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MAN-INDUCED CHANGES IN THE STRUCTURE AND DYNAMICS OF THE UPPER DUNAJEC RIVER CHANNEL

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The Dunajec River is a typical gravel-bed river draining the high-mountain Tatra massif. The river rises from the confluence of the Biały Dunajec and the Czarny Dunajec rivers. Long-lasting transport of gravels from the Tatra massif onto its foreland, which took place in the Pleistocene and the entire postglacial period, has led to the formation of a braided gravel-bed river. Due to human interference, the intensity of which has become pronounced from the turn of the 20th century onwards, the structure of the channel of the upper Dunajec underwent a series of adjustments. Channel narrowing and incision have been particularly intense since the 1960s resulting from channelization, as well as gravel extraction from the channel. These activities led to the destruction of several natural reaches of the channel and caused subsequent bed degradation. Engineering works aiming at flood-hazard reduction are effective only locally, while in the downstream reaches, their effect may be the reverse. Attempts at limiting sediment supply into the Czorsztyn Reservoir seem to have been ineffective.

Key words: gravel-bed rivers, fluvial processes, human impact, Carpathians

INTRODUCTION

Contemporary diversity of river channel types results from long-lasting natural and anthropogenic processes operating in their entire catchments. Morpho-

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dynamic channel reaches indicate the stage of channel evolution. The characterization of the entire channel systems allows to understand their functioning (Chorley and Kennedy 1971). This can be achieved through field research supplemented with the analysis of maps, aerial photos, as well as various archive materials. In several Carpathian fluvial systems, channelization and gravel mining have been undertaken without thorough prior examination. However, lack of the understanding of entire channel systems and subsequent unconsidered interference in some river reaches may produce effects disparate from the assumed ones. It is then essential to study whole systems rather than separate channel reaches if undesirable and negative effects are to be avoided (Wasson et al. 1993, Chełmicki and Krzemień 1999). Pattern changes, narrowing and degradation tendencies observed in the channel of the upper Dunajec River provide an illustration to geomorphic response to human interventions, frequently undertaken without sufficient recognition of the entire channel. Channel change in the upper Dunajec River is mostly associated with localized river channelization and gravel mining. This paper aims to present the transformation tendencies of the channel of the upper Dunajec River resulting from natural processes and human disturbance.

STUDY AREA

The study area comprises the upper part of the Dunajec River stretching from the headwaters of the Czarny Dunajec to the Czorsztyn Reservoir (Fig. 1). The drainage basin of the upper Dunajec, with an area of 1124 sq km, is located within the geomorphic regions of the Western Tatra Mountains, Sub-Tatra Trough, the Gubałówka Hills, Orawa-Nowy Targ Basin, Orawa Divides, Pieniny Klippen Belt and the Gorce Mountains (Klimaszewski 1972). The geology of the region is complex and encompasses metamorphic rocks, granitoides, limestones, dolomites, as well as flysch formations (sandstones and shales).

The Dunajec rises from the confluence of the Czarny Dunajec and the Biały Dunajec. From the geomorphological and hydrological point of view, the former (formed by joining of Kościeliski and Chochołowski Streams) constitutes the headwater part of the Dunajec River (Krzemień 1991). This study focuses on the varied and complex part of the channel system, located in the foreland of the Tatra massif.

In the study area, the channel is typically 30-50 m wide, locally reaching 200 m. Floodplain is commonly 100-500 m wide, dissected with several old channels and overgrown with trees and shrubs. The gravels of the upper Dunajec are varied in terms of lithology and grain-size (Borowski and Kociszewska-Musiał 1959, Nawara 1960, Werrity 1990). Granitic and quarzitic cobbles, 100-200 mm in size, predominate within the bed material. The percentage of granitoids increases in the uppermost section of the studied channel (down to Chochołów village) and then decreases down to the Czorsztyn Reservoir. Granitic and quarzitic gravels constitute the maximum fraction.

The high-energy regime of the Dunajec is determined by the high-mountain massif of the Tatras. The mean annual discharge at the Kowaniec gauging station is 14.2 m^3/s, and the average for the annual maximum discharges amounts to 239.1 m^3/s. The largest floods on the Dunajec are associated with heavy summer rainfalls. The largest flood discharges in the study area were noted in 1934 (1700 m^3/s at the Czorsztyn gauging station).

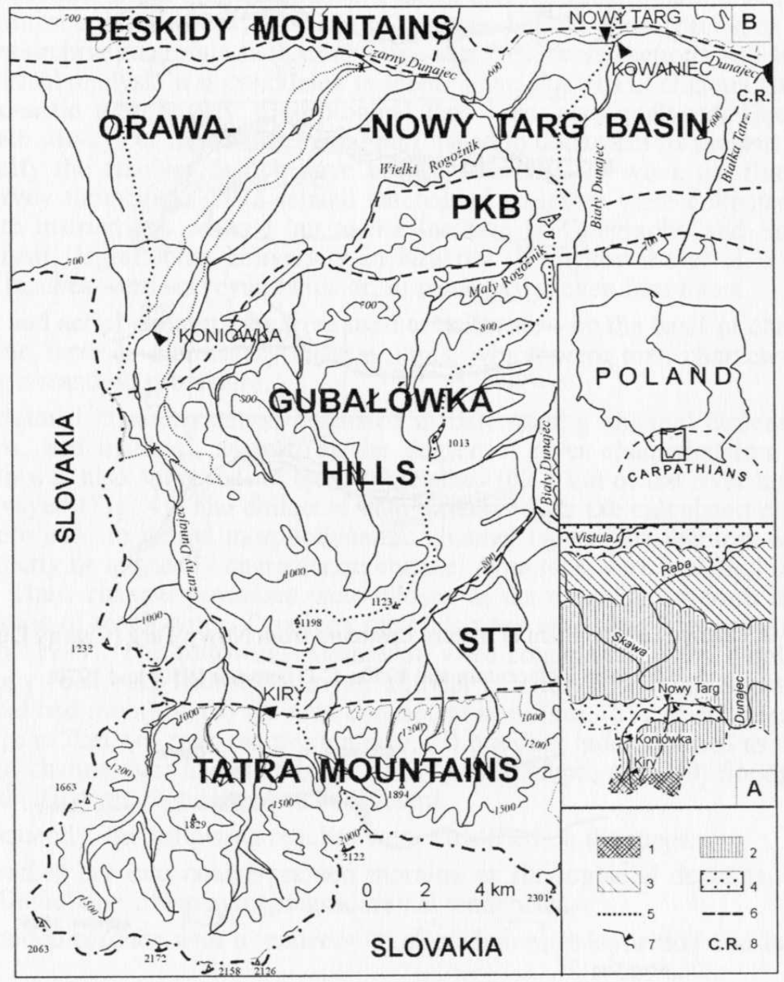

Fig. 1. (A) Location of the upper Dunajec on the background of physiographic regions of southern Poland. (B) Detailed setting

1 – high mountains; 2 – mountains of intermediate and low height; 3 – foothills; 4 – intramontane and submontane depressions; 5 – catchment boundaries; 6 – boundaries of geomorphic units; 7 – water-gauge stations; 8 – C.R. – Czorsztyn Reservoir; PKB – Pieniny Klippen Belt; STT – Sub-Tatra Trough

Until the 19th century the upper Dunajec was an active, braided river. Since then it has undergone significant narrowing and incision. Both processes were particularly intense in the 1970s and 1980s when the engineering works proceeded on a large scale (Figs. 2 and 3).

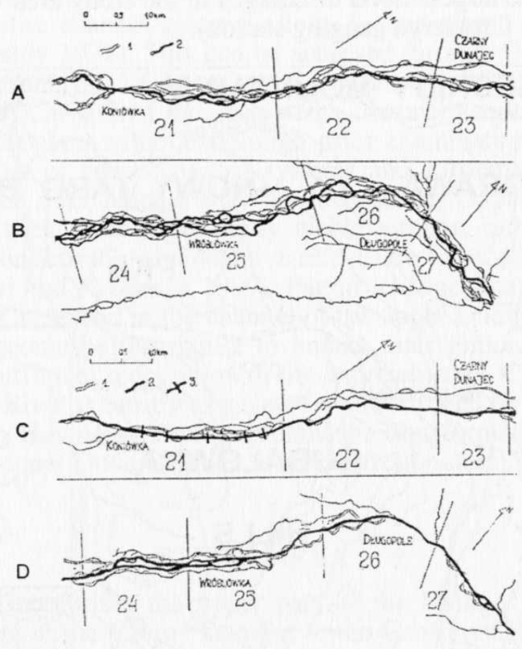

Fig. 2. Changes in the channel pattern upstream from Nowy Targ (Czarny Dunajec)
A-B between 19th century and 1950s, C-D between 1950s and 1970s

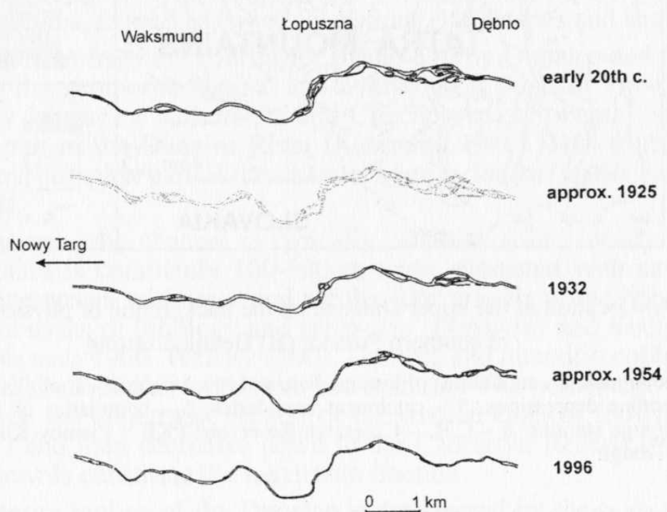

Fig. 3. 20th century planform changes of the Dunajec river downstream from the Czarny and the Biały Dunajec confluence

METHODS

The structure of the studied channel system and its transformation were investigated through fieldwork, analyses of maps and aerial photographs, as well as various archive materials such as channel sketches, cross sections and so on. The historical analysis was conducted to identify the changes in channel pattern and large-scale morphology. Hydrological data were also analysed. Detailed reach-scale surveys of the channel were performed to document its present state and identify the changes, which have occurred since 1977 when the first detailed survey took place. Data related to channel structure were collected according to instructions worked out at the Institute of Geography and Spatial Management, Jagiellonian University in Kraków (Kamykowska et al. 1999). Selected reaches were surveyed twice or, in some cases, even four times.

Maps and aerial photographs were used to delineate – on the basis of channel pattern and forms – elementary channel units, which were then characterized following a standard procedure.

The channel characterization consisted in determining channel dimensions and forms, bed material, as well as the degree of river channelization. The floodplain was also surveyed. In total, 49 reaches (62.8 km of the river length) were surveyed (Fig. 4). The collected data together with the calculated coefficients were used to define morphodynamic channel types. The features which either directly or indirectly characterize channel dynamics were included in the analysis. Thus, channel processes were chosen as the essential criterion in the identification of reach types. Typology methods were used after Kaszowski and Krzemień (1999). The following parameters were considered in the typology: (1) geology (bedrock, bedrock-alluvial, alluvial reaches), (2) channel pattern, (3) channel bed mobility, (4) bar area coefficient in m^2/km, (5) cutbank area coefficient in m^2/km, (6) maximum grain-size, (7) braiding index defined as number of mid-channel bars and islands per km, (8) width/depth ratio, (9) floodplain width and (10) river channelization coefficient.

Subsequently, the following reaches were identified on the maps:

(1) reaches cut into coarse-grained moraine or fluvioglacial deposits, bedrock or alluvial ones, displaying degradational tendencies,

(2) braided reaches with a tendency to aggradation, redeposition and lateral erosion,

(3) reaches with highest cutbank-area coefficients, indicating lateral erosion tendency,

(4) transportation reaches (lacking the above mentioned features).

Finally, seven dynamic channel-reach types were identified (Fig. 4):

(1) erosional reaches typified by downward erosion,

(2) erosional reaches typified by downward and lateral erosion,

(3) reaches typified by erosion and redeposition,

(4) redepositional reaches typified by redeposition and lateral erosion,

(5) transportational reaches,

(6) aggrading reaches (typified by deposition),

(7) reaches typified by redeposition and deposition (with prevalent redeposition).

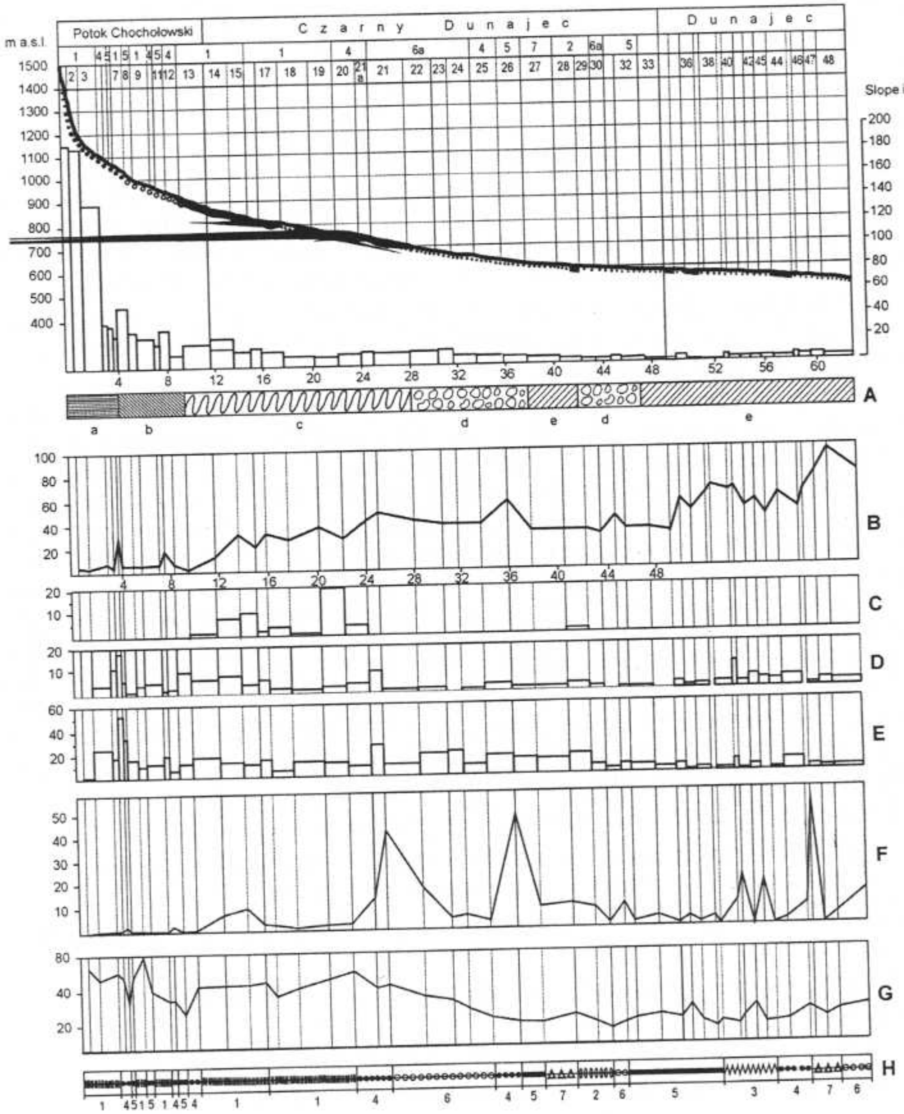

Fig. 4. Channel structure and its selected parameters

A – geology; B – channel width in m; C – number of rocky stops per 1 km; D – number of rocky bars per 1 km; E – number of undercuts per 1 km; F – area of bars and islands, in thousands m^2/km, G – maximum grain-size in cm, H – morphodynamic reach types

CHANNEL STRUCTURE AND ITS TRANSFORMATION UNDER HUMAN IMPACT

The channel system of the upper Dunajec is complex (Figs. 4 and 5). Its present structure is the outcome of long-lasting formation by natural processes and relatively short anthropogenic transformation. Although the latter encompasses a period shorter than a century, it significantly influenced both the channel morphology and its evolutionary trends.

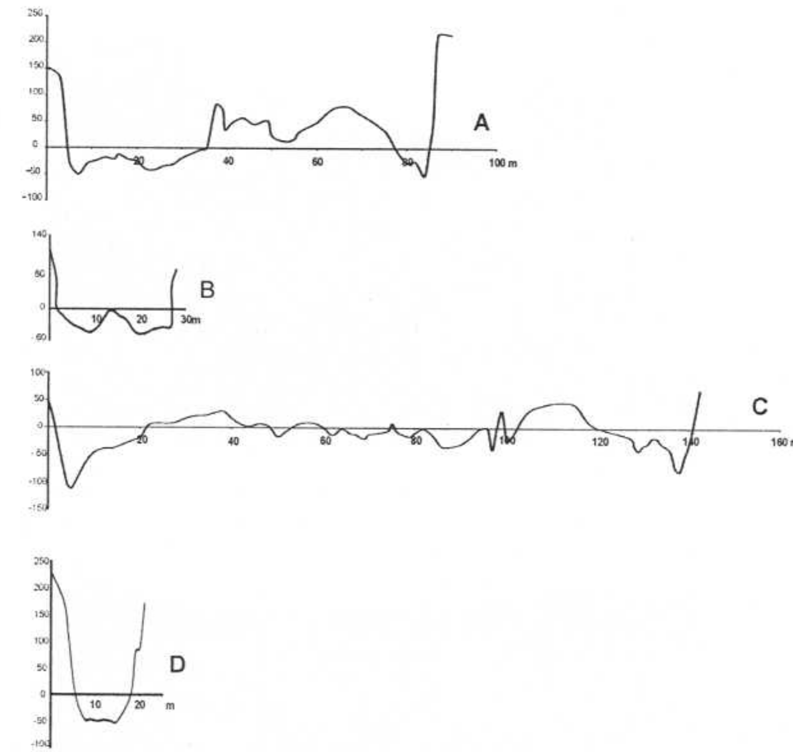

Fig. 5. Channel cross-sections of the Czarny Dunajec

A, C – natural, multi- thread reaches; B, D – altered or channelized reaches

The upper Dunajec channel underwent extensive but localized channelization. It was not systematic and different structures were applied in particular reaches of the channel over decades. Generally, channel manipulation involved resectioning, realigning, embanking and bank protection. The main purposes of the channelization were stabilizing the river course, flood hazard alleviation and protection of housing and cultivated land on the valley floor, as well as reduction in sediment supply and transport to the planned Czorsztyn Reservoir. Emergency channel works have been implemented after flood events, and as such have been essentially unplanned and frequently conducted by the people living nearby.

The upper Dunajec channel has been subject to gravel mining for several decades; starting after World War II, it reached highest intensity in the 1970s. The extraction operations were either large-scale businesses using machinery or were undertaken locally, on a smaller scale. They involved the extraction of boulders from the surface of channel bars or all gravel material accessible in the channel. Although gravel mining is now prohibited, it is still performed by local population and as much as entire bars can be removed.

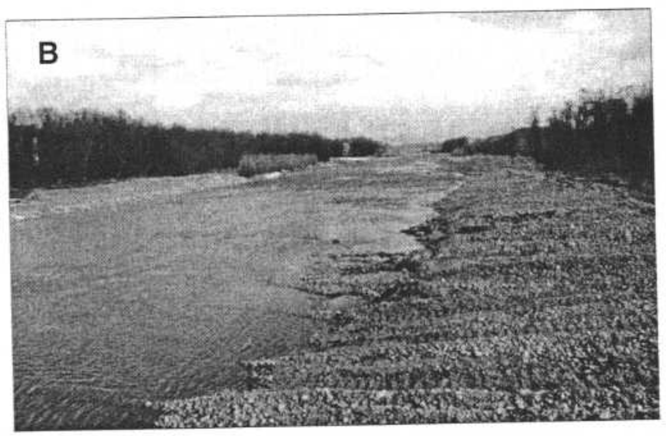

Fig. 6. Multi-thread reach of the Dunajec at Wróblówka in 1970s (A); the same reach in 2002 (B)

Both gravel mining and engineering works are found to have strongly promoted channel adjustments, namely narrowing, incision and transition from a braided to a single-thread pattern. While the structure of the channel within the Tatra massif has remained basically unchanged over the last decades, dramatic change has been observed downstream.

Single-thread sections, many of them straight with erosion-protected banks, replaced several braided reaches (Fig. 6) The remaining ones were significantly shortened. Braided channel still exists in reaches 21a and 25, where an increase in the number and area of bars, as well as bank undercuts has been observed (Fig. 5). However, some further channelization works have also been started there recently, aiming at channel realigning. Such actions are undertaken despite earlier declarations from the water management authorities to abandon further channelization of the Czarny Dunajec. In the lowermost section of the study area, i.e. downstream from Nowy Targ, multi-thread reaches have been eliminated completely (Fig. 3) and replaced with artificial straight or sinuous sections.

The analysis of historical maps, as well as repeated field surveys show that also the morphodynamic structure of the channel changed over time (Figs. 2 and 3, Krzemień 1981). At present, reaches typified by downward erosion can be found close to the border of the Tatra massif (reaches from 13 to 19). Several reaches were channelized by thalweg training and bank lining or construction of large concrete drop structures. The latter are either 2.5 m concrete steps or 0.8 m high structures, trapezoid in cross-section. This type of structure is less expensive and more effective in preventing channel shifting. After 22 years, deposition between the concrete steps has been observed in the reaches which had earlier been channelized using this method. In the section of the channel upstream from Nowy Targ, stabilization of the banks due to river-control works resulted in the change of the channel function into a transportational one. Downstream of the Biały and Czarny Dunajec confluence, the single-thread reaches are mostly transportational or erosion-redepositional in terms of their dynamics, the one exception to this being the largely depositional reach in the tailwater of the Czorsztyn Reservoir (Fig. 4).

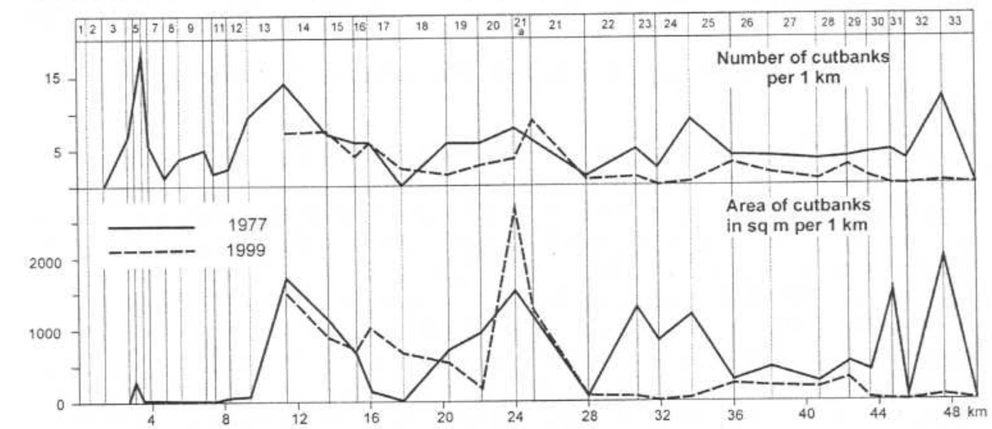

Fig. 7. Number and area of cutbanks between 1977 and 1999

The differences between some channel-structure parameters in 1977 and 1999 are shown in Figs. 7 to 9. Along the long profile of the Czarny Dunajec, a significant increase in the number of small bars is noticeable, particularly in reaches channelized with concrete steps. Generally, the bars are numerous but small-sized. The occurrence of these forms indicates that the channelization using drop structures did not restrict bedload transport completely. A proportion of the transported material is deposited between successive steps. These gravels undergo transport and redeposition during floods. In the reaches typified by bed degradation, the number of islands and the area of bars have diminished. In contrast, the area of bars and islands increased in braided reaches, in which sediment transported from channelized reaches located upstream is stored. This points to the natural modeling of the remnant braided channel.

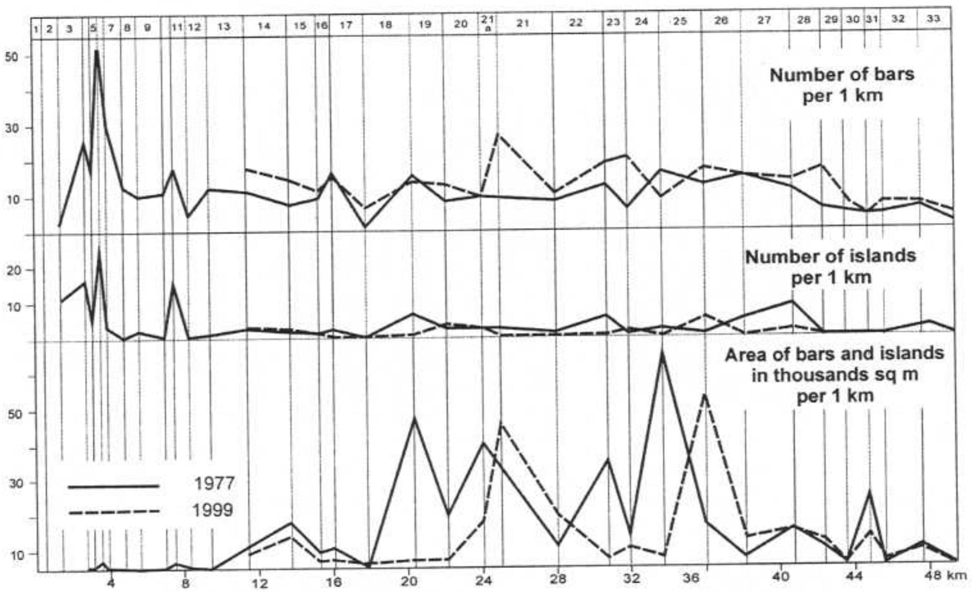

Fig. 8. Number and area of bars and islands between 1977 and 1999

In the entire system, the number and area of undercut banks have diminished, thus limiting sediment supply from banks, not only in the reaches where lateral erosion has been arrested but also in the unaltered sections. Consequently, in confined or straightened channel reaches with steepened slope, increased flow energy is directed to scour. This has added to the persistent destruction of bed-armouring by gravel extraction and has further enhanced sediment entrainment and transport. Such processes are particularly evident in reaches in the Tatra foreland, at the Kościeliski and Chochołowski Streams confluence at Roztok, as well as in the lower sections, that is downstream of Długopole and locally downstream of Nowy Targ. Channelization of the Dunajec channel by means of narrowing (resectioning), straightening (realigning) and embanking, together with extensive gravel extraction led to the exacerbation of bed scouring. Consequently, a transformation from alluvial to bedrock channel has taken place along several reaches. Generally, bedrock reaches were found to have extended by almost 80 per cent. What is more, channel incision has become a leading process in several reaches. One of its detrimental effects

is the undermining of bridge abutments and destruction of channelization structures. The analysis of water stages at the Kowaniec gauging station (Fig. 10) points to an overall lowering trend of the channel bed over the last 60 years.

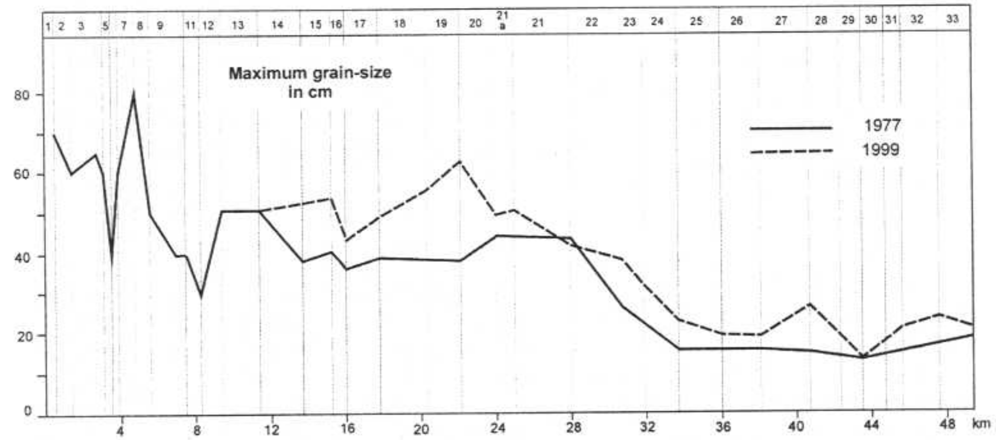

Fig. 9. Maximum grain-size between 1977 and 1999

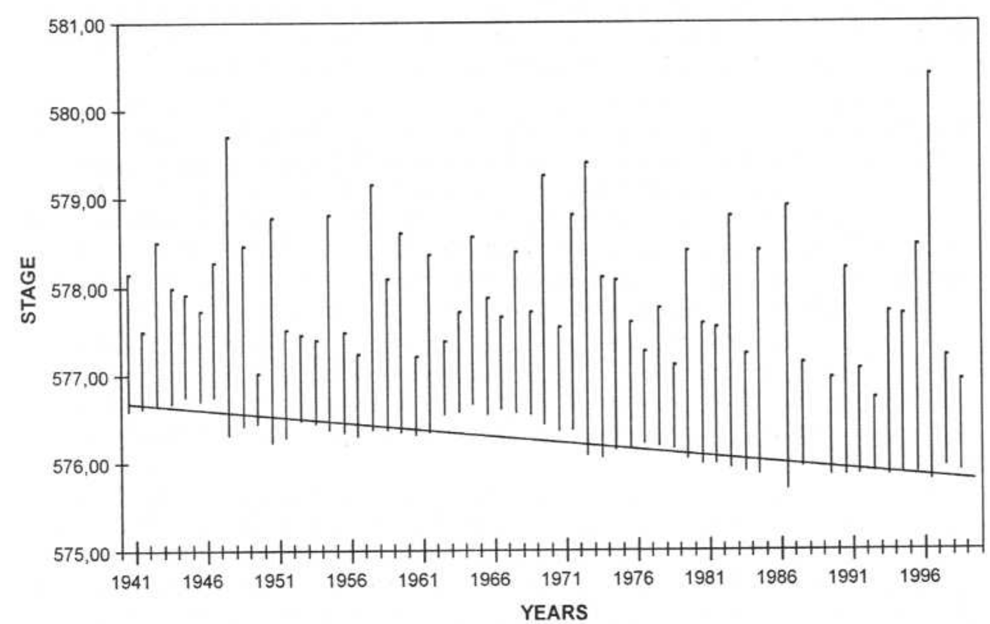

Fig. 10. Maximum and minimum annual water stages at the Kowaniec gauging station (1941-2000)

Greater transporting ability and channel incision are also reflected by the increase in the maximum grain-size between 1977 and 1999. Coarsening of the maximum fraction of bed material resulted from washing down fine particles and dissection of the underlying large-sized material, as a consequence of increased flow energy. .

Similar trends of channel response to river channelization, particularly increased flow energy, have been recognized in other rivers of the Polish Carpathians (Klimek 1983 and 1987, Wyżga 1991). However, in lower sections of the rivers both the river-control works and the subsequent channel adjustments started earlier in the 20th century.

CONCLUSIONS

The natural structure of the upper Dunajec developed during a long period of time in the foreland of a high-mountain massif. The prolonged transport of gravels from the Tatra massif onto its foreland, which took place in the Pleistocene and the entire postglacial period, has led to the formation of a typical braided channel. Natural modelling of this channel consisted mainly in lateral migration and, as a consequence, low amounts of sediment were being transported to downstream reaches. Since the turn of the 20th century, the channel has been subject to narrowing and incision. The intensity of both processes greatly increased over the past three decades. Incision has been accelerated as a result of restriction of the river's lateral migration by engineering works. Gravel mining significantly enhanced the process, the effects of which are commonly transmitted upstream and downstream of the affected reach.

Channel incision is associated with the transformation of former floodplains into terraces, which in turn reduces water retention in floodplain areas. As a result, downstream of channelized sections, the flood hazard must have increased. In the studied area, channel confinement through embankment construction and subsequent housing development in the vicinity of the channel exacerbated the threat of flooding and loss of property. Furthermore, the increase in flow energy caused by channelization enhanced the entrainment and transport of sediment. Another consequence is the loss of aquatic and riparian habitat diversity.

In general, the man-induced adjustments of the upper Dunajec channel are viewed as negative. Not only has the river management accompanied by gravel mining contributed to the destruction of the natural channel structure and subsequent bed degradation, but also may have augmented sediment supply to the Czorsztyn Reservoir.

In the recent years, river channels in Europe are subjected to renaturalization and protection (Chełmicki and Krzemień 1998 and 1999, Verbraak 1999). In the Podhale region, however, the natural structure of the Dunajec channel is still being destroyed by unconsidered engineering works and sediment mining. It is vital to encourage protection of the remaining semi-natural reaches (Dąbrowski 1998) to preserve one of the last gravel-bed braided channels in Poland.

REFERENCES

BOROWSKI, W., KOCISZEWSKA-MUSIAŁ, G. (1959). Analiza żwirów Dunajca między Tatrami a Pieninami na tle morfologii i geologii obszaru zlewni, *Kwartalnik Geologiczny*, 3 (2).

CHEŁMICKI, W., KRZEMIEŃ, K. (1998). Naturalne koryto rzeki Feshie w masywie Cairngorm Mts. i jego ochrona (Szkocja). In *Bliskie naturze kształtowanie rzek i potoków*. Zakopane (Politechnika Krakowska), pp. 239-240.

CHEŁMICKI, W., KRZEMIEŃ, K. (1999). Channel typology for the River Feshie in the Cairngorm Mts, Scotland, In Krzemień, K., ed. *River channels – pattern, structure and dynamics*. Prace Geograficzne, 104. Kraków (Instytut Geografii Uniwersytetu Jagiellońskiego), pp. 57-68.

CHORLEY, R. J., KENNEDY, B. A. (1971). Physical geography: a systems approach. London (Prentice-Hall).

DĄBROWSKI, P. (1998). Renaturalizacja Czarnego Dunajca jako element ochrony bioróżnorodności regionu. In *Bliskie naturze kształtowanie rzek i potoków*. Zakopane (Politechnika Krakowska), pp. 41-42.

KAMYKOWSKA, M., KASZOWSKI, L., KRZEMIEŃ, K. (1999). River channel mapping instruction. Key to the river bed description. In Krzemień, K., ed. *River channels – pattern, structure and dynamics*. Prace Geograficzne, 104. Kraków (Instytut Geografii Uniwersytetu Jagiellońskiego), pp. 9-25.

KASZOWSKI, L., KRZEMIEŃ, K. (1979). Channel subsystems in the Polish Tatra Mts. *Studia Geomorphologica Carpatho-Balcanica*, 8, 149-161.

KASZOWSKI, L., KRZEMIEŃ, K. (1999). Classification systems of mountain river channels. In Krzemień, K., ed. *River channels – pattern, structure and dynamics*. Prace Geograficzne, 104. Kraków (Instytut Geografii Uniwersytetu Jagiellońskiego), pp. 27-40.

KRZEMIEŃ, K. (1981). Zmienność subsystemu korytowego Czarnego Dunajca. *Zeszyty Naukowe Uniwersytetu Jagiellońskiego, Prace Geograficzne*, 53, 123-137.

KRZEMIEŃ, K. (1991). *Dynamika wysokogórskiego systemu fluwialnego na przykładzie Tatr Zachodnich*. Uniwersytet Jagielloński w Krakówie, Rozprawy Habilitacyjne, 215.

KRZEMIEŃ, K. (1999). Structure and dynamics of the high-mountain channel of River Plima in the Ortler-Cevedale Massif (South Tirol). In Krzemień, K., ed. *River channels – pattern, structure and dynamics*. Prace Geograficzne, 104. Kraków (Instytut Geografii Uniwersytetu Jagiellońskiego), pp. 41-55.

KLIMASZEWSKI, M. (1972). Karpaty Wewnętrzne. In *Geomorfologia Polski, 1: Polska Południowa*. Warszawa (PWN), pp. 25-52.

KLIMEK, K. (1983). Erozja wgłębna dopływów Wisły na przedpolu Karpat. In Kajak, Z., ed. *Ekologiczne podstawy zagospodarowania Wisły i jej dorzecza*. Warszawa (PWN), pp. 97-108.

KLIMEK, K. (1987). Man's impact on fluvial processes in Polish Western Carpathians. *Geografiska Annaler*, 69 A, 221-226.

NAWARA, K. (1960). Skład litologiczny żwirów Białki i Czarnego Dunajca. *Acta Geologicae Polonicae*, 10 (3), 36-52.

VERBRAAK, P. (1999). Re-naturalisation projects for the River Meuse: new opportunities for nature with an integrated water management approach. Kucharczyk, M., ed. *Problemy ochrony i renaturalizacji dolin dużych rzek Europy*. Lublin (Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej), pp. 209-215.

WASSON, J. G., BETHEMONT, J., DEGORCE, J. N., DUPUIS, B., JOLIVEAU, T. (1993). Approche ecosystémique du bassin de la Loire, Eléments pour l'élaboration des orientations fondamentales de gestion. Lyon, Saint-Etienne.

WERRITY, A. (1990). Downstream fining in gravel-bed river in S. Poland: lithologic controls and the role of abrasion. *3rd International Workshop on Gravel-bed Rivers*. Florence, pp. 43-61.

WYŻGA, B. (1991). Present-day downcutting of the Raba River channel (Western Carpathians, Poland) and its environmental effects. *Catena*, 18, 551-566.

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ANTROPICKÉ ZMENY V ŠTRUKTÚRE A DYNAMIKE HORNÉHO TOKU DUNAJCA

Horný Dunajec je rieka so štrkovým dnom, ktorá pramení vo vysokohorskej časti Západných Tatier a to ovplyvňuje režim jej toku. Študovaná oblasť zahŕňa tok rieky od pramennej oblasti až po jeho vtok do priehrady Czorstyn v štrkovej Nowotargskej kotline.

Koryto horného Dunajca bolo podrobené silnej, ale nesystematickej regulácii prostredníctvom rôznych stavieb, ktoré sa stavali celé desaťročia na jeho určitých častiach. Vo všeobecnosti išlo o jeho rozdelenie, úpravy, vybudovanie nábreží a hrádzí a ochranu brehov, pričom hlavným cieľom bola ochrana proti povodniam, ochrana domov a obrábanej pôdy, ako aj zmiernenie nánosov a ich odnosu do plánovanej priehrady Czorsztyn. Koryto horného Dunajca sa využívalo aj na ťažbu štrku, ktorá sa začala po druhej svetovej vojne a kulminovala v sedemdesiatych rokoch 20. storočia. Ťažba bola extenzívna s použitím mechanizmov; iba na miestnej úrovni sa ťažilo v malom. Aj keď je v súčasnosti ťažba štrku zakázaná, miestne obyvateľstvo v nej pokračuje, preto dochádza k odstráneniu celých nánosov, resp. plytčín.

Ťažba štrku a inžinierske práce sú hlavnými príčinami zmien koryta: zúženie, zarezanie a prechod od vetveného prúdu k jednotnému. Uskutočnili sa podrobné výskumy koryta na úrovni jednotlivých úsekov, ktoré dokumentujú jeho súčasný stav a zisťujú zmeny, ktoré v ňom nastali od konca sedemdesiatych rokov, keď vznikla prvá štúdia. Analýza historických máp a leteckých fotografií pomohla identifikovať zmeny v tvare koryta a veľkú morfológiu. Zatiaľ čo štruktúra koryta v rámci Tatier ostala takmer nezmenená, na dolnom toku sa zistili dramatické zmeny. Sekcie, kde je prúd jednotný, zväčša priame, s brehmi chránenými proti erózii, nahradili niekoľko rozvetvených častí rieky. Počet a plocha podmytých brehov sa znížila a obmedzil sa prísun sedimentov k brehom nielen v častiach, kde sa zabránilo laterálnej erózii, ale aj v nezmenených častiach. Najväčšie množstvo usadeného materiálu je v dolnej časti toku, čo prezrádza väčšiu schopnosť odnosu, ako aj delenie podložia. V strednej časti študovanej oblasti sa dĺžka úsekov s odkrytým podložím zväčšila takmer o 80 % a celková plocha plytčín a ostrovov značne poklesla. Evidentná je aj miestna agradácia v regulovaných úsekoch, ktorá naznačuje, že prirodzené tendencie tvarovania riečneho koryta môžu byť ešte vždy aktívne.

Zárez koryta sprevádza zmena bývalých nív na terasy, ktoré znižujú retenciu vody v zaplavovanej oblasti. V dôsledku toho sa zvýšilo povodňové riziko na úseku toku pod jeho regulovanou časťou. Nepriepustnosť toku, zapríčinená vybudovaním hrádzí, a následný rozvoj bytovej výstavby v blízkosti toku znamenajú zvýšenú hrozbu záplav a majetkových strát. Zvýšenie energie toku jeho zregulovaním podporuje aj prenos sedimentov. Ďalším nepriaznivým dôsledkom je strata diverzity vodného a riečneho habitatu.

Vo všeobecnosti možno povedať, že antropické zásahy do horného toku Dunajca sú posudzované negatívne. Hospodárenie s riekou, konkrétne ťažba štrku, prispelo nielen k poškodeniu prirodzenej štruktúry toku a degradácii koryta, ale pravdepodobne zvýšilo aj prenos sedimentov do priehrady Czorsztyn.

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