A survey of the fish fauna of Transkei estuaries Part Two: The Mbashe estuary

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The species composition, seasonal abundance and spatial distribution of the fish fauna of the Mbashe estuary (8 km long) was determined by means of gill nets. During the 37 month survey period, 2908 fish (2319,8 kg), comprising 27 species, were caught. The family Mugilidae, representing 58,8% of the numbers and 57,4% of the biomass, predominated the catches. In terms of biomass *M. cephalus, A. hololepidotus* and *P. commersonnii* were the most important species. Seasonal patterns for 10 of the 27 species were observed. *M. cephalus, A. hololepidotus* and *L. amia* were more abundant in spring/summer, *E. machnata* and *V. buchanani* in spring, *P. commersonnii* and *L. tricuspidens* increased numerically in winter and *M. capensis* in autumn, *Johnius dussumieri* and *Valamugil cunnesius* were rare in winter and summer, respectively. Largest catches were made in the middle reaches of the estuary followed by the upper and lower reaches, respectively.

Die spesiesamestelling, seisoenverspreiding, en voorkeurgebiede van visse is met behulp van kiefnette in die Mbashe-riviermonding (8 km lank) bepaal. Gedurende die 37 maande van die opname is 2908 visse (2319,8 kg) gevang en is 27 spesies geïdentifiseer. Die familie Mugilidae het 58,8% van die aantal visse, wat 57,4% van die totale biomassa uitgemaak het, verteenwoordig. Die vangste is deur *M. cephalus, A. hololepidotus, L. amia* en *P. commersonnii* oorheers (biomassa). Tien van die 27 spesies het seisoenspatrone vertoon, met *M. cephalus, A. hololepidotus* en *L. amia* volop in die lente/somer, *E. machnata* en *V. buchanani* in die lente, *P. commersonnii* en *L. tricuspidens* meer algemeen gedurende die winter en *M. capensis* in die herfs. *Johnius dussumieri* en *V. cunnesius* was baie seldsaam in die winter en die somer. Die middelste gedeelte van die riviermonding het die beste vangsresultate opgelewer.

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The motivation for and major objectives of the survey are given in Part One of this series (Plumstead, Prinsloo & Schoonbee 1985). The paucity of data for Transkei estuaries, the proposal that these estuaries form a transition zone between the warm temperate estuaries of the eastern and southern Cape and the sub-tropical estuaries of southern Mocambique, Natal and Transkei (Day 1981a), and the possible commercial exploitation of these estuaries briefly summarize the need for this survey. In order to acquire some of the above information, estuaries along the Transkei coast which were almost equidistant (50 km) from one another, were selected for investigation of the fish fauna.

The Mbashe River which has a large catchment area rising in the Transkei interior was included in the survey. The potentially deleterious effects of a proposed hydro-electrical scheme (O'Connell, Manthe & Partners 1974 as quoted by Eksteen, Van der Walt & Nissen, Inc. 1979) on the ecology of this estuary further emphasized the necessity of this survey.

This article (Part Two) deals with the species composition, seasonal abundance and spatial distribution of fish in the Mbashe estuary over a 37-month period.

Study area

The Mbashe estuary (32°16,5'S / 28°54,8'E) located approximately 70 km north of the Kei estuary (Figures 1A & B), separates the Dwesa Nature Reserve from the recently established Cwebe Nature Reserve. It has a catchment area of 6030 km^2, a mean annual precipitation and mean annual runoff of 844 mm and 800 Mm^3 respectively. The Mbashe River is perennial with 76% of the MAP falling between October and March (Weather Bureau 1972) which results in high flow conditions in summer and low flow conditions in winter. Periodic

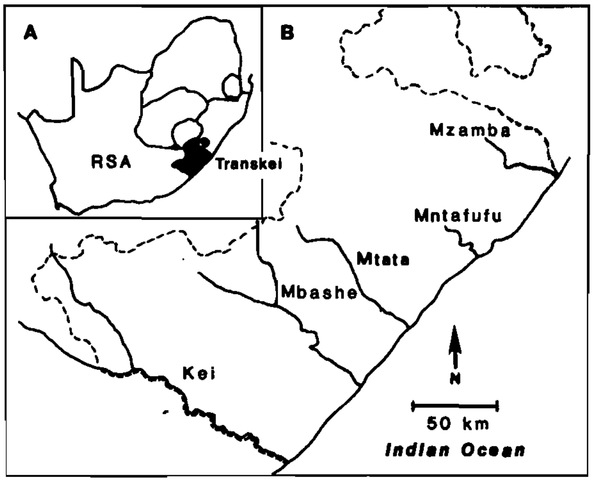

Figure 1 Geographical position of the Transkei (A) and estuaries (B) investigated within the confines of southern Africa.

floods in summer usually coincide with the peak rainfall months of October and January.

The upper parts of the Mbashe River and its tributaries dissect the Permotriassic Karroo sequence rocks which consist of Elliot formation mudstone and sandstone overlying Molteno formation mudstone and sandstone. The middle reaches dissect Beaufort group sediments and the lower reaches cut through Ecca shales and mudstones (G. Dardis pers. comm.). Vegetation in the upper catchment areas consists mainly of Dohne and Highland Sourveld while the river is bounded by Valley Bushveld from Engcobo to the coast. Owing to the above, the bad agricultural practices (Wallace & Van der Elst 1975; Branch & Grindley 1979), and the lack of any soil conservation measures, the Mbashe River carries a heavy silt load with high sedimentation occurring in the estuary. The water quality itself appears to be relatively good, Day (1981a) quotes low PO_4-P l^{-1}, NO_3-N l^{-1} and NH_3-N l^{-1} values with no obvious trends along the estuary. Concentrations of organo-chloride insecticides and trace metals were also reported as being low. A narrow channel 8 km from the mouth marks the upper limit of the estuary, which is approximately 100 m wide and runs through a wooded valley with rocky cliffs in places. On the eastern bank of the lower reaches a narrow saltmarsh extends from a small *Avicennia marina* stand to a steep hill 0,75 km further inland. A larger saltmarsh intermingled with a few *A. marina* and *Bruguiera gymnorrhiza* is present on the western bank of the lower reaches. The middle and upper reaches have narrow intertidal banks with the reed *Phragmites* sp. fringing much of the western bank and some of the eastern bank in the upper reaches. Excluding the mouth which is sandy, the estuary bed is covered with a thick layer of soft silt. During the present study, the mouth entered the sea closer to the high dunes east of the rocky promontory mentioned by Day (1981a), however, personal observations have shown that the mouth varies considerably from season to season.

A large sandspit was present on the west bank of the mouth.

Methods

The catch data for the Mbashe estuary are based on 99 gill net catches set between December 1979 and December 1982. Sampling stations representative of the lower, middle and upper reaches were established 1, 4 and 7 km respectively, from the mouth (Figure 2). A description of the gear and methods used to collect the physico-chemical and biological data is given by Plumstead *et al.* (1985). Fish were identified according to Smith (1977) and Smith & Heemstra (1986).

Results

Physico-chemical properties of the estuary

Monthly variations in surface and bottom water temperatures are given in Figure 3 with the mean values for the various reaches in Table 1. Upper estuarine temperatures were warmer than at the mouth during summer and cooler during winter, with the steepest horizontal temperature gradient occurring during summer in the bottom waters. A slight vertical temperature gradient existed, becoming more pronounced in winter when surface waters were approximately 1°C cooler. The highest temperatures were recorded in December, January and February with the coldest in June and July.

A marked vertical salinity gradient was present along the estuary even though the average depth was only 153,0 cm (Figure 4 and Table 1). Bottom water salinities at Stations 1 and 2 were usually higher than 10‰. Although floods reduced salinities at Stations 2 and 3 and the surface water at Station 1 to 0‰, the lowest value recorded for the bottom waters at the mouth was 12‰ (Figure 4). A reversed horizontal salinity gradient was noted on four occasions. At all other times a normal horizontal gradient existed along the axis of the estuary.

Although variable, oxygen tensions were reasonably high throughout the estuary (Table 1) and ranged from 4,9 mg l^{-1} (Station 2) to 11,3 mg l^{-1} (Station 3). As expected, values for samples collected near the bottom were usually lower than those at the surface and

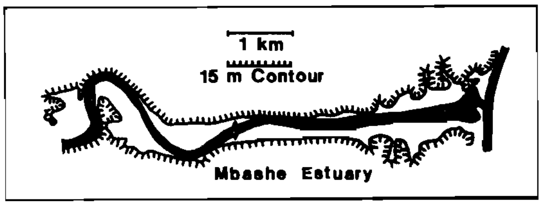

Figure 2 The Mbashe estuary with position of sampling sites indicated.

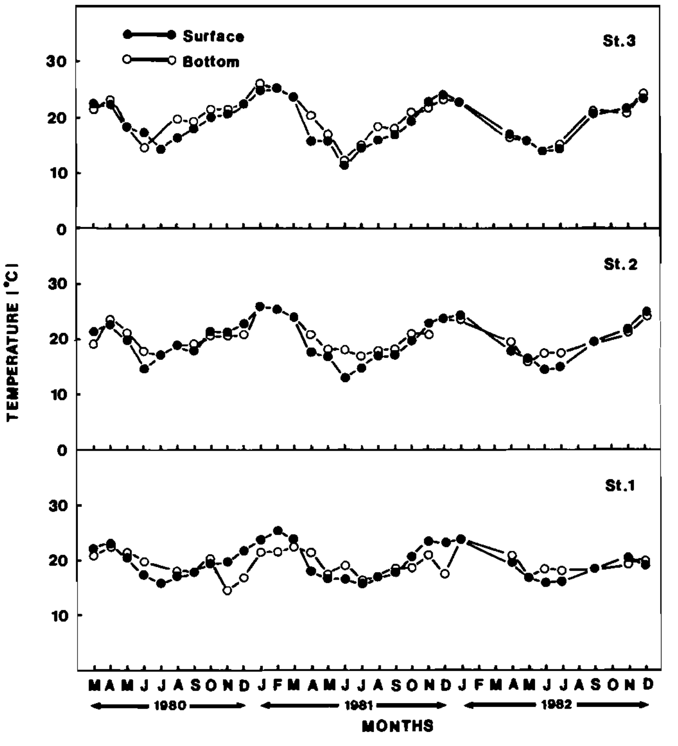

Figure 3 Monthly temperatures (°C) recorded at three Stations in the Mbashe estuary.

Table 1 Physico-chemical properties measured in the lower (Station 1), middle (Station 2) and upper (Station 3) reaches of the Mbashe Estuary

	Station 1				Station 2				Station 3			
	$\bar{x}$	*SD*	(Range)	*n*	$\bar{x}$	*SD*	(Range)	*n*	$\bar{x}$	*SD*	(Range)	*n*
Temperature (°C)												
Surface												
Summer	22,2	2,0	(19,4–25,5)	13	23,0	1,9	(20,0–26,0)	13	22,7	1,8	(19,5–25,5)	13
Winter	17,8	1,8	(16,0–22,8)	17	17,2	2,4	(13,2–22,8)	17	16,5	2,6	(11,5–22,5)	17
Bottom												
Summer	19,8	2,5	(14,6–22,5)	13	22,4	2,2	(19,2–26,0)	13	22,9	1,7	(21,0–26,0)	13
Winter	18,9	1,8	(16,3–22,5)	16	18,8	1,8	(16,0–23,5)	16	17,5	3,0	(12,1–23,0)	16
Salinity (‰)												
Surface												
Summer	8,8	12,0	(0,0–37,0)	13	4,0	6,5	(0,0–20,0)	13	0,5	0,8	(0,0–7,0)	13
Winter	22,6	9,6	(3,0–38,0)	17	15,8	10,2	(0,0–31,0)	17	3,6	3,3	(0,0–10,0)	17
Bottom												
Summer	33,4	1,9	(30,0–37,0)	13	20,1	15,3	(0,0–36,0)	13	8,8	13,6	(0,0–30,0)	13
Winter	33,1	8,1	(12,0–40,0)	16	30,6	9,8	(0,0–38,0)	16	16,8	12,6	(0,0–31,0)	16
Oxygen (mg l^{-1})												
Surface	8,0	0,0	(6,3–9,4)	19	8,3	0,9	(6,7–10,3)	19	8,7	1,1	(6,8–11,0)	19
Bottom	7,2	0,8	(6,0–9,0)	19	7,4	1,2	(4,9–9,3)	19	8,2	1,6	(5,6–11,3)	19
pH												
Surface	8,11	0,35	(7,12–8,62)	19	7,97	0,39	(7,00–8,55)	18	7,85	0,33	(7,00–8,33)	20
Bottom	8,10	0,33	(7,32–8,55)	20	7,93	0,42	(6,80–8,52)	18	7,79	0,34	(7,06–8,36)	20
Secchi disc (cm)	88,3	59,2	(2,0–180,0)	26	47,2	37,4	(2,0–114,0)	24	25,4	26,7	(2,0–93,0)	26
Depth (cm)	199,3	68,4	(88,0–300,0)	26	136,3	57,0	(69,5–300,0)	26	123,5	58,5	(50,0–300,0)	26

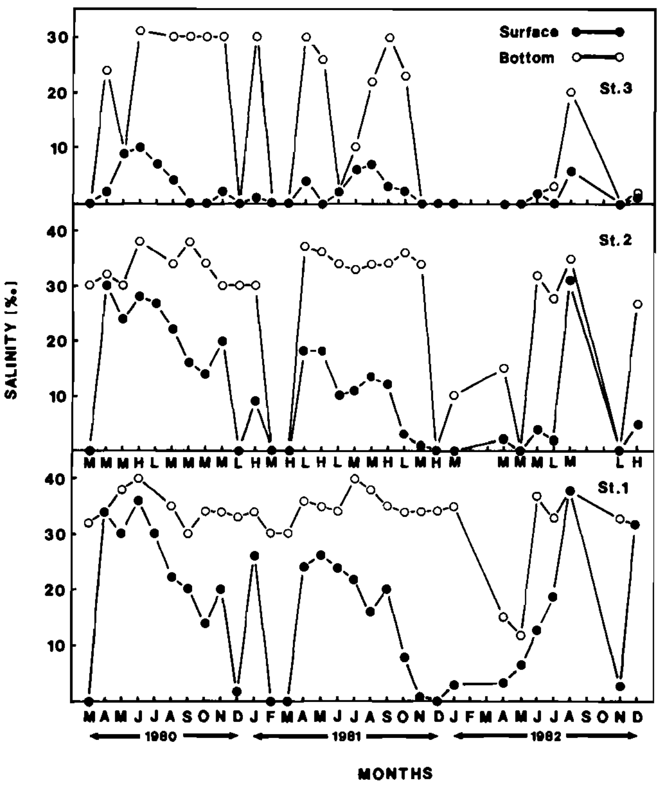

Figure 4 Monthly salinities (‰) recorded at three Stations in the Mbashe estuary (H – high tide, M – mid-tide, L – low tide).

fluctuations in oxygen levels were greatest in the upper reaches.

Secchi disc readings were normally less than 50 cm at Station 3 and varied between 2 cm and 100 cm at Station 2 (Table 1). The mean light penetration at Station 1 was 88,3 cm (Table 1) but was reduced to a few centimetres on six occasions when the river was in flood.

In this estuary pH values obtained decreased towards the head (Table 1) with surface water values always slightly higher than bottom values.

Fish fauna

The total catch consisted of 2908 fish comprising 27 species (Tables 2 and 3). Two species, namely *Mugil cephalus* (Linnaeus) and *Argyrosomus hololepidotus* (Lacepede) comprised 77,2% of the total numer *(N)* with *Pomadasys commersonnii* (Lacepede) (7,7%), *Liza tricuspidens* (Smith) (3,2%), *Myxus capensis* (Valenciennes) (3,0%) and *Lichia amia* (Linnaeus) (2,8%) contributing a further 16,7%. Five species accounted for 93,6% of the biomass (2319,8 kg), the freshwater mullet *M. capensis* no longer contributing significantly to the catch (1,2% only). The two most abundant fish were *M. cephalus* and *A. hololepidotus*, with practically no differences in their relative contribution to numbers or biomass. The leervis, *L. amia*, was ranked third, accounting for 8,9% of the total biomass of fish caught as

Table 2 Mean number and biomass (g) of fish caught monthly using gill nets over 12-h periods with 33 nettings at each of three localities in the Mbashe estuary

		12/79	01/80	03/80	04/80	05/80	06/80	07/80	08/80	09/80	10/80	11/80	12/80	01/81	02/81	03/81	04/81	05/81
Mugil cephalus	No.	13,7	36,3	2,3	9,3	17,0	19,3	12,0	10,3	25,0	4,0	13,7	11,0	5,7	2,7	4,3	7,0	17,7
	Mass	10881	25361	2096	8659	16053	12808	7480	7935	18569	4350	9327	6088	4201	2385	4106	6082	12046
Argyrosomus	No.	5,0	6,3	11,7	3,3	1,7	1,7	3,3	6,3	5,3	13,3	9,3	15,3	12,3	8,7	2,3	3,7	8,7
hololepidotus	Mass	4659	8245	9356	2146	2943	1902	5166	12040	12286	10815	9686	6628	6198	7294	873	2238	4171
Lichia amia	No.	1,7	1,0	1,3		1,0		0,3		1,3	2,0	2,7	4,7	1,3			0,3	0,3
	Mass	2444	1462	599		1249		1845		5338	7940	9906	13162	2190			910	253
Pomadasys	No.	0,7	2,0	12,0				0,7	0,3	1,0	2,7	4,3	0,7	1,0	4,0	0,7		0,7
commersonnii	Mass	152	744	2657				481	106	1174	1884	2089	62	149	2045	176		150
Liza tricuspidens	No.					2,0	6,3	1,7		0,7		1,0		0,7			0,3	4,3
	Mass					1680	4069	1912		228		1041		317			448	3545
Elops machnata	No.		0,7	0,3	1,0		0,3	0,3			0,7	1,7		0,7	0,3	0,7		0,3
	Mass		1397	950	1472		454	1112			1368	2892		1201	443	911		85
Valamugil	No.		0,3		0,3			0,7	1,0	1,7	1,0	0,3						
buchanani	Mass		364		390			1116	1214	2643	1339	619						
Myxus capensis	No.					1,0	0,3		1,7		0,3	0,3	0,3	0,3		0,3	4,0	2,7
	Mass					308	139		615		79	125	111	101		129	1318	684
Carcharhinus leucas	No.															0,3		0,3
	Mass															1512		1969
Pomatomus	No.		0,3					1,0	0,7	0,3		0,3						
saltatrix	Mass		534					1006	707	382		552						
Johnius	No.											2,3	0,7	2,3		0,7		2,3
dussumieri	Mass											1005	88	577		78		263
Liza richardsonii	No.				2,3	0,3												
	Mass				1289	192												
Acanthopagrus	No.														1,0			0,3
berda	Mass														511			204
Lithognathus	No.			0,3														
lithognathus	Mass			200														
Valamugil	No.					0,7			1,0			0,7						
cunnesius	Mass					93			72			121						
Rhabdosargus sarba	No.	0,3		0,3				0,3					0,3	0,3				
	Mass	18		27				334					54	8				
Rhinobatus	No.																	
annulatus	Mass																	
Thryssa	No.					0,7				1,0	0,3			0,7			1,3	0,3
vitrirostris	Mass					59				47	21			36			97	24
Sphyraena	No.																0,3	
acutipinnis	Mass																244	
Liza dumerilii	No.											0,3						
	Mass											47						
Torpedo	No.																	
sinuspersici	Mass																	
Valamugil	No.																	
robustus	Mass																	
Liza alata	No.								0,3									
	Mass								50									
Rhabdosargus	No.																	
holubi	Mass																	
Leiognathus	No.																	
equula	Mass																	
Caranx spp.	No.																	0,3
	Mass																	9
Monodactylus	No.																	
falciformis	Mass																	
		21,4	46,9	28,2	16,2	24,4	27,9	20,3	21,6	36,3	24,3	36,9	33,0	25,3	16,7	9,3	16,9	38,2
		18154	38107	15885	13956	22577	19372	20452	22739	40667	27796	37410	26193	14978	12678	7785	11337	23403

compared with a lower percentage of 2,8% or sixth ranking, when considered numerically.

When the total monthly catches (Table 2) are expressed seasonally it is evident that they are highest in spring / summer (spring – September, October, November; summer – December, January, February; autumn – March, April, May; winter – June, July, August) and lowest in autumn / winter (mass and numbers respectively). This trend was also reflected in *M. cephalus* abundance which comprised more than 50% of the total numbers and biomass. The flathead mullet catches decreased in February / March, increased in April / May, decreased once again in June/July, thereafter increasing to an often higher but fluctuating abundance.

Table 2 Continued

		06/81	07/81	08/81	09/81	10/81	11/81	12/81	01/82	04/82	05/82	06/82	07/82	08/82	10/82	11/82	12/82
Mugil cephalus	No.	3,7	21,0	15,7	11,3	4,0	18,0	19,7	16,7	16,3	36,0	11,0	11,0	22,7	23,7	26,3	21,3
	Mass	3497	19605	14580	11822	5112	15008	20071	14235	10513	26170	9249	11883	16294	18447	18580	17695
Argyrosomus	No.	6,0	7,3	5,7	5,3	8,3	6,7	14,0	28,3	7,0	16,0	3,7	3,7	0,3	9,3	9,0	7,3
hololepidotus	Mass	3750	14017	9678	3021	9892	4720	5026	11449	1801	6395	1313	1899	3555	4638	4738	4129
Lichia amia	No.	0,7	0,3	0,7	1,0	1,3	1,3		2,0		0,7				1,0		0,3
	Mass	1032	1113	1408	2601	2336	4529		1396		293				5744		870
Pomadasys	No.	1,0		0,3	1,3	2,3	2,7	4,0	5,7	1,0	1,7	1,0	1,3	3,3	2,3	14,0	2,3
commersonnii	Mass	1389		934	844	4217	1750	4994	709	161	225	946	1428	1435	937	3289	293
Liza tricuspidens	No.	1,7	3,0	6,3	0,3						0,3	1,0		1,7			
	Mass	3104	3482	6640	845						515	1484		2287			
Elops machnata	No.					0,7	0,7	0,3	0,7				0,7		0,3		
	Mass					1250	748	55	441				229		151		
Valamugil	No.			0,3			0,3		0,7						1,0	0,3	
buchanani	Mass			516			912		160						166	60	
Myxus capensis	No.	0,7	1,0	0,3	0,3	0,3	1,3	0,3		2,3	6,0			3,0	1,0	1,3	
	Mass	189	252	82	58	54	412	52		621	1905			1181	318	292	
Carcharhinus leucas	No.																
	Mass																
Pomatomus	No.																
saltatrix	Mass																
Johnius	No.	0,3				0,3			1,0	0,3						1,3	0,3
dussumieri	Mass	41				48			186	38						175	50
Liza richardsonii	No.			0,3													
	Mass			85													
Acanthopagrus	No.							0,3				0,7				0,7	
breda	Mass							85				80				184	
Lithognathus	No.							0,3					0,3			0,3	
lithognathus	Mass							611					106			58	
Valamugil	No.		0,3		0,3			0,3		0,3	0,7				1,0	0,7	
cunnesius	Mass		104		28			32		58	77				153	45	
Rhabdosargus sarba	No.				0,3				0,3								
	Mass				9				190								
Rhinobatus	No.					0,3											
annulatus	Mass					449											
Thryssa	No.		0,3	0,3		0,3											
vitrirostris	Mass		28	31		1											
Sphyraena	No.																
acutipinnis	Mass																
Liza dumerilii	No.			0,3													
	Mass			49													
Torpedo	No.					0,3											
sinuspersici	Mass					90											
Valamugil	No.										0,3						
robustus	Mass										81						
Liza alata	No.																
	Mass																
Rhabdosargus	No.		0,7														
holubi	Mass		20														
Leiognathus	No.								0,3								
equula	Mass								15								
Caranx spp.	No.																
	Mass																
Monodactylus	No.													0,3			
falciformis	Mass													5			
		14,1	33,9	30,2	20,1	18,1	31,4	39,2	55,7	27,2	61,7	17,4	17,0	33,7	39,6	53,9	31,5
		13002	38621	34003	19228	23449	28079	30926	28781	13192	35661	13072	15545	24757	30554	27421	23037

A number of other species showed some evidence of seasonality. Gravimetrically *A. hololepidotus, L. amia* and *P. commersonnii* were most abundant in spring, while *M. capensis* and *L. tricuspidens* were more common in autumn and winter, respectively. Numerically *P. commersonnii* and *L. tricuspidens* were most abundant in winter; *L. amia* in spring/summer; *A. hololepidotus* in summer and *M. capensis* in autumn. During December 1981, January 1982 and May 1982 many small *A. hololepidotus* were caught, suggesting that juveniles were entering the estuary. Conversely, the disparity between mass and numbers of *L. amia* indicated larger specimens were being caught in October, November and December. The following species caught in low numbers, also showed some form of seasonality by being present in low but constant numbers for most seasons with numbers

Table 3 Mean number and biomass (g) of fish caught by gill net at three sampling stations in the Mbashe estuary. Results based on 33 nettings per station

Species	Station 1		Station 2		Station 3		Total				Mean mass	
	n	Mass (g)	*n*	Mass (g)	*n*	Mass (g)	*n*	%	Mass (g)	%	Per net	Per individual
Mugil cephalus	5,76	4520,6	17,58	14381,2	21,18	16660,8	1469	50,5	1173570	50,6	11854,2	698,0
Argyrosomus hololepidotus	8,21	6189,3	8,82	7095,1	6,48	4612,9	776	26,7	590610	25,5	5965,8	761,1
Lichia amia	1,97	5583,2	0,52	655,2	–	–	82	2,8	205864	8,9	2079,4	2510,5
Pomadasys commersonnii	2,82	1475,6	2,88	1351,7	1,12	393,0	225	7,7	106271	4,6	1073,4	472,3
Liza tricuspidens	1,36	1125,8	0,91	1210,5	0,55	536,3	93	3,2	94793	4,1	957,5	1091,3
Elops machnata	0,36	558,3	0,48	789,2	0,09	30,5	31	1,1	45475	2,0	459,3	1466,9
Valamugil buchanani	0,33	452,5	0,39	355,4	0,03	55,7	25	0,9	28499	1,2	287,9	1140,0
Myxus capensis	0,76	224,7	1,73	527,1	0,18	68,6	88	3,0	27073	1,2	273,5	307,6
Carcharhinus leucas	0,03	137,4	0,03	179,0	–	–	2	0,1	10442	0,5	105,5	5221,0
Pomatomus saltatrix	0,15	198,1	0,12	112,1	–	–	9	0,3	10238	0,4	103,4	1137,6
Johnius dussumieri	0,18	23,5	0,15	23,8	0,76	184,4	36	1,2	7651	0,3	77,3	212,5
Liza richardsonii	0,18	66,3	0,12	65,9	0,03	17,4	11	0,4	4938	0,2	49,9	448,9
Acanthopagrus berda	–	–	0,18	70,9	0,06	28,2	6	0,2	3269	0,1	33,0	544,8
Lithognathus lithognathus	0,06	60,8	0,03	18,2	–	–	3	0,1	2607	0,1	26,3	869,0
Valamugil cunnesius	0,15	13,6	0,27	41,5	0,12	16,0	18	0,6	2344	0,1	23,7	130,2
Rhabdosargus sarba	–	–	0,12	20,5	0,09	37,8	7	0,2	1921	0,1	19,4	274,4
Rhinobatus annulatus	0,03	40,8	–	–	–	–	1	<0,1	1347	0,1	13,6	1347,0
Thryssa vitrirostris	0,15	10,2	0,27	17,5	0,06	3,7	15	0,5	1036	<0,1	10,5	69,1
Sphyraena acutipinnis	0,03	22,2	–	–	–	–	1	<0,1	732	<0,1	7,4	732,0
Liza dumerilii	–	–	0,06	8,8	–	–	2	0,1	291	<0,1	2,9	145,5
Torpedo sinuspersici	0,03	8,2	–	–	–	–	1	<0,1	269	<0,1	2,7	269,0
Valamugil robustus	0,03	7,4	–	–	–	–	1	<0,1	243	<0,1	2,5	243,0
Liza alata	–	–	–	–	0,03	4,5	1	<0,1	149	<0,1	1,5	149,0
Rhabdosargus holubi	0,06	1,8	–	–	–	–	2	0,1	60	<0,1	0,6	30,0
Leiognathus equula	–	–	0,03	1,4	–	–	1	<0,1	45	<0,1	0,5	45,0
Caranx spp.	–	–	0,03	0,8	–	–	1	<0,1	28	<0,1	0,3	28,0
Monodactylus falciformis	–	–	–	–	0,03	0,5	1	<0,1	15	<0,1	0,2	15,0
	22,65	20720,3	34,72	26925,8	30,81	22650,3	2908		2319780		23432,1	

either peaking or declining as follows: *Johnius dussumieri* (Cuvier) and *Valamugil cunnesius* (Valenciennes) were very rare in winter and summer respectively, while *Elops machnata* (Forsskal) and *Valamugil buchanani* (Bleeker) were most abundant in spring. The seasonal abundance of the remaining species could not be determined.

The biggest catches, numerically and gravimetrically, were made in the middle reaches, followed closely by the upper reaches (Table 3). Of the 27 species caught in the Mbashe estuary, 15 were found in the upper and 20 in each of the middle and lower reaches. Gravimetrically *Johnius dussumierii* showed a preference for the upper reaches; *M. cephalus* for the upper and middle reaches; *M. capensis, Valamugil cunnesius, Elops machnata* (Forsskal) and *Thryssa vitrirostris* (Gilchrist & Thompson) for the middle reaches; *A. hololepidotus, P. commersonnii, Valamugil buchanani* (Bleeker), *Liza richardsonii* (Smith) and *L. tricuspidens* for the middle and lower reaches; *L. amia* for the lower reaches.

Nearly 600 fish were caught in the 57-mm mesh sections of the nets, followed in decreasing order by 73 mm and 93 mm with 591 and 565, respectively. Highest biomass was obtained in the 93-mm mesh sections where the mean mass of the fish was 1066,8 g.

Discussion

Prior to this investigation very little research had been done on the ecology of the Mbashe estuary. Day (1981a) mentions collections being made by biologists from the Zoology Department of the University of Cape Town in January 1950, observation on the hydrology, nutrient concentrations and hydro-carbon residues in fish by Oliff (1976, 1978), unpublished references to the Bashee by Siegfried (1977) and statistical data on the river by Noble & Hemens (1978). Further information on the physico-chemical properties and fish fauna was collected by Marais & Prinsloo (1980) as well as an unpublished report by Connell (1980) dealing with the nutrient levels, physico-chemical properties, meiofauna and zooplankton.

Physico-chemical properties

The temperature characteristics recorded in the Mbashe were similar to those found in the Kei (Plumstead *et al.* 1985) and those reported for other South African estuaries (Branch & Grindley 1979; Marais & Baird 1980; Day 1981a). Upper estuarine temperatures showed the greatest seasonal variation (Wooldridge 1977; Branch & Grindley 1979; Marais & Baird 1980; Marais 1981; Marais 1983a & b; Hodgson 1987) reflecting the influence of the terrestrial environment (Day 1981a & b) on the waters of this region. The stabilizing influence of the sea on the temperatures of the bottom water in the lower reaches is evidenced by the relatively minor difference of 1°C between summer and winter means. The mean winter bottom temperature of 18,9°C (range 16,3–22,5°C) in the lower reaches was 2,6°C higher than the corresponding value for the Kei (Plumstead *et al.* 1985) where the temperature ranged from 11,5°C to 18,8°C over the same period. Day (1981a) reports a winter temperature of 18°C for the Mbashe, while further north the winter bottom temperature of the Mngazana (Branch & Grindley 1979) and Mntentu (Connell 1974) fell between 18–19°C. To the south the following winter temperatures were recorded: West Kleinemond – 15°C (down to 12°C occasionally) (Day 1981a); Kariega – 15 to 16°C (Hodgson 1987); Sundays – 12 to 15°C (Marais 1981); Krom – lowest recorded was 13°C (Marais 1983a); and Palmiet – between 13 and 16°C in the bottom waters of the lower reaches (Branch & Day 1984). The low temperatures recorded in the lower reaches in November 1980 and December 1981 (Figure 4) were possibly the result of coastal upwelling which Day (1981a) mentions occurs occasionally along the eastern and southern Cape coasts causing rapid variations in sea temperatures.

Salinity in the Mbashe estuary was not as variable as that of the Kei (Plumstead *et al.* 1985). Despite the shallowness of the estuary a vertical salinity gradient was present which rarely broke down in the middle and lower reaches.

As previously documented, estuaries in Transkei are very often turbid, with the problem usually increasing with an increase in the size of the river catchment area (Branch & Grindley 1979). The Mbashe estuary was generally much less turbid than the Kei estuary (Plumstead *et al.* 1985), but much more so than reported for the Mngazana (Branch & Grindley 1979), Krom (Marais 1983a) and Mlalazi (Hill 1966) estuaries. Oxygen levels were high, comparable to levels in the Kei (Plumstead *et al.* 1985), Mntentu (Connell 1974) and Palmiet (Branch & Day 1984) estuaries.

Fish fauna

Very little information is available with regard to the fish fauna of the Mbashe estuary. Day (1981a) stated that the fauna of the Mbashe was poor and that very few fish species occurred in it. Marais & Prinsloo (1980) in their two visits to the estuary only recorded 10 fish species. During this survey 27 fish species were captured by gill nets, 17 (63%) of these had subtropical (11) or tropical (6) affinities which was 11% higher than for the corresponding groups in the Kei (Plumstead *et al.* 1985). Using seine and gill nets Branch & Grindley (1979) reported 62 species mainly from the lagoon and tributary at the mouth of the mangrove-dominated Mngazana estuary. Fifty-three per cent of 59 species were of tropical origin and 17% subtropical. Day, Blaber & Wallace (1981) in analysing 59 common Natal estuarine fish species (Wallace 1975) suggested that 27 (59%) of the tropical species and 7 (15%) of the sub-tropical species would be found in Transkei.

During this investigation very few *Valamugil robustus* (Gunther), *Liza alata* (Steindachner), *Rhabdosargus sarba* (Forsskal), *Leiognathus equula* (Forsskal) and *Sphyraena acutipinnis* (Day) were caught. Subsequent seine netting has shown that *Rhabdosargus holubi* (Steindachner), *Liza dumerilii* (Steindachner), *V. robustus* and *Liza richardsonii* (Smith) rarely caught in gill nets are fairly common, particularly in the lower reaches of the Mbashe. Neither *V. robustus* or *L. alata* have been recorded from the nearby Mngazana (Branch & Grindley 1979) but occur in both the Msikaba and Mntentu estuaries (Blaber 1977) and increase in abundance further north. Low numbers of *R. sarba, L. equula* and *S. jello (japonica)* (Cuvier) were caught in Mngazana (Branch & Grindley 1979). Although more intensive sampling between the Mbashe and Sundays estuaries may reveal that the distribution of some of these fish does extend further south, it appears that *V. robustus, L. alata, R. sarba, L. equula* and *S. acutipinnis* are at or near the southern limits of their distribution.

The catch composition obtained in the Mbashe was similar to that of the Kei (Plumstead *et al.* 1985) and the eastern Cape estuaries of the Swartkops (Marais & Baird 1980), Sundays (Marais 1981) and Gamtoos (Marais 1983b) Rivers. In the Kei and Mbashe the family Mugilidae comprised 67,8% (Plumstead *et al.* 1985) and 58,8% respectively of the total catch as compared to a maximum of 42% from the Swartkops (Marais & Baird 1980). In Mhlanga (Whitfield 1980) mullet formed 29% of the total number of fish. The most abundant mugilids numerically and gravimetrically in the eastern Cape and Kei were usually a combination of *M. cephalus, L. tricuspidens, L. richardsonii* or *M. capensis*. This pattern changed in the Mbashe where *M. cephalus* alone comprised 88% of the mullet numbers and 50,5% of the total biomass. The remaining eight mullet species comprised a mere 8,2% of the total biomass, *L. tricuspidens* and *M. capensis* being the most abundant and *L. alata* and *V. robustus* the least.

Contrary to the findings of Marais & Prinsloo (1980) *A. hololepidotus*, and not *L. amia*, was the second most abundant species. It is common along the South African coast and features prominently in the catches from the Gamtoos (Marais 1983b), Sundays (Marais 1981), Kei (Plumstead *et al.* 1985) and was present in Mngazana catches (Branch & Grindley 1979). Never very abundant (0,83/netting), *L. amia* numbers were fairly constant during 1980/81 but decreased sharply the following year. Because of its mass per individual, *L. amia* was ranked third gravimetrically. The white seacatfish *Galeichthys feliceps* (Valenciennes), which occurs in large numbers in the eastern Cape (Marais 1981, 1983a & b) and in low numbers in the Kei (Plumstead *et al.* 1985) were not present in the Mbashe during this investigation although a few have been caught in subsequent netting. Generally this species is rarely found in Transkei estuaries as none were found in the Mngazana (Branch & Grindley 1979); the Mntafufu (Plumstead 1984); Mzamba (Plumstead 1984), very few in the Mbashe and constituted only 1,7% of the Kei catch (Plumstead *et al.* 1985). Van der Elst (1981) and Smith (1977) consider this species common along the southern African coast. Reasons for its scarcity in Transkei estuaries require investigation.

The work of Marais and co-worker (Marais & Baird

1980; Marais 1981, 1983a & b) showed that very few species exhibited seasonal changes in abundance. Similar results were obtained from Transkei where the abundance of only four species from the Kei (Plumstead *et al.* 1985) and ten species from the Mbashe changed seasonally. Kob numbers decrease in winter in the Mbashe and Kei estuaries (Plumstead *et al.* 1985), probably joining the migration into Natal suggested by Wallace (1975) and Day *et al.* (1981). No seasonal changes were detected in the Swartkops (Marais & Baird 1980) or Krom (Marais 1983a) estuaries when gill nets were used. Winter (1979) reported that when using seine nets in the Swartkops this species was most abundant numerically and gravimetrically in summer.

Apparently *L. amia*, which were more abundant in spring/summer in the Mbashe, Swartkops, Gamtoos and Krom estuaries (Marais & Baird 1980; Marais 1983a & b), follow the sardine shoals into Natal between May and June (Day *et al.* 1981). This summer abundance of garrick in the Mbashe is contrary to the data from the Mngazana where Branch & Grindley (1979) found this species to be absent in summer (December) and present in winter (June). This does serve to illustrate the value of more regular data collection than was the case at Mngazana where four sampling trips were made and nets used on only two of them.

Van der Elst (1981) considers the spotted grunter *P. commersonnii* essentially a summer fish and that it is most abundant in the Cape once summer water temperatures rise. In the eastern Cape Marais & Baird (1980) reported no seasonal trends for this species in the Swartkops. Winter (1979), using seine nets, found numbers and biomass peaking in spring in the same estuary. Maximum numbers and biomass occurred in summer in the Kei (Plumstead *et al.* 1985) and Mngazana (Branch & Grindley 1979). In the Mbashe, however, highest numbers were recorded in winter reaching their lowest levels in summer and autumn. Gravimetrically the situation changes with biomass peaking in spring and dropping to a minimum in autumn.

Both *M. capensis* and *L. tricuspidens* were uncommon in the estuary in summer. The freshwater mullet *M. capensis* was most abundant during the autumn months. This corresponded with the build-up of reproductive material (Plumstead 1984) prior to entering the sea where they are reported to spawn close inshore and in the vicinity of estuary mouths. Gonadosomatic indices (GSI) for this mullet in the Kei estuary (Plumstead 1984) showed a maximum peak of 7 in September, this being much higher than the maximum of 1,43 Bok (1979) recorded in the Kowie estuary. Abundance of *L. tricuspidens* in two Transkei estuaries appears anomalous. Numbers in the Mbashe were lowest in summer and high in winter yet in the Kei (Plumstead *et al.* 1985) they were lowest in winter and fairly evenly distributed in spring, summer and autumn. Comparative seasonal data are unavailable for other Transkei and Natal estuaries as none were caught in Mngazana (Branch & Grindley 1979), Mhlanga (Whitfield 1980), Tongati (Blaber, Hay, Cyrus & Martin 1984), and only juveniles on a single occasion in the Mdloti (Blaber *et al.* 1984). Blaber (1977) did not give any seasonal data for *L. tricuspidens* caught in the Msikaba and Mntentu. Maximum abundance of *L. tricuspidens* in Mbashe corresponded to the period during which the gonads, as determined by GSI (Plumstead 1984) were developing, finally reaching their peak in September/October. Van der Elst (1981) suggests that spawning occurs in winter and spring off the Natal coast, therefore the accumulation in winter may be part of their spawning migration. It is reported that *M. cephalus* congregates in large numbers in the lower reaches of estuaries in April and May (Wallace 1975; Whitfield & Blaber 1978; Plumstead 1984) later moving out and migrating to their spawning grounds. This autumn pre-spawning accumulation is not reflected in the catches from the Mbashe where autumn/winter catches were slightly lower than those in spring/summer.

The mean catch (biomass) in the Mbashe estuary (23,4 kg/net) was similar to that of the Sundays (20,5 kg/net; Marais 1981) and the Krom (17,9 kg/net; Marais 1983a) but lower than that of the Gamtoos (33,3 kg/net; Marais 1983b) and Kei (31,7 kg/net; Plumstead *et al.* 1985). This is less than the 34,0 kg/net (Marais & Prinsloo 1980) that has been quoted for this estuary. The spatial distribution of the fish resembled that of the Kei (Plumstead *et al.* 1985), Sundays (Marais 1981) and Gamtoos (Marais 1983a) estuaries with some mullet species *(M. cephalus, V. cunnesius, M. capensis)* preferring the upper and middle reaches, while predators such as *L. amia* and *A. hololepidotus* were found in the clearer waters of the middle and lower reaches. Large shoals of mullet, mainly *M. cephalus* and *M. capensis* were observed in the middle and lower reaches of the Mbashe estuary in May and June (Plumstead, pers. obs.). These fish were probably involved in their annual seaward spawning migration (Wallace 1975) as this coincided with the period of maximum gonadal development of *M. cephalus* (Plumstead 1984) and *M. capensis* (Bok 1979; Plumstead 1984).

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