UNIVERSIDAD POLITECNICA DE VALENCIA

Instituto de Ingeniería del Agua y Medio Ambiente

WORKSHOP
Summer School:
Advances in Ecohydrology
Palermo, 2010

Evaluation of direct and indirect anthropic effects over riparian vegetation zonation in several stretches of Mediterranean rivers in Spain

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    4.1. Flow regulation scenarios
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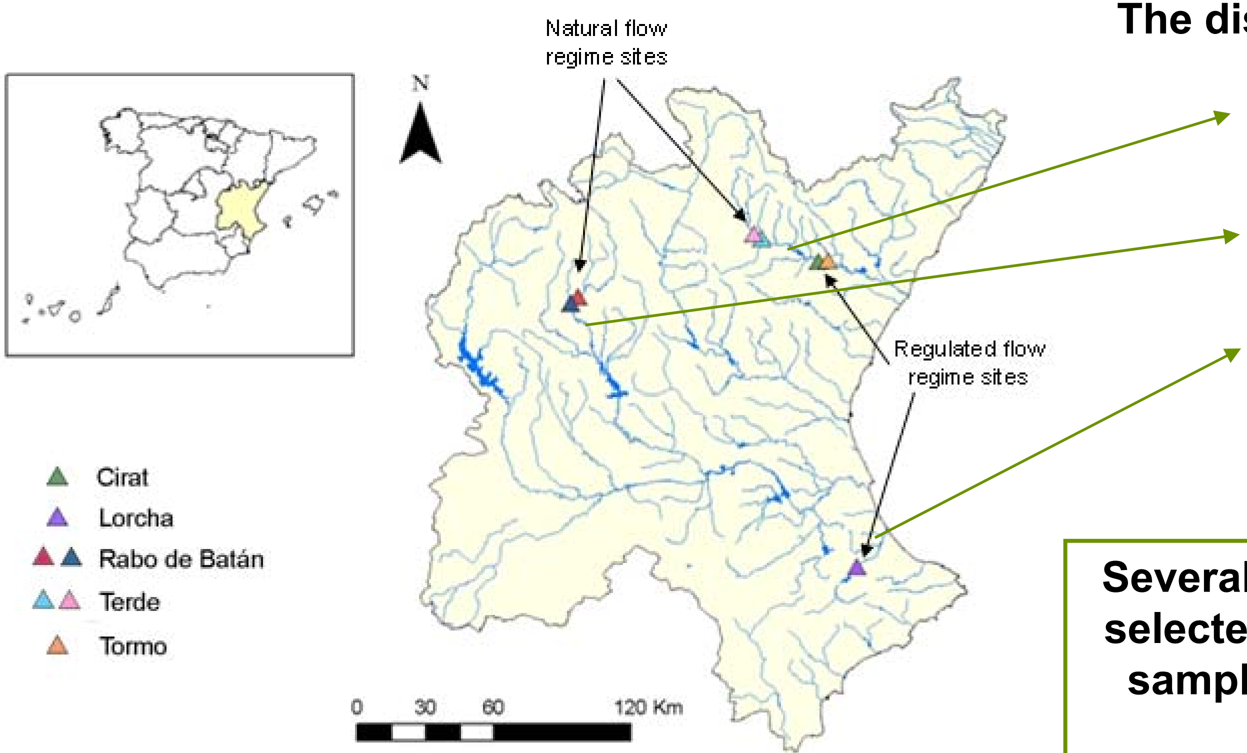
The Júcar River Basin District



The district system includes:

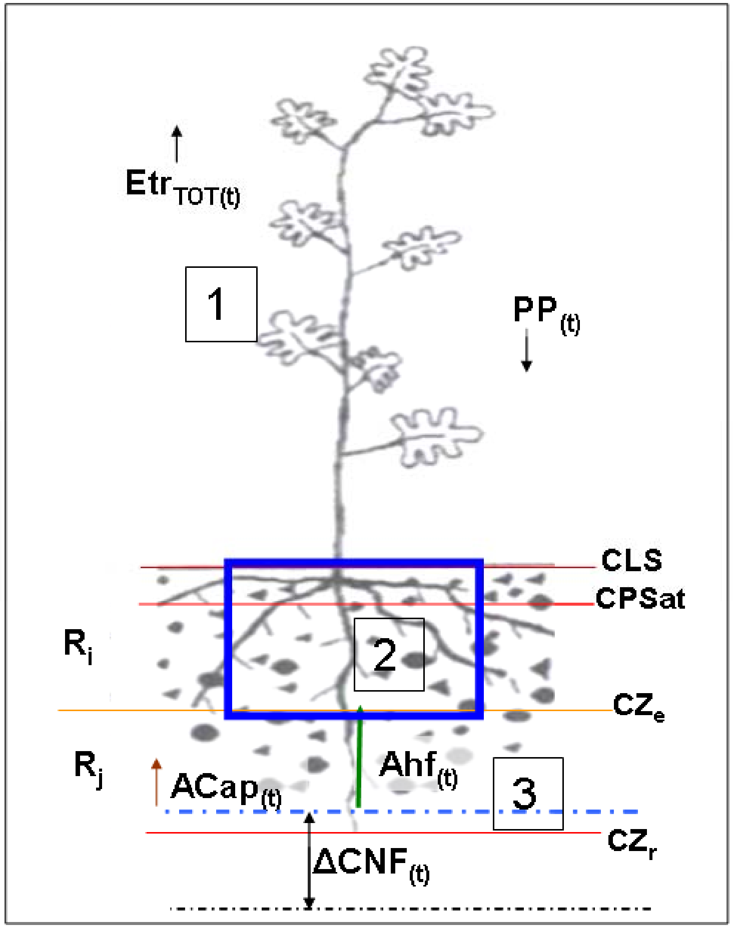
- **Mijares river**
- **Cabriel river**
- **Serpis river**

Several stretches have been selected as a representative sample of the River Basin District

The RibAV model

Elements:

1. **Vegetation**
2. **Static tank-unsaturated zone**
3. **Saturated zone**



Inputs (time series):

PP(t): Precipitation

ETo(t): Potential ET

Q(t): River daily discharges

Morales and Francés, Proceed. Internat. Conf. Sci. Inf. Tech. Sust. Manag. Aq. Ecosyst. 2009

The RibAV model

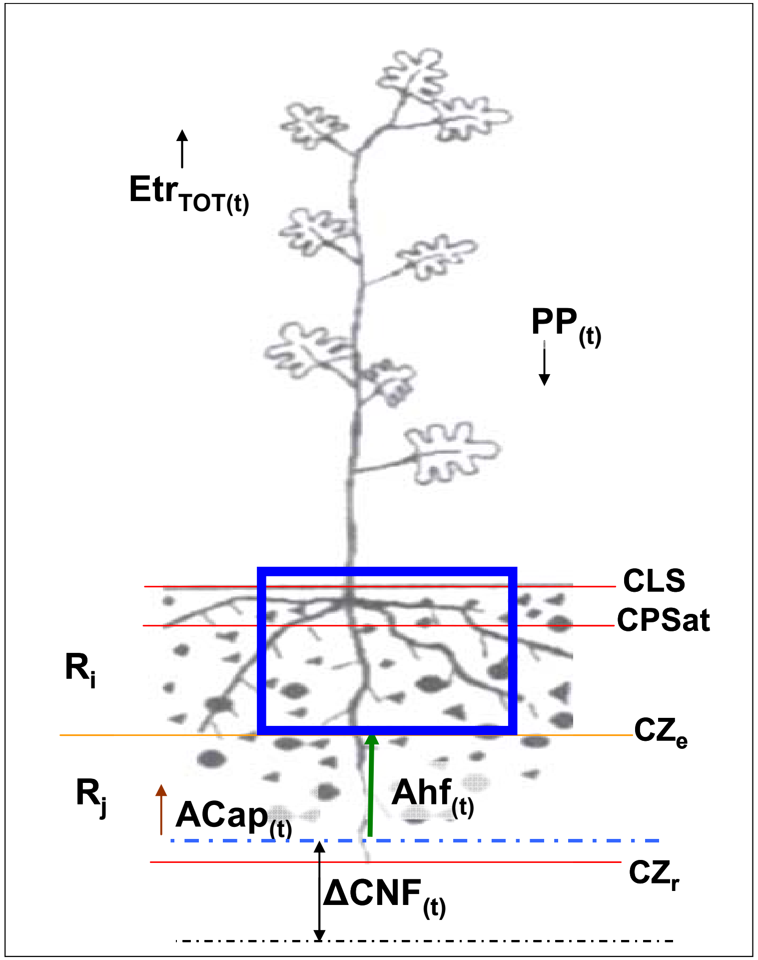
Processes:

→ **Tank Water Excess (Runoff +percolation)**

→ **Transpiration:**
- **Saturated Soil**
- **Non saturated Soil**
- **Plant drowning (then ET=0)**

→ **Acap(t): Soil capillary rise**

→ **Ahf(t):Root hydraulic lift**



Morales and Francés, Proceed. Internat. Conf. Sci. Inf. Tech. Sust. Manag. Aq. Ecosyst. 2009

The RibAV model calibration

- **The most relevant model parameters are:**
  - **Zr:** maximum root depth (m)
  - **Ze:** effective root depth (m)
  - **Zsat:** saturation extinction depth (m)
  - **Rj:** transpiration factor from the saturated zone ()
  - **Ri:** transpiration factor from the unsaturated zone ()
- **The model has been calibrated and validated using as objective function a confusion matrix:**

The confusion matrix compares the observed and the simulated riparian vegetation zonation

		SIMULADOS								Total	
		RH	RJ	RA	TV	RH+RJ	RH+RA	RJ+RA	RA+TV		
OBSERVADOS	RH					-	-	-	-		
	RJ					-	-	-	-		
	RA					-	-	-	-		
	TV					-	-	-	-		
	RH+RJ						-	-	-		
	RH+RA					-		-	-		
	RJ+RA					-	-		-		
	RA+TV					-	-	-			
	Total unicas										Tot obs
	Total todas										Tot sim

Group A Group B Group C

- **The Cohen's *k* test (Cohen, 1960) → *k*, coefficient of agreement for nominal variables**

Calibration in Lorcha

- Stretch: **Lorcha** (Serpis River)
- All vegetation functional types observed in field
- 431 simulation points
- 36 simulations required

BALANCE	Simulados	Observados	% Aciertos
RH	25	70	35.71%
RJ	2	5	40.00%
RA	17	18	94.44%
TV	110	125	88.00%
RH+RJ	8	20	40.00%
RH+RA	12	17	70.59%
RJ+RA	31	84	36.90%
RA+TV	92	92	100.00%

		SIMULATED									
		RH	RJ	RA	TV	RH+RJ	RH+RA	RJ+RA	RA+TV	Total	
OBSERVED	RH	25	3	39	3	-	-	-	-	70	
	RJ	0	2	1	2	-	-	-	-	5	
	RA	0	0	17	1	-	-	-	-	18	
	TV	0	0	15	110	-	-	-	-	125	
	RH+RJ	3	5	5	7	8	-	-	-	20	
	RH+RA	0	1	12	4	-	12	-	-	17	
	RJ+RA	2	2	29	51	-	-	31	-	84	
	RA+TV	0	0	51	41	-	-	-	92	92	
	Total singles	25	5	72	116	8	12	31	92	431	Tot obs
	TOTAL	30	13	169	219					431	Tot sim

2. Calibration

Default Vegetation Parameters

Parameter		Zr	Ze	Zsat	Ri	Rj	Cov	CRT	Pwp	Pcrit
		Maximum Root Depth [m]	Effective Root Depth [m]	Extinction at Saturation [m]	Transpiration Factor from Unsaturated Zone [ ]	Transpiration Factor from Saturated Zone [ ]	Vegetation density [ ]	Maximum Soil-Root Water Conductance [mm/Mpa/h]	Wilting Point Matrix Potencial [Kpa]	Critical matrix potential [Kpa]
Riparian Herbs	RH	0.8	0.7	-0.75	0.8	0.6	1	0.97	1500	500
Riparian Juveniles and small Schrubs	RJ	1.25	0.9	-0.1	0.9	0.35	0.8	0.97	1500	500
Riparian adults Trees and Schrubs	RA	3.5	0.9	-0.3	0.9	0.35	1	0.97	1500	250
Terrestrial Vegetation	TV	2	1.9	0.3	1	0	1	0.97	1500	95

- $k = 0.81 \pm 0.10$

$0.40 < k < 0.60$	ACCEPTABLE
$0.60 < k < 0.80$	GOOD
$0.80 < k < 1.00$	EXCELLENT

3. Validation

Validation in natural flow regime

Stretch - River	Matching cases percentage		*k*	Stretch features
	RIPARIAN	TERRESTIAL		
Rabo del Batán – Cabriel	93.04 %	20.69 %	0.69 ± 0.13	Forest stretch, natural flow
Terde – Mijares	89.15 %	70.83 %	0.69 ± 0.13	Forest stretch, natural flow

Validation in disturbed flow regime

Stretch - River	Matching cases percentage		*k*	Stretch features
	RIPARIAN	TERRESTIAL		
Cirat – Mijares	29.41 %	Not observed	0.01 ± 0.40	Agricultural, regulated flow
Tormo – Mijares	75.67 %	Not observed	0.40 ± 0.45	Forest stretch, regulated flow

Versatility of the model

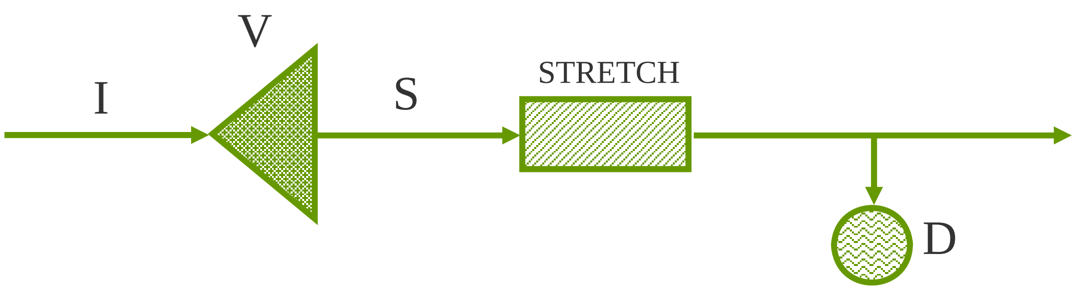
- Agricultural influence introduces high uncertainty in flow data
- The number of simulation points must be high to obtain a representative k value
- The k value should be interpreted with caution if there is absence of any vegetation functional types

Stretch - River	Matching cases percentage		*k*
	RIPARIAN	TERRESTIAL	
Combination	86.50 %	56.44 %	0.74 ± 0.07

Flow regulation scenarios

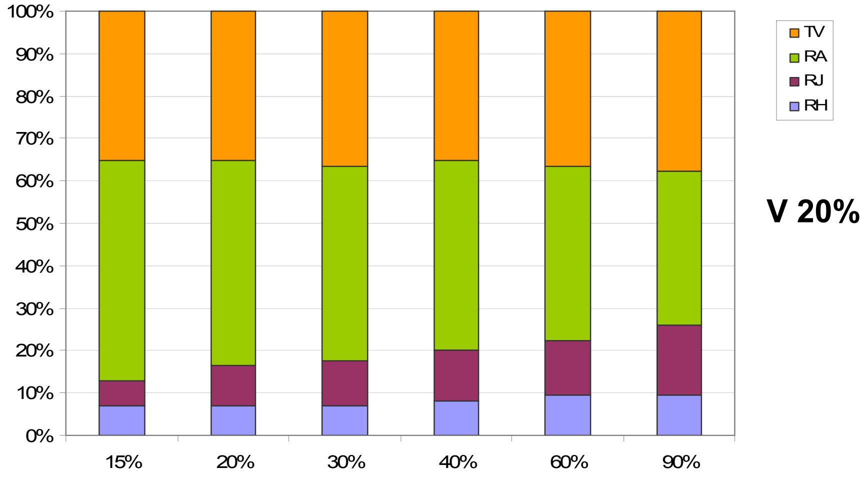
Hydrological data series of Terde were modified in order to obtain several flow regulation scenarios:

- Dam regulation by a reservoir 20%, 40%, 60%, 80% and 100% of the annual flow
- Agricultural, urban and hydroelectric demands without consumption

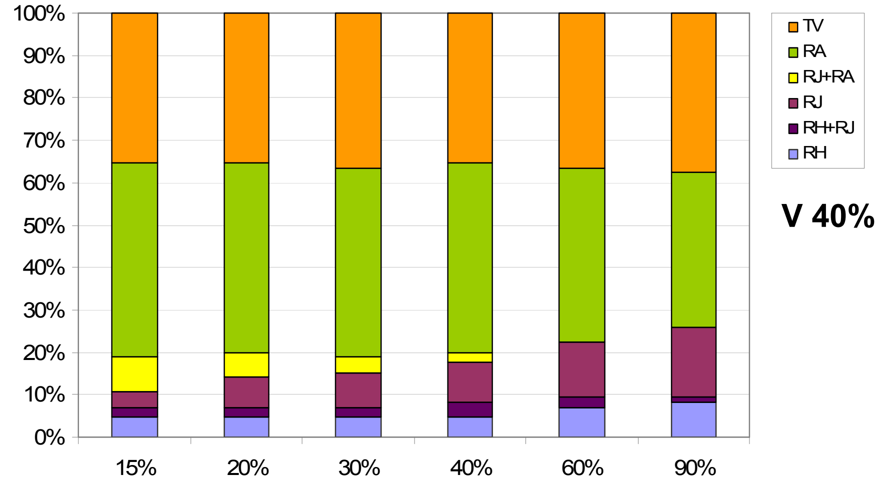


The initial volumes of the dams were established iteratively by the mean volume at that specific day of the year, for each dam capacity and demand scenario

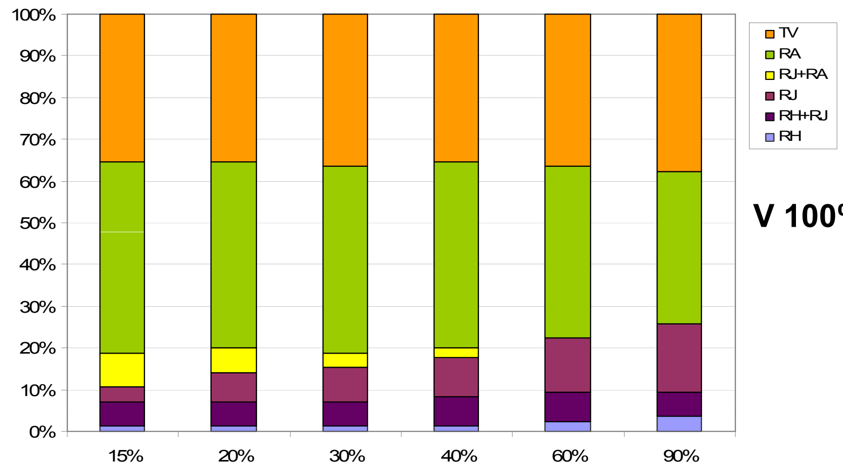
Dam regulation + Agricultural demand



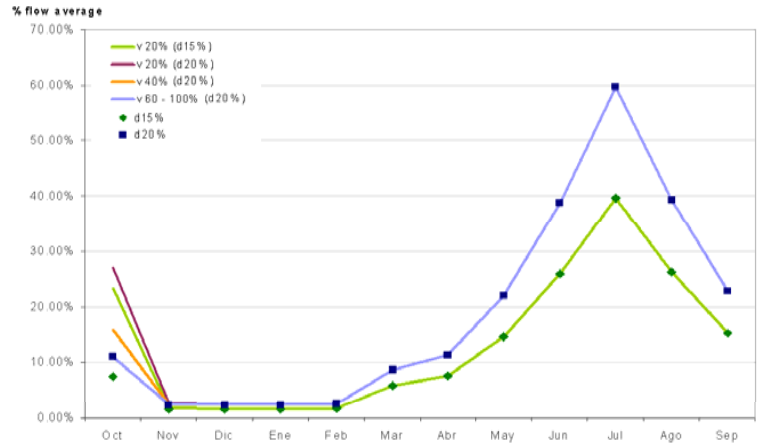
V 20%



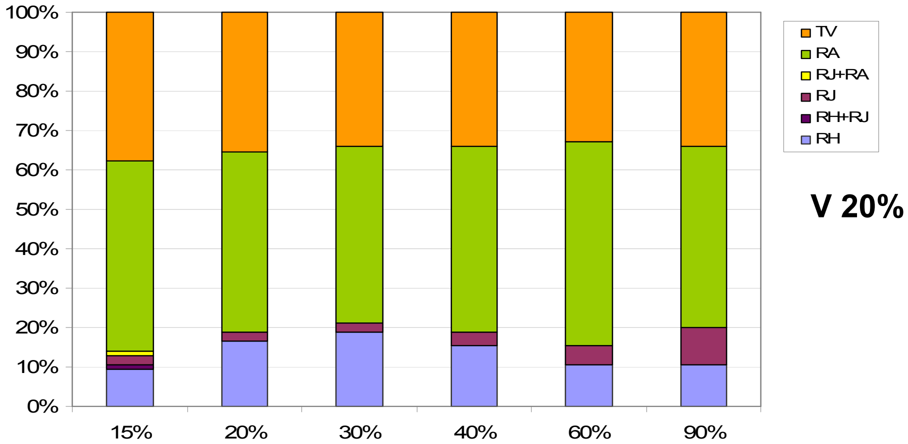
V 40%



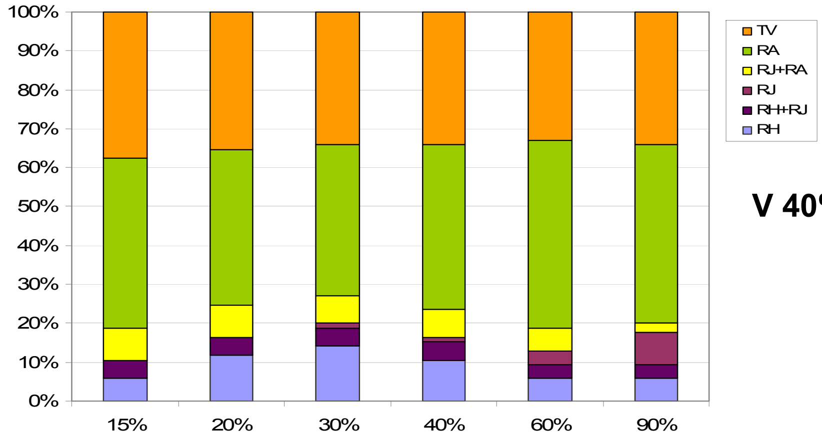
V 100%



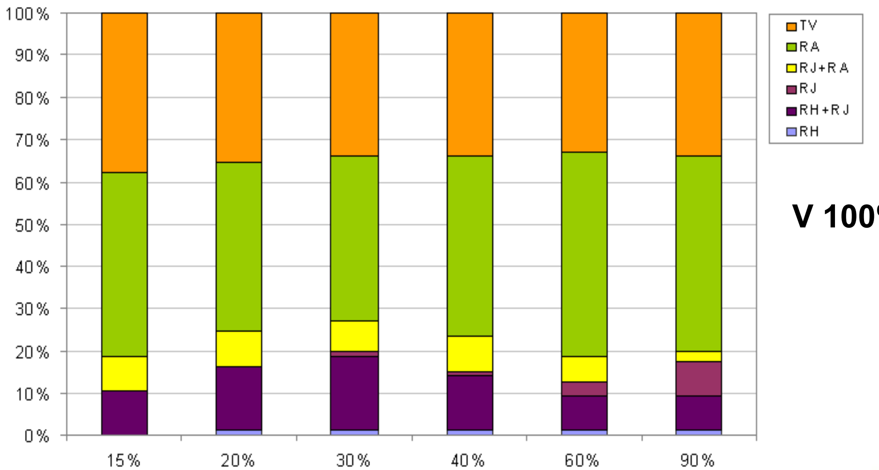
Dam regulation + Urban demand



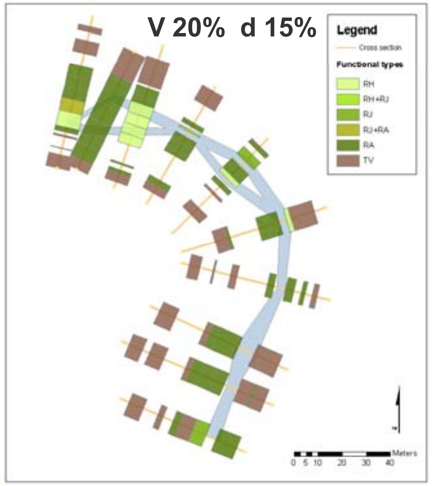
V 20%



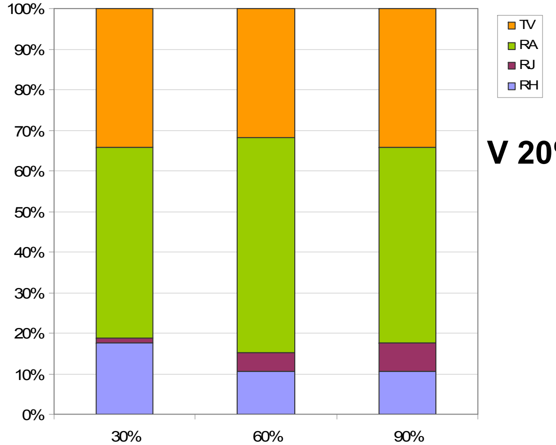
V 40%



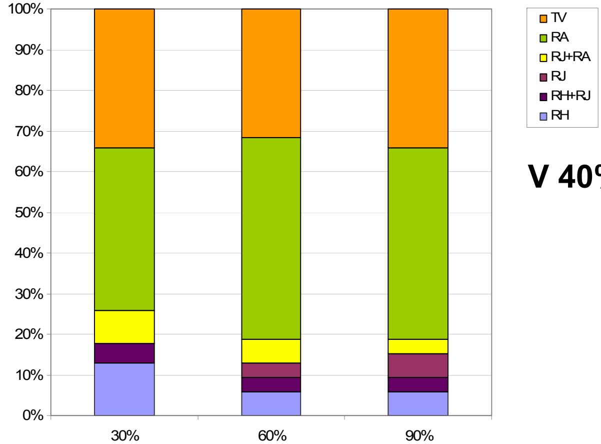
V 100%



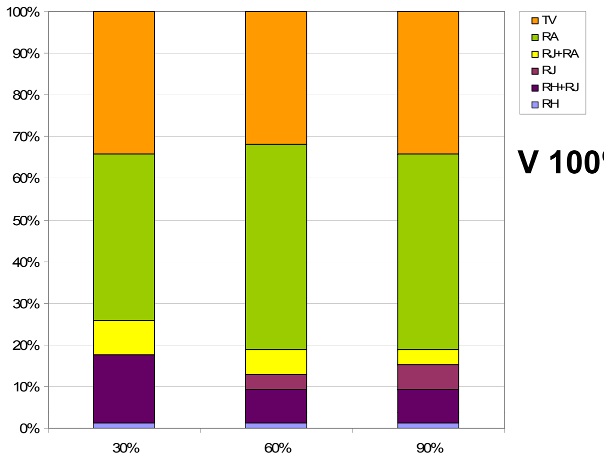
Dam regulation + hydroelectric demand



V 20%



V 40%



V 100%

6. Conclusions

- Changes in Mediterranean semiarid hydrologic systems cause changes in river associated vegetation
- RibAV model is an useful tool for evaluating several anthropic impacts considering changes in hydrological regimes or changes in the climatic conditions
  - But some predictions should be qualified
- Hydrologic regulation by dams (**w/o water consumption**) is not always unfavorable for riparian plants → more analysis is needed

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Thank you for your attention

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