

THE ROLE OF INTEGRATED WATER RESOURCES MANAGEMENT IN THE RESTORATION OF MEDITERRANEAN TEMPORARY STREAMS IN THE COSTA BRAVA, CATALONIA, NE SPAIN

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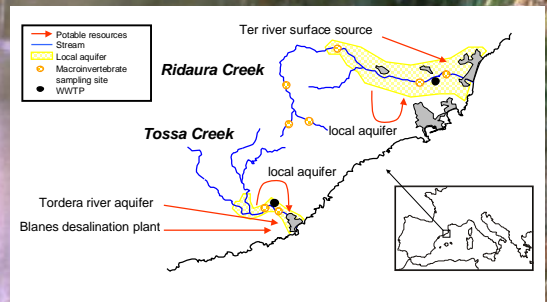
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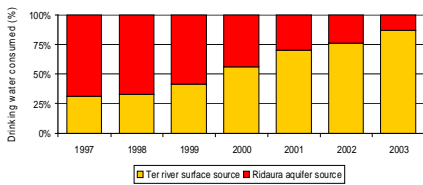
The Costa Brava is the most important touristic destination in north-east Catalonia (resident population, 150,000 inhabitants; maximum estimated occupation, 1,100,000 inhabitants). The urbanistic development of the area, related to touristic activities, began in the decade of 1960, transforming the traditional primary economy into a tertiary economy. Until the decade of 1990, the sole sources of drinking water were the local aquifers, and, as a consequence, the mediterranean kind of streams of the area remained dry throughout most of the year. Changes in the management of resources have led to a certain improvement in the ecological quality of the mediterranean streams in the Costa Brava.



Improvements in the Ridaura Creek basin

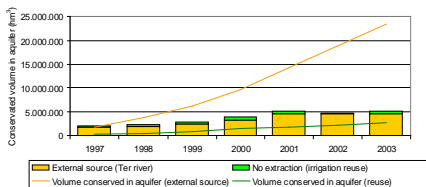
a) Increased use of external water sources

Period	Example year	Ridaura aquifer, %	External sources (Ter river), %
Until 1993	1990	100	0
1993-2000	1997	75	25
From 2001	2004	20	80



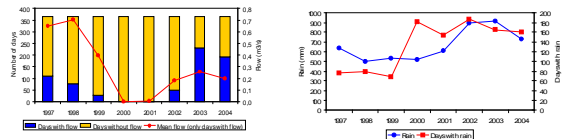
® saving of scarce local water resources

b) Reuse as another tool for groundwater conservation



® saving of scarce local water resources

c) Saving of local water resources



® recovery of flow during wet season

d) For total recovery of the water quality between the WWTP and the sea, it is still necessary to improve nutrient removal in treated wastewater. Restoration of riparian vegetation also needed.

Averages of seasonal sampling since 2004 (N=2 for each season except autumn 2005, not yet sampled)

Parameter	Winter	Spring	Summer	Autumn
Conductivity, mS/cm	0.357	0.483	0.295	0.247
Dissolved oxygen, mg/L	11.1	9.0	7.5	10.6
Total nitrogen, mg/L	<1	<0.3	ND	ND
Ammonia, mg/L	<0.3	<0.3	ND	ND
Nitrate, mg/L	<0.01	<0.01	ND	ND
Total phosphorus, mg/L	<0	2.0	ND	ND
BMWP	203	198	60	94
Category BMWP	I	I	II	I
ASPT	5.5	5.7	5.1	6.7
Taxa number	37	32	12	20
Conductivity, mS/cm	0.455	0.481	0.295	0.544
Dissolved oxygen, mg/L	11.5	9.4	7.5	10.9
Total nitrogen, mg/L	6.8	0.8	ND	ND
Ammonia, mg/L	<0.3	<0.3	ND	ND
Nitrate, mg/L	5.3	9.7	ND	0.4
Total phosphorus, mg/L	1.1	18	4.6	5.5
BMWP	142	162	70	70
Category BMWP	I	I	II	II
ASPT	4.3	4.4	5.2	5.2
Taxa number	33	37	16	16
Conductivity, mS/cm	0.838	0.843	1.542	1.061
Dissolved oxygen, mg/L	6.5	6.3	4.4	8.7
Total nitrogen, mg/L	6.9	23.3	38.1	11.1
Ammonia, mg/L	<6.2	1.2	30.0	6.2
Nitrate, mg/L	3.6	3.3	4.2	3.5
Total phosphorus, mg/L	2.0	<2.7	2.7	7.0
BMWP	93	78	31	93
Category BMWP	II	II	III	II
ASPT	3.6	3.4	2.6	4.7
Taxa number	26	23	12	20

ND: No data available



Improvements in the Tossa Creek basin

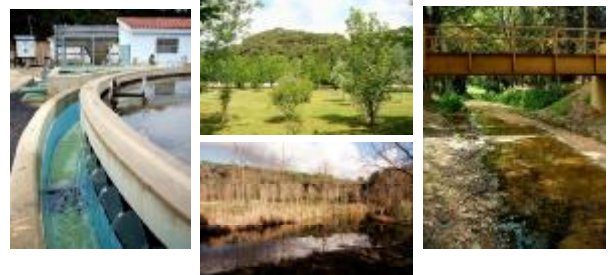
a) Increased use of external water sources

Period	Example year	Tossa aquifer, %	Tordera aquifer, %	Blanes desalination plant, %
Until 1980	1975	100	0	0
1980-2003	1990	20	80	0
From 2003	2004	20	52	28



® saving of scarce local water resources

b) Active reuse, after advanced wastewater treatment, for environmental enhancement. Transformation of a rubbish tip into an urban park irrigated with reclaimed wastewater. Infiltration from an ornamental, man-made pond maintains a small flow in the stream even in the peak of summer, when the rest of the creek dries out.



® recovery of flow all year round downstream of the pond

c) High quality of the water in the stream all year round, even after the recharge point.

Seasonal averages of data available since 2003, calculated from monthly values for physico-chemical parameters and seasonal values for biological parameters

Stretch	Parameter	Winter	Spring	Summer	Autumn
Before urban park (no influence of reclaimed wastewater)	Conductivity, mS/cm	0.408	0.358	0.435	0.435
	Dissolved oxygen, mg/L	10.4	8.4	8.8	8.8
	Total nitrogen, mg/L	<3.2	<3.9	<4.2	<4.2
	Ammonia, mg/L	<1.0	<1.2	<2.1	<2.1
	Nitrate, mg/L	1.6	1.8	1.9	1.9
	Total phosphorus, mg/L	0.7	<0.5	0.8	0.8
	Category BMWP	97	114	31	31
	ASPT	4.7	5.2	3.1	3.1
	Number of taxa	21	23	10	10
	After urban park (soil-filtered reclaimed water)	Conductivity, mS/cm	0.426	0.388	0.581
Dissolved oxygen, mg/L		10.6	9.0	8.3	10.9
Total nitrogen, mg/L		<3.2	<4.2	<4.2	<3.7
Ammonia, mg/L		<1.2	<1.3	<0.8	<1.7
Nitrate, mg/L		1.6	1.5	2.0	1.8
Total phosphorus, mg/L		0.9	<0.5	0.7	0.7
Category BMWP		108	121	85	55
ASPT		5.1	5.2	3.5	4.4
Number of taxa		21	24	24	13



d) Restoration of riparian vegetation

