AN ANALYSIS OF LONG TERM CATCH TRENDS IN MARINE FISHERY RESOURCES OF KARNATAKA STATE, INDIA

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Abstract. Marine fish production from capture fisheries in India has increased by about six folds during the past six decades. Therefore, monitoring the exploited marine fishery resources at regional level is very important for effective fisheries management for sustainability. In this regard, dynamic changes in Karnataka State's marine fisheries landings over the last five decades were examined after classifying them into 19 different resource groups. Decade wise Compound Growth Rate (CGR) and Coefficient of Variation (CV) of different resource groups were calculated. Most of the stocks classified as abundant and less abundant at national level fell under declining status in Karnataka State. The indicate that the state wise scenario is different from national scenario and thus understanding state wise marine fishery is important to formulate regulation and management measures.
Keywords: *Compound Growth Rate, fishery resources, Karnataka fishery, stock status, sustainability*

Introduction

Fisheries have rarely been sustainable (Pauly et al., 2002); many literatures around the globe describes the decline of fisheries worldwide (Casey and Myers, 1998; Pauly et al., 1998; Jackson et al., 2001; Mayers and Worm, 2003). FAO reported that 61.3% of the world's fish stocks are fully fished (FAO, 2014) and this scenario did not happen overnight (Jensen, 2002). It is the result of improvements in fishing technologies, overexploitation and mismanagement of resources over a period of time (Zeller and Pauly, 2005; Eagle and Thompson, 2003; Jensen, 2002; Bundy and Pauly, 2001; McManus et al., 1997; Caddy et al., 1998). Similarly, India is also not exempted from impending fisheries crisis. Marine fisheries in India are facing problems of excessive fishing pressure, over exploitation of majority of marine fisheries resources, reduced catch rates, catching juveniles and discards. Over the years, with the help of government schemes and supports, fishing has undergone drastic mechanization leading to imbalance in exploitation across the regions and among the resources. Karnataka, a state along the west coast of India has a coastline of around 300 km and a continental shelf area of 27000 sq. km. (GoI, 2012) with an exclusive economic zone of 87000 sq. km. Marine fisheries play an important role in Karnataka's economy and forms an important source of consumption, employment and foreign exchange. Marine fish production in Karnataka during 2011 was 437000 tonnes (CMFRI, 2012) contributing around 9% of

India's total marine fish production. As of now more than 80 species are commercially harvested along the coastal Karnataka (Bhatta et al., 2003). Among these, sardine (*Sardinella longiceps*), mackerel (*Rastrelliger kanagurta*), threadfin bream, cephalopods, carangids, ribbonfish, stomatopods, lizardfish and penaeid prawns contribute primarily to the state fish landings. Production was dominated by mechanized fishing gears mainly trawlers and other gears like seines and gill nets. Exploitation of resources has undergone major changes with the introduction of mechanised boats and trawlers. As per latest estimates, there are about 2847 trawlers, 422 purse seiners, 200 gill netters, 7518 motorized and 2862 non motorized boats operating along the coastal Karnataka (CMFRI, 2010).

In recent years, growth in marine fish production has almost been stagnant. Fisheries have been affected by number of problems and issues with serious consequences on the availability and sustainability of fish. The resources are highly under stress (Dehadari and Yadava, 2004) as they have been exploited to their maximum (Shyam et al., 2010). Thus it is very important to assess the status of commercially important marine fishery resources to understand their trend over a period of time. No detailed long term catch trend analysis has been carried out in Karnataka, though changes on a yearly basis are recorded in Central Marine Fisheries Research Institute (CMFRI) data base. However, Mohamed et al., (1998) studied Karnataka State's marine fisheries during 1990-1995. Also, Bhat and Bhatta (2001) studied economic analysis of sustainability of marine fish production in Karnataka State. Observations on pelagic resource dominance pattern for the period 1961-2003 was done by Kuriakose and Mini (2006). Understanding the pattern and crucial milestones in landings over a period of time is sine qua non and would provide insights into the level of resource exploitation there by helping to promate appropriate management measures. Time series landings data on major resource groups gives a broad understanding on the status of the stock.

Materials and Methods

Data on Karnataka state's marine fish production for the last fifty years (1961-2010) were collected from CMFRI, Cochin. The marine species were classified into 19 groups. Compound Growth Rate (CGR) was estimated decade-wise for overall catch and total landings of both Karnataka and India during 1961-2010 and compared. CGR for different growth phases (1961-1975, 1976-1985, 1986-1995 and 1996-2010) was also estimated.Coefficient of Variation (CV) was calculated for each decade and the decadal mean catch were calculated to see trends over the period from 1961-2010. Decade wise percentage contribution of each group to total state landings was also estimated to identify the major fishery contributing to the states production over a period of time.

Decade-wise trend in marine fish landings and major developments in Karnataka's fishery have been summarized. Present status of different resources of the state were estimated based on the criteria proposed by Mohamed et al., (2010) by classifying resources into five groups viz., Abundant, less abundant, declining, depleted and collapsed as shown in *Table 1*. Percentage contribution of these five groups to average total catch for the last ten years (2001-2010) and for last three years (2008-2010) were calculated.

Table 1. *Criteria used for fish stock classification*

Stock classification	Recent average catch in historical maximum (%)
Abundant	>70
Less abundant	50-69
Declining	11-49
Depleted	6-10
Collapsed	<5

Results

Total Marine fish landings of Karnataka, India: 1961-2010

The average fish production in the country rose from 832000 tons in 1961-70 to 2738000 tons in 2001-2010. Correspondingly, fish production in Karnataka has touched 253000 tons in 2001-2010 from 67 thousand tons in 1961-1970 (*Table 2*). Karnataka's share in India's fish production grew gradually from 8.05% during 1960s to 9.26% in 2001-10 with an average contribution of 8.51%. State's decadal mean marine fish production had an increasing trend till 1980's, decreased during 1990's and improved during recent decades. The trend equations for both India and Karnataka's fish production are shown in *Figure 1*. Less variations in landings as indicated by CV were observed during 90's for both India and Karnataka. Decade wise CGR for India and Karnataka (*Table 3*) indicates a low growth trend in 1991-2000 compared to other decades. Inter year growth rate in India during all decades showed significant difference except in 1970's (t value=2.184), where in Karnataka, a significant diference was shown during 1960's, 1980's and 2001-10.
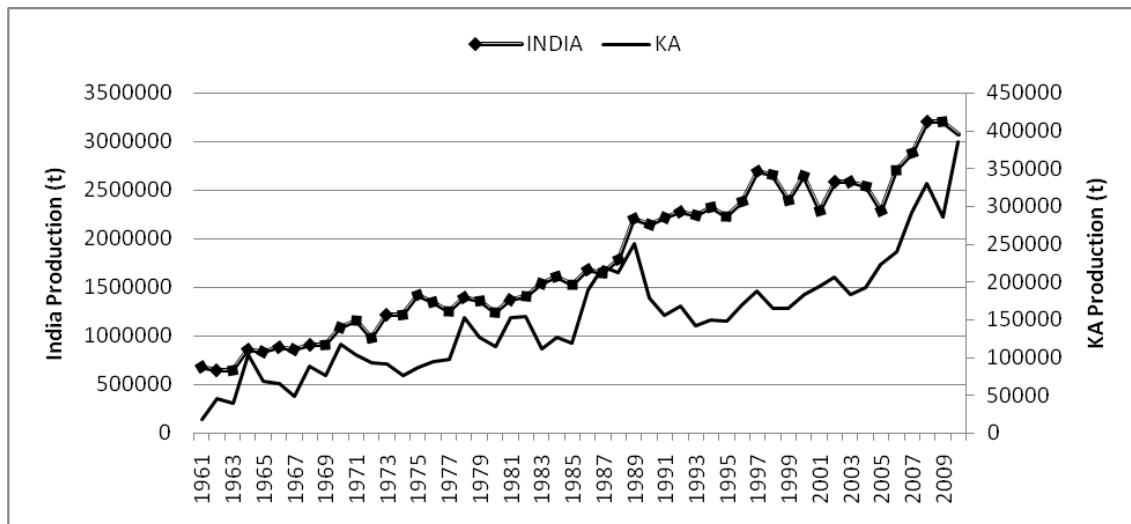

Figure 1. *Trend in total annual marine fish landings (tons) in India and Karnataka from 1961-2010*

Average mean catch, CV and CGR were estimated for different growth phases of Karnataka and compared with India (*Tables 4 & 5*). Highest average mean catch for the state (227042 t) and country (2678792 t) were observed during 1996-2000. Growth trend of Karnataka found to increase recently (5.54) compared to 1986-1995 phase (-4.84). But growth in national scenario (1.64) is decreased when compared to 1986-

1995 (3.84). In both state and national scenario,inter year growth rate was significantly varied from each other during all the decades (except in 1970's in Karnataka (t value= 0.967)).

Table 2. *Decadal mean catch (tons) Coefficient of Variation (CV) for Indian and Karnataka marine fisheries*

Year	Mean catch in India (t)	Mean catch in Karnataka (t)	C.V India (%)	C.V Karnataka (%)	% Karnataka contribution to India
1961-70	832426	67048	15.62	43.11	8.05
1971-80	1259624	103864	9.91	20.35	8.25
1981-90	1692597	171700	15.84	25.87	10.14
1991-00	2408687	163602	7.50	8.48	6.79
2001-10	2738943	253608	11.85	25.28	9.26
1961-2010	1786455	151964	41.39	49.19	8.51

Table 3. *Decade wise Compound growth rate (CGR) for India and Karnataka*

Year	CGR (India)	t value (India)	CGR (Karnataka)	t value (Karnataka)
1961-70	5.15	5.952	14.37	2.917
1971-80	2.26	2.184	4.02	2.057
1981-90	5.00	6.861	6.30	2.47
1991-00	2.04	3.588	1.70	1.954
2001-10	3.55	4.417	7.99	6.262
1961-2010	3.11	29.486	3.49	11.983

Table 4. *Mean catch (tons) Coefficient of Variation (CV) for Indian and Karnataka (KA) marine fisheries in different phases/ periods*

Year	Mean catch (India) in t	Mean catch (KA) in t	CV (India)	CV (KA)	% Karnataka contribution to India
1961-1975	954194	74808	22.85	35.46	7.84
1976-1985	1406816	125244	8.10	16.84	8.90
1986-1995	2075982	181804	12.00	18.87	8.84
1996-2010	2678792	227042	10.81	28.48	8.56

Table 5. *Compound growth rate (CGR) for India and Karnataka (KA) during different phases*

Year	CGR (India)	t value (India)	CGR (KA)	t value (KA)
1961-1975	5.13	10.481	7.70	3.236
1976-1985	2.17	3.342	1.94	0.967
1986-1995	3.84	4.474	-4.84	-3.675
1996-2010	1.64	3.164	5.54	7.328

Production during 1961-1970

Pelagic fishery were dominant in Karnataka's marine landings during 1960's. As apparent from the data in *Table 6*, clupeids accounted for 53.34% and mackerel contributes 22.48% to the state's total average landing. Indian oil sardine was the major species dominating the clupeid fishery. Contribution of demersal fishes to marine fish

landings was meager compared to pelagic resources. Resources such as catfish (3.34%), croakers (2.78%), elasmobranchs (2.12%), silverbellies (1.87%) were dominating among demersal groups. Average mean catch of crustaceans was 2723 tons, which was about 4.06% of the state's total catch. All the groups witnessed higher variation in landings. Trends in growth (CGR) during the decade were high for the majority of groups except for croakers (-11.10), elasmobranchs (-1.60), perches (-7.80) and barracudas (-21.25). Inter year growth rate showed significant variation for crustaceans, catfish, carangids and half beak & full beaks (*Table 6*).

Table 6. Mean fish catch (tons), CV, CGR and percent contribution of various major fish groups in Karnataka during 1961-1970

Species	Mean catch (t)	C.V	CGR	t value	% catch to total state landings
Clupeids	35763	67.54	24.46	2.093	53.34
Mackerel	15072	75.42	8.14	1.101	22.48
Crustaceans	2723	79.33	18.79	2.346	4.06
Catfish	2238	121.76	40.49	5.179	3.34
Croakers	1862	85.06	-11.10	-1.829	2.78
Elasmobranchs	1419	43.50	-1.60	-0.356	2.12
Silverbellies	1254	78.49	6.02	0.627	1.87
Carangids	794	55.56	19.34	4.279	1.18
Pomfrets	587	189.11	18.83	1.461	0.87
Seer Fish	499	80.65	17.01	2.318	0.74
Flatfish	453	56.37	6.45	1.137	0.68
Whitefish	271	55.47	11.46	1.254	0.40
Ribbonfish	239	73.62	9.08	0.743	0.36
Perches	165	53.82	-7.80	-1.231	0.25
HB & FB	92	60.04	19.00	2.434	0.14
Tunnies	73	89.77	0.04	0.002	0.11
Lizard fish	16	136.53	25.70	1.248	0.02
Molluscs	11	153.24	24.58	1.237	0.02
Barracudas	7	107.30	-21.25	-2.142	0.01

Production during 1971-1980

All the groups except half beak and full beaks showed increase in their landings which resulted in increased total state landings during 1971-1980 (*Table 7*). Major resources contributing during this decade were clupeids (35771 t), mackerel (31302 t), crustaceans (7288 t), catfish (3967 t) and elasmobranchs (2498 t). Even though catch increased, the contribution of clupeids and mackerel to state's total landings was decreased by 11.24% compared to previous decade, which may be mainly due to improved landings by other groups. Though the mean catch increased, resources such as mackerel (-2.25), crustaceans (-3.52), elasmobranchs (-0.85), seer fish (-2.16), whitefish (-10.63), and pomfrets (-3.29) showed a negative trend in growth (CGR), which was due to high variation in landings especially during mid 70's (1974-1977). Only three resources such as clupeids, catfish and tunas showed significant difference in inter year growth rate.

Table 7. *Mean fish catch (tons), CV, CGR and percent contribution of various major fish groups in Karnataka state during 1971-1980*

Species	Mean catch	C.V	CGR	t value	% catch to total state landings
Clupeids	35771	42.38	15.87	4.449	34.44
Mackerel	31302	51.57	-2.25	-0.334	30.14
Crustaceans	7288	43.31	-3.52	-0.665	7.02
Catfish	3967	58.94	15.99	3.393	3.82
Elasmobranchs	2498	35.48	-0.85	-0.212	2.41
Silverbellies	2431	55.39	12.22	1.914	2.34
Croakers	2306	35.00	7.76	1.806	2.22
Seer Fish	1685	30.15	-2.16	-0.561	1.62
Carangids	1315	92.31	10.82	1.267	1.27
Flatfish	1072	56.84	0.37	0.055	1.03
Whitefish	711	76.08	-10.63	-1.176	0.68
Pomfrets	674	76.81	-3.29	-0.396	0.65
Tunnies	586	76.60	22.70	2.796	0.56
Molluscs	581	161.54	51.48	1.78	0.56
Ribbonfish	565	76.28	14.61	1.688	0.54
Perches	473	95.22	17.25	1.614	0.46
Lizardfish	178	95.58	40.82	1.336	0.17
Barracudas	64	125.58	6.93	0.425	0.06
HB & FB	54	87.53	20.28	1.878	0.05

Production during 1981-1990

The combined landings of fish from Karnataka increased from 103864 t in 1971-1980 to 171700 t during 1981-1990. Mean catch, CV, CGR and percentage contribution of major groups to state's total landings are shown in *Table 8*.

Table 8. *Mean fish catch (tons), Coefficient of Variation (C.V.), Compound Growth Rate (CGR) and percent contribution of various major fish groups in Karnataka state during 1981-1990*

Species	Mean catch	C.V	CGR	t value	% catch to total state landings
Clupeids	60319	19.33	-1.07	-0.452	35.13
Mackerel	28183	95.94	28.71	2.583	16.41
Crustaceans	25427	50.48	11.93	2.859	14.81
Carangids	13805	65.35	27.53	4.071	8.04
Catfish	5449	57.50	-12.30	-1.881	3.17
Perches	4115	78.00	29.21	2.508	2.40
Silverbellies	3903	74.57	0.86	0.125	2.27
Flatfish	3550	53.01	13.80	1.614	2.07
Seer Fish	3463	42.01	-7.24	-1.919	2.02
Ribbonfish	3234	83.54	29.80	2.522	1.88
Tunnies	3187	50.19	9.38	1.673	1.86
Croakers	3081	35.39	7.46	1.756	1.79
Elasmobranchs	2622	46.09	-10.20	-3.218	1.53
Pomfrets	1873	33.65	7.71	1.283	1.09
Molluscs	1389	75.15	36.59	3.403	0.81
Lizardfish	1292	72.97	24.45	2.878	0.75
Whitefish	1226	52.99	9.46	1.887	0.71
Barracudas	216	94.78	31.37	2.527	0.13
HB & FB	192	37.69	5.69	1.191	0.11

All the landings except mackerel improved during the decade. The decade witnessed improvement in the demersal landings of the major groups. Even though the catch decreased, mackerel remained the second largest contributor (16.41%) to state's total landings, which is next to clupeids (35.13%). The combined contribution of these two groups to the state's landing once again decreased by 13.04% compared to 70's. Crustaceans showed an increasing trend in their contribution to state landings over the decades from 4.06% in 60's to 14.81 in 80's. Other pelagic resources such as carangids (8.04%), seer fish (2.02%), ribbon fish (1.88%) and tuna (1.86%) landings were increased. Meanwhile, demersal groups have also played significant role in increasing marine production of state during the decade. Resources like clupeids (-1.07), catfish (-12.30), seer fish (-7.24), elasmobranchs (-10.20) showed a negative trend in growth (CGR), even though their catch was increased.

Production during 1991-2000

Overall average marine fish landings of Karnataka decreased from 171700 t in 1981-1990 to 163602 t in 1991-2000 (*Table 9*). Important commercial groups such as clupeids, tunnies, seerfish, silverbellies, elasmobranchs, catfish and whitefish landings decreased during the decade. Clupeids lost their first position to mackerels in contribtion to state. Mean catch of crustaceans, carangids, croakers and pomfrets increased during the decade but showed a negative trend in growth, which was -4.53, -6.92, -3.90 and -8.85 respectively. In addition, elasmobranchs and catfish too showed a negative trend in growth of -2.19 and -8.45 respectively. Inter year growth rate for resources such as crustaceans, perches, croakers, seer fish, pomfrets and barracudas showed significant difference during the decade (*Table 9*). Variations in landings (CV) were less in majority of groups compared to earlier decades.

Table 9. Mean fish catch (tons), CV, CGR and percent contribution of various major fish groups in Karnataka state during 1991-2000

Species	Mean catch (t)	C.V	CGR	t value	% catch to total state landings
Mackerel	31914	37.45	4.24	0.901	19.51
Clupeids	31419	21.32	2.16	0.799	19.20
Crustaceans	27130	20.93	-4.53	-2.499	16.58
Carangids	18229	35.31	-6.92	-2.107	11.14
Perches	13348	51.92	22.19	7.866	8.16
Flatfish	8529	48.45	1.99	0.383	5.21
Molluscs	7588	35.56	11.53	2.19	4.64
Ribbonfish	5029	60.00	5.70	0.82	3.07
Croakers	3861	15.99	-3.90	-2.907	2.36
Tunnies	2511	80.77	6.73	0.612	1.53
Lizardfish	2439	39.40	12.04	2.186	1.49
Seer Fish	2266	37.26	8.88	3.612	1.39
Pomfrets	2096	37.49	-8.85	-3.292	1.28
Silverbellies	1871	23.35	2.22	0.821	1.14
Elasmobranchs	1267	26.97	-2.19	-0.688	0.77
Whitefish	1058	32.58	2.75	0.667	0.65
Barracudas	1027	52.85	18.61	3.116	0.63
Catfish	291	93.37	-8.45	-1.033	0.18
HB & FB	246	31.19	0.91	0.222	0.15

Production during 2001-2010

Karnataka's total average marine fish production drastically increased from 163602 t during 1991-2000 to 253608 t in 2001-2010. Resources such as clupeids, perches, crustaceans, ribbonfishes, lizard and seerfish showed a drastic increase in their landings (*Table 10*). Meanwhile, mackerel, carangids, flatfishes, tunnies, pomfrets, elasmobranchs and catfish landings decreased compared to previous decades.

Table 10. Mean fish catch (tons), CV, CGR and percent contribution of various major fish groups in Karnataka state during 2001-2010

Species	Mean catch (t)	C.V	CGR	t value	% catch to total state landings
Clupeids	75547	27.60	8.16	3.959	29.79
Perches	33079	25.15	4.84	1.783	13.04
Crustaceans	30148	20.32	0.19	0.08	11.89
Mackerel	29936	55.94	16.15	4.409	11.80
Ribbonfish	14761	49.09	13.55	2.456	5.82
Carangids	14111	30.89	4.33	1.106	5.56
Molluscs	13882	44.53	13.50	3.469	5.47
Flatfish	7871	26.46	-2.10	-0.692	3.10
Lizardfish	7834	77.60	27.39	4.328	3.09
Seer Fish	4610	21.62	3.25	1.157	1.82
Silverbellies	3971	25.25	1.57	0.509	1.57
Croakers	3911	32.00	7.40	2.188	1.54
Barracudas	2154	46.00	14.95	4.414	0.85
Tunnies	1858	40.37	-9.70	-2.186	0.73
Whitefish	1809	58.92	19.88	3.68	0.71
Pomfrets	1500	38.18	1.02	0.22	0.59
Elasmobranchs	1045	23.33	-0.89	-0.308	0.41
Catfish	875	104.92	23.09	1.889	0.34
HB & FB	261	26.58	-1.43	-0.418	0.10

During 1960's, clupeids and mackerel together formed around 75.82% of the state total catch. But in 2001-2010, clupeids, perchs, crustaceans, mackerel, ribbonfish, carangids and mollusks together formed about 83.37% of the State's total catch. This clearly shows how species composition changed over a period of time. Four resources such as flatfish (-2.10), tunnies (-9.70), elasmobranchs (-0.89) and half beak & full beaks (-1.43) showed a negative trend in growth as indicated by CGR. About seven resources such as clupeids (8.16), mackerel (16.15), ribbon fish (13.55), molluscs (13.50), lizardfish (27.39), barracudas (14.95) and whitefish (19.88) showed significant difference in inter year growth rate and their CGR was very high.

Present status of stock

While attempting to classify 19 resource groups following the method suggested by Mohamed et al., (2010), it was found that 8 resource groups fall under 'abundant', 4 groups under 'less abundant' and 7 groups under 'declining' class (*Table 11*). About 9 groups of 19 attained maximum historical landings during the decade 2001-2010, 3 groups during in 1991-2000, 6 groups in 1981-1990 and one group during 1961-1970.

The percentage contribution of these classified stocks to Karnataka's total average marine landings from 2008-2010 and 2001-2010 are shown in *Table 12*. Abundant class

contributed around 56.32% in 2001-10 and 57.43% in 2008-10 respectively. Less abundant group contributed around 23.38% in 2001-10 and 19.66% in 2008-10 where as declining class contributed around 18.55% in 2001-10 and 19.66% in 2008-10 to the average catch of Karnataka. Out of 19 groups in the present study, none of the resource fall under depleted and collapsed class.

Table 11. Classification of different resource groups based on last three years (2008-10) average landings

Resources	Average landings (t) during 2008-10	Maximum annual landing (t) during 1961-2010	Year	Percentage of total landings	Stock status of Karnataka	Stock status of India as per Sathianandan et al., (2011)
Clupeids	93543	110253	2007	84.84	Abundant	Abundant
Seer fish	5210	6826	1982	76.33	Abundant	Abundant
Whitefish	3134	3668	2010	85.45	Abundant	Declining
Barracudas	3373	4150	2010	81.28	Abundant	Abundant
Perches	43473	49151	2008	88.45	Abundant	Abundant
Croakers	5341	6542	2010	81.64	Abundant	Abundant
Lizard fish	16845	17312	2008	97.30	Abundant	Abundant
Molluscs	20787	25440	2010	81.71	Abundant	Abundant
Carangids	18457	29668	1991	62.21	Less abundant	Abundant
Ribbonfish	18305	28744	2006	63.68	Less abundant	Less abundant
HB & FB	251	363	2008	69.24	Less abundant	Abundant
Crustaceans	28601	57112	1987	50.08	Less abundant	Abundant
Mackerel	47203	101790	1989	46.37	Declining	Abundant
Tunnies	1484	7365	1992	20.14	Declining	Abundant
Silverbellies	4200	11563	1986	36.32	Declining	Abundant
Pomfrets	1763	3902	1968	45.17	Declining	Abundant
Catfish	1860	10253	1982	18.14	Declining	Abundant
Flatfish	7968	18185	1992	43.82	Declining	Less abundant
Elasmobranchs	1166	5058	1982	23.06	Declining	Less abundant

Table 12. Stock contribution to mean catch of Karnataka during different years

Stock contribution	Percentage contribution to average catch from 2001-10	Percentage contribution to the average catch from 2008-2010
Abundant	56.32	57.43
Less abundant	23.38	19.66
Declining	18.55	19.66

About 13 groups showed highest mean catch during 2001-2010 and 3 groups during the decade 1980's and 1990's (*Figure 2*). None of the resources showed any highest mean catch during the decade 1960's and 70's. Decadal change in compound growth rate with respect to number of groups (resources) is shown in *Figure 3*. Out of 19, 15 groups showed positive CGR during 60's & 2000, 14 during 80's and 13 during 70's & 90's. A negative CGR was shown by 6 groups in 70's & 90's, 5 groups in 80's and 4 groups in 60's & 2000. Mean coefficient of variation during different decades indicates that the variation in landings during earlier decades were higher compared to recent decades (*Figure 4*).
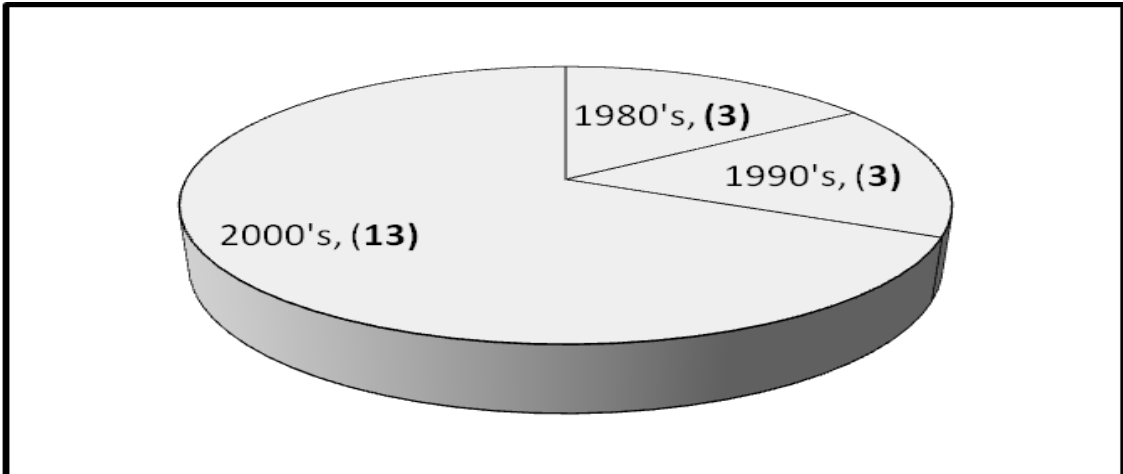
Figure 2. *Number of groups showing the highest mean catch during the different decades*
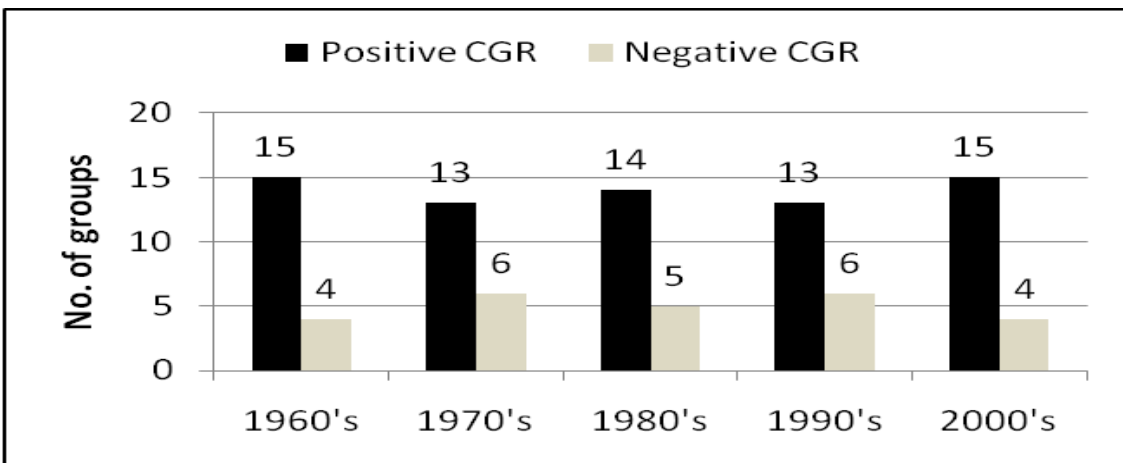

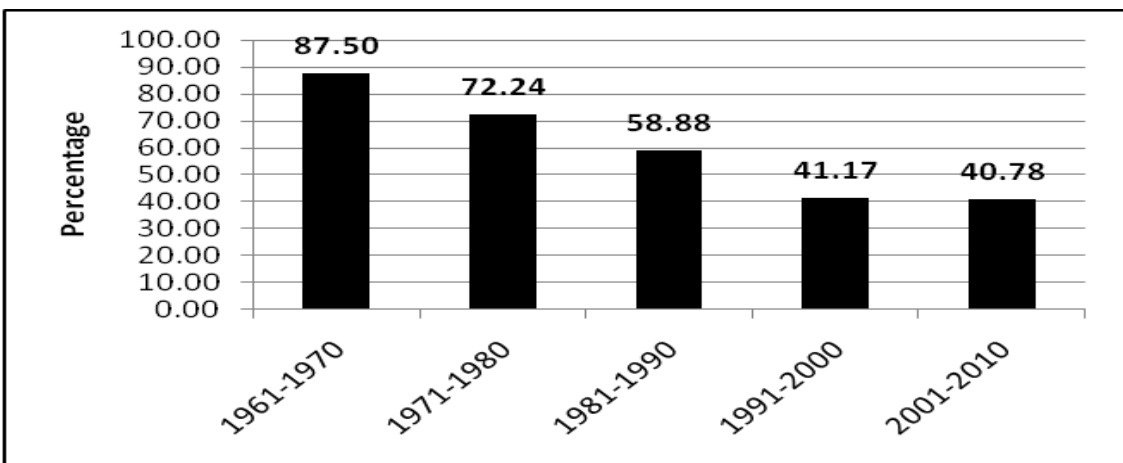***Figure 3***. *Decadal changes in CGR with respect to number of groups*

Figure 4. *Mean Coefficient of Variation during different decades*

Discussion

During the last five decades there had been structural and qualitative changes in marine fisheries along the Karnataka coast and showed an increase in mean catch except during 1990's. Out of 19 groups identified for study, pelagic resources dominate the fishery of state from 1961-2010. Pelagic fishery was characterized by the dominance of sardine and mackerel during the early decades. The exploitation of major marine fisheries resources during 60's was mainly by traditional fishing gears such as *Rampani*, small shore-seine, boat seine, gill net, drift net, cast net and hook and line. *Rampani* was the major gear, contributing around 60% of marine fish production. In 1966, a scheme for construction and distribution of trawlers was introduced in the state and modernization of fisheries took place during following decades which resulted in increased contribution of demersal resources. Introduction of more efficient gears, especially purse seines resulted in an increased pelagic catch during 70's and 1980's (Mohamed et al., 1998). Meanwhile, *Rampani* started disappearing during the 1970's, and mechanized crafts and gears started dominating the fishery. The contribution of pelagic groups to state's average total landings decreased because of increased contribution of demersal groups. The demersal landings improved from the 1980's onwards, especially with molluscs, flatfish and perches which were mainly caught by increased operation of multiday trawlers (Mohamed et al., 1998). Motorization of country crafts during mid 80's resulted in introduction of ring seine (Panikkar and Sathiadas, 1993) which led to the increased landings during 1981-1990. Increase in trawl production during 1990's was due to the adoption of high opening trawls and multiday trawls. Increased fishing efforts by mechanized fishing during 1991-2000 resulted in decreased landings of major resources like clupeids, seerfish, tunnies, catfish, elasmobranchs, silverbellies and whitefish which lead to decrease in the state's average catch. The modernization of fishing fleets and uncontrolled expansion of fishing efforts are the main reasons for declining growth rates of total marine fish production (Bhat and Bhatta, 2001). Major pelagic resources decreased mainly because of the reduction in purse seine catch. Though the average landings for state decreased during 1990's crustaceans and molluscs catch increased over the decades. Mechanized trawlers have increased the exploitation of prawns' resources since the beginning of the 1970's due to increasing demand of prawns for export (Sukumaran, 1985).

Cephalopod resources gained significance after 1985 and production increased substantially due to demand in foreign trade. Increased number of fishing days by multiday trawls, expansion of the fishing ground, introduction of steel trawlers resulted in increased landings of cephalopods during recent decades (Sasikumar and Mohamed., 2012).

Classification of different resource groups based on last three years' (2008-2010) average catch indicates that the state and country's situation as a whole is different. For example, whitefish stock falls under abundant group in Karnataka but are declining at national scenario. Similarly less abundant groups in Karnataka such as carangids, half beak & full beaks, eels and crustaceans falls under abundant category at national level.

The whitefish stock status has considerably improved recently and noted abundant in the present study which was once under declining category (Mohamed and Zacharia.,2009). Presently, stock status of mackerel, tuna and elasmobranchs are declining, while clupeids and seerfish fall under abundant group. According to Mohamed and Zacharia (2009) important resources such as mackerel, sardine, seerfish, tunas, shark, skates and rays decline in their catch within five years due to increase in fishing effort. This indicates that the stocks might have recovered during recent years

especially during 2007 to 2010. Increased fishing effort by multiday trawlers, introduction of purse seines in 1980s and pollution have been responsible for declining growth rates during 90's.

Despite contributing 9.26% to the total marine fish landings of India in the recent decade (2001-2010), the marine fishery of Karnataka is still successfully sustaining its fishery resources. Also, growth rates of important resources (15 groups) have shown a positive trend. The study shows how the state wise scenario is different from national scenario and state wise understanding of marine fishery resources is very important to formulate the regulation and management measures.

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