

The geomorphic effects of dams on rivers: some examples from southern Italy

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During the second half of the last century, many rivers in southern Italy have experienced huge channel adjustments mainly induced by anthropic interventions. Particularly, in several cases dams were built along them mainly to meet the growing need for energy and water for irrigation purposes.

The present study investigates the cases of Fortore and Biferno rivers, whose lower courses are regulated respectively since 1966 and 1976 by the Occhito and Ponteliscione dams, with the aim to verify possible impacts of the dams on channel morphology and adjustments over the last 60 years. Channel changes were analyzed by means of a multi-temporal GIS analysis of topographic maps and aerial photographs integrated with topographic and geomorphological field.

The obtained evolutionary trajectories highlight that channel adjustments occurred through two distinct phases and led to an overall channel narrowing and channel bed lowering accompanied by pattern changes in prevalence from multithread to single-thread channel configurations. Major channel adjustments occurred in the first phase, from the 1950s until the end of the 1990s, under the dominant control of in-channel mining, channel works and hydraulic interventions.

Regarding this phase, the impact of the dams is highlighted by net differences in the amount of channel adjustments of the reaches located respectively upstream and downstream of them. Especially channel narrowing was more intense in downstream reaches (up to 98% in the Fortore River and up to 96% in the Biferno River) than in upstream reaches (up to 81% in the Fortore and up to 86% in the Biferno). With respectively 7.4 m y⁻¹ and -7.8 m y⁻¹, averages rates of narrowing are very similar for the Fortore and Biferno in downstream reaches.

Observed differences suggest that, besides the control factors that guided the evolution of the entire fluvial systems, the closure of the two dams had additional and permanent effects on downstream reaches through overall discharge regulation and permanent sediment trapping as also confirmed by the progressive retreat of the river mouth areas.

From 2000 to 2016 (phase 2), a trend inversion is observed: channel narrowing is replaced by channel stabilization or widening and partial aggradation of upstream reaches and total stabilization of downstream reaches. Besides the cessation of in-channel mining, channel recovery appears favored by several major flood events, occurred from 2003 to 2015.

The ongoing trend to recovery of upstream reaches is well evident for the Fortore River, whilst for the Biferno River, due to the presence of several secondary hydraulic structures (small hydropower reservoirs and check-dams), only some localized resumption of river dynamics can be observed evidenced by bank retreat, channel widening and sediment deposition.

Regarding downstream reaches of both rivers, their stabilization can be interpreted as an amelioration of their condition with respect to the precedent period (phase 1). Nevertheless, their very scarce dynamics due to the permanent disturbance created by the dams along with the very low diversity of geomorphological and ecological river corridor features, the scarce to nil recovery potentials and associated high flood risks, strongly contrast possible restorative actions.