# Chapter 5   Fish abundance and biomass

5.0 General introduction

❑ Fish communities are quantified by replicate underwater visual transects during neap, low tides and only when clarity exceeds seven metres as described in McClanahan and Kaunda-Arara (1996) and McClanahan (1998).

❑ Fish are classified to the family level and using length-weight comparisons biomass estimates are gained (McClanahan and Kaunda-Arara,1996), but also given in the data-entry template.
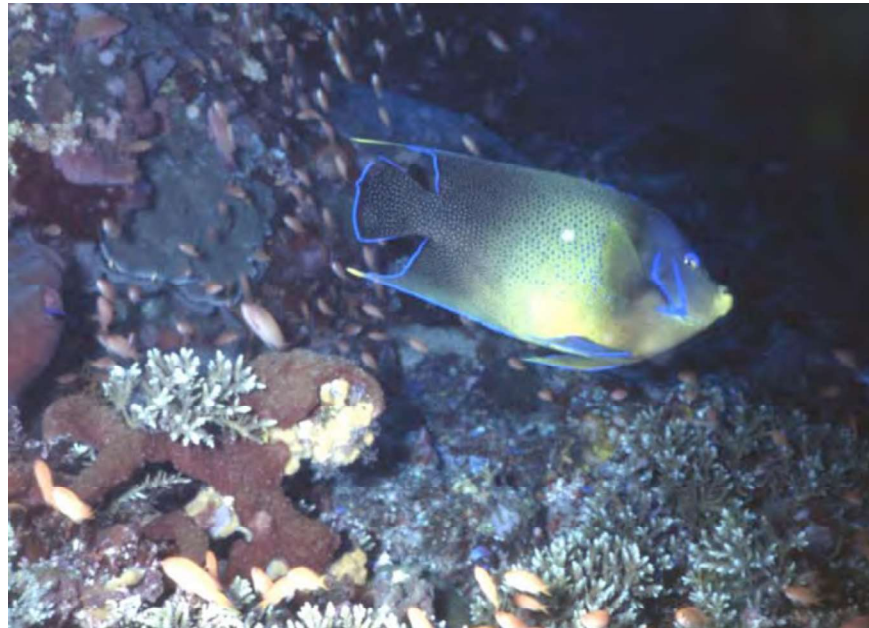
The semicircle angelfish, *Pomacanthus semicirculatus* (Family: Pomacanthidae).

5.1 Equipment and logistics

❑ Boat equipment if necessary and snorkel gear.

❑ Slate drawn up and pencil attached by string

❑ Ruler attached on the slate or calibrated top part of slate.

❑ 100m nylon transect line. Line has swivels at 20 m interval to prevent entanglement.

	3cm	10cm	20cm	30cm

Time & Tide: _____ Location: _____
Date: _____ Transect size: _____
Assistants: _____ Units: _____
Site 1

Fish families   sizes

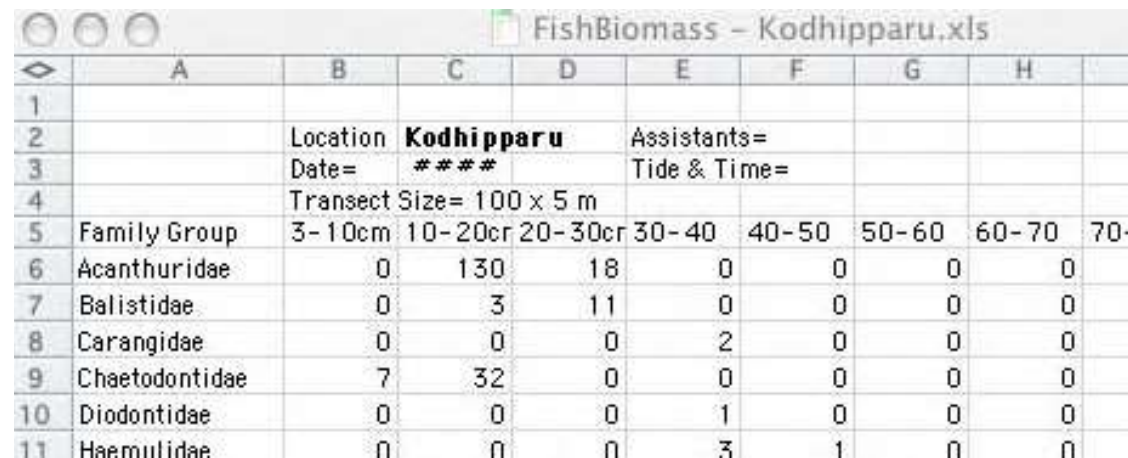|	3-10	10-20	20-30	30-40	>40
Acanthuridae					
Balistidae					
Chaetodontidae					

Fish abundance data entry slate. The upper part of the slate is calibrated or a ruler may be attached to aid in length estimations.

5.2 General procedure

❑ A 100 m line is laid out along the benthos 5 minutes prior to sampling.

❑ One observer then swims along at a steady pace, perpendicular to and at a constant distance of 2.5m from this line, carrying a slate with length markings, counting and recording fish seen 2.5m either side of himself, covering an area of 500m^2.

❑ Fish are placed in size categories: 3-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80 and >80cm, and into their families. Fish smaller than 3cm are omitted to standardize density comparisons.

❑ The observer adjusts his swimming rate slightly (10-30 min/transect), to account for the varying fish densities in different sites, sites with high fish densities are sampled slower than those with low densities.

❑ Other observers ensure they are well out of the way to avoid scaring the fish.

❑ The fish counts are conducted during neap high tides as the lower movement of the water means it is less likely for the fish to hide.

5.3 Data processing

❑ At the end of each day the data is entered from the slates into the database templates (available in public folder - http://idisk.mac.com/trmcclanahan-Public?view=web) and saved stating site, year, and type of template.eg. 'Fish-mombasa2005'

❑ The slates are not erased until necessary and after data entry has been checked at least twice cross checking with individual entries and overall analysis.

❑ Entries are only made onto the first sheet of the template, which is labeled entry sheet.

❑ The template summarizes this data, density data is converted to wet weight as kg/ha, using standard L-W conversions, published a and b values and the middle length from each size class.

FishBiomass – Kodhipparu.xls

	A	B	C	D	E	F	G	H
1								
2		Location	**Kodhipparu**		Assistants=			
3		Date=	####		Tide & Time=			
4		Transect Size= 100 x 5 m						
5	Family Group	3-10cm	10-20cr	20-30cr	30-40	40-50	50-60	60-70	70-
6	Acanthuridae	0	130	18	0	0	0	0
7	Balistidae	0	3	11	0	0	0	0
8	Carangidae	0	0	0	2	0	0	0
9	Chaetodontidae	7	32	0	0	0	0	0
10	Diodontidae	0	0	0	1	0	0	0
11	Haemulidae	0	0	0	3	1	0	0

Fish density data entry spreadsheet

5.4 Results in Kenya

□ Unprotected ● Protected ▲ Newly protected
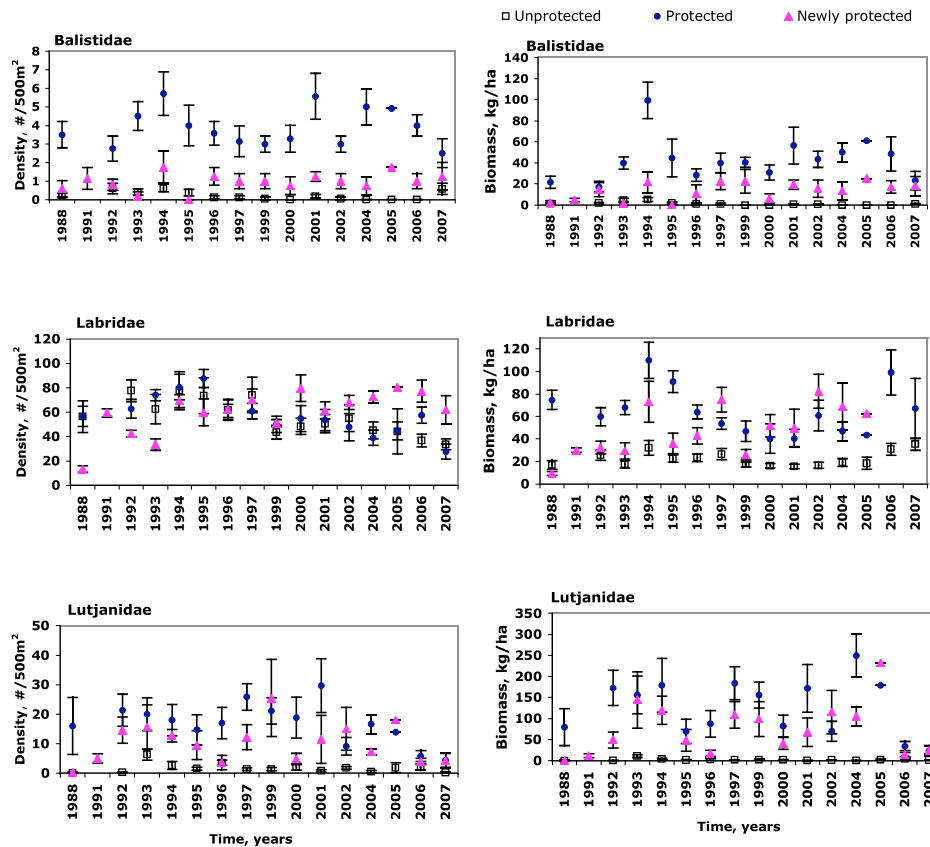
Fish density and biomass changes of selected families at protected, newly protected and unprotected study sites along the Kenyan coast for the period 1988-2007.

❑ Further reading:
- McClanahan TR, Kaunda-Arara B (1996) Fishery recovery in a coral-reef marine park and its effect on the adjacent fishery. Conservation Biology 10(4) pp 1187-1199

- McClanahan TR, Graham NAJ (2005) Recovery trajectories of coral reef fish assemblages within marine protected areas. Mar Ecol Prog Ser Vol 294 pp 241-248

Chapter 6   Fish Discrete Group Sampling

6.0 General introduction

- Fish communities are quantified by replicate underwater visual transects during neap, low tides and only when clarity exceeds seven metres as described in McClanahan and Kaunda-Arara (1996), McClanahan (1998).

- Fish are classified to the species level giving a density count with 4 transects per site.

Powder-blue surgeonfish, *Acanthurus leucosternon*.

6.1 Equipment and logistics

- ❑ Boat equipment if necessary and snorkel gear.
- ❑ Slate drawn up and pencil attached by string
- ❑ 100m transect line with swivels at 20 m intervals

Location			Assistants=	Tim
Date=			Tide & Time=	Neap, high
Transect Size= 100 x 5 m				

Family	Species	T1	T2	T3	T4
Acanthuridae	Ctenochaetus striatus		4	3	
	Acanthurus nigrofuscus		1		
	Zebrasoma scopas				
	Naso annulatus				
	Zebrasoma veliferum				
	Acanthurus triostegus		2	5	
	Acanthurus leucosternon				
	Ctenochaetus strigosus				
	Acanthurus nigricauda		1		
Scaridae	Scarus sordidus				
	Scarus scaber				
	Scarus ghobban			1	
	Scarus niger				
	Calotomus carolinus		1		
	Scarus frenatus				
	Scarus rubroviolaceus				
Balistidae	Balistapus undulatus				
	Rhinecanthus aculeatus				
	Sufflamen chrysoptera				
	Sufflamen fraenatus				
	Pseudobalistes fuscus				
	Balistes conspicillum				
	Balistoides viridescens				
	Rhinecanthus rectangulus				
Chaetodontida	Chaetodon trifasciatus		2	1	
	Chaetodon auriga		2		
	Chaetodon lunula			1	
	Chaetodon trifascialis				
	Chaetodon guttatissimus				
	Chaetodon melannotus				

Fish DGS entry sheet

6.2 General procedure

❑ A 100 m line is laid out along the benthic layer 5 minutes prior to sampling.

❑ One observer then swims along, perpendicular to this line, at a constant distance of 2.5m from it carrying a slate with length markings, at a steady pace, counting and recording fish seen 2.5m either side of the line, covering an area of 500m^2.

❑ Fish are identified to the species level where 1-3 fish families are sampled with each pass of the line transect. The transect is passed 4 times to count all the families of fish.

❑ The observer adjusts his swimming rate slightly (10-30 min/transect), to account for the varying fish densities in different sites, sites with high fish densities are sampled slower than those with low densities.

❑ Other observers ensure they are well out of the way to avoid scaring fish.

❑ The fish counts are conducted during neap high tides as the lower movement of the water means it is less likely for the fish to hide.

6.3 Data processing

❑ At the end of each day the data is entered from the slates into the database templates (available in public folder - http://idisk.mac.com/trmcclanahan-Public?view=web) and saved stating site, year, and type of template.eg. 'DGS-mombasa2005'

❑ The slates are not erased until necessary and after data entry has been checked at least twice cross checking with individual entries and overall analysis.

❑ Entries are only made onto the first sheet of the template, which is labeled entry sheet.

Annual monitoring–2006 data.xls

|	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	count/ 500m^2 transect													
2	Country	Man	year	Reef	Family	Genus	species	spp	C	F	T	T1	T2	T3
3	Kenya	u	2006	Rasiwatine	Acanthuridae	Acanthurus	triostegus	Acanthurus triosteç				1		
4	Kenya	u	2006	Rasiwatine	Acanthuridae	Ctenochaetu:	striatus	Ctenochaetus stria				5		
5	Kenya	u	2006	Rasiwatine	Chaetodontic	Chaetodon	auriga	Chaetodon auriga				2		
6	Kenya	u	2006	Rasiwatine	Chaetodontic	Chaetodon	lunula	Chaetodon lunula						
7	Kenya	u	2006	Rasiwatine	Chaetodontic	Chaetodon	melannotus	Chaetodon melanr				1		
8	Kenya	u	2006	Rasiwatine	Labridae	Cheilio	inermis	Cheilio inermis				2	1	
9	Kenya	u	2006	Rasiwatine	Labridae	Halichoeres	scapularis	Halichoeres scapularis				2		

Fish DGS database template

6.4 Results in Kenya

❑ **Further reading:**

McClanahan, TR (1995) Fish predators and scavengers of the sea urchin *Echinometra mathaei* in Kenyan coral-reef marine parks. *Environmental Biology of Fishes 43: 187-193*

McClanahan, TR. Graham, NAJ. Calnan, JM and MacNeil, M.A (2007) Toward pristine biomass: reef fishery recovery in coral reef marine protected areas in Kenya. *Ecological Applications 17(4): 1055-1067.*
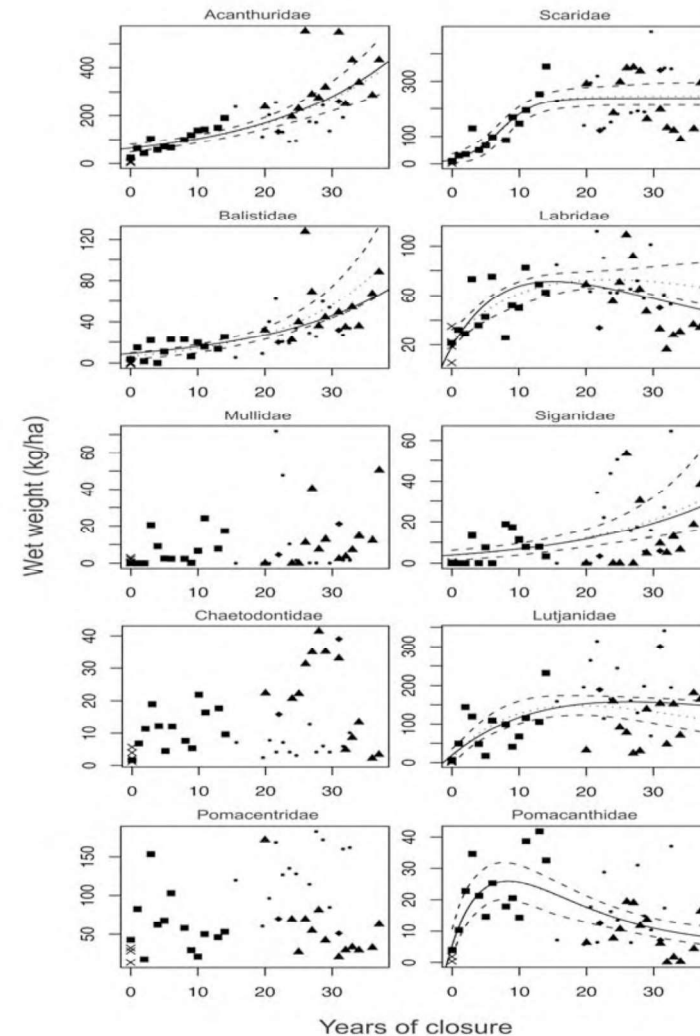
Recovery curves for total fish-family biomass in Kenya marine parks with years of marine protection. Symbols represent parks: unprotected parks(✕), Mombasa (■), Kisite (◆), Watamu (●) and Malindi (▲).