found that microincrement deposition was irregular, and concluded that otolith microincrements could not be used for aging skipjack.

The accurate and precise estimation of growth rates for Indian Ocean skipjack would appear to offer a major challenge for the future.

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Table 1. Maldivian skipjack tuna catches by vessel type, 1970-94. Source: Ministry of Fisheries and Agriculture / EPCS.

Year	Sailing P/L	Mech. P/L	Total P/L	Trolling	Total Catch
1970	27,068	---	27,068	616	27,684
1971	28,200	---	28,200	509	28,709
1972	17,634	---	17,634	337	17,971
1973	18,761	---	18,761	434	19,195
1974	21,760	---	21,760	400	22,160
1975	13,921	680	14,601	257	14,858
1976	14,777	4,826	19,603	489	20,092
1977	6,935	7,097	14,032	310	14,342
1978	3,338	10,211	13,549	275	13,824
1979	1,603	16,195	17,798	338	18,136
1980	1,349	21,725	23,074	487	23,561
1981	577	19,621	20,198	419	20,617
1982	214	15,480	15,694	187	15,881
1983	122	19,369	19,491	210	19,701
1984	11	31,582	31,593	335	31,928
1985	165	42,005	42,170	432	42,602
1986	169	45,099	45,268	177	45,445
1987	196	41,676	41,872	239	42,111
1988	142	57,966	58,108	438	58,546
1989	135	57,671	57,806	339	58,145
1990	47	59,724	59,771	128	59,899
1991	46	58,715	58,761	137	58,898
1992	93	58,269	58,362	215	58,577
1993	107	58,452	58,559	181	58,740
1994	67	68,453	68,520	891	69,411

Table 2. Catches and catch per unit effort (CPUE) of skipjack tuna for mechanized pole and line vessels, 1979-94. Source: MOFA / EPCS.

Year	Skipjack Catch (t)	Effort (Days)	CPUE (kg/day)
1979	16,195	79,904	203
1980	21,725	83,134	261
1981	19,621	83,731	234
1982	15,480	97,085	159
1983	19,369	117,172	165
1984	31,582	153,460	206
1985	42,005	162,430	259
1986	45,099	161,910	279
1987	41,676	158,785	262
1988	57,966	184,353	314
1989	57,671	183,944	314
1990	59,724	193,045	309
1991	58,715	198,320	296
1992	58,269	204,808	285
1993	58,452	222,548	263
1994	68,453	223,095	307

Table 3. Estimates of Maldivian skipjack growth rates.

Source	Growth rate (cm/mo) at length				Method
	40cm	50cm	60cm	70cm	
Hafiz (1985)	2.0	1.5	0.9	0.4	L. Freq.
Hafiz (1986)	1.6	1.2	0.8	0.5	L. Freq.
Yesaki & Waheed (1992)	2.4	2.1	1.8	1.4	Tagging
Anderson et al. (1995)	1.4	1.1	0.9	0.7	Tagging
Anderson et al. (1996)	0.8	0.5	0.2	0.0	Tagging

Fig. 1. Maldives skipjack catch by vessel type, 1970-1994

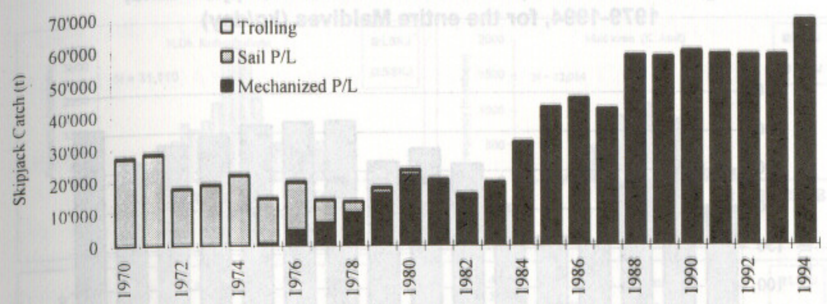


Fig. 2. Percentage of skipjack catch by vessel type, 1970-1994.

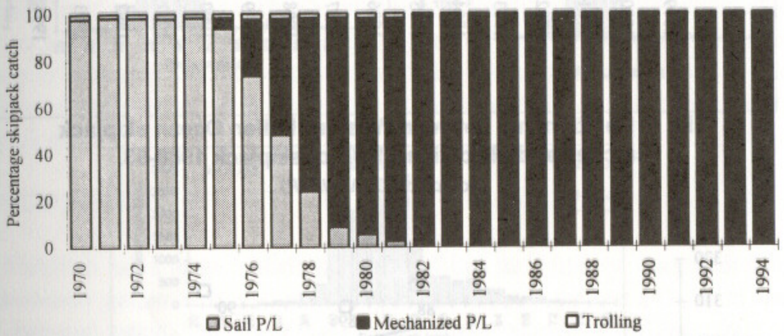


Fig. 3. Mechanized pole and line CPUE for skipjack tuna, 1979-1994, for the entire Maldives (kg/day)

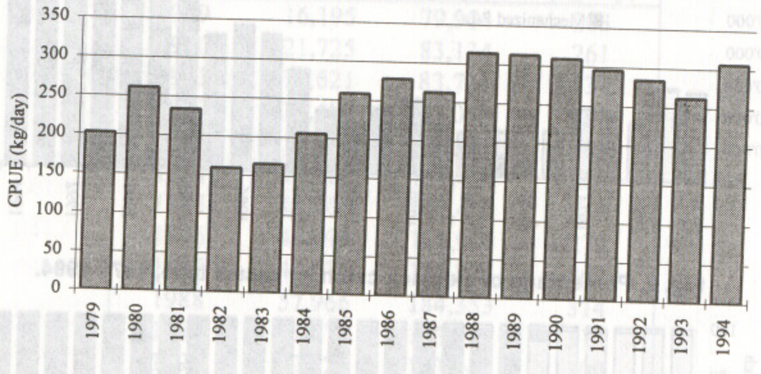


Fig. 4. Relationship between Western Indian Ocean skipjack catches and Maldivian CPUE of skipjack 1988-93.
(Sources: MOFA & IPTP)

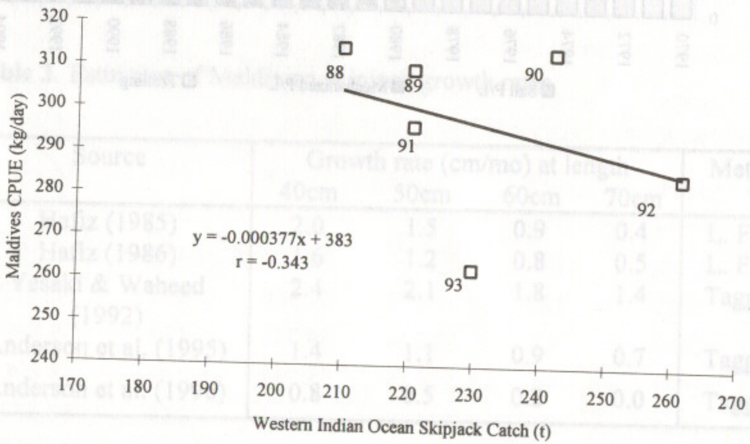
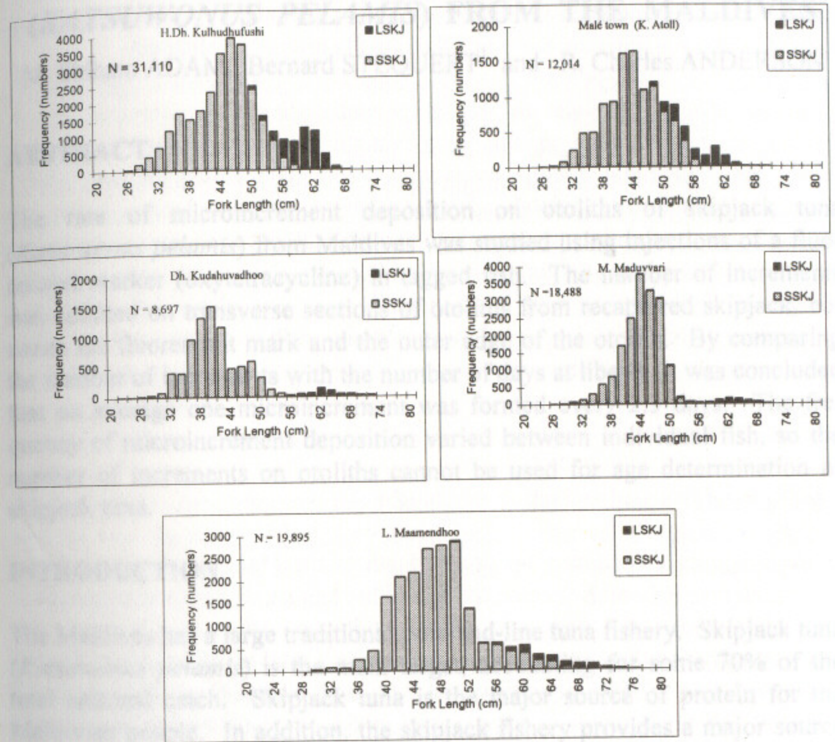


Fig. 5. Length frequency distribution of skipjack tuna from the Maldives, 1994



IRREGULAR MICROINCREMENT DEPOSITION ON THE OTOLITHS OF SKIPJACK TUNA (*KATSUWONUS PELAMIS*) FROM THE MALDIVES

M. Shiham ADAM, Bernard STEQUERT[1] and R. Charles ANDERSON

ABSTRACT

The rate of microincrement deposition on otoliths of skipjack tuna (*Katsuwonus pelamis*) from Maldives was studied using injections of a fluorescent marker (oxytetracycline) in tagged fish. The number of increments was counted on transverse sections of otoliths from recaptured skipjack, between the fluorescent mark and the outer edge of the otolith. By comparing the number of increments with the number of days at liberty, it was concluded that on average one microincrement was formed every 2.3 days. The frequency of microincrement deposition varied between individual fish, so the number of increments on otoliths cannot be used for age determination of skipjack tuna.

INTRODUCTION

The Maldives has a large traditional pole-and-line tuna fishery. Skipjack tuna (*Katsuwonus pelamis*) is the main target, accounting for some 70% of the total national catch. Skipjack tuna is the major source of protein for the Maldivian people. In addition, the skipjack fishery provides a major source of employment and a major source of export earnings.

It is believed that skipjack caught in the Maldives are part of an Indian Ocean stock. There is increasing concern that Maldivian tuna catches may be adversely affected by the growing catches of skipjack tuna being made elsewhere in the Indian Ocean. There is particular concern about the disasterous consequences for the Maldives that would result if the Indian Ocean skipjack tuna stock collapsed as a result of overfishing. To date there has been no comprehensive stock assessment of Indian Ocean skipjack. A prerequisite for

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such a stock assessment would be a sound understanding of Indian Ocean skipjack growth rates. The study of 'daily rings' in otoliths (Panella, 1971 and 1974) offers perhaps the best method for elucidating fish growth rates, provided that the periodic nature of the rings is properly validated.

The aim of this study was to test the periodic nature of microstructures in Maldivian skipjack tuna otoliths, as a first step towards determining growth rates. Skipjack tunas were injected with tetracycline during the course of a tuna-tagging programme (Waheed and Anderson, 1994; Anderson, Adam and Waheed, this volume). Otoliths from recaptured fish were examined to determine the number of microincrements between their outer edges and the flourescent marks caused by the tetracycline. It was planned to inject and release an initial 500 skipjack, so that methods could be tested prior to undertaking a larger study if required.

METHODS

Marking of fish and collection of otoliths

A tuna-tagging programme was carried out in the Maldives during 1993-95 by the Marine Research Section (MRS) of the Ministry of Fisheries and Agriculture (Waheed and Anderson, 1994; Anderson, Adam and Waheed, this volume). During the course of that programme a total of 494 skipjack (out of a planned total of 500) were injected with tetracycline prior to tagging and release. All these skipjack were tagged in the south of the Maldives in the vicinity of the One-and-a-Half-Degree Channel. Thirty-four of these skipjack were tagged and released during tetracycline injection trials in February and April 1994. The remainder (460) were injected and tagged in August 1994.

The length-frequency distribution of the tetracycline-injected fish is illustrated in Figure 1. One fish was not measured. The remaining 493 skipjack were within the size range 35-65 cm FL, with a modal length of about 46 cm. The weight of a modal-length fish is estimated at about 2.0 kg; the mean weight of all the skipjack injected is estimated to be 2.1 kg.

The dose injected was about 1ml of 100mg/ml oxytetracycline for an average-sized skipjack (i.e. nominally about 50 mg/kg). Minor seepage of oxytetracycline was often observed from the injection site, so the effective dose injected would often have been less than this. It was not practical to adjust dosage for individual fish, although the largest skipjack were injected with 2x1ml of 100 mg/ml oxytetracycline. Injections were made intramuscularly, just below the first dorsal fin origin, using a continuous pippetting syringe dispenser.

Orange tags were used to mark tetracycline-injected fish, to distinguish them from the yellow-tagged normal fish (Anderson, 1995). Arrangements were made with the Government-owned Maldives Industrial Fisheries Company (MIFCO) to collect recaptured orange-tagged skipjack from fishermen, and return them frozen to MRS in Malé. Fishermen were informed of the programme and of arrangements for the return of orange-tagged skipjack through a nation-wide publicity campaign, which included radio and TV broadcasts, and posters distributed to every fishing island and every MIFCO collector/freezer vessel. A premium price of MRf 200 (about US$17) was paid for each skipjack returned with orange tag in place and with full recapture information. Recapture information was recorded on printed forms distributed in advance to every island and collector/freezer vessel.

Not all Maldivian fishermen have access to collector/freezer vessels. Information was therefore broadcast recommending that such fishermen gut any orange-tagged skipjack that they might catch and preserve them in salt prior to forwarding to MRS in Malé.

In Malé all fish were measured to the nearest millimetre, and beheaded with a hacksaw. The top of the head was then cut off, again with a hacksaw, to expose the top of the brain. It was found easiest to cut the fish while it was frozen, and then allow the head to thaw before removing the otoliths. Removing the brain with coarse forceps exposed the cavities of the membranous labyrinths and semi-circular canals containing the otoliths. Sagittae were extracted with fine forceps and stored in a small numbered plastic tube. The first dorsal spine and a few vertebrae were removed from each fish at the same time for separate study.

Otolith preparation and procedures

In the ORSTOM laboratory, sagittae were cleaned in sodium hypochlorite (household bleach) and distilled water, then dried in alcohol. Each otolith was embedded in polyester resin (Sody 33) and a transverse section made with a low-speed saw (Isomet Buchler) to obtain a slice containing the primordium. This slice was attached to a glass microscope slide with thermoplastic glue (Crystalbond 109) and then ground with wet sandpapers (800 and

1200 grit sizes) sprinkled with aluminium powder (0.5μm). It was then polished on a polishing plate with water and aluminium powder (0.3μm and 0.1μm) until the primordium was very close to the surface. The microscope slide was then placed on a hot plate for a few seconds to soften the glue, making it possible to turn the section. The turned section was polished again until a preparation of 50-100μm thickness was obtained.

The characteristic yellow tetracycline mark was identified under an optical microscope by means of ultraviolet light emitted from a 100watt mercury burner. Excitation wavelength was limited by a filter to 355-420nm, and autofluorescence was minimized by a 390nm barrier filter. The position of the fluorescent mark was noted on a photographic print. The surface of the section was then partially decalcified with 5-7% EDTA (Ethylenediaminetetraacetic acid) to emphasize the increments. Under a separate microscope, using a Metallographic lens and a total magnification of 1000x, the number of increments between the position of the fluorescent mark and the outer edge of the otolith was counted. A minimum of six counts at different times were made on each otolith by two different readers, without prior knowledge of the previous counts.

A few skipjack otoliths were observed under a scanning electron microscope (SEM) to confirm the status of microincrements observed under the optical microscope.

RESULTS

To the end of August 1995 a total of 58 returns were made, as follows:

Orange-tagged skipjack, frozen	32
Orange-tagged skipjack, salted	2
Orange tag without skipjack	24
Total	58

Thus, the recapture rate for all tetracycline-injected skipjack was 11.7% (58/494). The return rate for all skipjack tagged but not injected during the period of September 1993 to August 1994 was 8.0% (481/5980).

Two skipjack preserved in salt were returned by fishermen to MRS. One had been gilled as well as gutted, and no trace of the otoliths could be found. The other had been gutted but not gilled, and one otolith was recovered. However, the outer layers of this otolith were badly deformed, with numerous microscopic cracks, making it unreadable.

From the 32 frozen skipjack returned to MRS, otoliths were obtained from 30. Not all of these 30 recovered otolith sets were usable for this study. On examination under UV light, only 8 showed a visible fluorescent mark on their otolith section. The pertinent information for increment counts in these 8 skipjack tuna otoliths is presented in Table 1. This sample included fish with fork lengths at recapture in the range 48.0 to 56.6cm, and which had been at liberty for between 32 and 225 days.

The mean number of increments counted between the tetracycline mark and the edge of otolith was less than the number of days at liberty in 7 out of 8 cases (Table 1 and Figure1). In fact, the estimated number of increments deposited per day varied greatly between individuals, from 1.26 to 0.27. The weighted average was 0.44 increments per day, i.e. an average of 1 increment every 2.3 days.

Because the number of increments deposited per day varies greatly between individuals, there is not a precise relationship between the number of increments and the number of days at liberty (Figure 2). Nevertheless, the best linear relationship between the number of increments (Ni, dependent variable) and the number of days at liberty (Nd, independent variable) is:

$$Ni = 0.245\ Nd + 25.9 \qquad (r = 0.73)$$

The confidence limit (1.96 SE) for the estimate of the slope (0.245) is 0.18. The slope of the relationship is significantly different from 1 ($p>0.95$). Since the slope might be expected to pass through the origin, the relationship (assuming it is linear) may also be represented as follows:

$$Ni = 0.395\ Nd \qquad (r = 0.52)$$

The confidence limit (1.96 SE) for the estimate of this slope (0.395) is 0.10, and is again significantly different from 1.

DISCUSSION

From these results it is concluded that the formation and deposition of otolith increments in Maldivian skipjack is not daily. Furthermore, since the number of microstriae deposited per day varies between individuals, otoliths cannot be used for age determination in Maldivian skipjack tuna. These results differ greatly from the results of Panella (1971, 1974) and most subsequent studies, which show that for most fish species increment deposition is daily.

Findings of non-daily increment deposition are known but are not common. Brothers *et al.* (1976) showed that the use of increment counts underestimated the age of 7- to 13-year-old hake (*Merluccius angustimanus*) by 2 to 3 years. Caillart and Morize (1989) found that, on average, one microstria was formed only every 2 days in a tropical grouper (*Epinephelus microdon*) from French Polynesia. Le Guen (1976) demonstrated that in a tropical sciaenid (*Pseudotolitus elongatus*) incremental age agreed with age determined by seasonal marks in immature fish, but underestimated age in mature fish by up to 30%.

Among Scombrid fishes, most of the studies on larvae or juveniles (Brothers *et al.*, 1983; Radtke, 1983; De Vries *et al.*, 1990; Jenkins and Davis, 1990; Wexler, 1993), and on adults (Wild and Foreman, 1980; Wild, 1986; Stéquert *et al.*, 1995) have demonstrated that increment deposition is daily. However, Wild and Foreman (1980) found that skipjack tuna in the eastern Pacific (Revillagigedo Islands - Baja California region) deposit significantly less than one increment per day. Their results suggested an average deposition rate of one increment every 1.3 days (0.76 ± 0.09 [mean ± 1.96SE] increments per day). Our results indicate an average deposition rate of one increment every 2.3 days (weighted average, equivalent to 0.44 increments per day) or one increment every 1.8 days (unweighted average, 0.57 ± 0.23 increments per day).

Comparing Wild and Foreman's (1980) original data on individual skipjack increment deposition rates (from their Table 8, but excluding their deleted sample K4334) with ours (Table 1), it is assumed that the two samples do not have equal variances ($F=3.27 > F_{0.025(7,24)}$). Given this, it is concluded that mean deposition rates are not significantly different ($t=1.78 < t_{0.05(8)}$).

It should be noted that there was a difference in otolith-reading technique between the study of Wild and Foreman (1980) and this study (cellulose acetate replica of external etched surface versus transverse section). Wild and Foreman (1980) noted that, using the cellulose acetate replica technique, ventral edge counts (i.e. the external equivalent of a transverse section) were significantly lower than rostral or postrostral counts in yellowfin tuna

(*Thunnus albacares*). They therefore counted skipjack increments only along the rostrum. However, Stéquert, Panfili and Dean (1995) have demonstrated that in yellowfin tuna the cellulose acetate technique underestimates ventral edge counts because increments overlap within the otolith and so cannot be seen on the external face. These increments are separable in transverse sections, under suitable magnification. The use of transverse sections in this study of skipjack otoliths is therefore not thought to be a source of error in estimating increment deposition rates Nevertheless, if the opportunity arises, the second otolith of each of the eight skipjack otolith pairs showing OTC marks will be examined in longitudinal/oblique section.

There are several explanations for deviations in increment deposition from the generally observed daily rate. Starvation experiments have been shown to lower deposition rates in larval anchovy, *Engraulis mordax* (Methot and Kramer, 1979) and in rainbow trout, *Onchorhynchus mykiss* (Brothers, 1978). Reduction in temperature and photoperiod has been shown to inhibit the formation of increments in sunfish, *Lepomis cyanellus* (Taubert and Coble, 1977). These results suggest that in the natural environment stresses such as thermal changes, lack of food, and perhaps also reproductive events, might be able to induce some breaks in growth that lead to a reduction in the deposition of increments.

For skipjack tuna, temperature changes may not be a significant factor affecting increment deposition rates, since they live in the upper layers of tropical waters where temperature variations are generally rather small (although if excursions through the thermocline are made major temperature variations would be experienced). A more important factor responsible for the observed reduction in increment deposition rate may be reproductive activity, which in this species is carried out all year round (Stéquert and Ramcharrun, 1995). However, the most significant factor affecting increment deposition rates in skipjack otoliths may well be food availability. This species is an opportunistic feeder, and can survive for several days without food when moving through unproductive areas. Such behaviour seems likely to reduce increment deposition rates.

One other possible explanation for the reduced increment deposition rate in skipjack tuna (namely that daily increments exist but are not visible to the observer) can be discounted. Davies *et al* (1988) studied the otoliths of smooth oreo (*Pseudocyttus maculatus*) and black oreo (*Allocyttus* sp.). Using a scanning electron microscope (SEM) they demonstrated that the crystalline structures in some areas of those otoliths were so complex and confused that they obscured the microincrements. Our observations on skipjack otolith sections under SEM did not reveal any such structures. All increments appeared well formed and clearly distinguishable from each other.

It is not known why only 8 skipjack out of 32 showed tetracycline marks in their otoliths. In the 8 skipjack that did have fluorescent marks the marks were clear, so it seems unlikely that the dosage of oxytetracycline administered was inadequate. Nor is it likely that mistakes were made in the labelling of otoliths, resulting in a mix-up between tetracycline-marked and unmarked otoliths. One explanation might be that some fish were frozen for much longer before being returned to MRS than others, resulting in deterioration of the tetracycline mark. Since those fish that did have useable otoliths (nos. 31, 32 and 34, and numbers 49-53) were grouped according to time, and hence batch, of return to MRS this is certainly a possibility. Unfortunately records of times spent frozen were not kept, but in any case in future experiments they will be kept to a minimum. It should be noted that the brand of tetracycline used in this experiment ("Terramycin" manufactured by Pfizer Inc.) is labelled "Do not freeze". However, Mr. Vince Petersen (Quality Operations Manager, Pfizer Pty. Ltd., Sydney, Australia, pers. comm.) informs us that "we have researched our archives and also undertaken some practical work in our laboratory and this indicates that there appears to be no effect on the fluorescence of the material due to thawing and freezing".

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Table 1. Skipjack measurement data and otolith increment counts.

Key: FL = Fork length; Δt = number of days at liberty; *Ci* = increment count number *i*

Fish no.	FL (cm)	Sex	Δt (days)	Different Increment counts C1	C2	C3	C4	C5	C6	C (mean)	Std. error	C/Δt
31	47	F	32	42	38	37	41	42	41	40.2	0.87	1.26
32	49	M	35	27	26	27	27	28	27	27.0	0.26	0.77
34	46	F	69	33	33	31	31	34	28	31.7	0.88	0.46
49	46	F	153	96	103	96	92	97	99	97.2	1.49	0.64
50	49	F	193	91	87	92	89	86	92	89.5	1.06	0.46
51	52	M	187	54	54	49	52	48	50	51.2	1.05	0.27
52	45	F	225	71	68	67	70	72	68	69.3	0.80	0.31
53	45	F	179	65	61	66	62	63	65	63.7	0.80	0.36

Fig. 1. Size frequency distribution of OTC injected skipjack tuna.

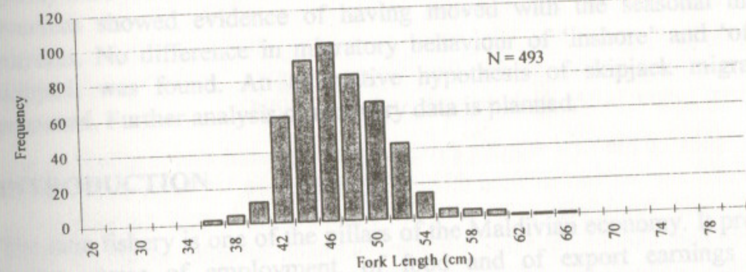
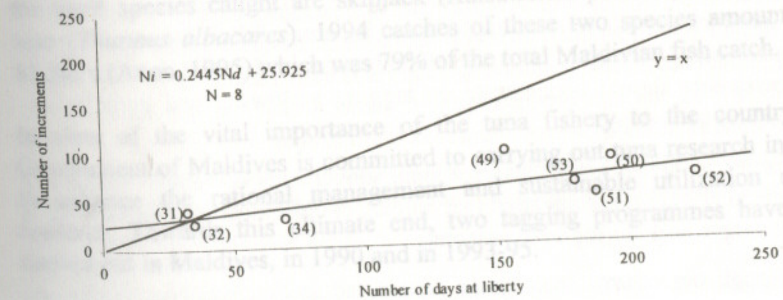


Fig. 2. Relationship between number of otolith increments (from OTC mark to the otolith edge) and number of days at liberty, for Maldivian skipjack tuna. Individual fish reference numbers in parentheses.



TUNA TAGGING ACTIVITIES IN THE MALDIVES, 1993-95

R. Charles ANDERSON, M. Shiham ADAM and Ali WAHEED

ABSTRACT

Between September 1993 and August 1995 a total of 7777 tunas were tagged, comprising 6474 skipjack (83%) and 1303 yellowfin (17%). Tetracycline injection of skipjack was carried out in 1994, and of yellowfin in 1995. To the middle of December 1995 a total of 576 recoveries had been received, which was 7.4% of releases. There were 553 skipjack recoveries (8.5% of releases) and 23 yellowfin recoveries (1.8% of releases). The majority of tags (96%) were recovered within the Maldives. Skipjack and yellowfin recovered overseas showed evidence of having moved with the seasonal monsoon currents. No difference in migratory behaviour of 'inshore' and 'offshore' skipjack was found. An alternative hypothesis of skipjack migration is proposed. Further analysis of recovery data is planned.

INTRODUCTION

The tuna fishery is one of the pillars of the Maldivian economy. It provides a major source of employment, of food and of export earnings for the Maldivian people. The tuna fishery is a traditional one which has been in existence for centuries. Despite economic diversification in recent years, tuna fishing continues to be of major importance to the Maldives, with record catches in 1994. The main fishing technique used is livebait pole and line, and the main species caught are skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*). 1994 catches of these two species amounted to 82,500 t (Anon, 1995) which was 79% of the total Maldivian fish catch.

In view of the vital importance of the tuna fishery to the country, the Government of Maldives is committed to carrying out tuna research in order to enhance the rational management and sustainable utilization of the resource. Towards this ultimate end, two tagging programmes have been carried out in Maldives, in 1990 and in 1993-95.

First Tagging Programme - Results and Recommendations

During 1990 the Marine Research Section (MRS) of the Maldivian Ministry of Fisheries and Agriculture (MOFA) carried out a tuna tagging programme, with assistance from the Indo-Pacific Tuna Programme (IPTP). Nearly 10,000 tunas were tagged, of which 81% were skipjack and 19% were yellowfin tuna (Yesaki and Waheed, 1992). Recoveries amounted to 17.8% for skipjack and 7.0% for yellowfin (Waheed and Anderson, 1994).

Analysis of returns from the first tagging programme gave insights into the migrations and growth of both skipjack and yellowfin tuna (Yesaki and Waheed, 1991 & 1992) as well as into some aspects of the population dynamics of skipjack in Maldivian waters (Bertignac, Kleiber and Waheed, 1994; Bertignac, 1994). That tagging programme successfully fulfilled all of its stated aims (Yesaki and Waheed, 1992; Lewis, 1992). It also raised a number of new questions. In order to address these questions, several recommendations were made for future tagging activities, and are summarized below (after Waheed and Anderson, 1994):

1. The results of the first tagging programme suggested that skipjack tagged 'offshore' moved further than those tagged 'inshore.' Yesaki and Waheed (1992) and Bertignac et al. (1994) recommended that future tagging experiments should tag more offshore skipjack in order to obtain better estimates of movements from the Maldives, and of the relationship between 'resident and migratory stocks.'
2. The results of the first tagging programme suggested that yellowfin tuna are more wide-ranging than skipjack. Yellowfin might therefore be more vulnerable to interactions with other fisheries. They might also potentially be more vulnerable to over-exploitation because of their longer life cycle. Yesaki and Waheed (1992) therefore recommended that future tagging experiments should concentrate on tagging yellowfin, and include both juveniles and adults.
3. In order to better understand seasonal movements of tunas, Yesaki and Waheed (1992) recommended that tagging should ideally be carried out in each target area during both seasons.
4. Although tag returns from tunas recaptured in the Maldives during the first tagging programme were believed to have been very good, information supplied with the tags was often lacking or of dubious quality. It was recommended that more effort be spent obtaining more accurate tag return information, particularly length-at-recapture information for growth estimates (Yesaki and Waheed, 1992; Lewis, 1992). The value of injecting tagged tunas with tetracycline to mark their otoliths for aging studies was also recognized.
5. Several recommendations were made for the improvement of tag return data, to facilitate future attrition model analysis (Bertignac et al., 1994). These included tagging in discrete 'pulses,' double tagging, and tag seeding.
6. Yesaki and Waheed (1992) recommended that more effort be expended on obtaining better information on the bait fishery.

Second Tagging Programme - Aims

The recommendations of the first tagging programme were used as the basis for planning the second tagging programme, which was carried out during 1993-95. However, a number of other considerations had also to be taken into account. First, with a budget allowing for approximately 7000 releases it was not practical to address all of these recommendations. Furthermore, although Yesaki and Waheed (1992) had recommended concentrating on yellowfin tuna, skipjack is by far the most important fish species for the Maldives. Skipjack catches averaged 68% of the total recorded national fish catch in 1992-94. Therefore emphasis was placed on tagging skipjack rather than yellowfin.

Tagging of skipjack was concentrated in the south of Maldives. From the results of the first tagging experiment, skipjack in that area were believed to be the most likely to show interactions with the western Indian Ocean purse-seine fleet. In addition, there is a highly productive 'offshore' fishing ground in the southern Maldives, in which it was believed large numbers of skipjack could be tagged. This is actually a seamount, known locally as *Satoraha*. It should be noted that it was impractical to tag near Malé because the high prices usually paid at Malé market make releasing tagged fish an unattractive proposition for fishermen there.

Only limited tagging of yellowfin could be carried out. It was therefore planned to concentrate on large individuals (>80cm FL) which show marked, but poorly understood, migrations in Maldivian waters, and are likely to show interactions with high-seas longline and purse-seine fleets.

The specific aims of the second Maldivian tagging programme were:

1. To tag at least 6000 skipjack tuna, divided as evenly as practical between inshore/offshore and northeast monsoon/southwest monsoon, in order to study their migrations.
2. To double-tag 500 skipjack, in order to obtain a first estimate of tag shedding rates.
3. To inject 500 skipjack with tetracycline prior to tagging and release, in order to validate otolith aging, and to test procedures for returning recaptured fish for future experiments.
4. To obtain estimates of skipjack growth rates from tag recovery data.
5. To tag up to 500 large yellowfin tunas (>80cm FL), in order to study their migrations. This was to be carried out both opportunistically on tagging trips mainly targeting skipjack, and on specific trips targeting known concentrations of large yellowfin. This objective proved impossible to achieve. It was therefore changed to the tagging and tetracycline injecting of 1000 juvenile yellowfin tunas, in order to validate otolith aging.
6. An additional non-tagging objective was to obtain information on the quantities of live bait used during pole-and-line fishing, in order to estimate total live bait utilization in the Maldives.

It was decided not to carry out tag seeding, for two reasons. First, because of the practical difficulties of doing so unobserved on a small open boat. Secondly, because every tuna caught in Maldives is individually handled about 2-5 times between capture and sale/processing/consumption, so non-reporting is believed to be minimal.

The aims of this report are to present a description of the tuna-tagging activities undertaken in the Maldives during 1993-95, together with a preliminary analysis of returns. Analysis of otoliths of tetracycline-marked skipjack is reported elsewhere in this Bulletin (Adam, Stéquert and Anderson, 1996). Analysis and reporting of skipjack returns using attrition models will be carried out and reported later. Returns of tetracycline-marked yellowfin

were very disappointing, and it has not been possible to complete the yellowfin aging study (Anderson, 1996).

METHODS

Tagging Strategy

Tagging strategy and methodology generally followed that established during the first Maldivian tuna tagging programme (Yesaki and Waheed, 1992). Tagging was carried out on board mechanized Maldivian pole-and-line vessels (*masdhoni*). These vessels are about 12-15m LOA and of traditional wooden construction. Fishing is carried out from a stern platform by 2-6 polers. *Masdhonis* typically leave from their home islands before dawn to collect live bait from nearby reefs. Baiting, with a simple lift net, may take 1-8 hours, although 3 hours would be typical. Once sufficient bait has been collected the fishermen move offshore in search of tuna schools. They return to their islands in the late afternoon or evening Fishermen sometimes collect bait on one day for use on the next.

Tagging took place during normal *masdhoni* day trips. The ideal strategy would have been to select the best *masdhonis* on the chosen island, and for each tagging team (there were normally two) to go out every day on the same boats. However, in order to ensure the cooperation of the entire fishing community it was necessary to carry out tagging from as many *masdhonis* as possible. Therefore it was normal practice to use a different fishing boat every day. Although the start of a day's tagging was often rather slow, the skill of the Maldivian pole-and-line fishermen meant that they very quickly adjusted their technique to the requirements of the tagging teams. As a result the need to use many different vessels did not prove to be a constraint.

Vessels were not chartered. Rather, fishermen were paid a premium rate for every tuna tagged and released from their vessel. The rates paid were 3-4 times market value, which was normally sufficient to ensure the fishermen's full cooperation. The rates paid were initially set at:

MRf 50	(about US$4.20)	for skipjack and yellowfin < 80cm FL
MRf 100	(about US$8.40)	for yellowfin 80-100cm FL
MRf 150	(about US$12.70)	for yellowfin >100cm FL

These rates were paid during tagging trips 1, 2 and 3. However, during trip 3 (at G.A. Villingili) problems arose as a result of arguments between those fishermen who had achieved high tag releases (and hence high financial rewards) and those who had achieved none. Subsequently, the payments for the release of skipjack and small yellowfin were reduced to MRf 40 per fish. During trip 6 (Fuvah Mulaku) fishing was poor, and the price available for large yellowfin on the island was high. In that case it was necessary to increase the price paid for releases to MRf 175 for yellowfin of 80-100cm FL and to MRf 250 for yellowfin greater than 100cm FL.

It was decided not to tag near FADs (of which there were 14 deployed in Maldivian waters in September 1993, and 28 in August 1995). To do so might have added a complicating factor to the analysis of attrition rates. An exception was made in the case of yellowfin injected with tetracycline during the tagging trip in August 1995. The main aim of that tagging exercise was the determination of growth rates, not the study of movements or attrition rates.

Tagging Methodology

Tagging was normally carried out by a team of three: a fish holder, a tagger, and a recorder. In addition, a member of the crew was often enlisted to help pass tunas to the fish holder. The tagging team sat on one side of the fishing vessel, just forward of the stern fishing platform. The crew fished from both sides of the fishing platform. They were instructed to fish as normal from one side. On the side with the tagging team the fishermen were asked to pole any tunas caught directly to the fish holder. The captured tunas were held on a 1m wooden measuring board on the deck while being tagged. When tagging juvenile yellowfin care was taken to avoid tagging any bigeye tuna (*Thunnus obesus*), but it is possible that a few individuals of this species may have been tagged by mistake. Plastic dart tags manufactured by Hallprint of Australia were used, in three varieties:

1. For skipjack and small yellowfin:

Tag type:	PDT (Yellow 10cm x 1.5mm)
Tag numbers:	MDV1201 - MDV8200
Legend:	No. MDV....MIN. FISH. & AGRI. MALDIVES. FAX(960)326558 No. MDV.... SEND LENGTH, LOCATION, DATE, SPECIES

2. For large yellowfin:

Tag type:	PDA-T (Yellow 12.5cm x 2.0mm)
Tag numbers:	MDV0001 - MDV0650
Legend:	No. MDV....MIN. FISH. & AGRI. MALDIVES. FAX(960)326558 No. MDV.... SEND LENGTH, LOCATION, DATE, SPECIES

3. For tetracycline injected fish:

Tag type:	PDT (Orange 10cm x 1.5mm)
Tag numbers:	MDV0651 - MDV1200 (For skipjack) MDV8201 - MDV9300 (For yellowfin)
Legend:	No. MDV... MIN. FISH. & AGRI. MALDIVES. FAX(960)326558 No. MDV... COLLECT OTOLITH, LENGTH, LOCATION, DATE, SPECIES

Stainless steel applicators of 140mm x 3mm were used for PDT tags (i.e. for skipjack and small yellowfin) and of 135mm x 4mm for PDA-T tags (i.e. for large yellowfin). Tags in their applicators were set out in plastic-impregnated canvas aprons prior to each day's tagging. Each apron was stitched with two rows of 50 pockets, enabling it to hold 100 applicators. The aprons could be folded and rolled into compact bundles when not in use.

Tags were inserted dorsally, adjacent to the second dorsal fin in such a way that the tag barb became caught under the fin ray extensions or the neural spines. Whenever possible fish were returned to the water in a slightly head-down attitude and facing the fishing vessel's bows. In this position the tagged tunas tended to swim down and forward, away from the feeding school at the stern. Tagging times (from first hooking to release) were of the order of 12-16 seconds at the beginning of tagging trips with inexperienced tagging teams, and of the order of 7-10 seconds with experienced teams. Tetracycline injecting was only carried out by experienced teams, but still increased tagging times by 2-5 seconds.

Large Yellowfin

Large yellowfin were caught by handline or troll, not by pole and line. A few were caught with handlines from pole and line vessels near Laamu and Gaafu Alifu Atolls during breaks in pole-and-line fishing. Near Fuvah Mulaku most were tagged from the small (5-9m LOA) local *dhonis*. During the first trip in November 1993 the large yellowfin were caught with short handlines; cut pieces of skipjack and/or other tunas were used as chum. Fishing times were of the order of 5-10 minutes, and tagging times were of the order of 1 minute or less. During the second trip to Fuvah Mulaku in April 1994 trolling was used to catch large yellowfin. Fishing times were of the order of 3-5 minutes, and tagging times were about 1 minute or less. A brief description of the Fuvah Mulaku yellowfin fishery is given by Anderson, Adam and Waheed (1993). Both trips made to Fuvah Mulaku were hampered by bad weather; another trip planned for November 1994 had to be cancelled because of bad weather.

Double Tagging

A total of 504 skipjack were double-tagged in order to provide an estimate of tag shedding rates. One tag was placed in the normal position, adjacent to the second dorsal fin on the left side of the fish. The second tag was inserted about 1-2 cm posterior to the first on the right side of the fish. Consecutively-numbered tag pairs were used.

'Dummy Tagging'

During the course of tagging operations it was noticed that live tunas are highly tensed during handling. Dead tunas when measured are (except during *rigor*) rather flaccid. It is therefore possible that one potential source of discrepancy between length at release and length at recapture, even for fish recaptured on the day of release, may be loss of tone following death. To quantify this possible source of error a small number of fish were tagged in the normal way, but then 'released' to the fish hold instead of the sea. Later, when dead, these fish were remeasured.

Tetracycline Injection

494 skipjack (out of a planned total of 500) were injected with tetracycline prior to tagging and release. Most skipjack were injected and tagged by a team of three: a fish holder, an injecter, and a tagger/recorder. The dose injected was about 1 ml of 100 mg/ml oxytetracycline (OTC) for an average-size skipjack (i.e. nominally about 50 mg/kg). Minor seepage of oxytetracycline was often observed from the injection site, so the effective dose injected would often have been less than this. It was not practical to adjust dosage for individual fish, although the largest skipjack were injected with 2 ml of 100 mg/ml oxytetracycline (again nominally about 50 mg/kg).

Injections were made intramuscularly, just below the first dorsal fin origin, using a continuous pippetting syringe dispenser. Care was taken to avoid injecting in the region of the lateral line. Tetracycline-injected skipjack were tagged with orange tags to differentiate them from 'normal' tagged skipjack (Anderson, 1995). The results of this experiment are reported elsewhere in this Bulletin (Adam, Stéquert and Anderson, 1996) and are not dealt with further here.

737 juvenile yellowfin tuna were injected with tetracycline prior to tagging and release during a trip to Baa Atoll in August 1995. Yellowfin were injected and tagged by a team of four: a fish holder, an injecter, a tagger, and a recorder. The dose injected was about 0.7 ml of 200 mg/ml oxytetracycline for an average-size yellowfin (i.e. nominally about 100 mg/kg). Minor seepage of oxytetracycline was often observed from the injection site, so the effective dose injected would often have been less than this. It was not practical to adjust dosage for individual fish, although the largest yellowfin were injected twice (nominally about 80 mg/kg). A higher dose of tetracycline was injected than had been used for skipjack because several otoliths from recaptured skipjack did not show a tetracycline mark (Adam, Stéquert and Anderson, 1996). As in the case of skipjack, injections were made intramuscularly, below the first dorsal fin origin, using a continuous pippetting syringe dispenser. Tetracycline-injected yellowfin were tagged with orange tags to differentiate them from 'normal' tagged tunas. The returns from this experiment were very poor (Anderson, 1996), and are not dealt with further here.

Publicity, Recoveries and Rewards

Tuna tagging activities have received considerable publicity within the Maldives. Each of the seven tagging trips undertaken received national radio news coverage. In addition, there have been periodic informative broadcasts on radio and TV, and occasional articles in local newspapers. Posters printed in the local language (Dhivehi) were distributed to each of the 202 inhabited islands and to every tuna collector and freezer vessel.

It was noted during the first tagging programme (Yesaki and Waheed, 1992) that recapture information, and in particular information on length at recapture, was often of poor quality. To try to improve recapture information, printed recapture forms and tailors' tape measures were distributed to the government offices on each inhabited island and to every collector/freezer vessel. Conversion factors for tape length to board length were prepared by MRS. Measuring boards were available on 16 islands with MOFA/MRS field officers.

Rewards for tags recovered in the Maldives were paid in cash, as recommended by Yesaki and Waheed (1992), at the following rates:

Tag without full information	MRf25 (about US$ 2.10)
Tag with full information	MRf 50 (about US$ 4.20)
Orange tag plus OTC injected fish	MRf 200 (about US$17.00)

In addition to the cash rewards paid for every recovery, a 'lucky dip' was held on Fishermen's Day (10 December) 1994 in which every tag number returned during the previous two years was entered. A total of ten tag numbers were drawn, each receiving a cash prize of MRf 1000 (about US$ 85). This 'lucky dip' received advance radio publicity, and the actual draw received live national radio coverage. A second 'lucky dip' was held on Fishermen's Day 1995, during which all tag numbers returned during the previous year were entered.

Internationally, the second Maldivian tuna-tagging programme was announced at the fifth IPTP Expert Consultation on Indian Ocean Tunas, held in Seychelles in October 1993 (Waheed and Anderson, 1994). English-language posters were distributed to selected delegates at that meeting. Subsequently, more English-language posters were sent to interested parties. Dhivehi posters were sent to Minicoy (the southernmost island in the Indian Lakshadweep Islands, where the inhabitants speak the same language as in the Maldives). IPTP printed a Sinhalese language poster for distribution in Sri Lanka. A number of announcements about the tagging programme were published in regional fisheries newsletters (Adam, 1994; Anon., 1993a, 1993b & 1994; Anderson, 1995; Anderson, 1996). T-shirts printed with information about the tagging programme were given as rewards for international tag recoveries. Results of the programme were presented at the sixth IPTP Expert Consultation on Indian Ocean Tunas, held in Colombo in September 1995.

Livebait weighing

Tagging teams usually requested fishermen to collect bait on the day before tagging took place, in order to maximize time spent tuna fishing. As a result relatively few baiting operations were observed. Despite this it was possible to weigh the total morning livebait catch of six *masdhonis*. Every haul of live bait (average 12 hauls per operation) was weighed in a large plastic container with several centimetres of water in the bottom, using a large pan balance. The average weight of livebait caught before each of the six days' tuna fishing was 46.7 kg. From these data it was roughly estimated that the total quantity of live bait caught in the Maldives was 11,100 ± 2800 t in 1993. The details of this study have been published elsewhere (Anderson, 1994) and are not considered further here.

Observers

During trip 3 (G.A. Villingili) two observers from the Indo-Pacific Tuna Programme, Colombo, participated in several tagging day trips. During trip 4 (L. Maamendhoo) two observers from the Fisheries Survey of India participated in several tagging day trips.

RESULTS

Tag Releases

Seven tagging cruises were carried out between September 1993 and August 1995, during which a total of 7777 tunas were tagged and released (Table 1). A location map showing tagging areas is given in Figure 1. The releases comprised 6474 skipjack (83%) and 1303 yellowfin (17%). In addition, a single frigate tuna (*Auxis thazard*) was tagged and released during trip no.3 (January 1994); it has not been recovered to date (October 1996) and is not included in any tables or totals in this report.

The 6474 skipjack were released during the course of 4 tagging trips between September 1993 and August 1994 (Table 2). The 6474 skipjack releases included 504 double-tagged fish and 494 which were injected with tetracycline. The length-frequency distribution of all the skipjack released (excluding a few for which release length was not recorded) is presented in Figure 2. The location of skipjack releases, by ½°x½° square, is given in

Table 3 and Figure 3. The numbering of the grid of ½°x½° squares used in Table 3 follows that of Waheed and Yesaki (1992). The sign indicates position relative to the equator (+ve is N; -ve is S). The first two digits indicate latitude, the next two digits indicate longitude, and the final digit indicates one of four ½°x½° squares within the 1°x1° grid.

Table 4 summarizes skipjack releases by position (i.e. inshore/offshore) and by season. Although it had been planned to release roughly equal numbers of skipjack inshore and offshore on each trip and in each season, this proved impossible because of the vagaries of weather and fishing. Despite this, roughly equal numbers were released in the two seasons: 3399 (53%) during the northeast monsoon and 3075 during the southwest monsoon. The division of skipjack releases between inshore and offshore was less equitable, reflecting the generally better fishing offshore. Offshore fishing was carried out in the vicinity of a seamount, known locally as *Satoraha*, which is about 6 hours by fishing vessel south of Laamu and 4 hours north of Gaafu Alifu. 4404 (68%) skipjack were released offshore, and 2070 inshore. Inshore fishing was generally within sight, or only just out of sight, of either Laamu or Gaafu Alifu Atolls.

1303 yellowfin were released during the course of 6 tagging trips between September 1993 and August 1995 (Table 5). Yellowfin releases included 83 large fish (i.e. FL>80cm). Catch rates for large yellowfin were very low, so it was not possible to meet the target of 500 releases. Therefore a new objective of tetracycline injection was introduced. 737 juvenile yellowfin were tetracycline injected during August 1995. The length-frequency distribution of all the yellowfin released (excluding a few for which release length was not recorded) is presented in Figure 4.

Tag Recoveries

Note that results presented by Anderson, Adam and Waheed (1995) were for recoveries up to the end of August 1995; in this report results are updated to include recoveries to mid-December 1995.

To the middle of December 1995 a total of 576 recoveries had been received, which was 7.4% of all releases. There were 553 skipjack recoveries (8.5% of skipjack releases) and 23 yellowfin recoveries (1.8% of yellowfin releases). For skipjack, tag recoveries by tag type and release date are summarized in

Table 6, and recoveries by release season and location are summarized in Table 7. For yellowfin, tag recoveries by tag type and release date are summarized in Table 8.

There was considerable variation between skipjack tag recovery rates according to release trip, season and position inshore or offshore. Overall recovery rates for skipjack released during the southwest monsoon were higher than those for skipjack released during the northeast monsoon (10.7% *vs.* 6.6%). However, the variation in recovery rates between the two tagging trips conducted during the southwest monsoon (2.6% *vs.* 12.9%) was greater than that between the two seasons. Overall recovery rates for skipjack released offshore were higher than those for skipjack released inshore (9.3% *vs.* 6.6%). Again, however, the variation in recovery rates between the two inshore tagging areas (5.3% *vs.* 12.9%) was greater than that between inshore and offshore.

Times of Recovery and Attrition Rates (Skipjack)

Of 553 skipjack recoveries, 20 did not have date of recapture information and 4 had suspect dates of recapture (i.e. date of recapture recorded as being before the date of release). Of the remaining 529 skipjack, 10 were caught on the day of release or the following day, and 251 (47%) were recovered during the first month after release. Thereafter skipjack recoveries declined exponentially (Figure 5), with the longest time at liberty being 563 days.

The attrition rate of all tagged skipjack returns was estimated at 24% per month (Figure 5a). The attrition rate of tag recoveries for skipjack tagged offshore was estimated at 23% per month (Figure 5b). For skipjack tagged inshore the tag attrition rate was estimated at 16% per month (Figure 5c).

Tag Shedding (Skipjack)

From 504 releases of double-tagged skipjack, 53 recoveries (10.5%) were received by the middle of December 1995. The majority of double-tagged skipjack were released during trip 5 (G.A. Kolamaafushi, August 1994). 51 recoveries (10.5%) were made from the 477 double-tagged skipjack releases made during that trip. Of the total of 53 recoveries, 46 were of skipjack with both tags still in place, and 7 were of skipjack with only a single tag in place. Thus, 99 out of 106 tags were recovered, i.e. 93.4%. Date of recapture was reported for 50 of the double-tagged skipjack. Times at liberty for these fish, from which tag shedding rates might be estimated, are summarized in the following list:

Time at Liberty (months)	Recaptured with two tags	Recaptured with one tag
0-1	20	2
1-2	6	1
2-3	8	0
3-4	1	0
4-5	1	0
5-6	0	0
6-9	4	0
9-12	2	1
12-15	0	0
Unknown	3	0
Total	46	7

Skipjack Growth

Of 553 skipjack recoveries, 20 had no information on date of recapture, a further 20 had no information on length at recapture, 4 were recorded as being recaptured before they were released, and 2 were recorded as having an unreliable release length. These 46 records were deleted, leaving 497 skipjack recoveries. From these were deleted all records in which measuring tool at recapture was unknown, and thus could not be corrected; all skipjack that were recorded as being measured with a board in inches (no such boards were distributed); all skipjack that had been recaptured after less than 30 days at liberty; and four obvious outliers. The lengths at recovery of the remaining skipjack that were recorded as being measured with either a tape or a ruler were converted to board lengths using a board length - tape length regression for skipjack (Anderson, Adam and Nadheeh, 1996). Skipjack that apparently showed negative growth were not removed, as they had been by Yesaki and Waheed (1992) and by Anderson, Adam and Waheed (1995) as this screening method is a biased one. The remaining skipjack recoveries were further screened following the procedure used by Yesaki and Waheed (1992): they were first segregated by length at release into 5-cm intervals (39 cm and below, 40-44 cm, 45-49 cm, and 50 cm and above). These four subsets were

then further divided into recoveries that had been at liberty for less than 120 days and those at liberty for more than 120 days. The means and standard deviations of the monthly growth rates were calculated for each of the 8 length/time groupings. Values beyond one standard deviation from the mean were deleted.

A Gulland and Holt plot of the remaining 153 screened skipjack recoveries is presented in Figure 6. There is clearly considerable variation in the estimated growth rates of individual recaptured skipjack, despite the rigorous screening. The average predicted growth rates are:

0.8 ± 0.11 cm/month at 40cm,
0.5 ± 0.07 cm/month at 50cm,
0.2 ± 0.14 cm/month at 60cm.

During the course of trip 5 (8/94) a total of 54 tunas of three species were 'dummy tagged.' They were measured and tagged but not released, and at the end of the day's fishing they were measured again. The numbers of fish measured and the differences in length between the two measurements are summarized below:

	Differences in length				Total number	Mean diff(cm)	SD
	-2cm	-1cm	0cm	+1cm			
Skipjack	3	8	5	0	16	-0.88	0.72
Yellowfin	0	7	19	3	29	-0.14	0.58
Bigeye	0	4	5	0	9	-0.44	0.53
Total	3	19	29	3	54	-0.41	0.69

These figures suggest that a tuna is on average about 0.4cm shorter alive than dead. This difference was not corrected for in calculating the growth rate estimates presented here, in part because of the relatively small numbers of tuna 'dummy tagged,' and uncertainty over the significance of apparent interspecific differences. Nevertheless, this is a source of error that could be taken into account in future, particularly if dealing with tunas that have been at liberty for short periods.

Skipjack Movements

Of 553 skipjack recoveries, 532 (96.2%) were from within the Maldives. Of these, recovery locations were reported for 521 skipjack, and are illustrated in Figure 3. Skipjack recoveries by season and position inshore/offshore at release are summarized in Table 7. A detailed study of recaptures within the Maldives is planned for later, so this aspect of the study will not be considered further here.

21 skipjack recoveries (3.2% of releases) were made overseas. Of these, 12 (1.9% of releases) were made by purse seiners operating in the western Indian Ocean to the west and southwest of Maldives. The remaining 9 overseas skipjack recoveries (1.4% of releases) were made by Sri Lankan vessels operating to the east and northeast of Maldives.

Yesaki and Waheed (1992) suggested that skipjack tagged offshore were more migratory than those tagged inshore. They based this idea on their observation that skipjack tagged offshore had a lower recovery rate within the Maldives, but a higher recovery rate overseas, than skipjack tagged inshore. Our findings are the exact opposite, and do not support this hypothesis. During this programme, tag recovery rates from within Maldives were higher for skipjack tagged offshore than for those tagged inshore (9.2% *vs.* 6.1%). Tag recovery rates from outside the Maldives were lower for skipjack tagged offshore than for those tagged inshore.

Quality of Tagging (Skipjack)

During tagging operations, efforts were made to ensure that only tunas in good condition and with well-placed tags were released. However, in some cases fish in slightly sub-optimal condition were released, in which case records of their condition and tag placement were kept.

370 skipjack were released in sub-optimal condition (5.7% of all releases). There were 521 recoveries of skipjack released in good condition (8.5% of such releases), and 32 recoveries (8.5% of releases) of skipjack released in sub-optimal condition. Thus there is no difference in recovery rates between the two subsets which suggests that the criteria for rejecting tuna were adequate.

177 skipjack were released with their tags sub-optimally positioned (2.7% of all releases). There were 547 recoveries of skipjack released with well-placed tags (8.7% of such releases), but only 4 recoveries (2.3%) of skipjack released with poorly placed tags. The difference between observed and expected recoveries for the two subsets is highly significant (chi squared = 7.67, df = 1, $p<0.01$). This suggests that in future tunas which have their tags inserted poorly should not be released, or if released that they should be excluded from most analyses.

Recoveries by School Type/Association (Skipjack)

On the tag recovery forms distributed to every fishing island, fishermen were asked to note the type of school (of which four categories were listed) from which their recapture had been made. This information was supplied for 521 of the 553 skipjack recoveries, as follows:

Reef-associated	11	(2.1%)
Free-swimming	268	(51.4%)
Flotsam-associated	15	(2.9%)
FAD-associated	227	(43.6%)

Yellowfin

To the middle of December 1995 a total of 23 yellowfin tag recoveries had been received (Table 8). This is only 1.8% of releases. However, over half of all releases were made in August 1995, from which only 5 recoveries had been made by the middle of December 1995 (and only 7 by the end of September 1996 (Anderson, 1996)). For the 566 yellowfin tagged before August 1995 there had been 18 recoveries (2.8% of releases) by mid-December 1995.

Recovery rates were particularly low for small yellowfin, i.e. those of less than 80cm FL (13/1220 = 1.1%). The overall recovery rate for large yellowfin (10/83 = 12.0%) was much higher than that for small yellowfin.

In November 1993, 31 large yellowfin were tagged near Fuvah Mulaku in the south of Maldives. 7 of these (22.6%) were recaptured, all close to Fuvah Mulaku and all within two months of release. A second trip to Fuvah Mulaku in April 1995 resulted in 36 more releases of large yellowfin, and 2 recaptures, both near Addu Atoll in August 1995. The tenth large yellowfin recovered was tagged near Laamu Atoll in September 1993 and recaptured near the same atoll in February 1994.

Two of the 23 yellowfin recoveries were from overseas, one from a Sri Lankan vessel, the other without precise information but probably from the western Indian Ocean purse-seine fishery (transshipped in Reunion).

DISCUSSION

Skipjack Growth

Because of the enormous variability in apparent growth of individual recaptured skipjack, the growth rates estimated during this programme might best be treated as unreliable. Yesaki and Waheed (1992) also concluded that their estimates of skipjack growth rates from Maldivian tagging returns were unreliable, because of inaccuracies in length measurements at both release and recapture. The results of the two programs are summarized for comparison:

Yesaki & Waheed (1992)	2.4 cm/mo at 40 cm	1.8 cm/mo at 60 cm
Anderson, Adam and Waheed (1995)	1.4 cm/mo at 40 cm	0.9 cm/mo at 60 cm
This report	0.8 cm/mo at 40cm	0.2cm/mo at 60cm

The differences between the results of Yesaki and Waheed (1992) and Anderson, Adam and Waheed (1995) are in part due to the correction of lengths at recapture measured with tapes in the latter study, but not in former. In this report much lower growth rates were estimated than in the previous two reports because the biased screening of all skipjack showing negative growth was not carried out. However, this did little to improve the precision of the growth estimates. In no study was correction made for fish tensing during tagging.

The estimation of growth rates from Maldivian tagging data is subject to many potential sources of error, and is highly sensitive to the data screening methods adopted. It is clear that tagging data of the type obtained here are unlikely to give robust estimates of tuna growth rates. It is therefore suggested that if/when a large-scale yellowfin tuna tetracycline marking experiment is carried out in the future, strenuous efforts should be made to obtain very precise measurements of length at both release and recapture.

Skipjack Movements

Yesaki and Waheed (1992) suggested that skipjack tagged offshore were more migratory than those tagged inshore, but our findings suggest the opposite. There are at least three possible explanations for this difference in findings.

First, account should be taken of the great variation in recapture rates between individual tagging trips, within seasons, and within release areas. As an example, the two skipjack-tagging trips conducted during the southwest monsoon season (trips 1 and 5) had overall recovery rates of 2.6% and 12.9% (Table 7). Much of this variation can be explained by differences in recaptures during the first month at liberty. As noted above, skipjack recaptures during the first month amounted to 48% of the total. During and after trip 1 the weather was very bad, and fishing activity was presumably limited. Only 14% of all recaptures from this trip were made in the first month (2 out of 14 recoveries with recapture dates). In contrast, during and after trip 5 the weather was very good, and fishing activity was presumably high. 51% of all recaptures from this trip were made in the first month (156 out of 305 recoveries with recapture dates). Substituting first-month recapture rates gives estimated total recapture rates of 4.6% of skipjack released during trip 1, and 7.3% for trip 5.

A second possible reason for the difference in findings on migration of inshore *vs.* offshore skipjack relates to the definition of 'offshore'. Yesaki and Waheed (1992) defined 'offshore skipjack' as any skipjack tagged in a ½°x½° square without land. The offshore area fished during this programme (grid area +01731, Satoraha) was specifically included in their definition (Yesaki and Waheed, 1992, p. 8). However, this fishing area includes a seamount with a general depth of about 270m, on the line of the Laccadives-Chagos Ridge. It might be argued that from a skipjack's perspective this is not an offshore area. The second area cited by Yesaki and Waheed (1992) as an offshore one was to the west of Raa Atoll, off the northwest Maldives, where there are no known seamounts. In general, though, the Maldives is a country of oceanic islands and the distinction between 'inshore' and 'offshore' is far from clear.

A third possible explanation relates to the size of fish tagged. Yesaki and Waheed (1992, p. 8) specifically note relatively low recapture rates within

Maldives of skipjack tagged offshore from Raa Atoll during their tagging trip 7. Their Figure 3 (Yesaki and Waheed, 1992, p. 6) shows that a large proportion of those skipjack were within the size range of 50-55cm. It is possible that the 'migratory skipjack' referred to by Yesaki and Waheed (1992) may have been '50-cm size class fish' rather than 'offshore' fish as such.

50-60 cm skipjack are known to be relatively under-represented in Maldivian catches (Anderson and Waheed, 1990; Adam and Anderson, 1996; see also Figure 2). Skipjack in Maldives mature at about 45 cm, and skipjack sex ratios are biased towards males (Hafiz, 1985; Anderson and Waheed, 1990).

50-60 cm skipjack are relatively common in Sri Lankan catches (Amarasiri and Joseph, 1985; Maldeniya and Suraweera, 1991; Maldeniya and Dayaratne, 1994). Within Sri Lankan waters, peak catches of skipjack are made off the southwest coast during the southwest monsoon (Maldeniya and Suraweera, 1991; Maldeniya and Dayaratne, 1994), i.e. off the coast facing Maldives when the current is from Maldives. Furthermore, Maldeniya and Suraweera (1991) note that female skipjack are unusually abundant at this time. Yesaki and Waheed (1992, p. 14) note that Sri Lankan recoveries of skipjack tagged in Maldives occurred predominantly during the southwest monsoon season (21 out of 23 recoveries), when prevailing currents are from west to east. Our results confirm this finding, with all 9 recoveries of skipjack from Sri Lanka being made during the southwest monsoon season.

Yesaki and Waheed (1992) state that skipjack recoveries from the western Indian Ocean purse-seine fishery were not so clearly current-related as those from Sri Lanka. Nevertheless, they report that most recoveries were made after the northeast monsoon when the prevailing current is to the west. Again, our results confirm this finding , with all 8 recoveries with known recapture dates being made during or just after the northeast monsoon.

On the basis of this information a provisional hypothesis of skipjack tuna migration in the waters around Maldives is proposed. Skipjack of 40-50 cm are abundant in Maldivian waters. After reaching sexual maturity these fish, and possibly females in particular, migrate offshore, moving with the prevailing currents. During the southwest monsoon season the prevailing current carries the skipjack into Sri Lankan waters. During the northeast monsoon the skipjack are carried towards the western Indian Ocean purse-

seine fishing area. At least some of these fish may return to Maldivian waters at a later date, since 60+cm skipjack are relatively well represented in Maldivian catches (Hafiz, 1985; Anderson and Waheed, 1990; Adam and Anderson, 1996).

It is not known at this stage to what extent the immature 40+cm skipjack in Maldives are essentially resident. However, the high recapture rates of such fish within Maldives (Yesaki and Waheed, 1992; this study) and the low skipjack diffusion rates within Maldives estimated by attrition model analysis (Bertignac, 1994) suggest that this is a possibility. It is also not known whether it is the attainment of sexual maturity itself, rather than the attainment of a certain size, that promotes the apparent change in skipjack behaviour.

Yellowfin

With only 23 yellowfin recoveries to mid-December 1995 there is limited analysis that can be carried out. It is hoped that more recoveries will be received and that a more detailed analysis of all yellowfin recoveries from both tagging programmes will be possible in the future.

It is remarkable that 7 out of 31 (22.6%) large yellowfin released near Fuvah Mulaku in November 1993 were recaptured there within two months. There is a distinct seasonal fishery for large yellowfin at Fuvah Mulaku every November-December (Anderson and Hafiz, 1986; Anderson, Adam and Waheed, 1993). There is also a less marked fishery in April-May. From analysis of longline data, Morita and Koto (1971) suggested that there is a movement of adult yellowfin from the equatorial western Indian Ocean, through the southern Maldives and up past Sri Lanka into the Bay of Bengal every year between October and March. It is possible that the yellowfin tagged at Fuvah Mulaku in November 1993 were part of this migration. Unfortunately, there have been no overseas recoveries of these fish so far. However, the fact that all 10 of the large yellowfin recaptures were made relatively close to their points of release suggests the alternative that large yellowfin may be relatively non-migratory within Maldivian waters.

Of 23 yellowfin recoveries made by mid-December 1995, two (8.7%) were made outside of the Maldives. This compares with 3.8% of skipjack recoveries from overseas. Similar results were obtained from the first Maldivian tagging programme, with overseas recoveries amounting to 17.9%

for yellowfin and 3.3% for skipjack (Waheed and Anderson, 1994). Thus, yellowfin tuna tagged in the Maldives appear to be 'more migratory' than skipjack (Yesaki and Waheed, 1992).

Of the two overseas yellowfin recoveries, one was actually reported as a bigeye tuna. As noted above, a very few bigeye may have been released by mistake and recorded as yellowfin. The specific identity of this individual is therefore in question.

Comparison of Recovery Rates from the Two Tagging Programmes

Recapture rates for tunas during this programme were much less than for those tagged in the first Maldivian tagging programme. Overall recapture rates for skipjack tuna tagged during the first tagging programme were 17.8% (Waheed and Anderson, 1994) compared with 8.5% for this second programme. Recapture rates for yellowfin were 7.0% for the first tagging programme (Waheed and Anderson, 1994) and only 1.8% for the second.

Two factors in particular may have influenced the lower recovery rates in the second tagging programme. First, the concentration of tagging in the south of Maldives, where fishing effort and hence the chances of recapture are less than in the north. Secondly, the particularly poor weather during and after several tagging trips, which may not only have reduced the chances of recapture but also may have reduced the quality of some tagging. It is therefore recommended that in future tagging activities should as far as practical only be carried out when the weather is good.

Yesaki and Waheed (1992) noted that of 33 overseas recoveries of skipjack tagged during the first tagging programme, 13 (39%) were from the western Indian Ocean. It was anticipated that a higher proportion of overseas skipjack recaptures would be from the western Indian Ocean purse seine fishery during the second tagging programme, because tagging was concentrated in the south of Maldives. This proved to be the case, with 12 of 21 overseas skipjack recoveries (57%) being from the western Indian Ocean.

Quality of Recovery Information

Yesaki and Waheed (1992) recommended that more effort should be given to obtaining more accurate tag return information in future Maldivian tagging experiments. To this end tag return forms were printed and distributed to every inhabited island and all collector/freezer vessels, together with instructions and measuring tapes. MOFA/MRS field officers on 16 islands were given measuring boards and instructions on how to deal with recoveries. As a result of these efforts more information and more consistent information was received with recovered tags. As an example, Yesaki and Waheed were able to use information from only 192 out of 1407 skipjack recoveries in their estimation of skipjack growth rates. Anderson, Adam and Waheed (1995) were able to use information from exactly the same number of recoveries to estimate growth rates, but from a total of only 540 skipjack recoveries. Furthermore, because the recovery forms requested information on the measuring tool used, it was possible to correct for the use of tape measures.

Another useful insight provided by information on the tag recovery forms was the percentage of fish caught from different school types. Of particular interest is the observation that nearly 44% of skipjack recoveries were reportedly made close to FADs. There are a number of sources of error associated with this estimate (e.g. difficulty of assigning fish caught to specific schools, misreporting, and possible regional biases). Nevertheless, it does provide the first estimate of the magnitude of the catch currently being taken near FADs in the Maldives.

RECOMMENDATIONS

1. Further analysis should be carried out, including the recoveries from the first Maldivian tagging programme wherever possible. Attrition-model analysis of skipjack returns is to be carried out. A detailed analysis of the accuracy of recaptured tuna length measurements from both Maldivian tagging programmes may allow growth estimates to be refined, and indicate means by which length at recapture information might be improved in any future study.

2. Further tetracycline marking and tagging of juvenile yellowfin tuna should be carried out.

3. The one recommendation of Yesaki and Waheed (1992) that could not be addressed was to concentrate tagging on yellowfin tuna. Further tagging of yellowfin tunas, with the principal aim of studying their movements and interactions with other fisheries should be carried out in the future, ideally as part of a wider Indian Ocean study.

4. Other questions that could be addressed by tagging in Maldivian waters include aging frigate tuna and kawakawa (*Euthynnus affinis*) using tetracycline injections.

5. More accurate recapture information might be obtained in future if, in addition to any types of publicity already undertaken, MRS staff visited the 20 or so most important fishing islands in the country to brief fishermen and island officials on the proposed activities prior to any major tagging experiment.

6. The use of cash rewards for tag recoveries within the Maldives has proved successful. On balance, though, the amounts paid for tag releases seemed a little high, while those paid for rewards seemed a little low. They should be adjusted in any future tagging exercise.

7. The use of T-shirts as rewards for international recoveries is satisfactory, but the number given (one per tag) is not. The number given should be increased to perhaps five T-shirts per tag. This would be more in line with the value of such returns, and would also enable more fishermen from the recapturing vessels to benefit from the rewards.

8. Fishermen are not normally keen to have their live-bait catches weighed. However, on tagging trips, with the prospect of a large financial reward for tag releases, they are normally very amenable. During future tagging exercises full use should be made of this cooperation to weigh livebait catches.

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Table 2. Summary of Skipjack tag releases by trip and by tag type, 1993-94.

Trip No.	Date	Season	Location Atoll	Island	No. Skipjack Tagged Normal	Double	OTC	Total
1	9/93	SW	L.	Maamendhoo	643			643
3	1-2/94	NE	G.A	Villingili	2075	5	2	2082
4	4/94	NE	L.	Maamendhoo	1263	22	32	1317
5	8/94	SW	G.A	Kolamaafushi	1495	477	460	2432
Total	-	-	-		5476	504	494	6474

Table 3. Number of Skipjack tag releases by grid area of release, 1993-94.

Grid No.	Location	Survey (No. and Atoll) 1. Laamu	3. GA	4. Laamu	5. GA	Total
+01734	SE of Laamu		-	1021		1021
+01733	S of Laamu	635		57	-	692
+01724	SW of Laamu	8			-	8
+01731	'Satoraha'	-	1853	239	2312	4404
+00724	NW of G.A.	-	-	-	2	2
+00733	N of G.A.	-	34	-	118	152
+00734	NE of G.A.	-	195	-	-	195
Total		643	2082	1317	2432	6474

Table 4. Summary of Skipjack tag releases by distance from shore and by season, 1993-94.

Location		Monsoon Season SW (9/93)	NE (1-2/94)	NE (4/94)	SW (8/94)	Total
Inshore	Near Laamu	643	-	1078	-	1721
Offshore	'Satoraha'	-	1853	239	2312	4404
Inshore	Near G.A.		229		120	349
Total		643	2082	1317	2432	6474

Table 5. Summary of Yellowfin tag releases by trip and by tag type, 1993-95

Trip No.	Date	Location Atoll	Island	No. Yellowfin Tagged Normal	Large	OTC	Total
1	9/93	L.	Maamendhoo	354	15	-	369
2	11/93	Gn.	Fuvah Mulaku	-	31	-	31
3	1-2/94	G.A.	Villingili	46	-	-	46
5	8/94	G.A.	Kolamaafushi	83	1	-	84
6	4/95	Gn.	Fuvah Mulaku	-	36	-	36
7	8/95	B.	Thulaadhoo	-	-	737	737
Total	-	-		483	83	737	1303

Table 6. Summary of skipjack recoveries up to mid-December 1995, by tag type and date of release.

Trip No.	Date	Numbers Recovered Normal	Double	OTC	Total	Percentage Recovered Normal	Double	OTC	Total
1	9/93	17	-	-	17	2.6	-	-	2.6
3	1-2/93	126	0	0	126	6.1	0	0	6.1
4	4/94	95	2	0	97	7.5	9.1	0	7.4
5	8/94	203	51	59	313	13.6	10.7	12.8	12.9
Total		441	53	59	553	8.1	10.5	11.9	8.5

Table 7. Summary of Skipjack recoveries up to mid-December 1995, by tagging trip/season and by distance from shore at release.

Tagging	Location	Recoveries by Monsoon Season of Release SW (9/93)	NE (1-2/94)	NE (4/94)	SW (8/94)	Total
Inshore	Near L	17 (2.6%)	-	75 (7.0%)	-	92 (5.3%)
Offshore	*Satoraha*		106(5.7%)	22 (9.2%)	288 (12.5%)	416 (9.4%)
Inshore	Near G.A.	-	20 (8.7%)	-	25 (20.8%)	45 (12.9%)
Total Recoveries		17 (2.6%)	126 (6.1%)	97 (7.4%)	313 (12.9%)	553 (8.5%)

Table 8. Summary of Yellowfin recoveries up to mid-December 1995, by tag type and date of release.

Trip No.	Date	Numbers Recovered				Percentage Recovered			
		Normal	Large	OTC	Total	Normal	Large	OTC	Total
1	9/93	6	1	-	7	1.7	6.7	-	1.9
2	11/93	-	7	-	7	-	22.6	-	22.6
3	1-2/93	1	-	-	1	2.2	-	-	2.2
5	8/94	1	0	-	1	1.2	0	-	1.2
6	4/95	-	2	-	2	-	5.6	-	5.6
7	8/95	-	-	5	5	-	-	0.7	0.7
Total		8	10	5	23	1.7	12.0	0.7	1.8

Fig. 1. Location Map of the Maldives showing tagging areas and the atolls and islands mentioned in the text.

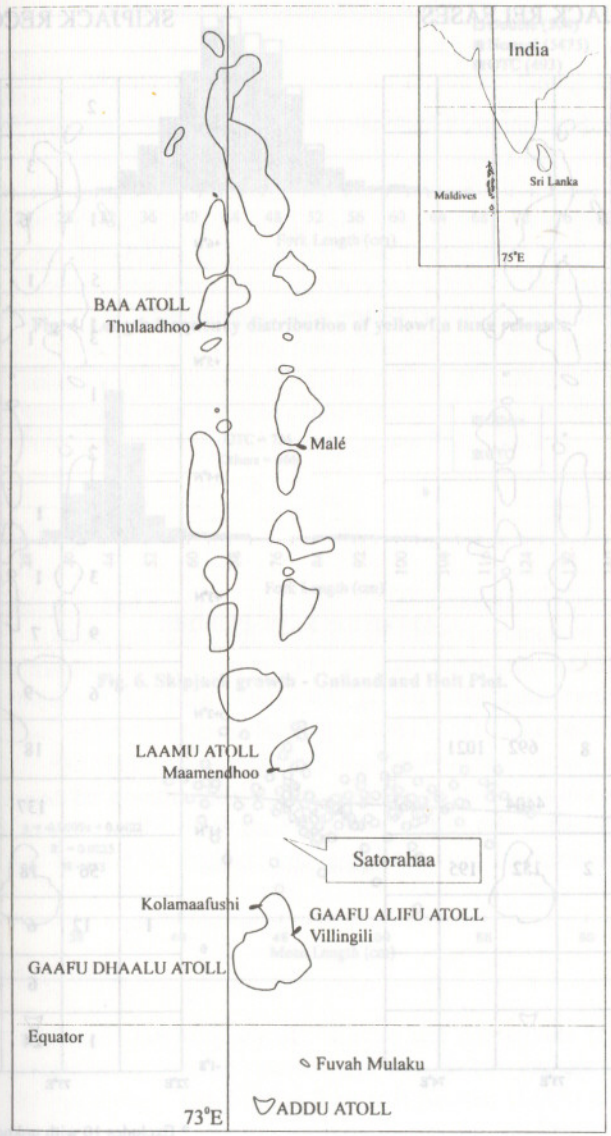


Fig. 3. Skipjack tuna releases and recoveries by grid area (recoveries to mid Dec. 95)

* Excludes 10 with unknown location of recovery and 21 overseas recoveries.

Fig. 2. Length frequency distribution of skipjack tuna releases.

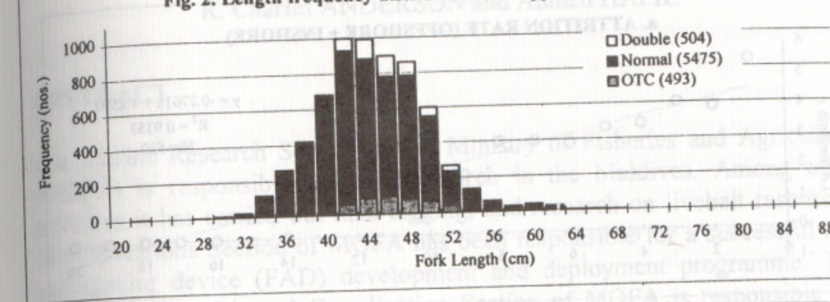


Fig. 4. Length frequency distribution of yellowfin tuna releases.

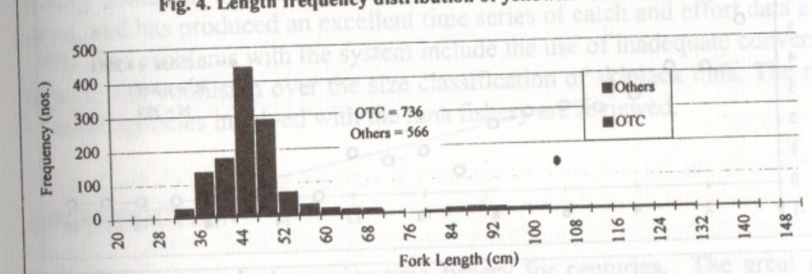


Fig. 6. Skipjack growth - Gulland and Holt Plot.

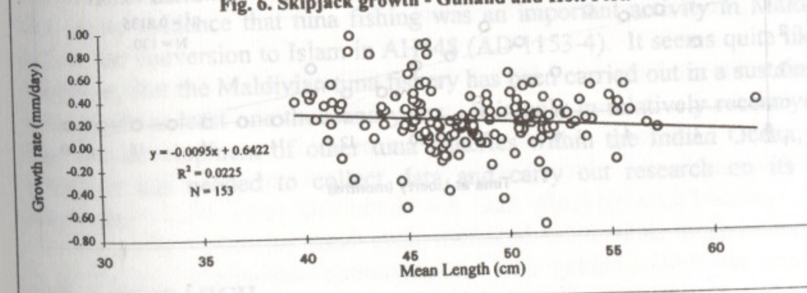
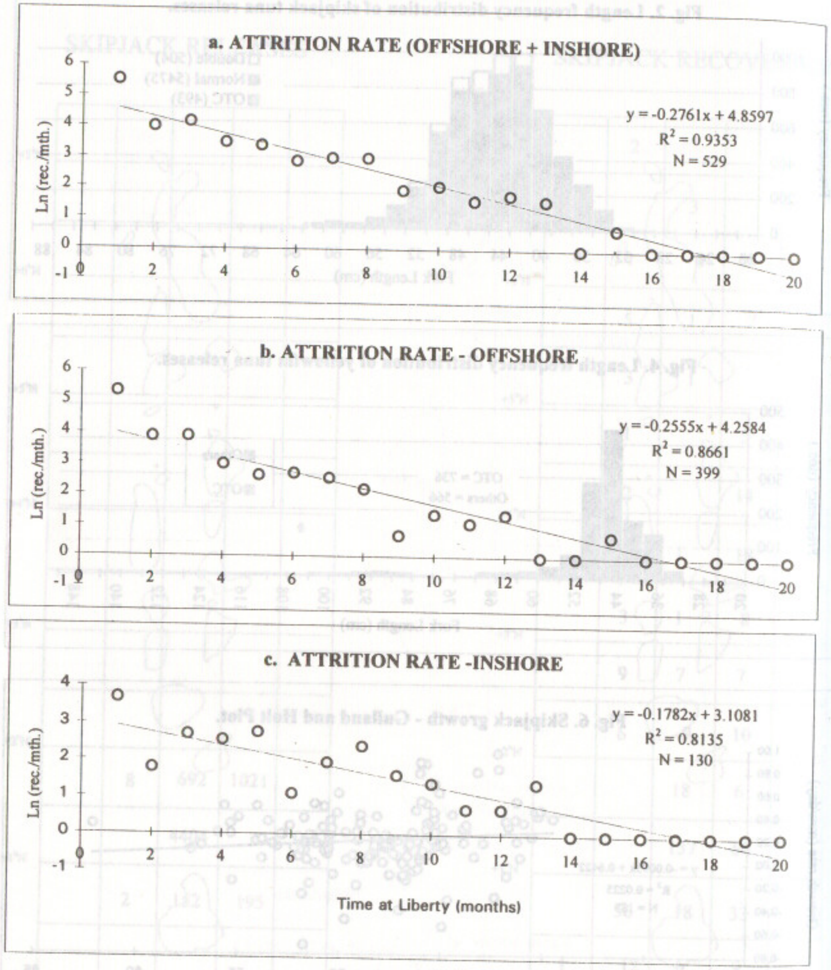


Fig. 5. Attrition rate of skipjack tuna tag recoveries by position of release (inshore and offshore), up to mid Dec. 95.



STATUS OF TUNA RESEARCH AND DATA COLLECTION IN THE MALDIVES

R. Charles ANDERSON and Ahmed HAFIZ

ABSTRACT

The Marine Research Section of the Ministry of Fisheries and Agriculture (MOFA) is responsible for tuna research in the Maldives. Among other activities it has carried out tuna tagging, and research on livebait resources. The Operations Section of MOFA has been responsible for a successful fish aggregating device (FAD) development and deployment programme. The Economic Planning and Coordination Section of MOFA is responsible for fishery statistics. The Maldivian fishery statistics system is geared towards tunas, and has produced an excellent time series of catch and effort data since 1970. The problems with the system include the use of inadequate conversion factors, and confusion over the size classification of skipjack tuna. The roles of other agencies involved with the tuna fishery are reviewed.

INTRODUCTION

The Maldives has had a major tuna fishery for centuries. The great Arab traveler Ibn Battuta gives a clear account of the importance of tuna in the Maldives at the time of his visits in 1343-44 and 1346 (Gray, 1889). There is also some evidence that tuna fishing was an important activity in Maldives before the conversion to Islam in AH548 (AD 1153-4). It seems quite likely, therefore, that the Maldivian tuna fishery has been carried out in a sustainable manner for at least one thousand years. It is only in relatively recent years, with the development of other tuna fisheries within the Indian Ocean, that Maldives has needed to collect data and carry out research on its tuna resources.

TUNA RESEARCH

Within the Maldives, the Ministry of Fisheries and Agriculture (MOFA) has statutory responsibility for the rational and sustainable management of all living marine resources. The Marine Research Section (MRS) of MOFA is responsible for carrying out the research necessary for the Ministry to fulfill that mandate. MRS was formed in 1984. Tuna-related research activities undertaken by MRS are reported elsewhere in this Bulletin, and will be mentioned only briefly here. They include:

- Two tuna-tagging programmes, during which some 17,000 skipjack and yellowfin have been tagged and released (Yesaki and Waheed, 1992; Waheed and Anderson, 1994; Anderson, Adam and Waheed, 1996). In addition to providing information on growth and migration, these tagging programmes have given insights into the population dynamics of skipjack in Maldivian waters (Bertignac, Kleiber and Waheed, 1994; Bertignac, 1994). Recommendations for further tagging studies have been made by Anderson, Adam and Waheed (1996).

- A limited amount of analysis of catch and effort and biological data, notably for yellowfin tuna (e.g. Anderson, 1988b; Adam, 1993; Adam and Anderson, this Bulletin). It is planned to carry out a detailed analysis of all available data for each of the four major tuna species caught in the Maldives (skipjack, yellowfin, frigate tuna and kawakawa) over the next two years.

- Research on the live-bait resources that support the pole and line fishery, including studies of the basic biology of the species involved (Milton *et al.*, 1990a & b); studies of their ecology (Blaber *et al.*, 1990; Anderson and Saleem, 1994 & 1995); and estimation of catch (Anderson and Hafiz, 1988; Anderson, 1994). There are plans to carry out further research on baitfish, aimed specifically at promoting integrated reef resources management, over the next few years.

The Operations Section of MOFA has been responsible for the successful completion of a fish aggregating device (FAD) research and development programme. Starting in 1981, a design of FAD suitable for Maldivian conditions has been evolved (Naeem, 1988; Naeem and Latheefa, 1994). The latest model FADs typically last for about two years after deployment. Thirty-two sites around the Maldives have been identified as appropriate locations for FADs, taking into account bottom topography, proximity of fishing islands and local tuna abundance. MOFA aims to maintain FADs at all of these sites, with 28-30 FADs in place at any one time.

Lack of trained manpower, and to a lesser extent limited funding, are the main constraints on the development of tuna research activities in the Maldives.

DATA COLLECTION

The Economic Planning and Coordination Section (EPCS) of MOFA is responsible for the collection, compilation and dissemination of Maldivian fishery statistics. Fishery statistics are collected from every inhabited island, of which there are some 200 scattered over 19 administrative atolls. The Maldives has a well-developed system of regional government, with a government office on every inhabited island. It is one of the duties of island officials to record tuna catches. Data sheets are compiled by month in each atoll and returned to Malé. EPCS compiles these records, and also collects catch and effort data directly from Malé market. EPCS produces an annual report of "Basic Fisheries Statistics" (e.g. MOFA, 1995), as well as periodic multi-annual summaries. These reports include not only catch and effort statistics, but also export data, collected by Customs and compiled by EPCS. Annual statistics are normally compiled before the middle of the following year, and are reported to interested parties, including the Indo-Pacific Tuna Programme (IPTP), soon afterwards.

Tuna catch statistics

Traditionally the Maldivian fishery has been a tuna fishery, and the Maldivian fisheries statistical system was developed to record catches of tuna. Other varieties of fish have not been favoured, either for local consumption or for export, and have tended to be ignored. Maldivian "reef fish" catch statistics are therefore not too reliable. Tuna catches are recorded by number, in a total enumeration system. Since it is the custom to count the catch at the end of each day's fishing, while dividing it among crew and boat owner, this system has proved to be very successful.

The collection of tuna catch statistics started in 1959. The system has been gradually expanded and improved since then. In 1959 only the total tuna catch by pole-and-line vessels was recorded. In 1966 the system was expanded to include trolling vessels and to record the numbers of tunas caught in three categories: large skipjack; small skipjack and yellowfin; kawakawa and frigate tuna. From 1970 the five categories of tunas were recorded separately. Mechanization of the pole-and-line fleet started in 1974-75; from 1979 catches of sailing and mechanized pole-and-line vessels were recorded separately. From 1984 catches of dogtooth tuna were recorded. The majority of yellowfin tuna caught in the Maldives are surface-swimming juveniles taken by pole and line. However, there are also landings of adult yellowfin, taken mainly by handline and troll. From 1992 catches of "large yellowfin" have been recorded separately from "small yellowfin".

Effort data

Since 1959, effort data have been recorded in terms of both number of vessels and numbers of days fished. Because tuna fishing is carried out on day trips, "number of fishing trips" and "number of days fished" are synonymous. In line with the catch statistics, the collection of effort statistics was expanded to include trolling vessels in 1966. The numbers of mechanized pole-and-line vessels was recorded from 1974, but numbers of days fished by sailing and mechanized pole-and-line vessels were not recorded separately until 1979. From 1985 the number of pole-and-line vessels actively fishing, in addition to the number registered, has been recorded.

Sources of error

Although there are clear advantages to the well-established total enumeration tuna statistics system, it is not without problems. A detailed review of the system and some of its limitations has recently been provided by Parry and Rasheed (1995). There are three major potential sources of error:

1. Misreporting.
2. The use of inadequate conversion factors.
3. Confusion over the size classification of skipjack tuna.

Misreporting

A large potential source of error is improper reporting. Apart from instances of presumably random error (e.g. clerical mistakes), cases of both under-reporting and over-reporting have occurred.

Some over-reporting is believed to have occurred between the mid-1950s and 1981, when prizes were given to top crews or islands in order to encourage fish production. Since 1981 there have been occasional prizes but the awards have tended to be small and are not believed to have influenced catch reporting. In 1984 a registration fee was introduced for transport vessels. In order to qualify for exemption, fishing vessels had to complete 180 days fishing per year. This requirement is believed to have resulted in some over-reporting of fishing effort, and possibly also of catch. In 1990 the exemption

requirement was dropped to 120 days fishing per year, and it is believed that this will have minimized over-reporting.

Some under-reporting has probably occurred at all times, for example as a result of fishing skippers or boat owners failing to report catches or trips to their island offices. This may not be as great a problem in Maldives as it might be elsewhere, both because of the nature of Maldivian society and because of the desire of owners to meet the 120 days fishing requirement. Another problem is that less valuable species (notably non-tunas, but also tunas other than skipjack) may be consistently under-reported. It is possible that socioeconomic changes within the Maldives, and the changing pattern of island life, are leading to an increase in under-reporting.

Anderson (1986) suggested that for the period 1970-84 over-reporting and under-reporting may to some extent have tended to cancel out, and that reports of numbers of tunas caught and numbers of days fished may have been accurate to within ±15%. More recently there has been little reason to suspect over-reporting, suggesting that there may have been a net under-reporting of catches. Parry and Rasheed (1995) reviewed the accuracy of 1994 skipjack and yellowfin catch records, matching over 1000 individual pole-and-line trip records in the databases of both MOFA and MIFCO (Maldives Industrial Fisheries Company, see below). They suggested that skipjack catch numbers may be underestimated by about 5% and yellowfin catch numbers by about 15%.

A partial solution to the problem of under-reporting was used by EPCS to correct the 1994 skipjack and yellowfin catch records. Individual fishing vessel records in the MIFCO database (i.e. audited records of sales by weight and number) were matched with catch records reported to MOFA. For vessels that reported less to MOFA than they sold to MIFCO, MIFCO weights were used. For other vessels MOFA records and conversion factors were used. This correction procedure is partially responsible for the increase in reported catches of skipjack and yellowfin in 1994.

Conversion factors

A second major potential source of error in Maldivian tuna catch statistics is in the use of conversion factors. Maldivian tuna catch statistics are collected in terms of **numbers** of fish. For most purposes a knowledge of catch **weight** is of more interest, therefore conversion factors are required. The nature and magnitude of the conversion factors used by MOFA have been the source of much controversy over the years (Anderson, 1986; Rochepeau and Hafiz, 1990; Mines, 1992; Wright, 1992; Cook, 1995; Parry and Rasheed, 1995). The most important single problem with the conversion factors used so far is that they have been based on inadequate sampling, both in terms of numbers of fish measured and in terms of area of coverage. The various conversion factors estimated over the years are listed below:

Large skipjack	Small skipjack	Yellowfin	Kawakawa	Frigate tuna	Source
7 kg/pc	1.963 kg/pc	1.963 kg/pc	1 kg/pc	1 kg/pc	Shiji & Sato (1962)
6.18 kg/pc	2.12 kg/pc	2.12 kg/pc	0.95 kg/pc	0.95 kg/pc	? (1975)
5.87 kg/pc	2.01 kg/pc	2.12 kg/pc	0.95 kg/pc	0.95 kg/pc	? (1983?)
5.9 kg/pc	2.2 kg/pc	2.6 kg/pc	1.4 kg/pc	0.6 kg/pc	Anderson et al (1987)
5.7 kg/pc	2.1 kg/pc	2.6 kg/pc	1.1 kg/pc	0.6 kg/pc	Anderson (1988a)
6.70 kg/pc	2.42 kg/pc	2.31 kg/pc	-	-	Parry & Rasheed (1995)

- The first conversion factor estimates, due to Shiji and Sato (1962), were based on the measurement of only 70 small skipjack at a single location (in Thaa Atoll). The average weights of other species and sizes were guessed. These average weight estimates were used for catch data from 1959-1975.
- Further sampling in 1975 (the details of which have been lost) led to the introduction of revised conversion factors in 1976.
- A third set of conversion factors, again of unknown origin, were used from 1984-87. These included an average weight estimate of 2 kg/pc for dogtooth tuna.
- On the basis of market sampling, Anderson *et al.* (1987) estimated the average weights of tuna species landed at Malé in 1986. Apart from skipjack, yellowfin, frigate tuna and kawakawa, dogtooth tuna average weight was also calculated, at 6.0 kg.
- Further market sampling in 1987 resulted in new average weight estimates for Malé tuna landings (Anderson, 1988a). These average weight estimates have been used as national conversion factors from 1989 to date.
- From 1992 an average weight conversion factor of 20 kg/pc was introduced for large yellowfin, on the basis of information provided to EPCS by MRS.

- Parry and Rasheed (1995) reviewed commercial (MIFCO) purchase records for 1994 to estimate average weights of large skipjack, small skipjack and small yellowfin catches.

The use of fixed species conversion factors from one location for year after year clearly fails to take account of the considerable seasonal, regional and interannual variations that occur in tuna sizes. The conversion factors currently used by MOFA are the average weights of tunas landed at Malé market in 1987 (as estimated by Anderson, 1988a). In the absence of any national sampling programme these average weight estimates have been used as conversion factors for the entire country.

The use of these conversion factors was recognized as inadequate by Anderson *et al.* (1987; also Anderson, 1988a) and has been criticized by Rochepeau and Hafiz (1990), Wright (1992), Cook (1995) and Parry and Rasheed (1995). While the conversion factors in use at present are undoubtedly inadequate, they are not necessarily biased. For example, in the case of yellowfin tuna, Rochepeau and Hafiz (1990), on the basis of some regional sampling, concluded that the yellowfin conversion factor was underestimated, and that a conversion factor of over 3 kg/pc might be appropriate. In contrast, Parry and Rasheed (1995), on the basis of a detailed analysis of 1994 commercial purchases, concluded that the yellowfin conversion factor in use is too high, and a conversion factor of 2.31 kg/pc was appropriate. The conversion factor problem is well recognized, and MOFA has started a regional tuna length frequency sampling programme to solve it (see below).

Skipjack Average Weight

The inadequacy of the conversion factors currently used in the Maldives applies to all tuna species, but there is a particular problem with the use of conversion factors for skipjack tuna. This is of special significance since skipjack contributes something of the order of 70% to the total recorded catch. Therefore errors in the conversion factors used for skipjack may have significant effects on the estimates of total catch.

Traditionally, Maldivians have classified skipjack into two size classes: small (*mas*) and large (*godhaa*). A large skipjack is one which when carried by the tail will have its snout touching the ground. The broadly bimodal size distribution of skipjack catches in the Maldives is believed to provide a biological basis for this division (Anderson *et al.*, 1987; Hafiz and Anderson, 1988).

MOFA uses two separate conversion factors for skipjack (5.7 kg and 2.1 kg), based on these two traditional size categories. There is considerable overlap between the two categories, but the dividing line is approximately 55-60 cm fork length, which corresponds to about 4 kg.

In recent years about one-third of the skipjack catch has been purchased for export by the Government (i.e. by freezer or collector vessels, or the Felivaru cannery). These purchases have for the most part been according to two different size categories: 1.5-2 kg, and above 2 kg. Many fishermen who sold their fish to one of the Government agencies reported their daily catches according to the details on their sales receipts. As a result the numbers of "large" skipjack being reported has increased. Since MOFA continues to use the traditional skipjack conversion factors for all reported catches this is believed to have led to errors in the estimation of the total weight of skipjack caught.

Rochepeau and Hafiz (1990) noted that there had been an increase in the proportion of large skipjack in the Maldivian catch during the 1980s. They suggested that this was the result of increasing misreporting of "large" and "small" skipjack, resulting in skipjack catch being overestimated. They used the proportion of large skipjack in 1979-82 catches to estimate annual catches for 1984-88. They concluded that for those years skipjack catch could have been overestimated by 6-11%. It should be noted, however, that these estimates did not take account of possible under-reporting, nor of the extent to which other factors may have caused a real increase in large skipjack catches.

Mines (1992) stated that the discrepancy between MOFA and commercial conversion factors resulted in tuna catch being overestimated. Using export data and estimates of local consumption, he calculated total fish catches for the years 1984-90. These estimates were up to nearly 30% lower than MOFA catch figures. It should be noted, however, that Maldivian fish consumption estimates are notoriously inaccurate and are not a good basis for calculations of this type.

Parry and Rasheed (1995) reviewed MOFA data for 1994 and identified several atolls in which the proportion of large to small skipjack was very

much higher than the national average. They suggested that in these atolls the bulk of reporting may be according to the commercial conversion factors rather than the traditional MOFA ones, and that for these atolls the conversion process should be altered accordingly.

A number of other solutions to this problem have been suggested, but all have their limitations:

1. After the problem first became apparent in 1988, MOFA added a new box to the fish catch recording forms which are completed on every island. The island official filling the form was supposed to indicate in the box whether he was recording the two sizes of skipjack according to the traditional division or according to the modern commercial division. This scheme does not work because the island officials do not tick the box.

2. MIFCO purchases up to about one-third of all skipjack caught in Maldives. Numbers and weight are recorded, so the average weight of a very substantial sample is available, and could be used for the entire catch. The problem with this approach is that MIFCO does not buy the smallest fish, so their sample is biased. The extent of the bias has been reduced since December 1993, when MIFCO started buying skipjack of less than 1.5 kg. However, some bias remains because MIFCO prefers to buy large fish rather than small fish. Therefore, when catch exceeds purchasing/holding capacity, the average weight of the fish purchased by MIFCO will be greater than that of the fish caught. This bias is not easy to estimate because it will vary according to catch and purchasing capacity. In addition, fishermen will tend to keep the least valuable (i.e. the smallest) fish for their own consumption.

3. It should be possible to combine size-frequency samples for both small and large skipjack to obtain a single size-frequency distribution and hence a single average weight conversion factor. This, however, relies on strictly random sampling or careful stratified random sampling, which in practice are difficult to achieve. Small skipjack are more common than large skipjack, and there is a tendency to over-sample the less common fish. This tendency is exaggerated at Malé market, where fishermen sort their catches by size. Prior to August 1987 skipjack sampling at Malé market was not stratified by size; this led to a considerable overestimation of the occurrence of large skipjack in the catch (Anderson *et al.*, 1987).

This problem is still under review by MRS and EPCS. One possible solution is to use MIFCO conversion factors for all skipjack purchased by MIFCO (matched as far as possible by individual fishing vessel, but otherwise stratified by atoll and by month) and new MOFA/MRS regional and seasonal conversion factors for the remainder of the skipjack catch. There are two difficulties that would arise with this approach. First, when there is an excess of fish MIFCO will tend to buy the larger ones. Therefore fish not sold to MIFCO but returned to the island and reported will be smaller than the average estimated by MOFA conversion factors. This may tend to cause an overestimation of total catch. Secondly, fishermen who sell part of their catch to MIFCO may not report the unsold balance of their catch to MOFA. This will tend to cause an underestimation of total catch. These two opposing biases may tend to cancel out, but this needs further research.

Regional Length-Frequency Sampling Programme

The need for a regional length-frequency sampling programme has long been recognized within MOFA. As a first attempt, office-based non-fishing field officers were employed on a number of islands by MOFA. Length-frequency sampling was only one of their duties, and an unpopular one at that. The quality and quantity of their length-frequency data returns were inadequate. Therefore, in late 1993 MRS initiated a regional tuna length-frequency sampling programme using active fishing skippers, who are employed to measure their own catches. A total of 13 skippers have been recruited on 7 islands, representing all regions of the country. The skippers were instructed in sampling methodology, and given monthly targets amounting to 2000-3000 tunas, depending on season. They are contacted regularly by post, radio and personal visits to ensure that the quality of their work is maintained. In addition to the sampling in the atolls, MRS staff sample landings at Malé market on about 20 days per month.

Although there are some problems with this programme it is proving successful. The advantages of using active fishing skippers are their access to the fish, the help they have available from their crews, and in most cases their high motivation. The disadvantages of using fishing skippers are their tendency to sample rather few catches (even though total numbers of fish sampled may be high), and the fact that sampling stops when they stop fishing. This programme has been reviewed by Anderson *et al.* (1996). During 1994 a total of over 285,000 tunas were measured. Numbers

measured by sampling location and species (to the nearest 100) are listed below:

Region	Atoll	Island	Skipjack	Yellowfin	Frigate	Kawakawa	Total
NE	H.Dh.	Kulhudhoofushi	31100	11700	8200	500	51500
NW	R.	Alifushi	15500	10000	4700	1800	32100
EC	K.	Malé	12000	2800	4300	2200	21400
EC	M.	Maduvveri	18500	2300	1000	13	21900
WC	Dh.	Kudahuvadhoo	8700	10000	1300	700	20600
S	L.	Maamendhoo	24600	6800	200	0	31600
SE	G.A.	Villingili	22500	12200	4500	2900	42000
SW	G.Dh.	Thinadhoo	39800	18600	5600	200	64200
Total			172900	74400	29800	8300	285400
Average (of 8 islands)			21600	9300	3700	1000	35700

These data have been compiled by MRS. Two constraints prevented the completion of this work in time to estimate conversion factors for use with the 1994 catch statistics. The first is a shortage of trained manpower at MRS. The second was the lack of adequate tape length-board length and length-weight relationships.

Board-tape and Length-weight Relationships

In almost all cases tunas are measured with measuring boards. However, at Malé market fishermen object to their fish being handled by samplers. As a result the use of measuring boards, which had been in use since 1983, had to be discontinued in February 1986. Tape measures have been used since March 1986. Calipers were used for a trial period in December 1993, but proved unpopular with both samplers and fishermen, and so their use was discontinued. A very few tuna length-frequency samples outside Malé have also been measured with tapes. Tape lengths are usually slightly longer than board lengths, the exact difference depending on fish size, species and degree of curvature (although grossly bent tunas are not measured). To correct for this, tape length - board length conversion tables have been prepared by MRS (Anderson, Adam and Nadheeh, 1996).

To convert length-frequency data to weight frequency and hence to average weight, length-weight relationships are required for each species. New length-weight relationships for Maldivian tunas have been prepared by MRS (Anderson, Adam and Nadheeh, 1996).

Overview of the Tuna Statistics System

In summary, MOFA has a well-established system of total enumeration for tuna catches. There are at present problems with under-reporting, with the confusion over skipjack size reporting, and with the use of inadequate conversion factors. The latter problem will largely be solved once MRS's regional length-frequency sampling programme starts producing regional and seasonal conversion factors for each species in a regular and timely manner. The use of commercial (i.e. MIFCO) data, and/or some other sampling scheme, will be necessary to estimate and correct for underreporting. Despite these problems the MOFA system produces tuna catch estimates that are of an accuracy as good or better than that of almost any other country. In particular, despite any minor inaccuracies, the 25-year time series of Maldivian tuna catch and effort data compiled by species, atoll and month from 1970 gives a coherent picture of major trends and forms an invaluable resource for further research.

OTHER AGENCIES

Although MOFA has primary responsibility for the collection of tuna statistics and the carrying out of research on tuna resources, a number of other government agencies do have related responsibilities. These include:

1. The Maldives Industrial Fisheries Company (MIFCO) is a government tuna-exporting agency. MIFCO purchases fresh skipjack and yellowfin from fishermen, for which purpose it maintains an extensive fleet of freezer and collector vessels. This fish is exported either frozen (e.g. to Thailand for canning), canned (mainly to Europe from the cannery on Felivaru in Lhaviyani Atoll), or smoke dried (to Sri Lanka). In addition, small quantities have recently been exported to Japan for *sashimi* and to Europe as loins. MIFCO maintains detailed daily records of its fish purchases (i.e. total numbers and weight of skipjack and yellowfin by size category purchased from each fishing vessel). Although mainly a fish purchasing agency, MIFCO has carried out offshore longlining since 1993, using a Far Eastern high-seas vessel. Detailed catch records are maintained.

2. The Ministry of Trade and Industries (MTI) is responsible for licencing all foreign-registered fishing vessels operating in Maldivian waters. For the most part this applies to longliners operating in the outer waters of the Maldivian EEZ (i.e. 75-200 miles offshore). However, a single foreign big game fishing boat is also registered with MTI. All foreign vessels are supposed to supply complete catch and effort statistics to MTI. These statistics are on the whole of poor quality. They have been compiled by MOFA but have not been reported to IPTP.

3. The State Trading Organization (STO) was the government agency involved with the transshipment of purse-seine catches in Addu Atoll during the 1994-95 Chagos season.

4. The Customs Department is responsible for monitoring and recording all imports and exports. Detailed records are maintained of all fish product exports, by value and weight. These are compiled and summarized on an annual basis by MOFA/EPCS.

5. The National Security Service Coastguard is responsible for fisheries surveillance throughout the Maldivian EEZ.

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Documentation of the centuries-old tuna fishery of the Maldives was minimal until about 15 years ago. Since then there has been an explosion of information published on the fishery. However, this information is mostly scattered in obscure reports, and is not easily accessible. Indeed, until now there has been no bibliography and it has been almost impossible for newcomers to the fishery to find out what has been written before.

Much of the material listed here is in the form of unpublished reports, which are only available through government offices in Malé. Others are published in journals that may be unfamiliar to some. Foremost among these is the annual fisheries journal of the Ministry of Fisheries and Agriculture, *Rasain*. Many of the papers printed in *Rasain* are written in *Dhivehi*, and these are listed separately. Several of the reports were produced in cooperation with international or regional fisheries organizations. These include the Food and Agriculture Organization of the United Nations (FAO) based in Rome; the Bay of Bengal Programme (BOBP) in Madras; and the Indo-Pacific Tuna Development and Management Programme (IPTP) in Colombo.

This bibliography is not complete. Interim reports of tuna research and development projects have been excluded whenever more comprehensive final reports are available, and some short notices of only ephemeral value have been omitted. Reports with restricted distributions such as some of those of development banks, and the annual reports of the Felivaru tuna processing plant are not included. Furthermore this bibliography emphasizes work on tuna resources, reflecting the research interests of the compilers, and is less thorough in other areas. The user is cautioned that, as the first such bibliography, there are bound to be several omissions of important works, which will hopefully be made good in a later edition. Nevertheless, it is hoped that this bibliography will provide a useful reference source for anyone with an interest in the fascinating and vitally important tuna fishery of the Maldives.

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އުޅުމާއި ދުވަ ހޮޓާތަކުގެ ނިސްބަތަށް. އިޤްތިޞާދު ސަރވިސަސްގެ 26 ޕަސެންޓުން 50 ޕަސެންޓަށް އަރާފައެވެ.

ހޮޓާތަކުގައި އެމްޕްލޯއިން ބޭނުން ކުރުމުގެ ބާވަތްތަކުގެ އިތުރަށް މަސްވެރިކަމުގައި ބޭނުން އެކިއުޅެން ކުރުމުގެ ބާވަތްތަކުގެ މަސްވެރިކަމުގެ މުޅި ދާއިރާގައި އުފެއްދުމުގެ ބައިވެރިވުމެވެ. ހޮޓާތަކުގައި ކުރެވުނު އުފެއްދުން މުއްސަނދި ރައްޔިތުން ގިނައިން ހިމެނޭ ކުރިއެރުން މަސްވެރިކަން ބޮޑުވަމުން ދިޔަ ގިނަތަން ކުރައްވާފައިވާ ކުރިއެރުން ސަރުކާރުން ހިންގަވާ މަސައްކަތް މަސްވެރިކަމުގެ ބޭނުން ޚިދުމަތް ފޯރުކޮށްދިނުމަށެވެ.

ކުރުމުގެ މަސްވެރިކަމުގައި މިހާރު އަތޮޅުތަކުން ދިވެހިރާއްޖޭގެ ހަރަކާތް ފުރިހަމަ ބާނަންތެރިކަމާ ސަރަހައްދުތަކުން ކުރިއަށްދާ މީހުންނަށް ހިތްވަރުދޭ ކަންކަން މިހާރުވެސް ކުރުމުގައި ކުރިއަށްގެންދަނީ ގިނަ. ހަރަކާތް ޖާގަ ތަނަވަސް އެދުމާ ބޭނުން ފަރާތްތަކުން. މިކަމުގެ ކުރިއެރުމަށް ރިޔާސީ ކަމަށްވާ ކުރުމުގެ ފުރުސަތު މަސްވެރިކަން ހަމަ ހިންގުމުގެ ބޭނުން ކުރުމަށް ކަމުދާ ކަމެއް ކަމަށެވެ.

އެއްގަމުގެ އެހެން މިގޮތުން ކުރުމުގެ ކަމެއް ދާއިރާތަކުން ބިނާވެފައިވާ ދެމިއޮތް ބޮޑު ތަރައްޤީގެ 2 ވަނަ އަހަރުން ހޮޓާތަކުގައި ކުރުމުގެ މަސްވެރިކަމުގެ ފެށުން ކުރިއެރުމާ ދުވަހު ކުރިއަށް މިބޮޑު ސަރުކާރު ފަހިކަމާ ގެނެސްދިނުމަށެވެ.

ދިޔައީ ޖަހަމުގެންނާއި ފަތުރުވެރިކަމުގައި ދުވަ ސަރވިސްގެ ކޮންސްޓްރަކްޝަނުގެ ބޭނުން ކުރެވޭއެވެ.

ވަރަށް ކޮންސްޓްރަކްޝަން ދަތުރުފަތުރު ހޮޓާތަކާއި މަސްވެރިން ބޭނުން ކުރާތަކެވެ. ބޭނުން ކޮށްދޭ ނަމަވެސް ރަނގަޅު އެހެން ކޮންސްޓްރަކްޝަން މަސައްކަތެވެ. ދަނޑު ބިނާ ސަރވިސްގެ ކަތަ ކޮންސްޓްރަކްޝަންގެ ވާދަ ކުރިއެރުން ވަރަށް ބޮޑު. އަހަރު ބާކީ ކޮންސްޓްރަކްޝަން މަތީގައި ބޮޑުތަކެއް އެއްވެސް މުއްދަތެއް ކުރުމެވެ. ސަރުކާރުން ފަރާތްތަކުން ކުރިއަށްދާ ހޮޓާތަކުގެ އިތުރުން ފައިސާ ހޭދަކުރުމަށް 500 މިލިއަން ކަތަ ކޮންސްޓްރަކްޝަން ހިންގަމުންދެއެވެ. އެއީ ޖީޑީޕީގެ ބޮޑު ބައެއް 0.5% އެވެ.

ވިޔަފާރިއަށް ހޮޓާތަކުން 3 ވަނައަށް އެންމެ ގިނައިން ބޭނުން ކުރުމުގެ ބާވަތެވެ. ފަހަރަކުން އެހެން ހޮޓާތަކުން ބޭނުން ވިޔަފާރީގެ އަގުތަކާ ގުޅިގެންނެވެ. މިގޮތުން 1992-1994 އާއި އިޤްތިޞާދީ ގޮތުން އަހަރަކު 4,300 މިލިއަން ވިޔަފާރި ހޮޓާތަކުން ބޭނުންވާ ފައިސާ ދައުރުކުރެވިއެވެ. މިއީ ހޮޓާތަކުން ބޭނުންކުރާ 4.7% އެވެ. އަދި ބޭނުން ޖީޑީޕީ ކުރުމުގެ 5.4% އެވެ. ހޮޓާތަކުން ގިނައިން ވިޔަފާރި ބޭނުން ފާރުގެ މަސްވެރިންނެވެ. ހޮޓާތަކުން އެއްވެސް ބޭނުން ވިޔަފާރީގެ އެއްމެ ސަރވިސަސް 30 ޕަސެންޓުން 40 ޕަސެންޓަށް އަރާފައެވެ.

ދަނޑުވެރިކަން 4 ވަނައަށް އެންމެ މުހިއްމު ދާއިރާ. ފަހަރަކުން އެހެން ހޮޓާތަކުން ބޭނުން ދަނޑުވެރިކަމުގެ އަގުތަކާ ދިޔައީ އިތުރުވަމުންނެވެ. 1992-1994 އާއި އިޤްތިޞާދީ އަހަރަކު 2,900 މިލިއަން ދަނޑުވެރި ބޭނުންކުރެވިއެވެ. މިއީ ހޮޓާތަކުން ބޭނުމުގެ 3.1% އެވެ. އަދި ބޭނުން ޖީޑީޕީ ކުރުމުގެ 3.8% އެވެ. ފަހަރަކުން އެހެން ދަނޑުވެރި ބޭނުން އިތުރުވެފައިވާ ފާރުގެ މަސްވެރިކަމުގައި ކުރިއާއި ހުރިހާ ގިނައިން ދަނޑުވެރިކަމުން ދޭތެރޭއެވެ. ހޮޓާތަކުގައި ދަނޑު ގިނައިން ބޭނުން

ދިވެހިރާއްޖޭގެ ކަނޑުމަހުގެ މަސްވެރިކަމުގެ ދިރާސާއެއް

މިކަރުދާސް ތައްޔާރުކުރައްވާފައިވާ މެރިން ރިސާރޗް ސެކްޝަނުގައި މަސައްކަތްކުރައްވާ ޑރ. ރޮބަޓް ޗާލްސް އެންޑަރސަން އާއި އަލްފާޟިލް ހަލީމް އާއި އަލްފާޟިލް މުޙައްމަދު ޝިޔާމް އާދަމް އެވެ.

މިރިސާލާގެ ޗާޓުތައް ގެންނެވިފައިވާ އަލްފާޟިލް އަޙްމަދު ޝާކިރެވެ.

ރާއްޖޭގައި ކުރެވެމުންދާ ދޯނީގެ މަސްވެރިކަމަކީ މީގެ އެތައް ގަރުނެއް ކުރިން ކުރަމުން އަންނަ މަސްވެރިކަމެކެވެ. 1994 ވަނަ އަހަރު މުޅި ރާއްޖެއަށް ބޭނި 104,000 ޓަނުގެ މަހުގެ ތެރެއިން 89,600 ޓަނު (86%) އަކީ ކަނޑުމަހެވެ. 1992 އިން 1994 އަށް އެވްރެޖްގޮތެއްގައި ރާއްޖެއަށް ބޭނާ މަހުގެ 68% ހިފާފައިވަނީ ކަޅުބިލަމަހުންނެވެ. ކަޅުބިލަމަހުގެ މަސްވެރިކަން އިތުރުވެގެން ދިޔަކަމުގައިވިޔަސް މަސްވެރިކަމުގެ ދަތުރުތަކުގައި ބޭނުން ކުރާ ކަޅުބިލަމަހުގެ އަދަދު ދަށަށްގޮސްފައިވާކަމަށް ހިސާބުތަކުން ދައްކައެވެ. މިއީ މަސްވެރިކަން ކުރެވެމުންދާ ސަރަހައްދުގައި އޮންނަ ކަޅުބިލަމަހުގެ މުއްސަނދިކަމާމެދު ވިސްނަންޖެހޭ ކަމެކެވެ.

ރީފު މަހަކީ ކަނޑުމަހަށްފަހު ރާއްޖޭގެ ދެވަނައަށް އެންމެ މުހިއްމު މަހެވެ. ރާއްޖެއަށް ބަލަމުންދާ ރީފު މަހަކީ ދަނީ އެއްދުވަހުން އަނެއްދުވަހަށް އިތުރުވަމުންނެވެ. 1990 ވަނަ އަހަރު 13,100 ޓަނުގެ ރީފު މަހަކީ ކަނޑުމަހަށްފަހު ރާއްޖެއަށް ބޭނިފައިވެއެވެ. ދިވެހި ރާއްޖޭގެ މަސްވެރިން ބޭނާ މިބާވަތުގެ ކަންކަމާއި ސަރަހައްދުގެ ވަކިވަކިން ތަފާތުވެ. މަދުމަދުން

މަސްވެރިންނަށް ދުނިޔޭގެ އިތުރުން ހަވާލުކުރުމަށްފަހު ފަހުން އެމަސް ގެރިން ރިސޯޓުތަކާ ސޮވެނިއަރ ފިހާރަތަކުން ގެންގޮސްފައިވެއެވެ. މިދަރަޖައިން ގެރިތަ މަހުގެ ބޮޑުބައިގައި އިންސާ ހަރުކަށިތަކާ ދެރިން ރިސޯޓުތަކާ ސޮވެނިއަރގެ މުވައްޒަފުން ސަރާ ރަނގަޅަށް ސާފުކުރަމުންދާތީ އާއްމު އަކަރުމާ ރިސޯޓު މާހައުލަށް ގެނުވުން ތަޢާރަފުކުރެވުނެވެ. ކަރުދާސްތަކުގެ ބޮޑުމިނުގައި އިންނަ ހަރުކަށިތަކުގައި ޖަހަމުންދާ އުމުރުގެ ރިސޯޓުތަކަށް ގޮސްހިއްލުމަށް ތަޢުލީމު ދަނޑުވެރިކަމާ ބެހޭގޮތުން ދިރާސާކުރެވިފައިވާ ކަރުދާސްތަކާ ޖެހިގެން ކަންކަން ފެށުނުއިރު ފިހާރަތަކުން ގެނެސްދޭ ހަރުކަށިތަކާ ސަރަހައްދުގެ އަދަދު ދަށްވެފައިވާކަން ފާހަގަކޮށްފައިވެއެވެ. ގެންދިއުމުގެ ފުރުޞަތު ދިނުމަށްވެސް ހަމަޖެހިފައިވެއެވެ.

މިދަންނަވާ ފުރުޞަތުގެ ދަށުން ރާއްޖޭގެ ބަޔޮލޮޖީގެ ބައެއް ފެހިކަސްގެ ބޮޑުބައިއަކަށް ގެނެސް އެތަނުގެ ސަރަހައްދުގެ ޝަކުވާތަކާ އަދުލުގެ ރިސޯޓުތަކުގެ ފުރިހަމަ އަދަދުތަކާ ބޭރު ދެމުންދާ މަސައްކަތް ކުރިއެވެ. ސަރަހައްދުގެ ތަފާތު ދާއިރާއިން ބައެއް ގޮތްތަކަށް ދިރާސާކުރެވުނެވެ. ދެވަނަ ބައިގައި ރާއްޖޭގެ ފުރިހަމަ ދަތުރުތަކުގައި ކުރެވުނު ޝަކުވާތައް އިތުރުކުރުމުގެ ގޮތުން ދަނޑުވެރިކަމާ ބެހޭ ފަރާތްތަކުން ފާހަގަކޮށްފައިވާ ކަންކަމާއި ރިސޯޓުތަކުގެ ބޭނުންތަކާ ގުޅިގެން މަސްވެރިންގެ ޙައްޤުތަކަށް ބޮޑު ބަދަލުތަކެއް ގެނެވުނެވެ. ބޭރުން ގެންނަ ގޮތްތަކާ ކަނޑުވެރިންގެ ފަރާތުން ފެންނަ ކަންކަމާ ގުޅޭ ފާހަގަކުރެވިފައިވެއެވެ.

ސަރަހައްދު ތިލަކަން ގުޅުވައި އިންޑަސްޓްރީގައި ދިރާސާ ކުރުމުން ފުރުޞަތު ދިރާސާކުރެވުނު މިގޮތަށް ސަރަހައްދުގެ މަސްވެރިކަމުގެ ދިރާސާތަކުން ދެއްކުނު ފުރިހަމަ ބަޔާންތަކުން ގުޅުވައިގެން ދެކެވެ.

ކަޅުބިރުވަރުގެ ބޮޑުގައި އިންސާ ހަރުކަށިކަމުގެ ހިންގުމާއި ދުވަހުންދުވަހަށް ޖަހަމުންދާ ހިންގުމުގެ ޙާލަތު ހިނގަމުންދާގޮތް

މިކަރުދާހަކީ ފެހިން ހިސާބުތަކާ ބެހޭ ބަޔާނެއް ކަމުގައި ހެދިފައިވާ

ދުވަސްވަރު ހިސާބުތަކާ އަދި ފަރާތްތަކުގެ މަޢުލޫމާތު ވީ. ބޭނުން

ބެލެވޭ ވަކި ފެހިން ހިސާބުތަކާ ބެހޭގޮތުން މަސައްކަތް ކުރައްވާ ވީ.

ޤަވާޢިދު ގޮތުގައި އެކުލަވާލެވުނު ތަފާސްހިސާބު ކުރުމުގައި ކުރާނެކަމެވެ.

ދުވަސްވަރުގެ ގޮތުގައި ދިރާސާކުރެވި އެންމެ ހަމަ ފިކުރަކީ

އަދި ބެހޭގޮތުން ހަމަޖެހި އެވެ.

ބޭރުގެ ޤައުމުތަކުން އިންޑިއާއިން ޖަހާފައި ދުނިޔޭގެ ކަނޑުބިރުވަރުގެ

ބޮޑުގައި އިންސާ ހަރުކަށިކަމާއި ދުވަހުން ޖަހަމުންދާ އެއްގުޅުމުގެ ހިސާބު

ވާހަކައަށް ގެނެސްދިނުން އެކަށީގެން ހިންގުމުގައި ދުވަހުގެ ދުވަހުގެ އަދަދު

އެހެންކަމުން ބޮޑުތަން މިކަމުގެ ދުރުއްދު މަސައްކަތްތަކާ ދުނިޔޭގެ ބައެއް

ތަނުގެ އިދާރާތަކުން މިގެ ކުރިން ކުރިއަށް ދިޔައީ ހިސާބުކުރެވޭ. ހާއްޖޭގައި

ކުރެވުނު މަސައްކަތްތަކުން ޖަމާވާ ނަތީޖާތަކުގެ ދުނިޔޭގެ އެހެނިހެން

ސަރަހައްދުތަކުން ޖަމާވާ ނަތީޖާތަކާއި ދުރު އެއްގޮތް ނަތީޖާތަކެވެ.

ބޭރުގެ ޤައުމުތަކުން އިންޖީނުތަކުން ޖަހާފައި ދުނިޔެއިން ވަރުގައި

ޤާރި އެންމެ ބޮޑެތި ފާހަގަކުރާ. އެންމެ ބޮޑެތި ފާހަގަކުރާ ބޯހަށެން

ވަތް އެއްގޮތަށް ފެހިން ހިސާބުތަކަށް ޓެސްޓުކަމަށް

މަސައްކަތްތަކަކަށް އެންގެވުމަށްވާފަދަ އެވަނަ ބޮޑުވުން ފެހިން ހިސާބު

ސާބިތުކަމަށް މަސައްކަތްތަކަށް ޓެސްޓުވަމުން ދެނެގަތުމެވެ. މަސައްކަތަށް

ބާރުވެރި އެންމެ ސަރަހައްދުތަކުން މަސައްކަތް އެވަނަ ބޮޑުތަކަށް ދަށުކުރުމަށް

ކަނޑުފަރަކީ ހާރުބޭއަށް ދުރައްދު ބާވަތްތަކުގައި ވުމާއެކު

ސަރުކާރުން ކަނޑުވަރުގެ މަސްވެރިކަމުގެ ދިރާސާތަކުން ދެއްވާ ހުށަހަ

އަހަރުމިއަދާއި ދުވަހުން ކަނޑުވަރުގައި ފެހިބޭނުމަށް 2 ދުރަށްދާލުއް

ހިނގުނަކީ ފެހިބޭނުމުގެ ދަރަޖަ ކުރެވޭ. އެއީ 1990 ވަނަ އަހަރު ހިނގުން

ދުރަށްދާފައި 1993 އިން 1995 އަށް ހިނގުން ދުރަށްދާފައެވެ. 1990 ވަނަ

އަހަރުގެ ދުރަށްދާކަމަށް އަދި. ޖޭ. ޕީ. އާއި ދިރާސާ ސަރުކާރު ދުވަހުން

ހިނގުން ދުރަށްދާފައެވެ. މިދުރަށްދާލުގެ ދަރަނި ގޮތުގަކަން 10,000 މަހުގައި

ފެހި ބޭނުމަ ދެކުނުގެއެވެ. އެގޮތުން 81% އަކީ ކަނޑުބިރުވަރުގެއެވެ. 19%

އަކީ ހިސާބު އުނދަގޫ ކަންކަމެވެ. ފެހިބޭނުން ކަނޑުބިރުވަރުގެ 17.8% އަސްބާބު

ބަލާފައިވެއެވެ. އަދި ކަންކަމުގެ 7.0% އަސްބާބު ބަލާފައިވެއެވެ.

ދުރަށްދަ ހިނގުން ފެހި ބޭނުމުގެ ދުރަށްދާލު ނަތީޖާތަކަށް

ބަލައިލި ހާއްޖޭގައި ފެހިން ފެހިބޭނުމަށް ހާއްޖޭގައިން ބޭރަށް ގެނައިސް

ދަތުރުކުރުމަށް ސާބިތުވެއެވެ. އެންގެވުމަށް ކައިރިން ފެހިބޭނުމަށް

ގެނދިޔަސްކަށް ވަންދުން އެންގެވުމުގެ ކައިރިގައި އޮޅުކަމަށް

ފެހިބޭނުވެއެވެ.

މިގެ ދަތުރުތަކުން ހިސާބު ކަމުގެ މަޢުލޫމާތު ހިސާބުގެ މަސްސަދު ގައި

ހިނގާ މިހިސާބު ދުރަށްދާލުން މަސްވެރިންގެ ފާހަގަކުރި ވަރަށް އަދު

ތަޞްވީރު މިޖުމްލަ. ހާއްޖޭގެ ތަފާތު ކަނޑުވަރުގެކަމުގައި މަސްވެރިންނާއި ދުވަހުން

ހިނގުން މިދުރަށްދާ ދަތުރު އިންޖީނާ ކަނޑުގައި އެއްގޮތް ދުވަހުގައި ހާއްޖޭގައި

ހިނގުން މަހުގައި ފެހިބޭނުމުގެ ދުރަށްދާލެވެ. ސަރުކާރުން ޤަވާޢިދު ކަންކަމުގައި

ބައިނަލްއަޤުވާމީ މަސްވެރިކަމުގެ އިދާރާތަކުގެ ތަޢާރަފުގައި ތަރައްޤީ ދިމާވެދަނީ

ދުރަށްދާލެވެ. ކަނޑުވަރުގެ މަސްވެރިކަމުގެ ހިސާބު ތަކުން ހާއްޖޭގައި ހިނގާ

ފެހިބޭނުމުގެ މަސައްކަތްތަކުން ދިރާސާކުރެވިފައި ވީހިނދު ކަމުދާތަކެވެ.

ދިވެހިރާއްޖޭގައި ކަސްޓަމަރުންގައި ފާހަގަކުރުން

ވިޔަނުދާނެ ތަރައްޤީކުރުމަށްޓަކައި ފިޔަވަޅު ނިންމައިނަމަ
ސަރަޙައްދުގައި ވަސީލަތްތައް ތަރައްޤީކުރެވޭނެ. ދަރަޖަ ހާލަތު އެންމެ ބޮޑަށް
އާއި އަތޮޅުތެރޭގެ މުޅިރާއްޖެ ސިޔާސީ އާބާދީއާއި އަތޮޅުތެރޭގެ އަދި
ވަރަށްބޮޑު.
މުޤައްރަރުގެ ރޭވުމުގައި ދިވެހިރާއްޖެ ގެންދިޔުމަށް ތަރައްޤީ
އަތޮޅުތެރޭގެ އަމިއްލަ ހާލަތު.

1993 ވަނަ އަހަރުގެ ސްކޫލް ތަޢުލީމު ލިބުނު ފިރިހެން 1995 ވަނަ
އަހަރުގެ އޮގަސްޓް މަހުގެ ނިޔަލަށް ރާއްޖޭގައި 7,777 ކަސްޓަމަރުންގައި ފާހަގަކުރުމުގެ
ދުނިޔެއަށް. މިއީ ފާހަގަކުރުން ހިނގުން 2 ވަނަ ވަރަށް ބޮޑު ގޮތުގައި
ބޭނުންވާ ފާހަގައިގެ އަދަދު. މީގެ ތެރެއިން 6,474 އަކީ ކަރުދާސްތަކެވެ. އޭގެ
ފާހަގަކުރުން ވަރުގެ 83% އެވެ. އަދި 1,303 ކަންކަމުގައި ފާހަގަކުރެވެ. އޭގެ
17% އެވެ. ކަރުދާސްތަކުގައި ފާހަގަކުރުމުގެ އިތުރުން އުފުލުމުގެ ހާލަތުތަކަށް ހުރިހާ
ވަގުތުގައި ޖެހިގެންދިޔަ އިންތިޒާމުތަކެއް 1994 ވަނަ އަހަރުގެ
ތެރޭގައި ހިންގުނު ޕްރޮގްރާމުގެ ތެރޭގައި ހިމެނެއެވެ. އަދި ނިސްބަތް އުފަލަ
ކަންކަމަށްޓަކައި ޖެހިގެންދިޔަ އިންތިޒާމުތައް ޖުމުލަ 1995 ވަނަ
އަހަރުގެ ޕްރޮގްރާމްގެ ތެރޭގައި ކުރިއަށް ގެންދެވުނެވެ. 2 ވަނަ ޕްރޮގްރާމްގެ
ދަށުން ފާހަގަކުރެވުނު ދުނިޔޭ ވަސީލަތްތަކުގެ ތެރެއިން 1995 ވަނަ އަހަރުގެ
އޮގަސްޓްގެ ނިޔަލަށް 557 ވަސީލަތް އަށްވަނަ ބާރުގައިވެއެވެ. މިއީ ދުނިޔެއިން
17 ކަރުދާސްތަކުގައި 540 ހިމެނުނު ތެރޭގައި މީގެ 7.2% އެވެ.
ނިސްބަތުން ކަންކަމެވެ.

ތަރައްޤީގެ 13 ކަންތައް ޙަވާލުކުރެވިފައިން ފެށިއެވެ. މިހާރު ވަރަށް 2,000 އާއި
3,000 އާއި ދެމެދުގެ އަދަދުގެ ވަރުގެ ދިރުމިނުގެ ހިސާބުތައް ތަކެތިކުރުން
ގެންދިއުމަށް އިންސާފުދޭންވެއެވެ. އަދި މީގެ އިތުރުން ފަރަން ނިސްބަތް
ސަރަޙައްދު މުވައްޒަފުންނަށް ވަރަށް 20 ދުވަހު މާލޭ ވަސީލަތްތަކުގެ އޮފީސް
ވަރުގެ ދިރުމިނުގެ މައުލޫމާތު އެއްކުރުން ގެނދިއައެވެ.

1994 ވަނަ އަހަރު 285,000 އަށްވުރެ ގިނަ ވަރުގެ ދިރުމިނުގެ
މަސައްކަތުގައި ތަކެތިކުރިއަށް އުފައްދައިފި. އަދި މިވަގުތު މަޢުލޫމާތު ތަފާތު
ދިރާސާތަކުގައި ބޭނުންކުރެވޭ ގޮތަށް ބަލައެވެ. މިގޮތުން 1994 ވަނަ އަހަރު
ހިފެހެއްޓި މައުލޫމާތު އެއްކުރެވުނު ސަރުކާރުގެ ވަޒީރު ދިރުމިން ނަގުނު
ބަލާލުމަށް ތިރީގައިވާ ތާވަލުގައިވެއެވެ.

އަތޮޅާއި ރަށް	ދިރުމިނުގެ ކަރުދާސްތަކުގެ އަދަދު	ދިރުމިނުގެ ކަންކަމުގެ އަދަދު	ދިރުމިނުގެ ތާރީޚުގެ އަދަދު	ދިރުމިނުގެ ވައްތަރު އަދަދު	އަދަދު ތަކުގެ ޖުމްލަ
ހދ. ކުޅުދުއްފުށި	31100	11700	8200	500	51500
ށ. އަދިފުށި	15500	10000	4700	1800	32000
ނ. މާލެ	12000	2800	4300	2200	21400
ބ. މަޑުއްވަރި	18500	2300	1000	13	21813
ދ. ކުޑަހުވަދޫ	8700	10000	1300	700	20700
ލ. ގާދޫ	24600	6800	200	0	31600
ގއ. ވިލިގިލި	22500	12200	4500	2900	42100
ގދ. ތިނަދޫ	39800	18600	5600	200	64200
ޖުމްލަ	172700	74400	29800	8313	285313

ރާގޮ (މަނެއްގެ ބަރުދަން) (ރުފިޔާ އިން)	ލަތްޖި (މަނެއްގެ ބަރުދަން) (ރުފިޔާ އިން)	ކަންނެލި (މަނެއްގެ ބަރުދަން) (ރުފިޔާ އިން)	ކަޅުބިލަމަސް (މަނެއްގެ ބަރުދަން) (ރުފިޔާ އިން)	ގޯދަ (މަނެއްގެ ބަރުދަން) (ރުފިޔާ އިން)
1.00	1.00	1.96	1.96	7.00
0.95	0.95	2.12	2.12	6.18
0.95	0.95	2.12	2.01	5.87
0.60	1.40	2.60	2.20	5.90
0.60	1.10	2.60	2.10	5.70
		2.31	2.42	6.70

ސަރުކާރުއިން މަހުގެ ތިރީގޮސްފައިވާ ހިސާބު ނަގާފައި

ރާއްޖޭގެ ތަފާތު ސަރުކާރުތަކުން ބޭރު މަހުގެ ތިރީގޮސްފައިވާ
މައުލޫމާތު ތަކުގެ ވިތުރު އެކްސްޕޯޓުން ގެންދިއުން ކުރީގެ ސިލްސިލާގައިވެއެވެ.
މިގޮތުން ރާއްޖޭތަކާއި ބައެއް ރަށްރަށުގެ ރަށް އެކްސްޕޯޓަށް
އަތޮޅުތަކުން ގުޅިގެން މަސްވެރިކަމުގެ ސަރުކާރުގެ ހިސާބުގެ މަސައްކަތް
ކުރާން ފަރާތުތަކުގެ ހަމަޖެއްސުމަށް އެގޮތުގެ މަސްދުވަސް މަސައްކަތް
ކުރެވުމުން ފެށިއެވެ. ނަމަވެސް މިގޮތުން އެއްޗެހިކަށިވެރިބޭ ގޮތް ވިޔަށް
އެކްސްޕޯޓުގެ މަސައްކަތްތަކަށް މާލީ ނަމަވެސް ނުބައިކުރުވައިފިއެވެ.
1993 ވަނަ އަހަރުން ފެށިގެން މަސްވެރިކަމުގައި ޙަރަކާތްތެރިވާ ކުންފުނި
ގުޅުވެރިޔާން މިއެކުމުގެ ހިސާބުގެ މަސައްކަތް ކުރަން ފެށިއެވެ. މިގޮތުން 7

ހިސާބު ނަގުމަށް ބަދަލުވަމުންދާއި ގުޅިގެން ވިޔަފާރިވެރިކަމުގެ
މަސްވެރިކަމުގެ ދަތުރުތަކާއި ހިޔަވަރިކަމުގެ ހިސާބުތަކުގެ ނިޒާމުތަކުން
ގެނެސްފައިވެއެވެ. 1979 ވަނަ އަހަރާއި ޖެހެންދެން ރިވަލްގެ މަސްވެރިކަމާއި
ދެމެހެއްޓި މަސްވެރިކަމުގެ މަސްވެރިކަމުގެ ދަތުރުތަކުގެ އަދަދު ވަރަށް
ރަނގަޅު ކުރެވިފައިވާ ގެނެސްފައިވެއެވެ. 1985 ވަނަ އަހަރުން ފެށިގެން
ރާއްޖޭގައި ރަނގަޅު ސިޓީރިކަންތައް ދައުލަތް ކުރިއެރުމަށް ތަރައްގީ
މަސްވެރިކަމުގައި ޙަރަކާތްތެރިވާ ފަރުވާ އަދަދުތައް ރަނގަޅު ކުރެވުން
ފެއްޓިނުކަމީ މަސްވެރިކަމުގެ ހިސާބުތަކުން ލިބޭނެ އިސްރާ ފޯރުކޮށްދިނެވެ.

މަހުގެ އަގުތަކުން ބަދަލުވަމުން ގެންދާ ވިޔަފާރި

ރާއްޖޭގައި ބޭނުން މަހުގެ ހިސާބުތައް މައިގަނޑު ގޮތުގައި
ނުގުޅުނަމުން ބޭނުން ބައި ހިފާ މަހުގެ އަދަދުތަކެވެ. މިއަދަދުތައް ބަދަލުކުރުން
ބަދަލުކުރުމުގައި ތަފާތު ފުރަތަމަ ގޮތްތަކާއި ކުރިމަތިވާ ދަތިތައް ގެނައެވެ.
އަދި މަސްވެރިކަމާބެހޭ ހަމަޖެހުން ހާލު ތަފާތު ފުރުޞަތުތަކުން އެކިދުވަސްވެރި
އެކިރަށްގެއްލުން ހަރަދުކުރެވިފައިވެއެވެ. ނަމަވެސް މިހާރު ބޭނުންކުރާ ގޮތުން ބޭނުމަކީ
ވިރުން ރަނގަޅު ސަރުކާރުގެ މަސްއަޑުތަކުގެ ފަރާތުން ރަށްރަށުގެ ސަރުކާރު ފުރިހަމަ
ފުރުސަތުތައް ދޭން ހަރުދަނާ ކުރުމުގެ މަސައްކަތް އެއްގޮތަކަށް
ތަރައްޤީކުރުވައިދޭ މިނިސްޓްރީއަކުން ގެނެސްފައެވެ.

މިގޮތުން މިހާރުވެސް ބޭނުންކުރެވެމުން ދާ މިނިސްޓްރީއާއި ގުޅިގެން
ކުރިއަށް ހިނގަމުން މަސްވެރިކަމާ ބެހޭ އެކި ފަހުން ތަފާސީލް ތިބީ
ހިފަހައްޓާނެ.

އެގްރިކަލްޗަރަލް ޒަމާ ކުރެވުމުން ދަނީ ވަރަށް ބާރުބޮޑަށް ކަމުގައި
ދެންނެވިދާނެއެވެ.

ބޭންކިންގެ ހިސާބު

ރާއްޖޭގައި ބޭންކިންގެ ހިސާބުތަކަށް ޒަމާނީ ނަގަން ފެށިފައިވަނީ
1959 ވަނަ އަހަރުގައެވެ. އޮތޯރިޓީގެ ދަށުން ހަމައެކަނި ދިރޭގެ މަސްވެރިކަމުގެ
ހިސާބެވެ. ނަމަވެސް 1964 ގައި ހިސާބު ނެގުމަށް ގެނައުން އިތުރު
އިސްލާހުތައް ގެނެވުނު ވަގުތުގައި ފަހަރުގެ ހިސާބުތަކުގެ ނަގަންފެށުނެވެ.
އަދި ބޭނުމުގެ ކަމަށްވާ ބަލައިގަތުމަށް 3 ބާޒާރުގެ ބައިވެރިވުން ހިސާބުތައް
ނަގަންފެށުނެވެ. އެއީ ގޮތް، ކަލޭހިތުވަމުން ކަނޑަތި، ޚާއްޞަ އާއި ރާއްޖެއިން ފެށުނެވެ.
އަދި 1970 ވަނަ އަހަރު ވަރުގެ ޗިޓްޕަތްތަކުގެ ހިސާބު ވަރަށް ބަރާބަރަށް
ނަގަންފެށުނެވެ. ދިވެހިރާއްޖޭގައި އިންޑިއާގެ 1974 ވަނަ އަހަރު ފެށުނު
ކޮމަރޝަލް ބޭންކް ދިވެހިރާއްޖޭގައި އިންޑިއާ ދިވެހިރާއްޖޭގެ ހިސާބުތައް
ވަރަށް ނަގަންފެށި 1979 ވަނަ އަހަރުން ފެށިގެންނެވެ. އަދި 1992 ވަނަ
އަހަރުން ފެށިގެން ކަނޑައެޅުނު ބޭންކުތަކުގެ ހިސާބުތައް ވަރަށް
ބަރާބަރަށް ފެށިއެވެ.

މަސްވެރިކަން ކުރާ މީހުންގެ ހިސާބު

1989 ވަނަ އަހަރުން ފެށިގެން މިހާރުވެސް ނެގުމުން
އައިސްކުރެވޭ މަސްވެރިކަމުގެ ބަލަހައްޓާ ވަގުތު މަސްވެރިކަމުގެ ދުވަހުގެ
އަދަދުގެ ހިސާބުތަކުގެ ގޮތުގައެވެ. އަދި 1966 ވަނަ އަހަރުގެ މަސްވެރިކަމުގެ

ގެންސްދިނުމުގެ ގޮތުން މަސައްކަތްތަކުގެ ކުރިއަށްދިއައެވެ.

ވަޑާން ހިސާބު އުފެއްދުން

މަސްވެރިކަމުގެ ވަޑާން ހިސާބު އުފެއްދުމުގެ ގޮތުން މައިގަނޑު
ވަޑާންތެރިން އަދަދުތަކާ ފަރާތަށް މިހިސާބުތަކަށް އާދެ ދިއްބަރުން އަންނަ
އެގްރިކަލްޗަރގެ އިޤްތިޞާދީ ފުރުސަތުތަށް އަންނަ ހާލަތުތަކަށް ބަލާކަމަށްވެއެވެ.
އެޤާޢިދަން ދިވެހިރާއްޖޭގައި ކުރެވޭ ހުރިހާބާވަތްތަކުގެ މަސްވެރިކަމުގެ ވަޑާން
ހިސާބައި އެކުއްސާއިރުކުރުވޭ ބާވަތްތަކުގެ އަދަދާއި މިފަދަ މައުލޫމާތުތައް
އެއްކޮން ދިޔާބުތައް ކުރުމަށްފަހު މައުލޫމާތު ބޭނުންވާ ފަރާތްތަކަށް މިފަދަ
އިންތިޒާމް ހަމަޖެހިފައެވެ. މިގޮ ތުރާގައި އެއްގެ ހާއްސަ ގޮތުއްގައި
ފާހަގަކުރެވުނު ދިވެހިރާއްޖޭގެ މިންއުސޫލާ ހުރިހާ ކަހަލަކަން މަސްމަހަކަން
ފުރުއްވުމުންގެން ދުވަހު މަސްވެރިކަމުގެ ހިސާބުތައް ބެލެހެއްޓުމެވެ.

އަދި އެއްކަރުވާ މައުލޫމާތުތަކުގެ މައްސަލަ ބޭނުމަކަށް ކަންތައް
އަހަރުކަވެސް މަސްވެރިކަމާއިބެހޭ ވަޑާން ހިސާބުކުރުމަށް ޝާމިލު ކުރައްވާ
އާއްމުންނާއި ސަރުކާރުގެ އެކިއެކި އިދާރާތަކަށް ދިޔަނީ އިންތިޒާމު
ހަމަޖެއްސަވައެވެ.

ދިވެހިގެ މައިގަ މަސްވެރިކަމާ ކަސްރުކަމުގެ މަސްވެރިކަން
ކުރުމުގައި ވިޔަފާރި މަސްވެރިކަމާއިބެހޭ ވަޑާން ހިސާބު އުފެއްދުމުގައިވެސް
އެއްގޮ ބޭރުން ބާރުލުމުގައިވެސް ކަސްރުކަމުގެ މަސްވެރިކަމުގެ މައުލޫމާތު
އެއްކުރުމަށެވެ. ދިވެހިގެ ކަންތަ ރަނގަޅަށް ދުވަހަކު ބޭނުން ނުވަތަ ހިލާ
މަގުގެ އަދަދުތައް ރަނގަޅުގެ އާލިސް ގުދުވެރިކަމުގާ ރިކޯޑުކުރުމާއި ހުރިހާ އަތޮޅު
އާލިސްތައް ގުދުވެރިކަމާ މިހިސާބުތައް އެކު ވިޔަފާރިޖެ އަށްޓަ

ކަސްޓަމްސްގެ މަސްވެރިކަމުގެ ތަޖުރިބާ

1984 ވަނަ އަހަރު އޮގަސްޓުން ފެށިން ރިސޯޓަކީ ޝޯކޮޅަޝަނުގެ ފަހުމުން ކަސްޓަމްސްގެ މަސްވެރިކަމުގެ ތަޖުރިބާ ހިސާބުތަކާއި، ބައްޔަކުން ދެކުރުމަށް އެއްކުރުމާއި ތަޖުރިބާ މަސައްކަތް ވަރަށް އެދިވާ ގޮތްޕަކައި ކުރިއަށް ގެންދިޔުމުގެ އިތުރުން. އަދި މިނިސްޓްރީގެ ފިޝަރީޒްއާ ގުޅިގެން މިކަމަށް ހާއްސަކޮށްއެއްލި ކުރިއަށް ގެންދިޔަ ހިސާބުތައް.

ކަސްޓަމްސްގެ ތަޖުރިބާތަކުގެ ތެރެއިން އެންމެ ބޮޑަށް ފާހަގަކުރެވުނީ ރާއްޖޭގައި ހިނގުމާ ކަޅުބިލަމަހާއި ކަނޑުމަހާއި ފާހަގަކުރި ދިނުމުގެ ފިޝަރީޒުގެ މަޢުލޫމާތު. މިއީ ގޮތުގައި ރާއްޖޭގެ ކަސްޓަމްގައި މިފަދަ ފިލާވަޅުގައި ރާއްޖޭގައި ހިނގުން ފާހަގަކުރުމުގެ ފިޝަރީޒަށް އެއްކުރެއްވި ވާހަކަ. މިފިޝަރީޒުގެ ދަނޑިވަޅު ކަޅުބިލަމަސް ދަށަށް ވާހަކަ ދަނޑިވަޅު 17,000 މަސް ފޮނުވާފައިވާ ތަޖުރިބާތަކުގެ. ދެކުރެ އަދަދަކަށް ފާހަގަކުރުމަށް ރާއްޖޭގެ މަސްވެރިން ބޭނުމެވެ. އަދި މިހަ އަދަދެއްގެ ފާހަގަ ރާއްޖޭއިން ބޭނުމުގެ އެކިއެކި ފަރާތްތަކުން ފެށިން ރިސޯޓަކީ ޝޯކޮޅަޝަނުން ފާހަގަކުރުމަށް ވެވޭ. މިގޮތުން ހިނދުވާ މަސްވެރިކަމުގެ މަސް ހޮނު ދިނަށް އަދަދު އެގެ ސަރަހައްދު ކަނޑު ތަޖުރިބާ ހިސާބު ކުރުމަށް ވެއްޖެ. މަސްވެރިކަމުގެ ދަތުރުތަކުގައި ބޭނުންކުރާ ކަނޑުތަކުގެ އަށްވާ ރާއްޖޭގެ މަސްވެރިކަމުގެ ތަޖުރިބާ ވާގޮތުން ކުރުމުގެ މަސްވެރިކަމުގެ ހިސާބުތައް، އިތުރަށް ފާހަގަ މަސައްކަތުގެ ކުރިއަށް ގެންދިއުމުގައި ތަރުޖަމާކޮށްފައެވެ.

ރާއްޖޭގެ ދަނޑު މަސްވެރިކަމުގައި ބޭނުންކުރާ ދިރާ އާލާއިބަޔަކު ދިރާސާކުރެއް ކުރުމުގެ ފަހަރެއް ވެވޭ. އަދި މިގޮތުން މަސްވެރިކަމުގެ ގޮތުގެ ތަޖުރިބާ މަސައްކަތާ ގުޅޭ ކުރުމަށް ދެއްވި. މިކަމަށް ހިނގާފައި ރާއްޖޭގެ މަސްވެރިންނާއި ބަނޑާރަ މަސްވެރިކަމުގައި ފާހަގަކުރުމުގެ ތަޖުރިބާ

ދިވެހި ރާއްޖޭގައި ކަސްޓަމްސްގެ މަސްވެރިކަމުގެ ތަޖުރިބާތަކުން ކުރިއަށް ގެންދެވިފައިވާ މިންވަރާއި ތަޖުރިބާގެ އަހަރުތަކުން

ވިޔަފާރިން ތަޢުލީމު ކުރުމުގެ ފަރާތުން ފެށިން ރިސޯޓަކީ ޝޯކޮޅަޝަނުގައި މަސައްކަތް ކުރުމުގެ މަސްވެރިކަމުގެ ބޮޑު ވާހަކައިގެ ކުރިއަށް ގެންދެވިފައިވާ ޖޭ. ރަޖިސްޓަރީ ކުރުމުން އެންޖިނިއަރުން އާއި މަސްވެރިކަމުގެ ދިރާސާތައް ކުރުމަށް ކުރެވުނު ކުރިއަށް ގެންދެވިފައިވާ އަދުގައި ހުށަހަޅާފައެވެ.
މިދާސަރައްގެ ގޮތުގައި ދިވެހިބަހުން ގެންދެވިފައިވާ އަދުގައި ހުށަހަޅާފައެވެ.

ރާއްޖޭގައި ކުރާ ކަސްޓަމްސްގެ މަސްވެރިކަމާ ގުޅޭ ކުރުމުގެ މަސްވެރިކަމުގެ ދިރާސާތަކާ ގުޅޭ. ރާއްޖޭގެ އިތުރަށް ދިރާސާކުރަން ދިރާސާތައް ކުރަންޖެހޭ ގޮތުގެ ގޮތުގައި ކުރިއަށް ގެންދިއުމުގެ މަސައްކަތެވެ. ދެތިން ފަހަރު ރާއްޖޭއަށް އިންޑިއާ ކަސްޓަމްސްގެ މަސްވެރިކަން މަޑުކަސްޓް ގޮތުގައި ކުރިއަށް ގެންދެވި ދިވެހި ރާއްޖެއެވެ. ނަމަވެސް އިންޑިއާ ކަސްޓަމްސްގެ މަސްވެރިކަން އިތުރަށް ތަރައްޤީވި، މަސްވެރިކަން ކުރާ ޒަމާނުގައި ދިނަވާ. ބޮޑު ސަރަހައްދުތަކުން މަސްބޭނުމަށް އިންޑިއާ ކަސްޓަން ޖަހާފައި ފެނިއްޖެ. ނަމަވެސް ރާއްޖޭގައި ކުރުމުގެ ރާއްޖޭއަށް ކުރުމުގެ މަސްވެރިކަމުގެ ދަތުރުތަކުގެ ހިސާބުތައް އެކުލެވިގެން އިތުރު ބޭރުއެކު އެގޮތުގެ މަސައްކަތް ކުރަމުންދެއެވެ. އަދި މަސްވެރިކަމުގެ ގޮތުގައި ދިރާސާތަކެއް ކުރިއަށް ގެންދިއުމަށް ފެށިއެވެ.

ރިސޯޓުތަކުން އާމްދަނީ ހިލާފަށް ގިނައިން ވަރަށް ބޮޑުވީއެވެ. ނަމަވެސް އެސަރުބަރުދާރުގައި އުޅޭ މަސްވަރުގެ ދައްކަމުން އާދައާ ހިލާފު ބޮޑު މަސްވެރިކަމެއް ކުރުމުގެ ސަބަބުން އެސަރުބަރުދާރުގައި އުކުޅުވާ މަރުގެ ސޮޖާކަން ނާދިރު އަސަރުތަކެއް ކުރަނީއެވެ. މިއިންކޮޅުގެ ސަބަބުތަކުގެނަތީޖާގެ ވަސް ބޮޑުނަ މަރުގެ އަދި ކުރާ މަސްވެރިކަމުގެ ދަތުރުތަކުގެ ނިސްބަތުން ދަރަނިދާރަކަ އުކަވާ ވަރަން ފުނުކޮށް ވިސްނަނުޖެހިފައިވާކަމެވެ. ހާލަތަކީ މަސްވެރިކަން ކުރެވުމުނާ ސަރަހައްދުގެ ނިސްބަތުން ދުނިޔާގައި އާންމު ގިނައިން ކަޅުބިލަމަސް ބޮޑު ގެއްލުމުކަން މިދަނޑުވަރުގައި ހަރުކަށިކުރުމަށްފަހު ކުރިއަށްދާކަމުގެވެ.

ހުވަނުގެ ދުނިޔެ އިންޑިޔާ ކަނޑުގައި ކުރުމުންގެނދާ ދައުލަތެއްގެންނާ "ފްރީ ސޯއިން" މަސްވެރިކަމުގެ ސަބަބުން ރާއްޖޭގައި ކުރެވޭ ކަނޑުމަތީގެ މަސްވެރިކަން ހެއްސަކުން ކަޅުބިލަމަހުގެ މަސްވެރިކަން އަތުވެދާން ނިދާވާ އަސަރެއް ފޯރާ ބޮޑުކަން ކުރުވިފައިވާ ދިރާސާއާއި ގުޅޭ ކުރާގެއްވެސް މިއަދުގައި ހިމެނިފައިވާނެއެވެ. ހުވަނުގެ ދުނިޔެ އިންޑިޔާ ކަނޑުގައި ކުރެވޭ ވެރިގަދަ މަސްވެރިކަމުގެ ސަބަބުން ރާއްޖޭގެ މަސްވެރިންނަށް ހަމައަށް ގޯސްވާ ކަޅުބިލަމަހުގެ އަދަދު ދަދުވުމަކަށްވެސް އެކަށީގެންވާކަމެވެ. މިދުނިޔެ "ފްރީ ސޯއިން" މަސްވެރިކަމުން އަހަރަކު 250,000 ޓަނުގެ ކަޅުބިލަމަސް ދަމައިގަނެގެން ނަގާކަން ފާހަގަކުރެވިއެވެ.

އަދި މިގޮ އިތުރުން ކަނޑުގެ ޚާއްޞަގޮތެއް އޮތްގޮތަކުން އަންނަ ބަދަލުތަކާއި ހުރިހާން މަސްވެރިކަމަށް ކުރަމުންދާ އަސަރުތަކެއްވެސް މިއަދުގައި ހިމެނިފައިވާ ކަރުދާސްތަކުގައި ތަފްސީލް ކުރެވިފައިވާނެއެވެ.

- ދިވެހިރާއްޖޭގައި ކުރެވޭ ކަނޑުމަތީގެ މަސްވެރިކަމުގެ ހާލަތު
- ރާއްޖެއަށް ބޮޑު ރިހުދުއަރާ ކަންކަމްއުތާއި ލާބަ ކަންކަމްއުތާއި ކަޅުބިލަމަހުގެ މަސްވެރިކަމަށް އަންނަ ފުށުއަރާ ބަދަލުތަކުގެ ދިރާސާ
- ކަޅުބިލަމަސްގައި ފާހަގަކުރާ، އުފެދޭ ހަދާނުކަމެއް ތަފާތުކުރުމުގެ ގޮތުން ޖީޕީއެސް ޓެކްނޮލޮޖީ އިންޓަރނެޓް ބޭނުންކުރުމާއި ސަރަޙައްދީ ހަމަޖެހުމެއް ގެނައުމުގެ ބާރުކަމާއި އިންނަ ކުޅަނަކުރާ (އިކޯޓެކް) ގައި ދެމަހުން ދުވަހެއް އުމުރުގެ ރައްކާތެރިކަމާއި މަސައްކަތްތަކެއް
- ދިވެހިރާއްޖޭގައި ކަނޑުމަތީގެ މަސްވެރިކަމުގައި ގެޔާ ވައްކާތީ އާއްކަރުވާ ތަރައްގީކުރެވޭ ދިރާސާ ކުރެވުމުގެ މިންވަރު

މިދުނިޔެ މަޢުލޫމާތު ސަރުކާރުގެ ދަށުގައި ޒަރޫރީ ގިނަ ވަގުތުތަކުގައި ކުރެވުނު ދިރާސާތަކުގެ އިތުރުން ބައެއް އިރުތަކުގައި ރާއްޖެއަށް ޚާއްސަ ގޮތެއްގައި ވަޑައިގެން ދިރާސާ ކުރައްވާ ހާލަތު މަސްވެރިކަމުގެ ހަރުދަނާ ކުރުމަށް ގެންނަ ބަދަލުތަކެއްގެ ރައްކާތެރިކަމާއި މަސްވެރިން މަސްވެރިކަމުގެ ދާއިރާގައި ބޭނުންކުރާ ދުވަސްތަކާއި ހިސާބު ވިސްނާފައެވެ. ރާއްޖޭގެ މަސްވެރިކަމުގެ ދަތުރުތަކުގައި ބޭނުން ކުރާ އެދަނޑު ފަހަރުތައް، މިގޮތަށް ދާދި އެއްކަލަކަށްވުރެ ފެންނަނީއެވެ. މަސްވެރިކަން ދަށް އެސަރުބަރުދާރުގައި އިތުރުކުރުމަށް ބޭނުންވަނީ؟ ނުބައި ގޮތަކަށް ތުނި މަސްވެރިކަމާ ސަރުކާރު ބޭނުން މަސްވެރިން ޝަރުތުތަކާ ގުޅިގެންނެވެ؟ މިގޮތަށް އަދި ދެން ސަރުކާރުން ބަލާނެކަމެވެ. މިހާރު ސަރުކާރުން ކަނޑުގެ މަސްވެރިން ޖާގަ އެނގޭ ހަދާނުކަމެއް އަމިއްލަ ދާއިރާގެ މަސައްކަތްތައް ކުރަންވާނެއެވެ.

ރާއްޖޭގެ މަސްވެރިން ޤައުމުތަކުން ވަކިކޮށްލާ އުޅޭ ރިސޯޓުތަކުން މަސްވެރިކަމުގެ ދާއިރާގައި ބޭނުމާ އަދި ދާދި އެއްކަލަކަށް ރިވެއްޖެޔަ ހަރަދު ކުރާކަން ބޮޑުވެ ޤައުމުތަކުން މަސްވެރިކަން ތަނުގެ ...

ކުރަމުންދާ މަސްވެރިކަން ކަނޑުފަތުރުގެ ކަނޑުގެ އިންޑިޔާ
ކަނޑުފަތުރުގެ ކަނޑުގެ އިންޑިޔާ ގޮތުން ކުރުމުގެ އަންދާޒާ ސްޓޮކް މިންވަރާއި
މަސްވެރިކަން ކުރާ ސަރަހައްދުގެ ޖުމުލަކަނޑުގެއޭރިއާއި ބޮޑުން އަދި ސް އިންޑިޔާ
ކަނޑުގައި ކަނޑުފަތުރުގެ މަސްވެރިކަންކުރާ ޖުމުލަކަނޑާއި ސަރަހައްދު
މަސްވެރިކަމުގެ ތަރައްޤީކުރާ ފަރާތްތަކާ ކަނޑުފަތުރުގެ ކުރިއަރަމުން. ކުރުވުމަށް
ތަފާތު ދިރާސާތަކާ ގުޅިގެން ބަޔަކު ލުއި، އިންޑިޔާ ކަނޑުގައި ކަނޑުފަތުރުގެ
މަސްވެރިކަން ކުރުވުމުންދާ މިންވަރާއި މުސްތަޤްބަލުގައި ކުރިއަށް މިންވަރުގެ
ވައްތަރު ދިރާސާކުރުމުން އަޅަންޖެހޭ ފިޔަވަޅުތައް. މިދިޔަ މަސައްކަތުތަކުން
ކުރައްވަމުން އައިސްފައިވާ އިންޑިއާ ޢިލްމީ ޖަމުޢިއްޔާ ޗެއާ ޑިރެކްޓަރުންގެ އެންމެ
މުހިއްމު ދައުރަކީ ކަމުގެ (އައި. ޑީ. ޖީ. ބީ) ހިސާބުކުރާ ދާނދާއެވެ. އިންޑިޔާ
ކަނޑުގެ ކަނޑުފަތުރުގެ ސްޓޮކްއާއި ބާޒާރު ދިރާސާތަކާއި ގުޅިގެން މަސްވެރިން
ރޭވުން އެންމެ ފަހުން ބޭއްވުނު ބައްދަލުވުމެއް 1995 ވަނަ އަހަރުގެ
ސެޕްޓެމްބަރުގެ ސްރީލަންކާގެ ކޮޅަމްބުގައި ކަމަށް ބޭއްވިއެވެ.

މިބައްދަލުވުމުގައި، ހިއްސާވެގެން ކުރުވުމަށް ކަނޑުފަތުރުގެ
މަސްވެރިކަމާއި ގުޅޭ ދިރާސާތަކުގެ ރޭވުމެއް ބޭނުންކުރާ ތަޢާރަފުކުރުމުގެ ގޮތާއި 7
ކުރުވުމުގެ ތަޢާރަފު ކުރުމުގެ ހުށަހެޅުއްވިއެވެ. "ބާރުބޮޑުވެ ދިރިއުޅެމުން ދާ
ބޮޑުތަން" ބައި މިފަދަ މަޢުލޫމާތު ދިރާސާ ރާއްޖެތެރޭގެ މަސްވެރިންގެ ދިރާސާތަކުގެ 7
ކުރުވުމުގައި ދެކޮޅު މަޢުލޫމާތުތައްވެ. މިއީ ސަރުކާރުގެ ފަރާތުން
އިނގިރޭސި ތަޢާރަފުކުރުމުގެ ކުރުވުމުގެ ކަމާގުޅޭ ދިރާސާތަކާއި ކަމާބެހޭ ކޮންމެ
ކުރުވުމުގައި ގޮވާލުން ކުރުމުގެ ރިޕޯޓުގެ ދަށުން އެކުލަވާލައިގެން
ހުށަހަޅާފައިވެއެވެ.

މިދެންނެވުނު ކުރުވުމުގެ ދާއިރާގައި މިފަދަ ދިރާސާ
އަދި ދާއިރާގައި ވަޒީފާ ލިބޭ މަސްވެރިން ޖުމްލަ ދާއިރާގައި ކަނޑުގެ ކަންކަމުގެ
މަސައްކަތެވެ.

ދެމެހެއްޓެނިވި ބޭނުންކުރުމުގެ ކަނޑު ފަރުތަކާއި ރާއްޖެއިން ބޭރުގެ މަސްވެރިކަންކުރާ ފަރާތްތަކެވެ.
ދުނިޔޭގެ ތަފާތު ކަނޑުތަކުން އަންނަން ފަށާފައިވާ ބޮޑު ބޯޓުތަކުން އިންޑިޔާ
ކަނޑުގައި ކުރާ ކަނޑުފަތުރުގެ މަސްވެރިކަމުގެ ދިރާސާތަކުގެ ދާއިރާގައި ކުރާނެ
ކަމަށް ބޮޑެތި ދިރާސާތައް ކުރުމަށެވެ. އަދި ސަރުކާރުން ކުރުމަށް ކުރުވުމުން
ދިރާސާކުރުމުގެ އިންޑިޔާ ކަނޑުގެ ބޭރުން ކަނޑުގެ ކަނޑުފަތުރުގެ ކަޑަ
ކަނޑުފަތުރުގެ މަސްވެރިކަން ބޮޑުތަކުން ކުރާއިރު. އާދައިގެ މިދަރަޖައިން ކުރިއަށް
ވަރަށް ބޮޑުކޮށް ގަތުން. މަސައްކަތުގެ މަށްޗަށް އިންޑިޔާ ކަނޑުގައި އެކުއެކި
މިދާއިރާގެ ދާއިރާ ސަރުކާރުން ދާދަ އަސާސީ ވައްތަރެއް ކުރަމުންނެވެ. ކުރުވުމުގެ
ގަދަވަރު މަސްވެރިކަމުގެ ސަރަހައްދުތަކެވެ. ބަނޑުބޯ އަދިބަސް މިދާއިރާގެ
ވަރަށް ދުނިޔޭގެ މާލީކުރުމުގެ ބާޒާރުތަކުން ކަމުގެ ފައިދާ ތަޢާރަފު އަދިބަސް
އިތުރު މިދާއިރާގެ މަސްވެރިކަން ކުރުވުމުގެ ކަމާގުޅޭ ތަރައްޤީކުރުމެވެ.
އެންމެ ފަހުން ކާބޯތަކެތި ހިއްސާކުރުމަށް އިންޑިޔާ ކަނޑުގެ މަސްވެރިންގެ
ދިރާސާ އެކަށީގެންވާ ކަމެކެވެ.

ރާއްޖޭގެ ކަނޑުފަތުރުގެ މަސްވެރިކަމުގެ އެހީތެރިއާއި
މަސްވެރިކަމުގެ ކުރުވުމުގައި ވިއްސާ އަދި އެމެރިކާއިން އަރާމުގައި ކުރާ މަސްވެރިކަމުން
އަރައި ސަރަހައްދުގެ ކުރާކަމުން އަމިއްލަ ކުރާކަމުން ވާދަކުރާ، ސަރުކާރުން ކަނޑުފަތުރުގެ
މަސްވެރިކަމުގެ ތަރައްޤީގެ ކަމުގައި ހިންގާ ރާއްޖެ އަރައިގަތުމުގެ
ދާއިރާގައި މީރިއުކުރި އެހީ ވިޔަފާރި ދެންނެ އަތުވެރިކަމުގެ ރ ދެއްކުން
ރާއްޖެއަށް ސަރުކާރުން ތަރައްޤީ ކުރާ މަޢުލޫމާތުތަކެއް ވަނީ އެކުލަވާ.
ބޭނުންވާ އަވަސް ދިރާސާތަކުގެ ކުރުވުމުގައި. މިދެންނެވި ހިންގުމަށް
ކުރުވުމުގެ ދިރާސާތަކާ މަސްވެރިކަން ތަރައްޤީކުރުމަށް ކުރިއަށްދާނެ
ނިޒާމަށް ބޭނުންވާ މަޢުލޫމާތުތަކެއްވެ. އަދި ސަރުކާރުން ފެންވަރުގައި
ބައިނަލްއަޤްވާމީ ފެންވަރުގައި ހިއްސާ ސަރުކާރުން ދިރާސާތަކުގެ ތަރައްޤީކުރުމަށް އެހީ
ދިނުމަށް ވަޒީފާތަކެއް ކުރުވުމެވެ.

ސުއްދާވާ ފަދަ މިދެންނެވި މަސްވެރިކަމަކުން ހިނގާ ކުރުވިގެން ބޭގެޖ އަސާސީކޮށްގެން ކުރުވަނީ އެކަށީގެންވާ ކަމެކެވެ. ނަމަވެސް އަދި ދުވެލިއްޖެހިލި މަސްވެރިކަމުގެ ކުރުވަނީ ނުވާނަމަވެވެ.

ބަލާބަލައިރު މަސްވެރިކަމަށް ކަނޑުމަހުގެ އިންޑިއާކަނޑުގެ މުޅި
1974 ވަނަ އަހަރުން ފެށިގެން 1993 ވަނަ އަހަރަށް ފާއިތުވި 20
އަހަރުތަކުގެ ތެރޭގައި މިކަނޑުން ބޭނާ އަދި ހިފާމަހުގެ އަދަދު 240% އަށް
އިތުރުވެފައިވެއެވެ. އެއީ 195,000 ޓަނުން 839,000 ޓަނަށެވެ. އަދި
މިއިތުރުވުން މިހާރުވެސް ދަނީ އަހަރުތަކުގައި ފާހަގަ ވަމުންނެވެ.

ރާއްޖޭގެ މަސްވެރިކަމުގައި 1994 ވަނަ އަހަރު ބާނާފައިވާ
ކަނޑުމަހުގެ އަދަދަކީ:

ކަޅުބިލަމަސް	69,411	ޓަނު
ރީނދޫ ކަންނެލި	12,620	ޓަނު
ރާގޮނޑި	4,019	ޓަނު
ލައްތި	2,656	ޓަނު
ލޮބޮޑު ކަންނެލި	506	ޓަނު

ފެށުމުގައި ވިއްސަކަން އަހަރުގެ ތެރެއަށް ބަލާލާއިރު ދުނިޔޭގެ ތަފާތު ކަންކަމުތަކުގައި މަސްވެރިކަމަށް ވަރު މަސްވެރިކަމުގެ ފައިދާވެވުން ބަނޑުދުޅަވުން ދާތަންތަނުގައި ފުރިހަމައެވެ. އެއީ އުފެދި އިތުރުވާ މެންބަރުތަކުގެ ބޭނުމަށް އިންސާނުންގެ ގިސަލަ ބޭނުންތަކުން ގެއްލުނު ނަގާމުން ހިއްސާތަކުގެ ބޭނުން ނަމަ ގެއްލިއްޖެއެވެ. މިއީ މިއަދު އެވޭނަކަށް ކަނޑުމަހުގެ މަސްވެރިކަމުގެ ތަރައްޤީ ވެގެންދިޔައީ ވަރަށް ގޮތަށެވެ. މަސްވެރިކަމުގެ މުސްތަޤްބަލަށް ގުދުރަތީގެ

ތަޢާރުފު

ކަނޑުމަހުގެ މަސްވެރިކަމަކީ ދިވެހިރާއްޖޭގައި ފުރަތަމަ ވަޒަންވެރިން ފެށި ކުރިން، އަދި މިއަދާހަމައަށް ފުރާނަ، ތަރައްޤީވަމުން އައިސްފައިވާ މަސްވެރިކަމެކެވެ. މިއީ ދިވެހިންނަށް އާދައިގެ ރާއްޖޭގައި ދިރިއުޅުމުގެ ފުރިހަމަ ކަސްތަކަށް ކަސްރަވަކެވެ. އިއްތިހާދު ގެ ބޭރުބައްޔިތުން ހަމަޖެހުމަށް ގެންދަނީ މިދެންނެވި މަސްވެރިކަމުންނެވެ.

ދިވެހި މަސްވެރިންނަށް ފައިދާ މަސްވެރިކަމުގައި އަމަލުކުރި ކުރިމަށް ބާއްވެ. ކަނޑުގެ އަދިވެސް ދަންނަ، ކަނޑުގައި ހީވާ ސުއިވަމުގައި ތުޅަދުނާ ބީރައްޓެހި ދަތުރުކުރުމުގެ ހުނަރު ޖަމާކުރުމުގެ ދަރުނަ ކުރުމާ ފެށިގެން ވުމުގެ ބާއްޖެވެ.

ރާއްޖޭގައި ކުރިއުރުމުނާ ކަނޑުމަހުގެ ފައިދާ މަސްވެރިކަން
މައިގަޑު ގޮތެއްގައި ކުރިއުރުމުނަށް ތަފާތު 5 ބާވަތެއްގެ މަހުގެ މައްސަލަވެ.
މިބާވަތްތަކަކީ ކަނޑުތަކުގައި އަބަދުވެސް ދަތުރުކުރާ މަހެވެ. ހިޖުރަކުރާ
މަސްވަރުވެ. އިންޑިއާކަނޑުން ރާއްޖޭގެ މަސްވެރިން ބާނާ މަހަކީ ހަމައެކަނި
ރާއްޖޭގައި މަހާ ވަސްއަޑުނުވެ. އަދި ހިޔާލަކު އެއީ ހަމައެކަނި ރާއްޖޭގެ
މުޅިސަރަޙައްދު ކަޅުބިލަ ނުވެދުންތަކެވެ. ރާއްޖޭގެ ސަރަހައްދުތަކުގެ ވަނަން
ވަރަށް ފުރި އިންޑިއާ ކަނޑުގައި ހިފާނީ ކަނޑުމަހުގެ ސްޓޮކްތަކެވެ. މި
ސްޓޮކުން މަސްބާނާ އެހެން ޤައުމުތަކުން ހިންގާ އަމަލުތަކުން ނުވަތަ ސްޓޮކްތަކުން
ގެއްލުން ލިބޭ ވަރަށް އިންޑިއާކަނޑުން ކަނޑުމަހުގެ މަސްވެރިކަން އެއްވެސް
ބައަކު ކުރުވިކަމަށް އެކުލެވޭ ނުއްދާވާ އަސާސުތަކުގެ ރާއްޖޭގެ މަސްވެރިކަމަކަށް ފެށް
ޖެހިފައެވެ. އެކަން މިއީ ކުރިން ފެށް ދެންނެވި ފަރާތުން އެއްސްޓޮކްތަކުން
ކުރީ މަސްވެރިކަމަކަށް ފޯރިއެވެ. އަދަދަކީ ހަމަވަމުން ވެސް މަސްވެރިކަމަކަށް

ކޮމްޕިއުޓަރ ކަމަކަށްބަލައި ވިސްނުންތަކުގެ އެސޯސިއޭޝަނުން ރިސާރޗް އޮފިސަރ
އަލްފާޟިލް އިބްރާހީމް ސަލީމްއަށް ޝުކުރު ދަންނަވަމެވެ. "މޯލްޑިވްސް
މެރިން ރިސާރޗް ބުލެޓިން"ގެ މިއަދަދު ތައްޔާރުކުރުމުގައި މެރިން ރިސާރޗް
ސެންޓަރުގެ ހުރިހާ މުވައްޒަފުންނަށްވެސް އެހީތެރިވެދެއްވި ފަރާތްތަކަށް
މިދުވަހު ޝުކުރު ދަންނަވަމެވެ.

މުހައްމަދު ޝާހިދު
އެޑިޓަރ

ސަރުކާރުން ވަރަށް ބޮޑު އަހައްމިއްޔަތެއް ދެއްވާކަމެވެ. ގުދުރަތީ ވަސީލަތް ރައްކާތެރިކޮށް
މިދުވަހު މިއަދުގެ ހާލަތު ބަލާއިރު ދިވެހިރާއްޖޭގައި އެކި އިޤްތިޞާދީ
ދާއިރާތަކުގެ މަސައްކަތްތަކުގައި މެރިން ރިސާރޗް ސެންޓަރުން ތަޢާރުފް ވަރަށް
ގިނަ އެކި ކަމުގައި ފައިދާތަކެއް ފޯރުކޮށްދީފައިވާ ގޮތުން ހިންގާފައިވެއެވެ.
ބުލެޓިންގެ މިއަދަދުގައި ހިމެނޭ މައުލޫމާތު މިފަދަ ކަރުދާސްތަކުގެ
މަސައްކަތްތަކާއި ކުރިއެރުން ހިންގުން ފޯރުކޮށްދިނުމަށް ކުރިއެރުން
ތައްޔާރުކޮށްފައިވާ މިފަދަ ކަރުދާހެއް ކަމުގައި މިކަމުގެ ދާއިރާގައި ކުރާ
ތަހުގީގުގެ 1995 ވަނަ އަހަރުގައި ކުރިއަށްގެންދެވުނު ދިރާސާ ތަކުން
ދަނެވޭ ބޭނުން ކުރެވޭ ފައިދާ ހުރި ރަން ތަނެއް "އެކްސްޕޯޓް
ކޮންސަލްޓަންޓް އެކު އިންޑިޔާގެ ޕްރޮފެސަރ" އަށް ހުށަހެޅިފައެވެ.
ބުލެޓިންގެ މިއަދަދުގައި މިކަރުދާސްތައް ޝާއިޢު މިކަރަށް ރާއްޖޭގެ ގިނަ
ބަޔަކަށް މިމައުލޫމާތު ކިޔުމުގެ ފުރުސަތު ލިބި މިކަމުން މަންފާ
ކުރާނެކަމުގެ މަތިވެރި އުއްމީދުކުރަމެވެ.

"މޯލްޑިވްސް މެރިން ރިސާރޗް ބުލެޓިން"ގެ މިއަދަދު
އެކުލަވާލުމުގައި ވަރަށް ގިނަ ފަރާތްތަކެއްގެ އެހީތެރިކަން ލިބިވަޑައިގަތުން
ޝުކުރުދަންނަވާއިރު ފާހަގަކުރަމެވެ. ޚާއްސަ ގޮތެއްގައި މިބުލެޓިންގައި ހިމެނޭ
ކަރުދާސްތައް އެކުލަވާލުމުގައި ޖެހި. ތަރުޖަމާކޮށް އެންމެހާ ކޮންޕިއުޓަރ
ބޭނުންކޮށްގެން ކަނޑައެޅި އަދި ވަރަށް ބުރަކޮށް އުޅުއްވުމުން ހިއްވަރުދެއްވާފައި
ކުރުއްވާފައިވާ ތަރުޖަމާ މިބުލެޓިންގައި ހިމެނޭ ބޭފުޅުން މަޝްވަރާކޮށް ކޮންމެއިރު
ވިސްނުންތަކުގެ ޖާގައިގެ ޗެކްނިކަލް އަޑިސްޓް އަހަރަށް ގޮވާލައިން ޝުކުރު
ދަންނަވަމެވެ. މިއަދަދުގައި އެކުލަވާލައިވާ ރިސާރޗް ކުރުވާފައިވާ
މައުލޫމާތުތަކުން ބޭނުންވާ އަދަދުއްގެ މަޢުލޫ ހިސާބު
އެއްކުރުމުގައި މިސްޓޯރީ އޮވެ ފިޝަރީޒް އެންޖީ އެކްސްޕާޓް ވައިޒް އިސްތިއުމާލް
ފުރުސަތުގެ އެންޖީ ކާރިޔާއްސަން ސަޕޯޓަން އިން ވިދުވެ އެހީތެރިކަން
ޝުކުރުދަންނަވާއިރު ފާހަގަކުރަމެވެ. ބުލެޓިންގައި ހިމެނޭ ދިރިހުރި ބަޔަކު ޖަހައިގެން

އެޑިޓޯރިއަލް

"މޯލްޑިވްސް މެރިން ރިސާރޗް ބުލެޓިން" ގެ ދެވަނަ އަދަދު ވުޖޫދަށް ނުކުންނަނީ މިއަހަރުގެ މަސްވެރިންގެ ދުވަސް އާދެ! 10 ޑިސެމްބަރު އާއި ގުޅިގެންނެވެ. އަދި ބުލެޓިންގެ މިއަދަދުގައި އެކުލެވިފައިވާ ހުރިހާ ލިޔުންތަކަކީވެސް މިއަހަރުގެ މަސްވެރިންގެ ދުވަހަށް ސަރުކާރުން ކަނޑައަޅުއްވާފައިވާ ޝިޢާރު "ދިވެހިރާއްޖޭގެ މަސްވެރިކަން- މަސްވެރިންގެ ކުރިއެރުން" އާއި ވަރަށް ބޮޑަށް ގުޅުންހުރި ލިޔުންތަކެއްކަމުގައި ދެކެމެވެ. ބުލެޓިންގެ މިއަދަދުގައި އަލިއަޅުވައިލެވިފައިވާ ދިވެހި މަސްވެރިކަމުގެ ތާރީޚު ކުރުކޮށް ހިމެނޭ ކަނޑުފަރުގެ މަސްވެރިކަމާއިބެހޭ ގޮތުންނެވެ.

އެތައް ޒަމާނުއްސުރެ ދާދިފަހަކާ ޖެހެންދެން ދިވެހިރާއްޖޭގައި ރާއްޖޭގައި ކުރެވިގެންދިޔަ ހަމައެކަނި ކަސްބަކީ މަސްވެރިކަމެވެ. ރާއްޖޭގެ އަތޮޅުވެރިންނަށް އާމްދަނީ ލިބޭ ވަސީލަތަކީވެސް ކަސްބުވެރިކަމުގެ މަސްވެރިކަމެވެ. ތާރީޚީ ގޮތުން ބަލާއިރު ރާއްޖޭގައި ހިފޭ މަސްތަކުގެ ބާވަތްތަކާއި އެކަމާ ގުޅުންހުރި ކަސްބުތަކާއި ދިވެހި މަސްވެރިކަމުގެ ތަރައްޤީއާއި ކުރިއެރުމަށް ބާރުއަޅާ ސިޔާސަތުތަކުގެ ބޭނުން ހިފިއްޖެނަމަ ރާއްޖޭގެ މަސްވެރިކަން ކުރިއަށް ދިއުމަށް ހުރި ފުރުޞަތުތައް ބޮޑެވެ. ދިވެހި މަސްވެރިކަމުގެ މުސްތަޤްބަލަށް ދިމާވާ ގޮންޖެހުންތަކާ ކުރިމަތިލުމަށް ދިވެހިރާއްޖޭގައި މަސްވެރިކަމުގެ ދާއިރާ ފުޅާކުރުމުގެ ބޭނުންތެރިކަން ވަނީ އިތުރަށް ބޮޑުވެފައެވެ. އާދެ! ރާއްޖޭގެ އިޤްތިޞާދީ ތަރައްޤީއަށް ޓަކައި ކަސްބުވެރިކަމުގެ މަސްވެރިކަން ދެމެހެއްޓެނިވި ގޮތެއްގައި ކުރިއަށް ގެންދިއުމަކީ ދިވެހި މަސްވެރިކަމުގެ މުހިންމު ބޭނުމެކެވެ.

"މޯލްޑިވްސް މެރިން ރިސާރޗް ބުލެޓިން" ނެރުމުގައި އަމާޒަކީ ދުވަހަކު ނުކުތް މިމަޢުލޫމާތު މިނިސްޓްރީ އޮފް ފިޝަރީޒް އެންޑް އެގްރިކަލްޗަރގެ މެރިން ރިސާރޗް ސެކްޝަން އިން ނުކުތް މަޢުލޫމާތުތަކެވެ. މިމަޢުލޫމާތު މަސްވެރިކަމާ ގުޅޭ ދިރާސާކުރާ ފަރާތްތަކާއި އަދި ކުރިއަށް ދަސްކުރާ ދަރިވަރުންނަށް ފައިދާހުރި މައުލޫމާތު ލިބިގެންދާނެ ކަމަށް ދެކެމެވެ. ކުރިން ފެށިގެން ދިވެހި މަސްވެރިކަމުގެ ދާއިރާއިން ކުރެވޭ ދިރާސާތަކުގެ ނަތީޖާތައް އާންމުކޮށް ދޭހަވާ ގޮތަށް ފޯރުކޮށްދިނުމެވެ. ބުލެޓިން ޝާއިޢުކުރުމާ ގުޅިގެން ހުށަހަޅާ ލިޔުންތަކާއި މަޢުލޫމާތު ބާރަށް ދިރާސާކުރުމަށް ބޭނުންކުރާނެ ކަމަށް ދެކެމެވެ. ބުލެޓިންގައި ޝާއިޢުކުރާ ލިޔުންތަކާއި މަޢުލޫމާތު ފޯރުކޮށްދޭން ކުރިއަށް އިތުރު ފަރާތްތަކުން ކަމުގެ ދަރުމަވަންތަކަމާ ފޯރުކޮށްދީފައިވާ ހިތްވަރަށް ޝުކުރުއަދާކުރަމެވެ.

ބުލެޓިން އާއި ބެހޭގޮތުން އިތުރު މަޢުލޫމާތު ބޭނުންފުޅުވާ ފަރާތްތަކުން ތިރީގައިވާ އެޑްރެހުން ގުޅުއްވުން އެދެމެވެ.

އެމް. އެމް. އާރް. ބީ. އެޑިޓޯރިއަލް ބޯޑު
މެރިން ރިސާރޗް ސެކްޝަން
މިނިސްޓްރީ އޮފް ފިޝަރީޒް އެންޑް އެގްރިކަލްޗަރ
ހ. ވައިޓްވޭވްސް
މާލެ، 20-06
ދިވެހިރާއްޖެ.

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