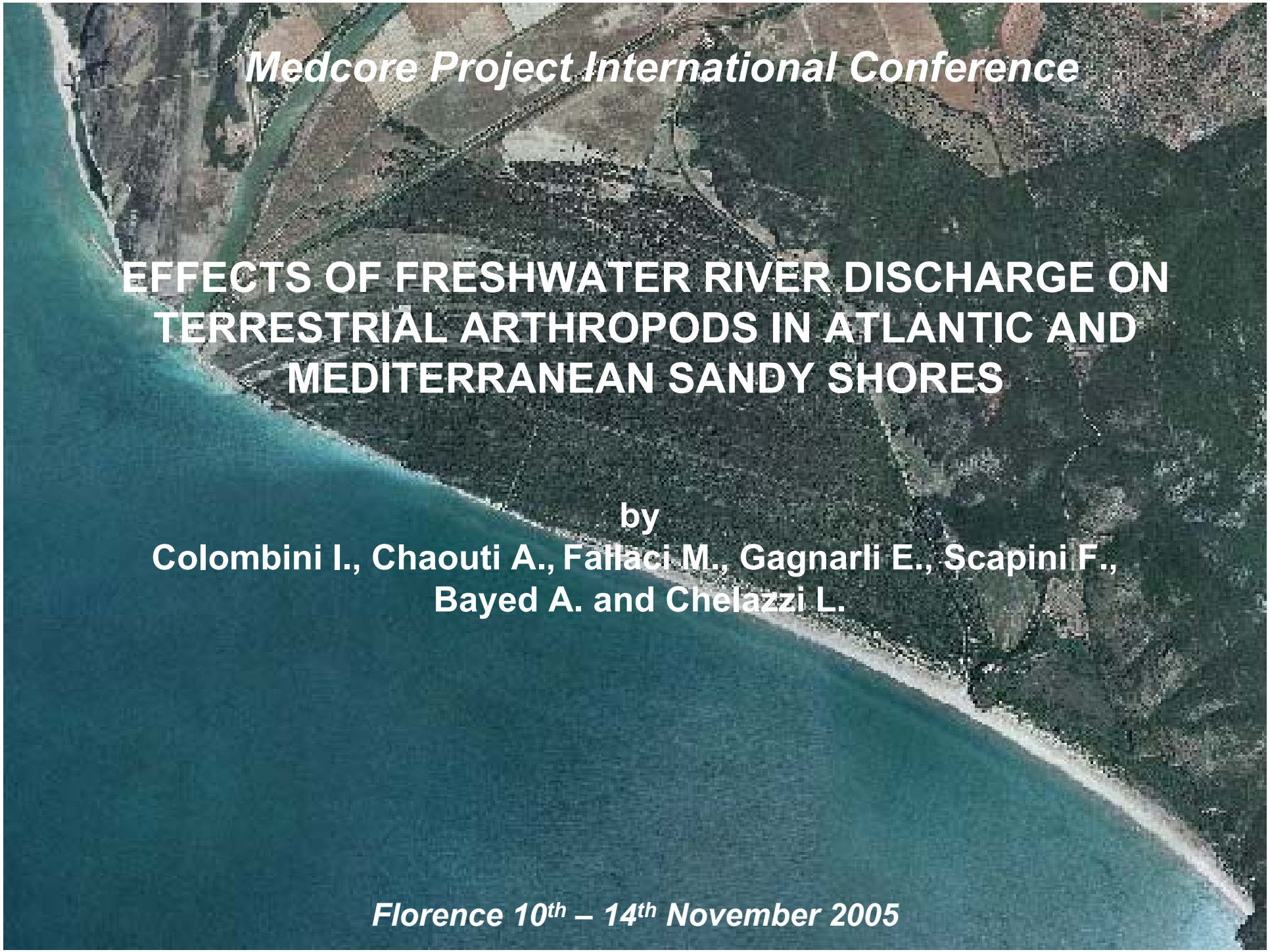


Medcore Project International Conference

EFFECTS OF FRESHWATER RIVER DISCHARGE ON TERRESTRIAL ARTHROPODS IN ATLANTIC AND MEDITERRANEAN SANDY SHORES

by
Colombini I., Chaouti A., Fallaci M., Gagnarli E., Scapini F.,
Bayed A. and Chelazzi L.

Florence 10th – 14th November 2005

MEDCORE PROJECT

(ICA3-CT2002-10003, 5° FP, INCO-MED Programme)

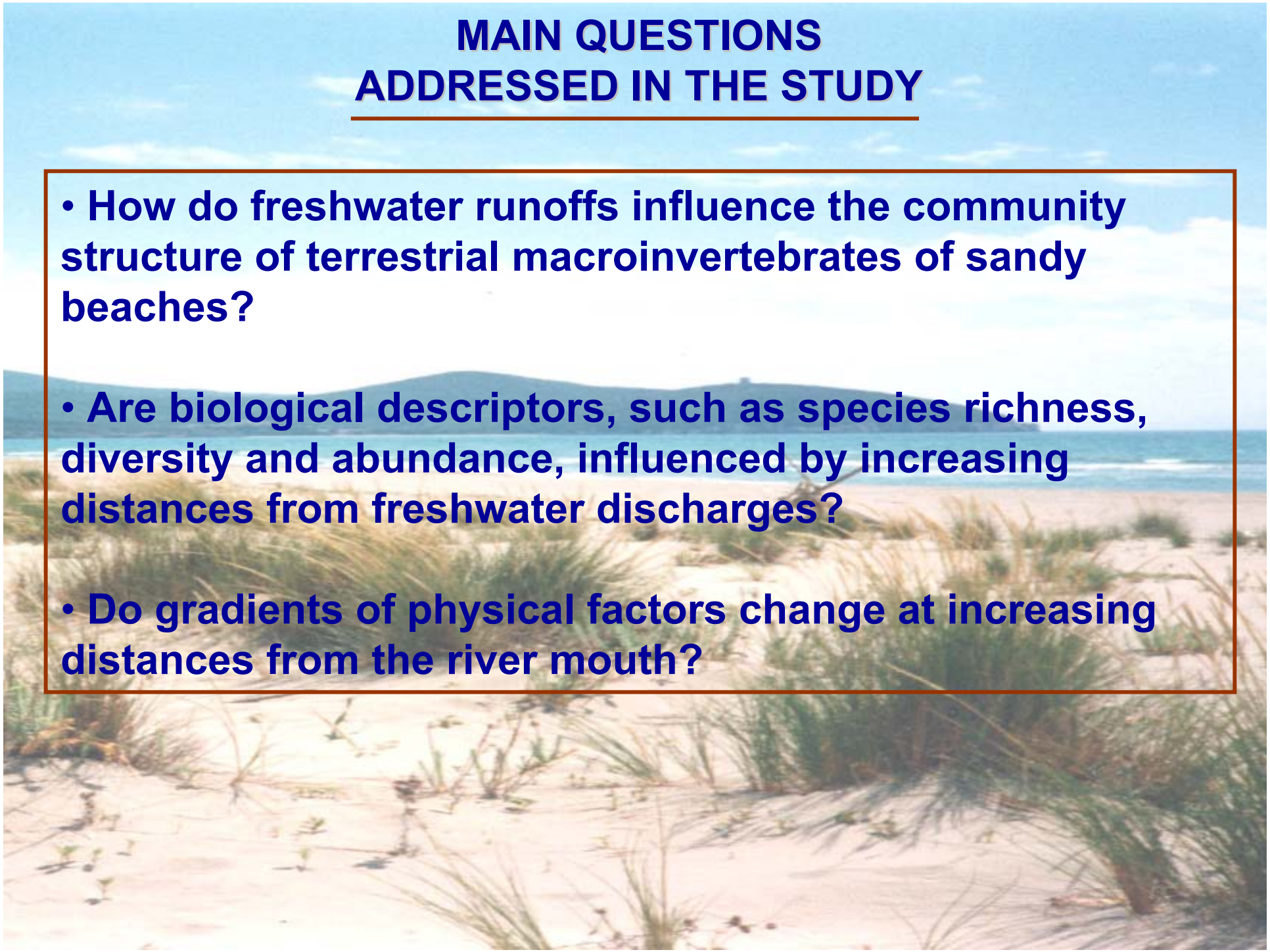
"FROM RIVER CATCHMENT AREAS TO THE SEA: A COMPARATIVE AND INTEGRATED APPROACH TO THE ECOLOGY OF MEDITERRANEAN COASTAL ZONES FOR SUSTAINABLE MANAGEMENT"

BILATERAL PROJECT ITALY – MOROCCO

CNR - CNRST AGREEMENT
2002-2005

Université Mohammed V – Agdal
Institut Scientifique

"SMALL-SCALE SPATIAL DISTRIBUTION OF MACROFAUNA ALONG ATLANTIC AND MEDITERRANEAN SANDY SHORES"



MAIN QUESTIONS ADDRESSED IN THE STUDY

- How do freshwater runoffs influence the community structure of terrestrial macroinvertebrates of sandy beaches?

- Are biological descriptors, such as species richness, diversity and abundance, influenced by increasing distances from freshwater discharges?

- Do gradients of physical factors change at increasing distances from the river mouth?

LOCATION OF SITES

0 1000 km

Criteria for choice of sites

Both beaches were:

- exposed
- intermediate (sensu Short, 1996)
- low quantities of beach-cast material
- similar climatic regimes
- similar fluvial outputs
- small latitudinal differences
- high human impact around river mouths

Main differences were:

- beach stability
- tidal regimes: microtidal vs mesotidal excursions (Italian site tidal range $\leq$ 40 cm; Moroccan site tidal range up to 3.7 m during spring tide).
- sea influence


Italian site


Moroccan site
al-Qanitrah
Mahdiyah
Sidi Bou Knadel
Sidi ech Chafi

Dominant marine currents

ITALIAN SITE: Maremma Regional Park

MOROCCAN SITE: Mehdia beach

ITALY: STATIONS FROM THE RIVER MOUTH

Station 1

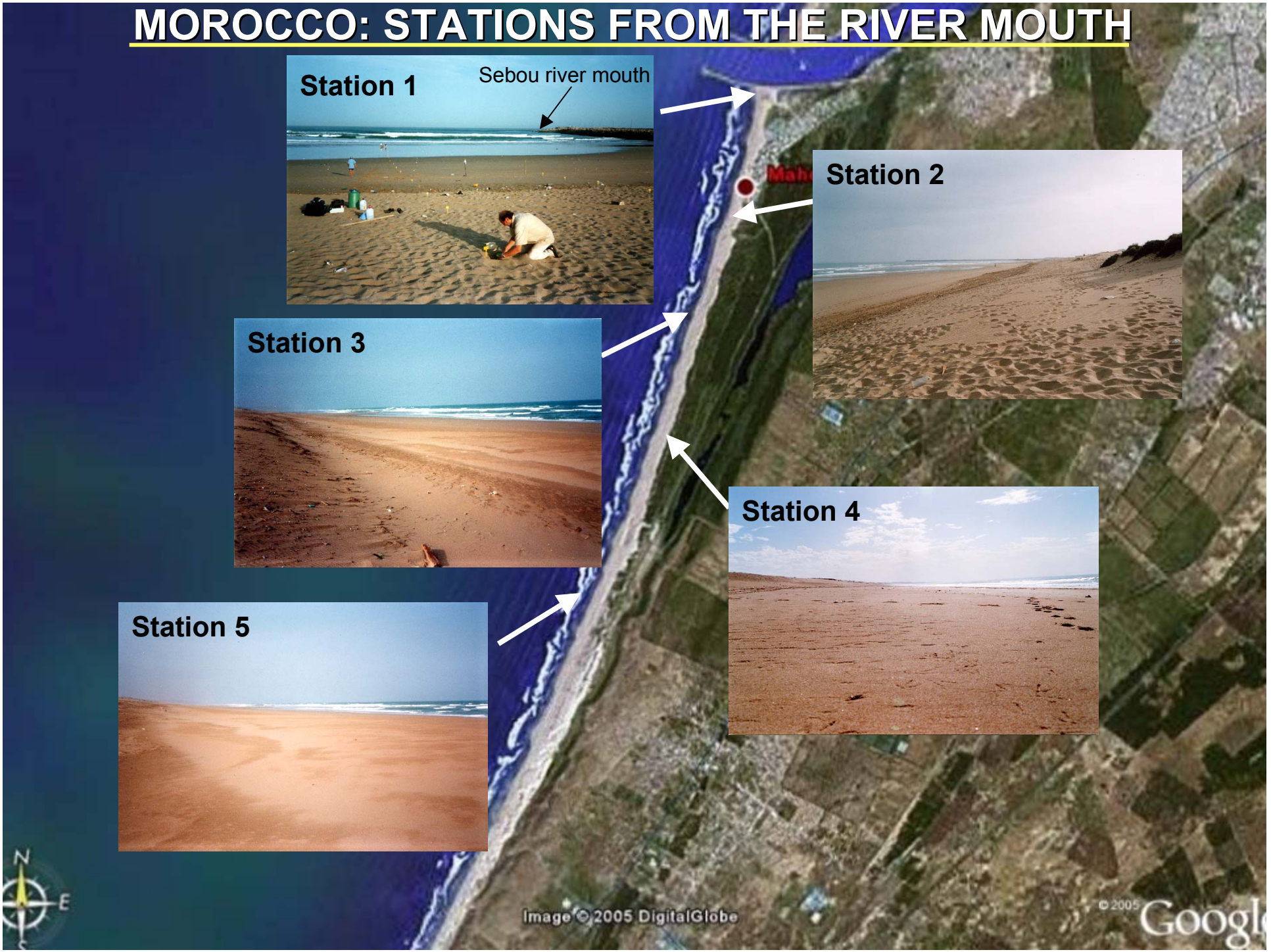
Station 3

Station 4

Station 2

Station 5

MOROCCO: STATIONS FROM THE RIVER MOUTH



SAMPLING METHODS

Arthropod sampling
(Transects with pitfall traps)

Environmental samples

beach slope and width

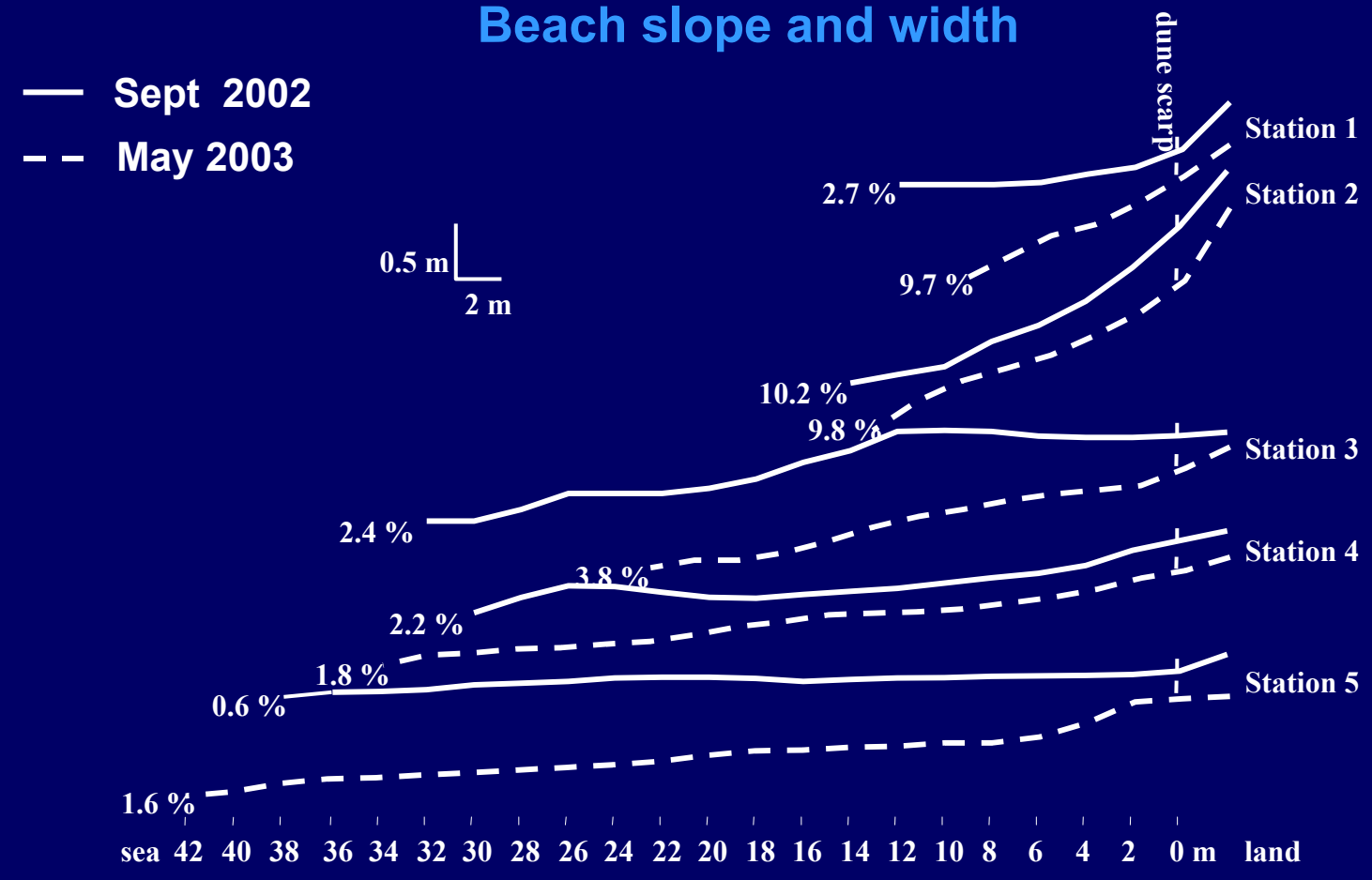
beach penetrability

sand samples
(sand moisture, salinity, pH, total organic matter, grain size)

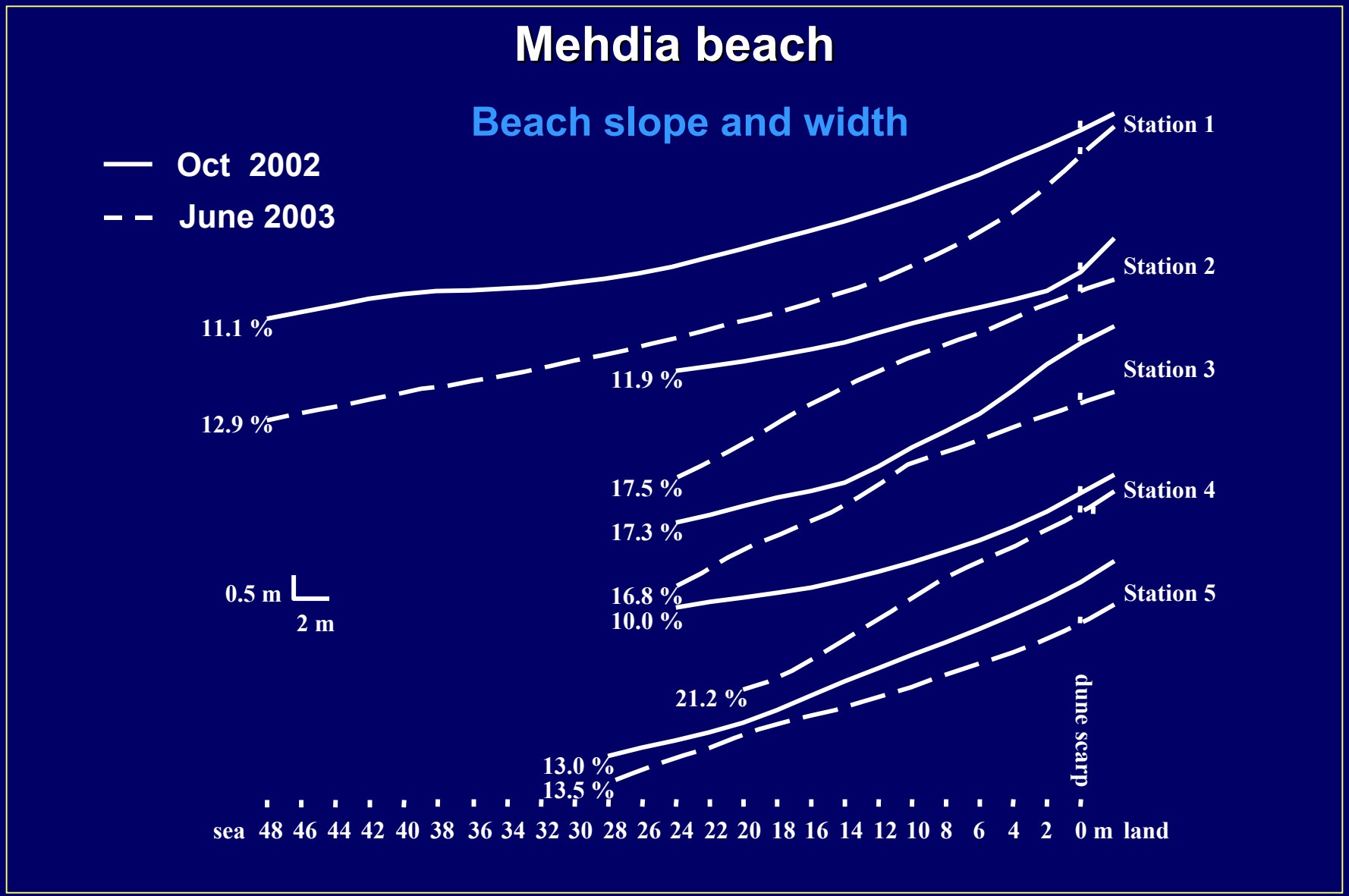
RESULTS

Maremma Regional Park

Beach slope and width



RESULTS


Mehdia beach
Beach slope and width
Oct 2002
June 2003
Station 1
Station 2
Station 3
Station 4
Station 5
11.1 %
12.9 %
11.9 %
17.5 %
17.3 %
16.8 %
10.0 %
21.2 %
13.0 %
13.5 %
0.5 m
2 m
dune scarp
sea 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0 m land

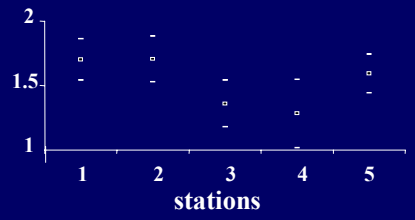
RESULTS

Maremma Regional Park

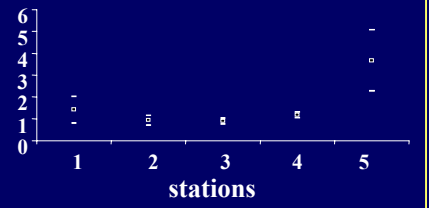
Sand parameters

September 2002

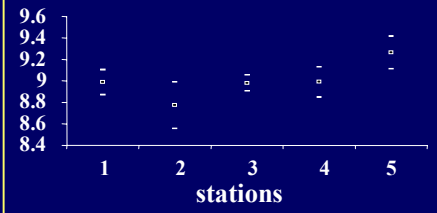
Organic matter (%)



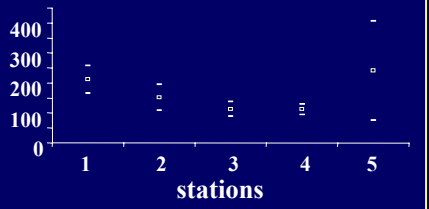
Sand moisture (%)



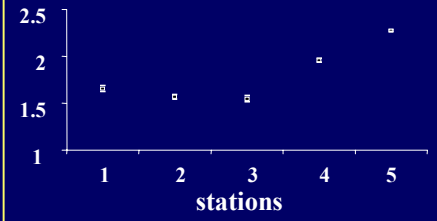
pH



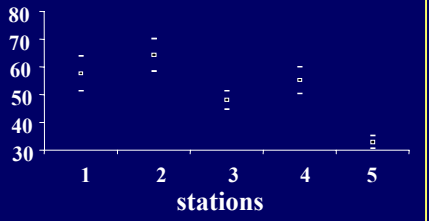
Salinity (µScm^{-1})



Sand size (φ)

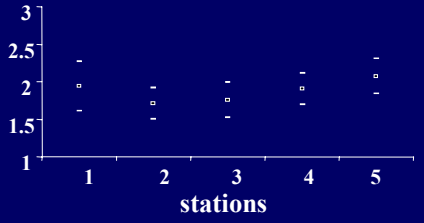


Penetrability (mm)

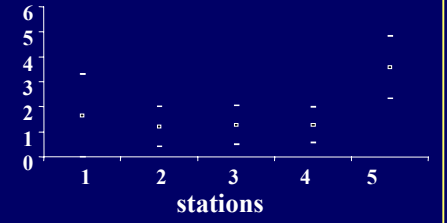


May 2003

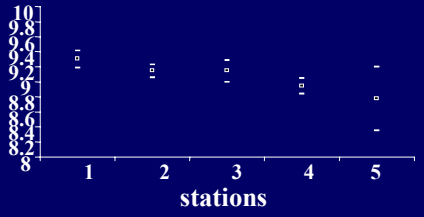
Organic matter (%)



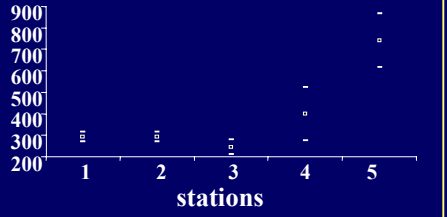
Sand moisture (%)



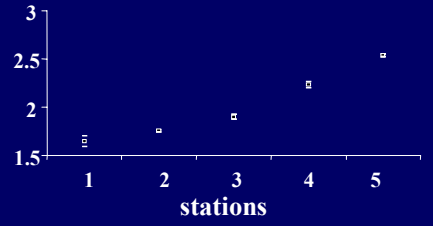
pH



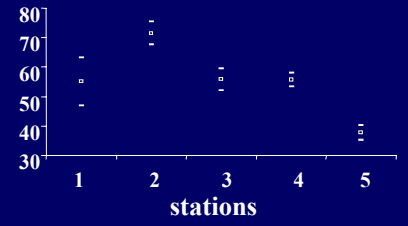
Salinity (µScm^{-1})



Sand size (φ)



Penetrability (mm)

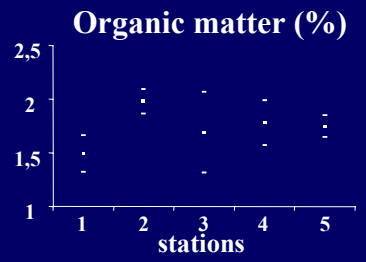


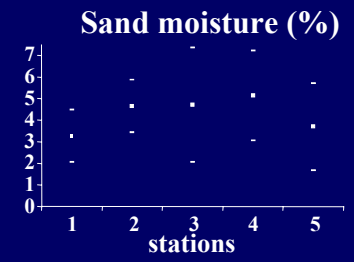
RESULTS

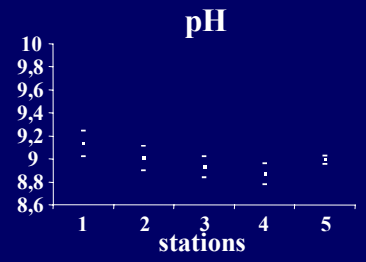
Mehdia beach

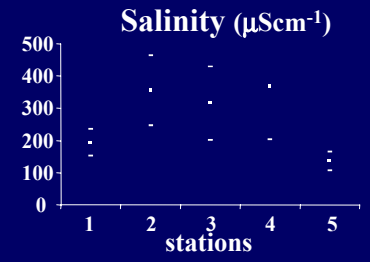
Sand parameters

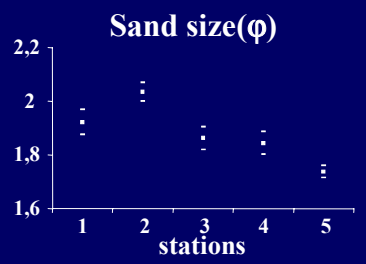
October 2002

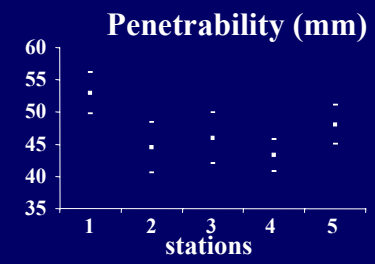




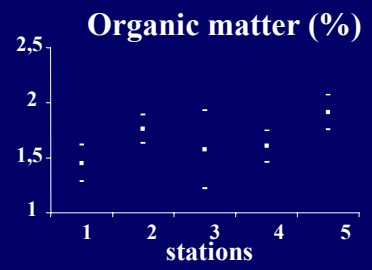


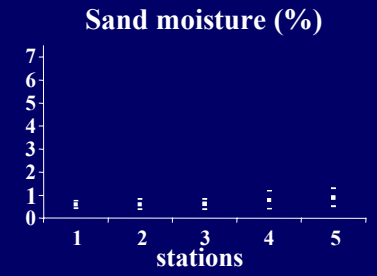


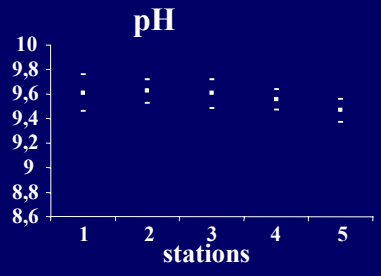


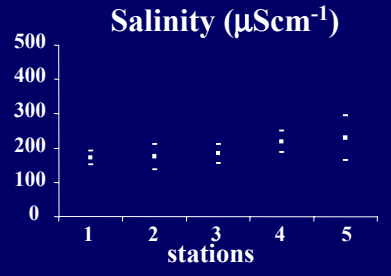


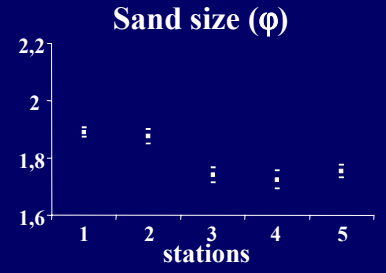
June 2003

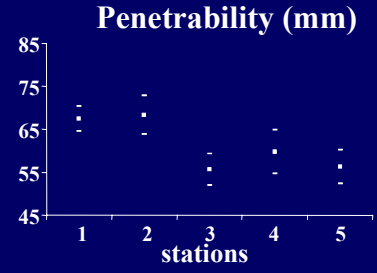






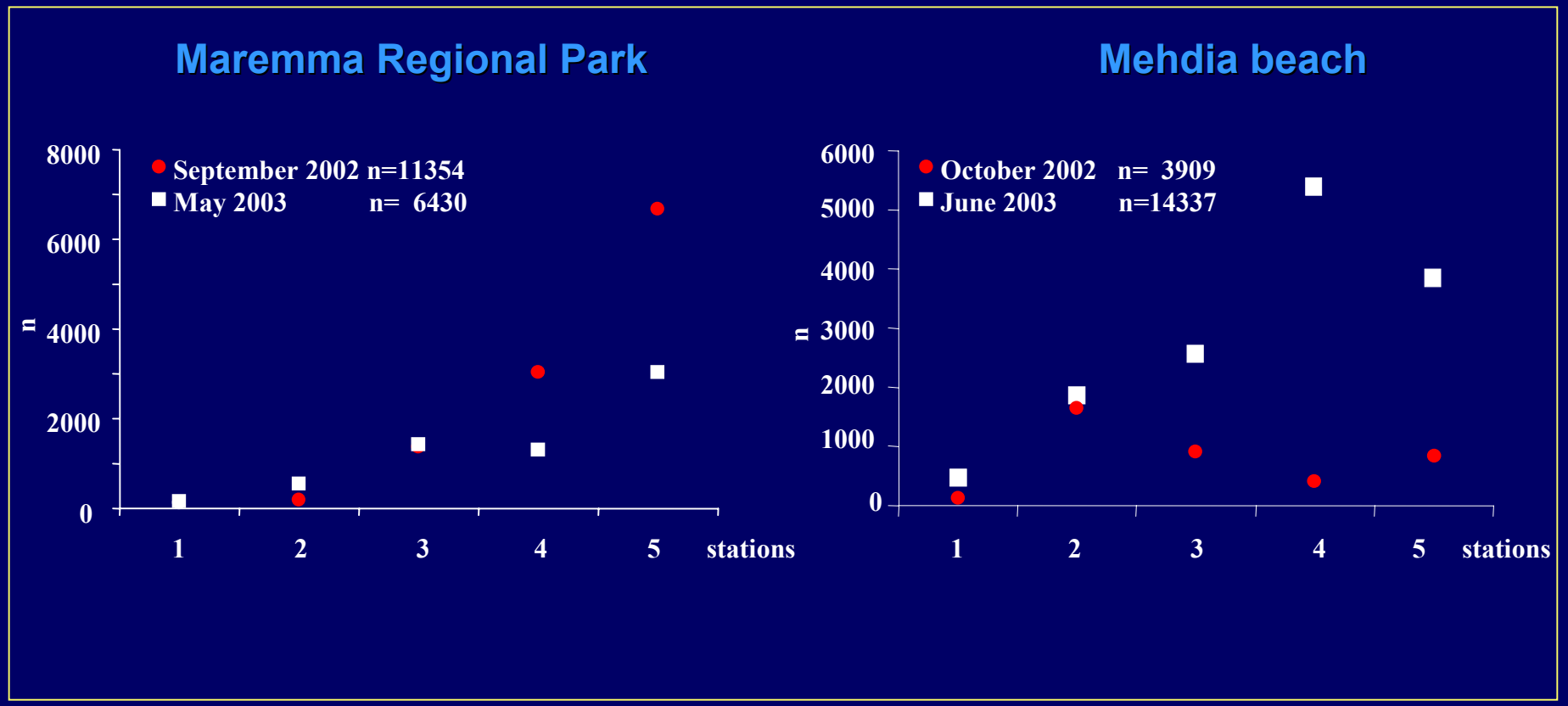






RESULTS

TOTAL CAPTURES



RESULTS

MAIN CAPTURED SPECIES

Maremma Regional Park

	September	May
Tylos europaeus	14.75 %	7.10 %
Talitrus saltator	72.92 %	49.63 %
Phaleria provincialis	9.27 %	25.19 %
Other Coleoptera	0.95 %	5.42 %
	97.89%	87.32 %

Mehdia beach

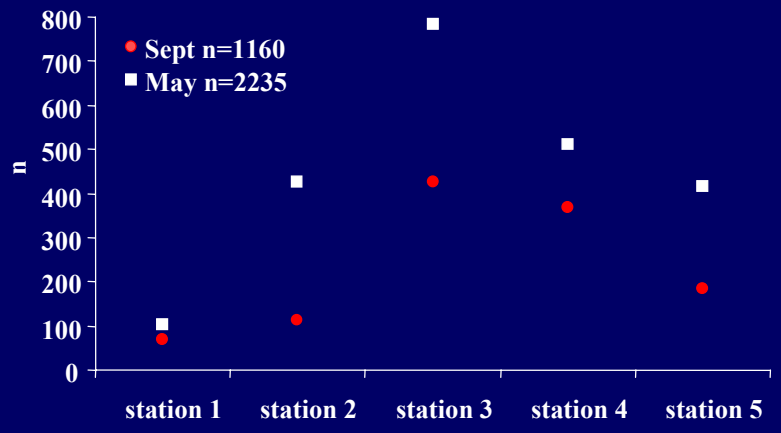
	October	June
Tylos europaeus	56.89 %	24.13 %
Talitrus saltator	22.05 %	58.85%
Talorchestia brito	5.70 %	3.61 %
Talorchestia deshayesii	0.08 %	0 %
Talorchestia spinifera	1.18 %	0.50 %
Talorchestia sp	2.48 %	0.17 %
Phaleria cadaverina	3.40 %	2.23 %
Other Coleoptera	1.59 %	3.69 %
	93.37 %	93.18 %

RESULTS

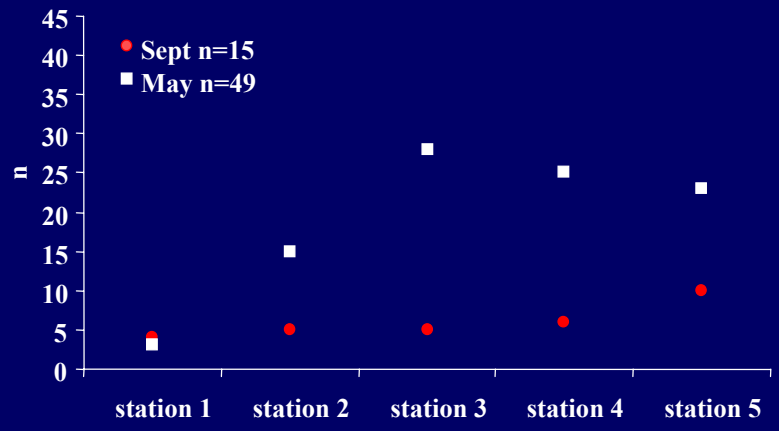
Abundance and species richness of Coleoptera at increasing distance from the river delta

Maremma Regional Park

Abundance n=3395

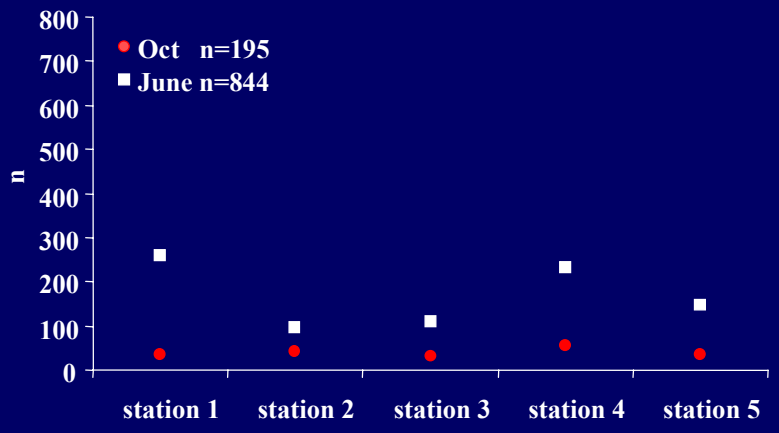


Species Richness n=55

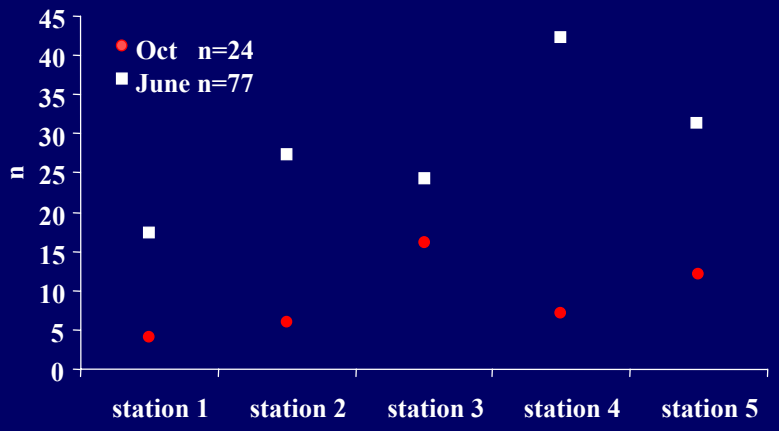


Mehdia beach

Abundance=1039



Species Richness n=94



RESULTS

Diversity indices (Coleoptera)

Maremma Regional Park

	September 2002					May 2003					Total	
Stations	1	2	3	4	5	1	2	3	4	5	Sept	May
α sup. l	1.18	1.31	0.93	1.19	2.68	0.73	3.44	6.02	6.37	5.84	2.72	9.41
α diversity	0.93	1.07	0.8	1.02	2.27	0.58	3.03	5.67	5.51	5.25	2.43	8.85
α inf. l	0.68	0.83	0.66	0.84	1.86	0.43	2.62	5.15	4.65	4.65	2.15	8.03
β diversity	0.11	0.02	0.05	0.02	0.01	0.01	0.12	0.08	0.05	0.03		
Brillouin	0.45	0.41	0.29	0.25	0.83	0.13	0.61	0.96	1.55	1.59	0.44	1.28
Pielou	0.35	0.27	0.18	0.14	0.38	0.12	0.23	0.03	0.05	0.53	0.17	0.34
Simpson	0.76	0.08	0.88	0.09	0.62	0.94	0.74	0.64	0.39	0.32	0.83	0.53

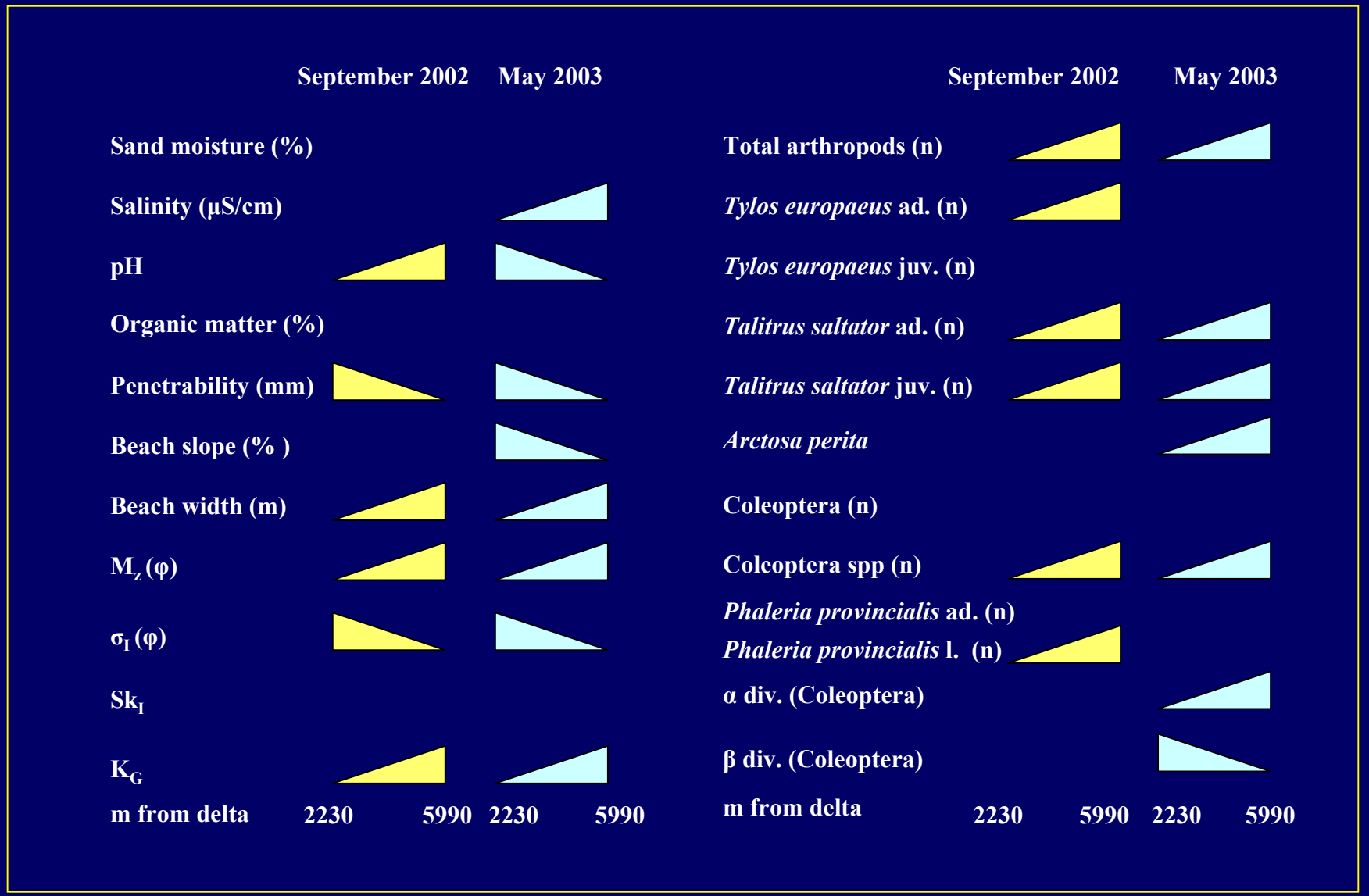
Mehdia beach

	October 2002					June 2003					Total	
Stations	1	2	3	4	5	1	2	3	4	5	Oct	June
α sup. l	1.59	2.47	18.19	2.69	8.23	4.65	14.45	10.99	16.62	13.64	8.15	21.97
α diversity	1.19	1.92	13.93	2.13	6.45	4.09	12.40	9.52	14.96	12.00	7.19	20.61
α inf. l	0.79	1.36	9.67	1.57	4.67	3.52	10.35	8.04	13.30	10.35	6.24	19.25
β diversity	0.02	0.10	0.03	0.002	0.05	0.07	0.11	0.12	0.003	0.06		
Brillouin	0.40	0.65	1.81	0.60	1.66	1.01	2.18	2.30	2.01	2.20	1.38	2.31
Pielou	0.32	0.41	0.84	0.34	0.81	0.37	0.76	0.81	0.59	0.71	0.47	0.56
Simpson	0.77	0.66	0.14	0.70	0.17	0.55	0.14	0.10	0.24	0.16	0.47	0.20

RESULTS

Maremma Regional Park

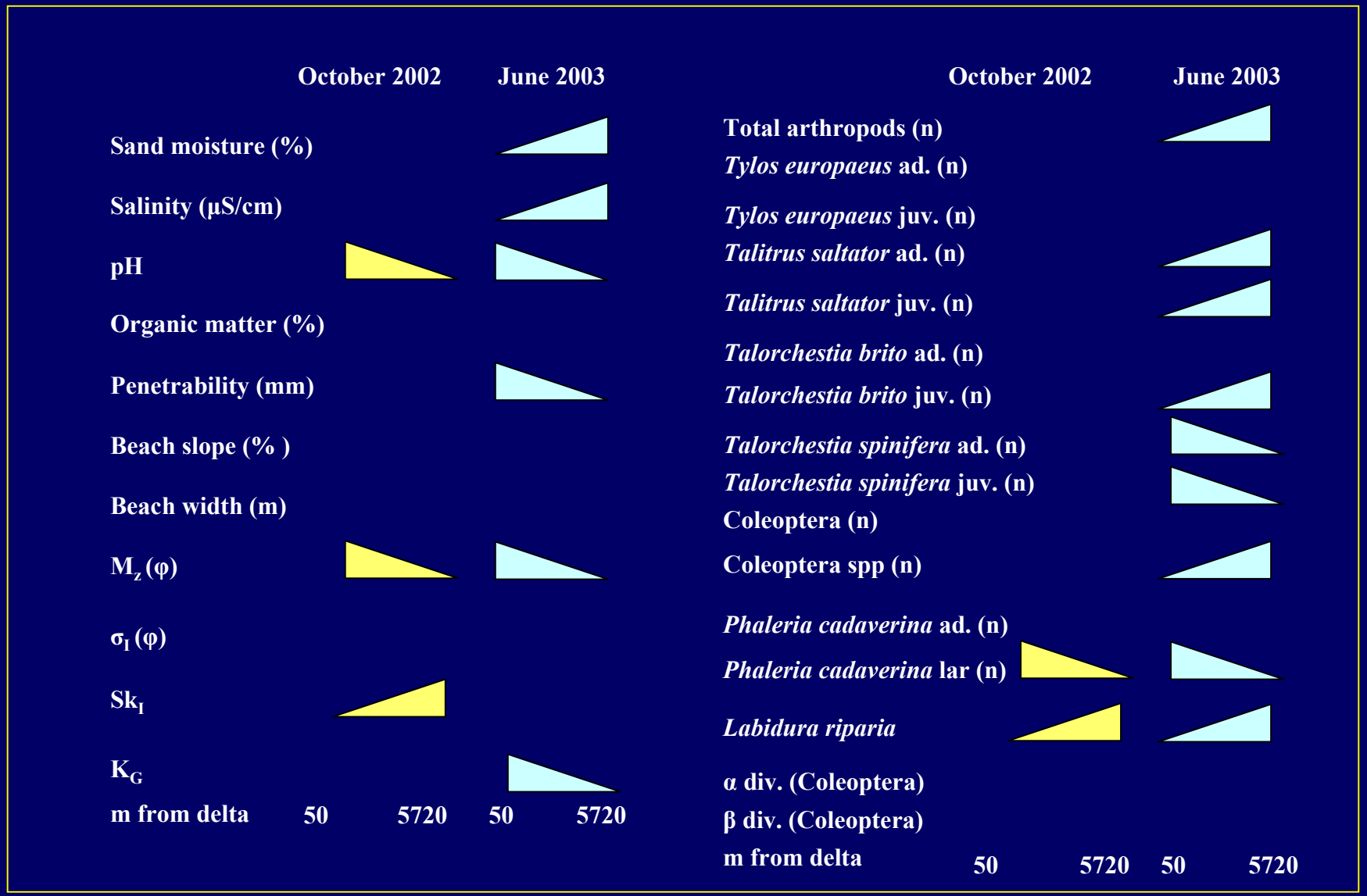
Simple linear regression analysis



RESULTS

Mehdia beach

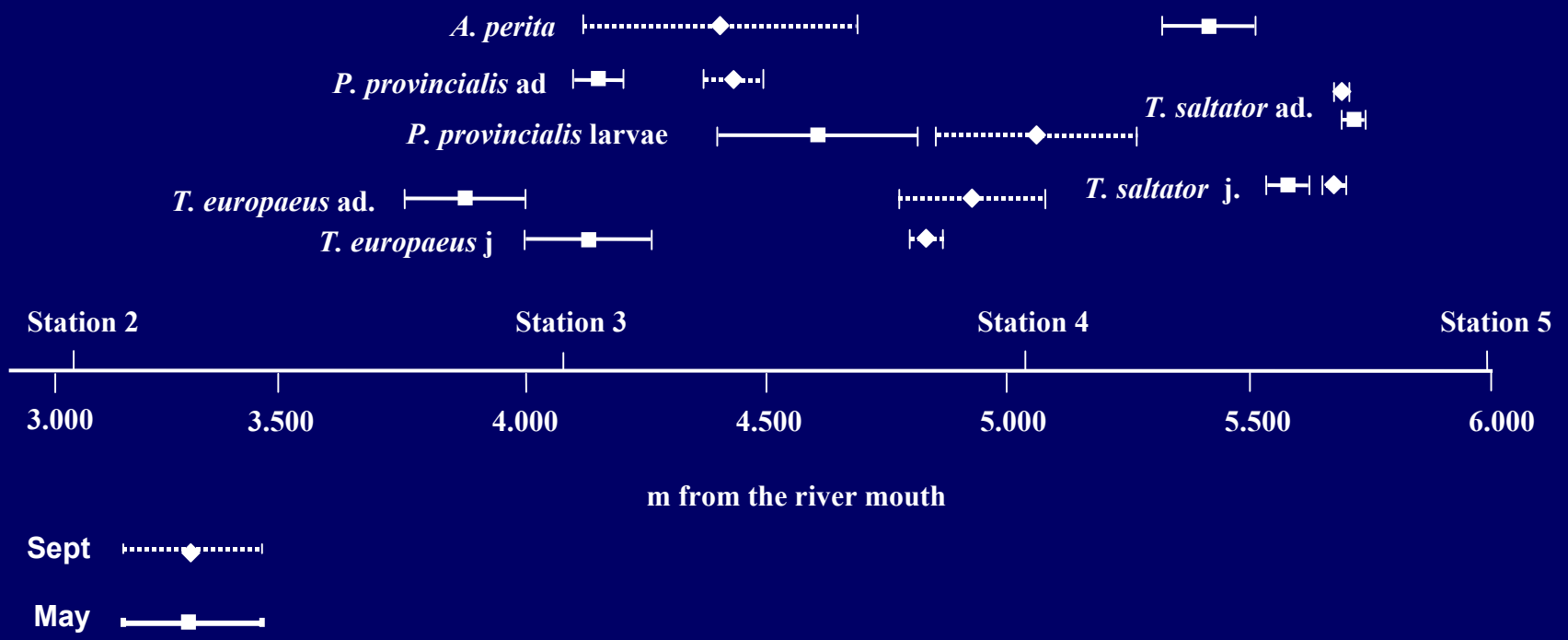
Simple linear regression analysis



RESULTS

Maremma Regional Park

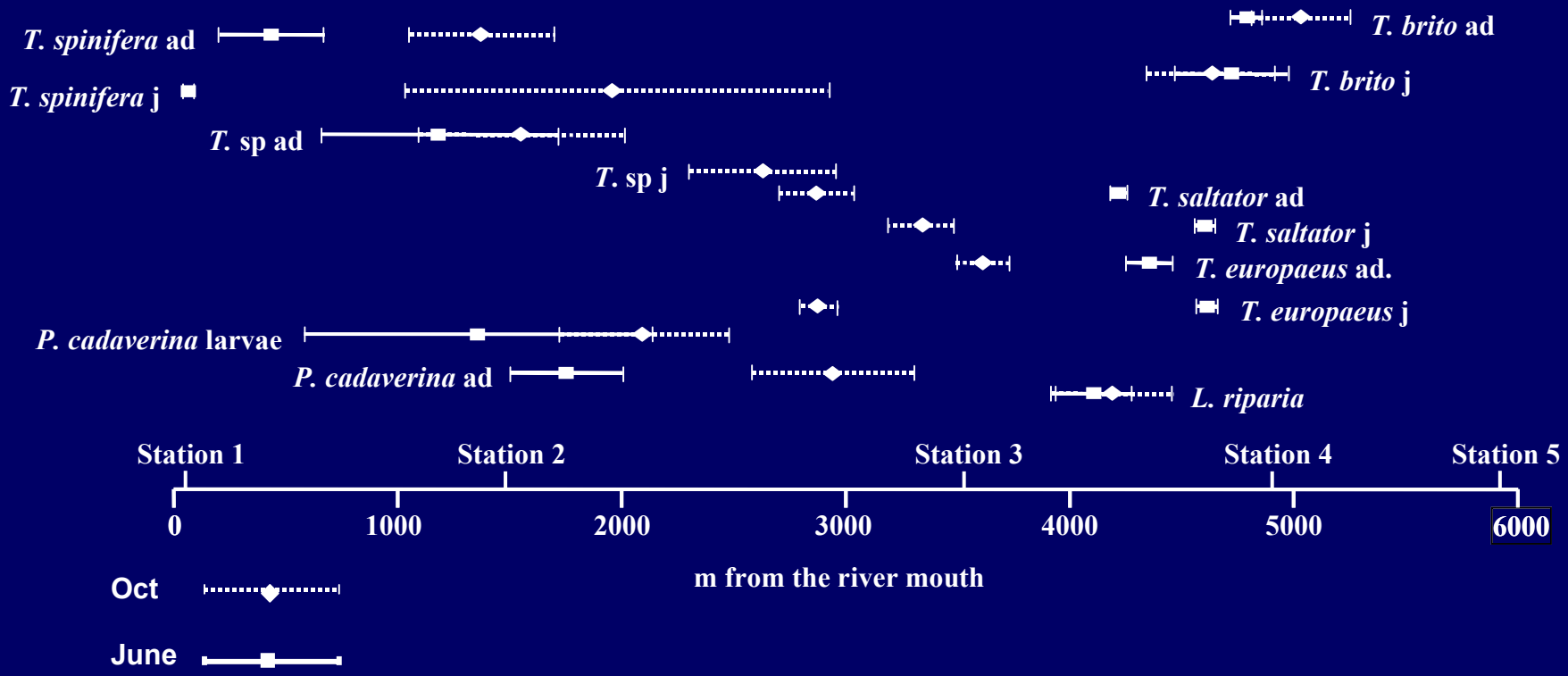
Long-shore distribution of most abundant species



RESULTS

Mehdia beach

Long-shore distribution of most abundant species



RESULTS

Maremma Regional Park

Multiple regression analysis

	moist. (%)		Sal. (µS/cm)		pH		O. mat. (%)		Pen. (mm)		slope (%)		width (m)		M_z (φ)		R^2	
	S	M	S	M	S	M	S	M	S	M	S	M	S	M	S	M	S	M
Total arthropods	+			+					+	–	+		+	+		–	0.992	0.965
T. europaeus ad.	–	+			–	–		+	+	+	–	–	+	–	+		0.989	0.816
T. europaeus j.		+				–		+	+		+	–				–	0.769	0.992
T. saltator ad.	+			+					+		+		+				0.989	0.956
T. saltator j.	+			+						–	+		+	+	+	–	0.993	0.958
Coleoptera						–			+			–	+		–	–	0.969	0.873
Coleoptera spp						–		+	–			–		+		–	0.767	0.987
P. provincialis ad						–			+			–	+		–	–	0.958	0.878
P. provincialis l.				–		–	+	–		–		+	+	+	+	–	0.952	0.997
α div. (Cole.)						–		+	–	+		–	–		+	–	0.874	0.974
ß div. (Cole.)											+			–			0.890	0.444

RESULTS

Mehdia beach

Multiple regression analysis

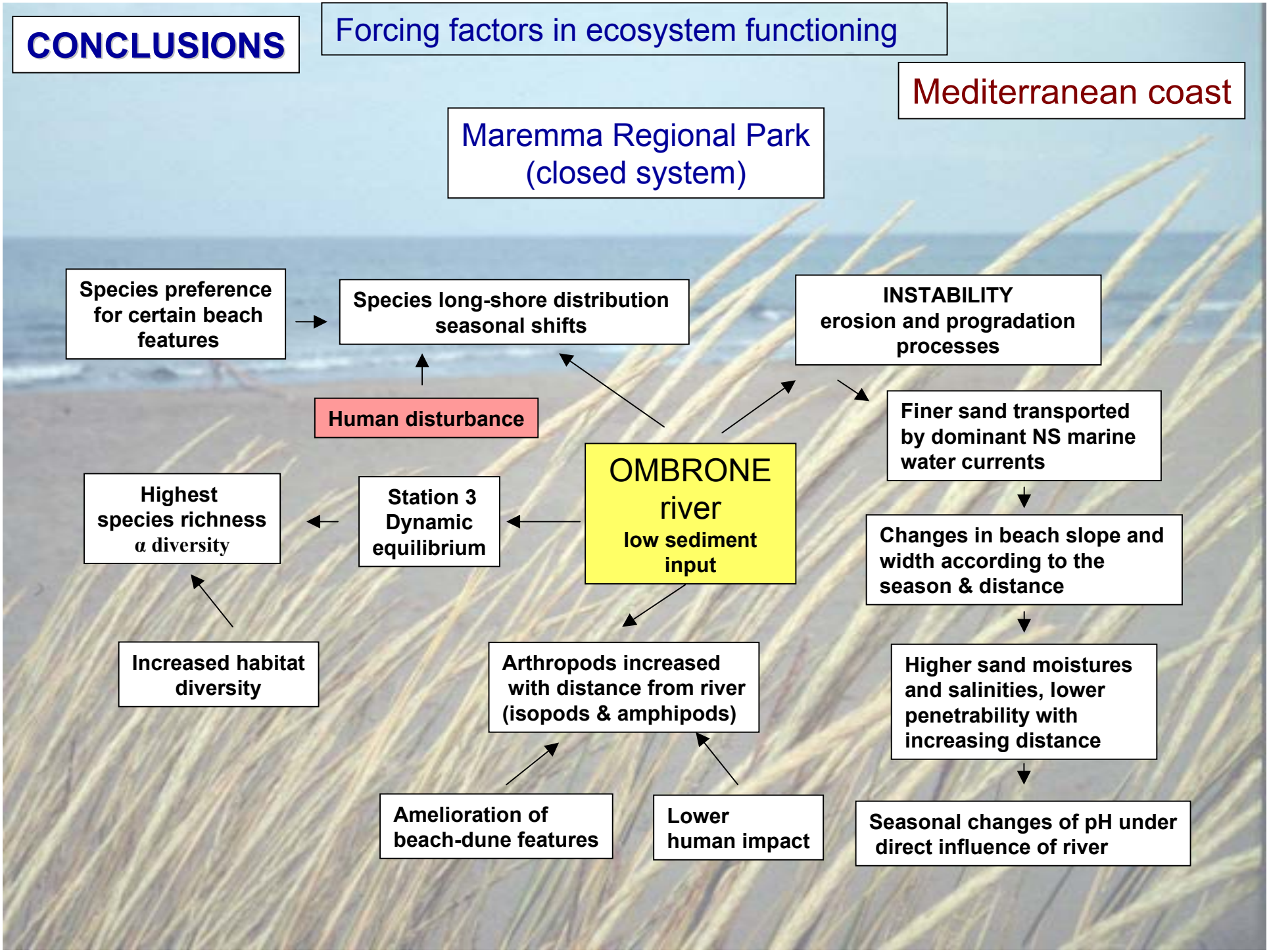
	Moist (%)		Sal. (µS/cm)		pH		O. mat (%)		Pen. (mm)		Slope (%)		width (m)		M_z (φ)		R^2	
	O	J	O	J	O	J	O	J	O	J	O	J	O	J	O	J	O	J
Total arthropods									+				-			-	0.804	0.553
Tylos europaeus ad.		+		-		-						+	-				0.533	0.704
Tylos europaeus juv.					+					+			-			-	0.628	0.693
Talitrus saltator ad.	-												-		+		0.942	0.813
Talitrus saltator juv.							+			-	+			-		-	0.580	0.494
Talorchestia brito ad.					-				+								0.389	
Talorchestia brito juv.									+				-		-	-	0.597	0.326
Talorchestia spinifera ad.															+		0.536	
Talorchestia spinifera juv.		+				+		-		+				+		-		0.987
Talorchestia sp ad.						+						-		-				0.769
Labidura riparia	+	+	-	-	+	-	+		+	-		+			-		0.992	0.958
Coleoptera	+			+	+	+		-		+		-	-		-	-	0.729	0.918
Coleoptera spp										+	+					-	0.834	0.861
Phaleria cadaverina ad.	+	+				+		-		+	-			+			0.750	0.915
Phaleria cadaverina lar.		+										+		+	+	+	0.333	0.770
α diversity (Cole.)		-		+	-	+	-		+	+	+	-	-	-		-	0.939	0.976
ß diversity (Cole.)				-		-			+				-				0.603	0.428

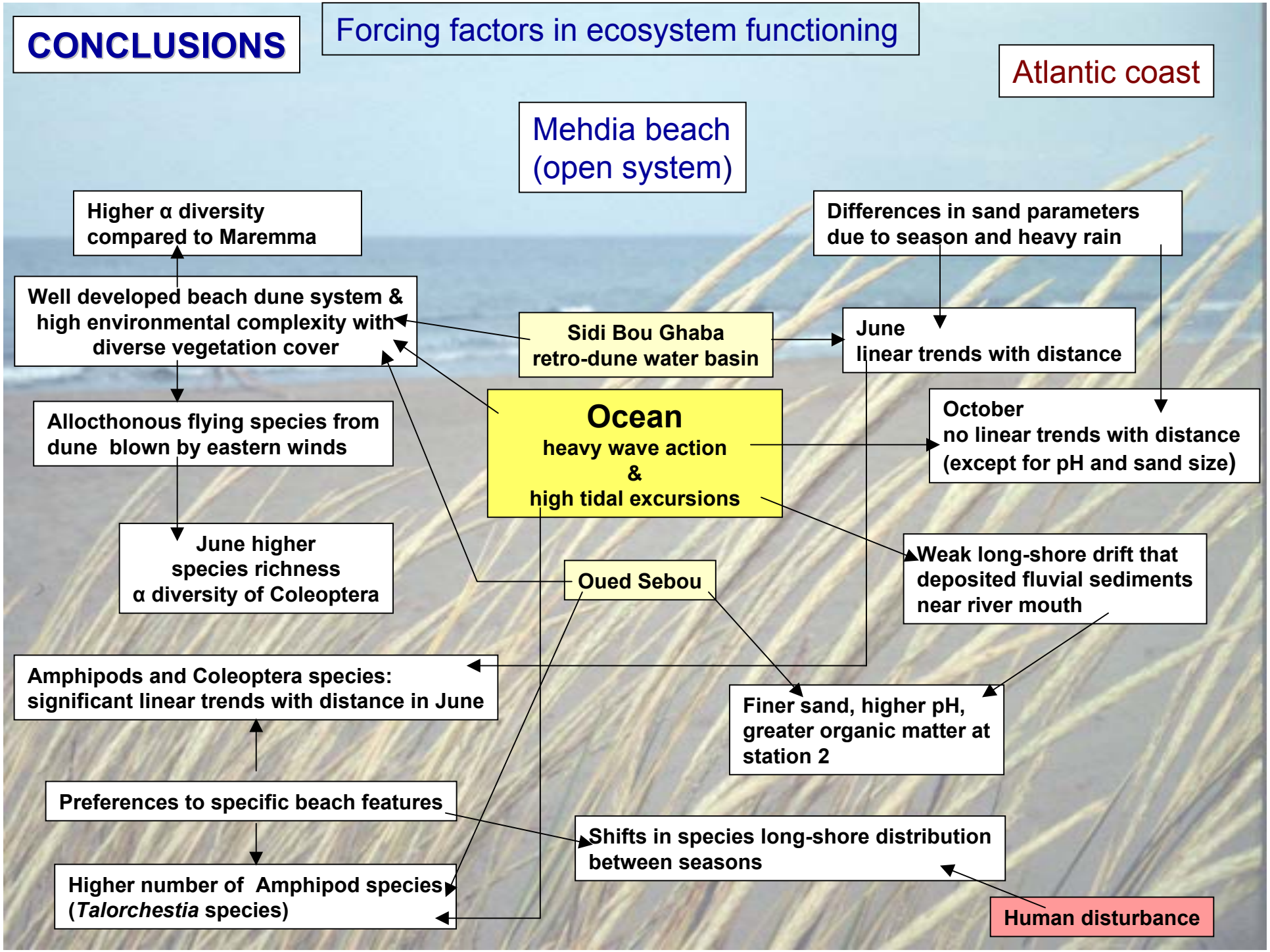
CONCLUSIONS

Forcing factors in ecosystem functioning

Mediterranean coast

Maremma Regional Park (closed system)




CONCLUSIONS
Forcing factors in ecosystem functioning
Atlantic coast
Mehdia beach
(open system)
Higher α diversity
compared to Maremma
Differences in sand parameters
due to season and heavy rain
Well developed beach dune system &
high environmental complexity with
diverse vegetation cover
Sidi Bou Ghaba
retro-dune water basin
June
linear trends with distance
Allocthonous flying species from
dune blown by eastern winds
Ocean
heavy wave action
&
high tidal excursions
October
no linear trends with distance
(except for pH and sand size)
June higher
species richness
α diversity of Coleoptera
Oued Sebou
Weak long-shore drift that
deposited fluvial sediments
near river mouth
Amphipods and Coleoptera species:
significant linear trends with distance in June
Finer sand, higher pH,
greater organic matter at
station 2
Preferences to specific beach features
Shifts in species long-shore distribution
between seasons
Higher number of Amphipod species
(*Talorchestia* species)
Human disturbance


THANK YOU