Approaches to evaluation of benefits

from conversion of even-aged secondary spruce stands in the Ukrainian Carpathians into mixed, uneven-aged woodlands

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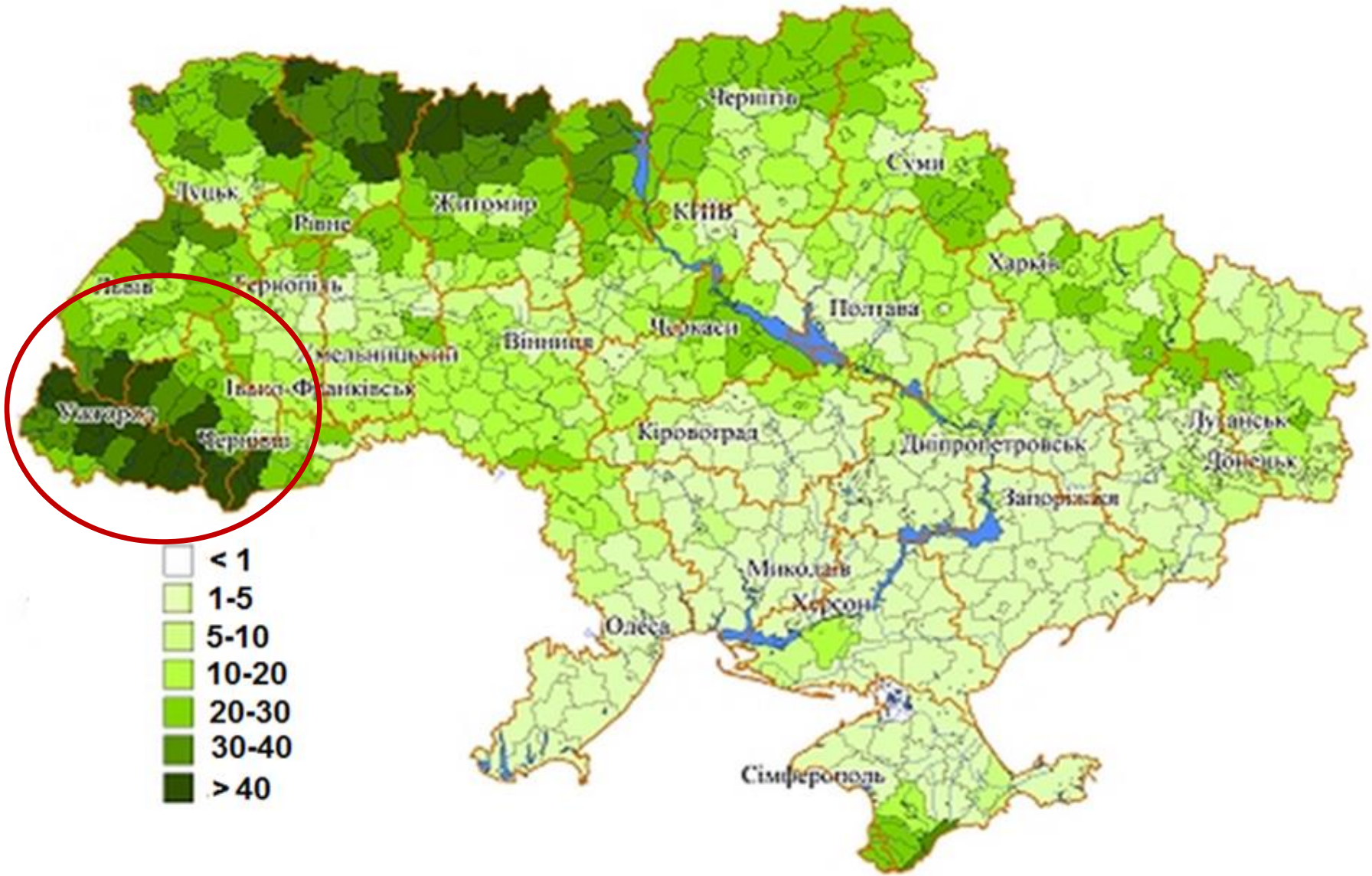
Social-ecological context of recent forest decision-making in the Ukrainian Carpathians

- During the Austro-Hungarian period native beech, *Fagus sylvatica*, and mixed forests were converted, for economic reasons, to Norway spruce, *Picea abies*, which was not native to this region (*Keeton and Crow, 2009;* Slobodiyan, 2012; Parpan et al., 2014).

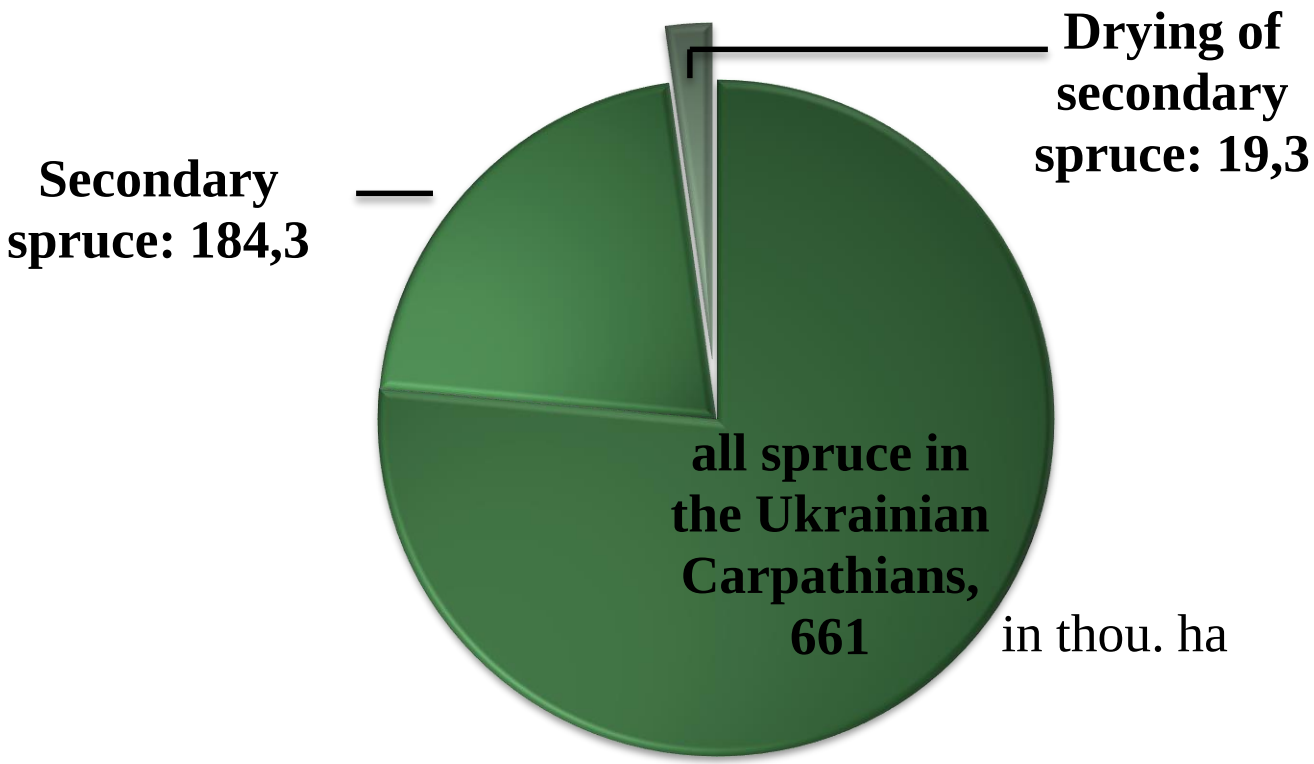
- More recent exhaustive timber harvesting (1956-1960), when annual harvested volume exceeded average increment almost twice (*Gensiruk, 2002*), resulted in current strong disproportion in forest age structure, drastic shrink of biological and landscape diversity and a disturbed hydrological regime in the Carpathians.

- These factors have undermined the welfare of local communities and prosperity of the region (*Krynytskyy et al., 2014; Soloviy, 2010*).

Wooded cover in Ukraine (in %)



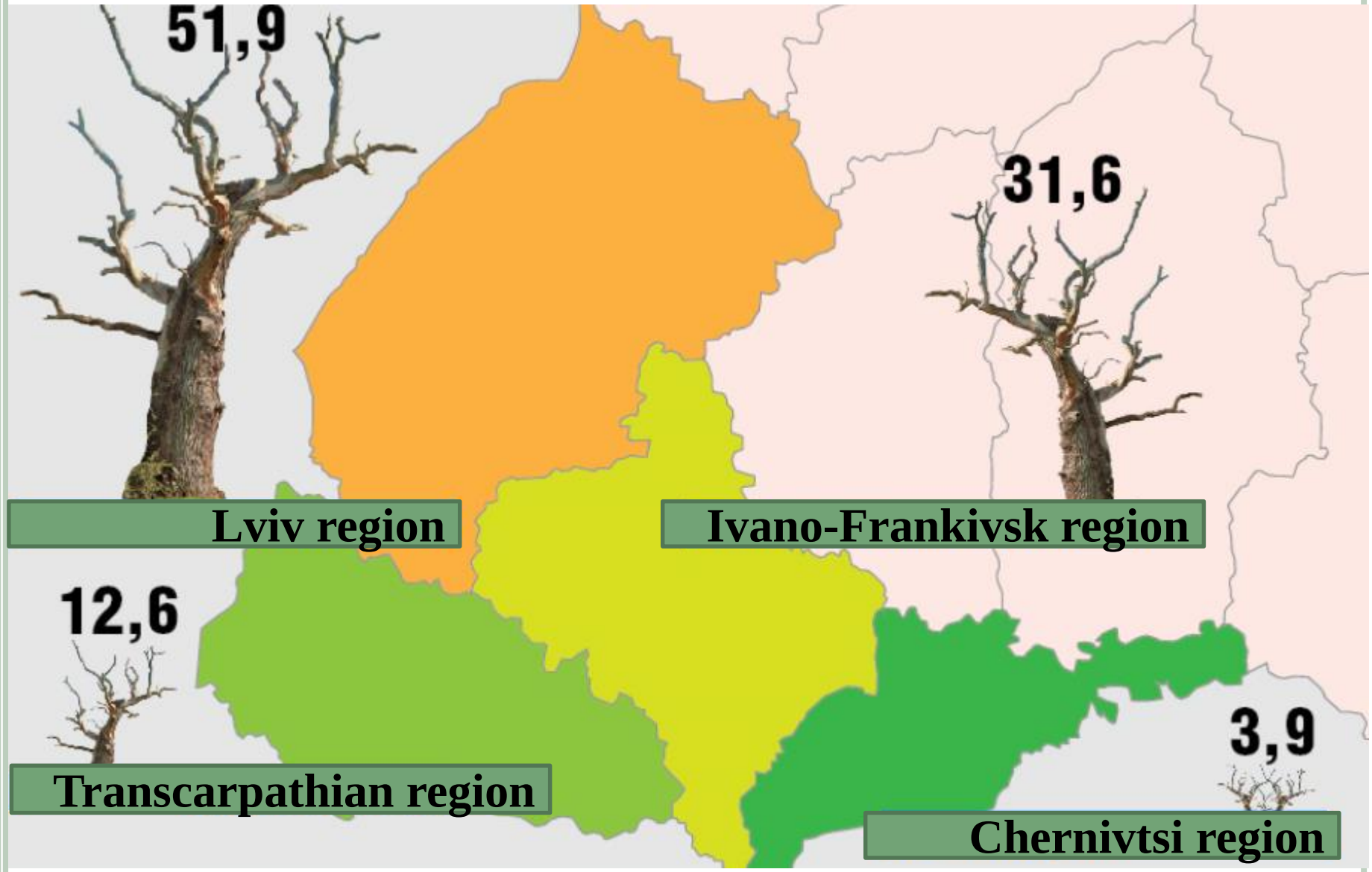
Decay of spruce stands
(Slobodiyan, 2012; Parpan et al., 2014)



in thou. ha

with wood volume nearly *6 million m³*

AREA OF DRYING SECONDARY SPRUCE IN THE UKRAINIAN CARPATHIANS, %
(GOVERNMENTAL COURIER, 2014)

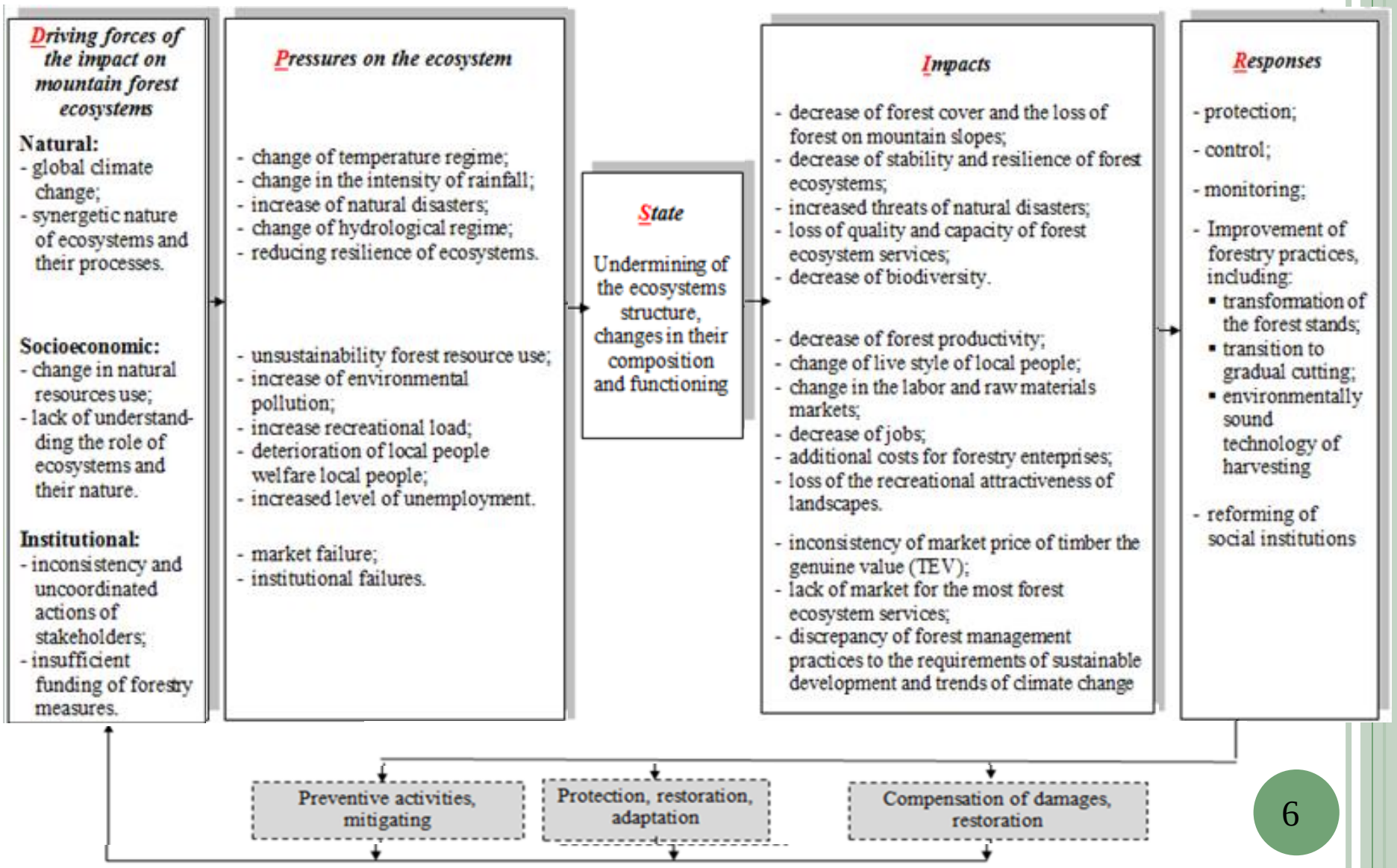


THE MAIN DRIVING FORCES OF SPRUCE STANDS DETERIORATION:

- global warming;
- environmental pollution;
- spruce planting in the not typical for spruce forest types;
- the massive spread of the spruce diseases and pests; and
- the spruce stands' damages by windfalls and snow.

(Parpan et al., 2014)

DPSIR-MODEL OF INTERACTIONS BETWEEN SOCIETY AND MOUNTAIN FOREST ECOSYSTEM IN THE UKRAINIAN CARPATHIANS



(Zahvoyska and Pelyukh, 2015)

Conversion process

- Conversion cutting are complex cutting that are aimed at the gradual transition from even-aged pure stands to mixed, uneven-aged stands.

(*Ukrainian legislation, №724*)

- ***M. Hanewinkel (2001):***
- Conversion include two aspects:

- a change in the species composition from pure to mixed stands;

- a change in the stand structure from regular, even-aged stands to more irregular, uneven-aged stands.

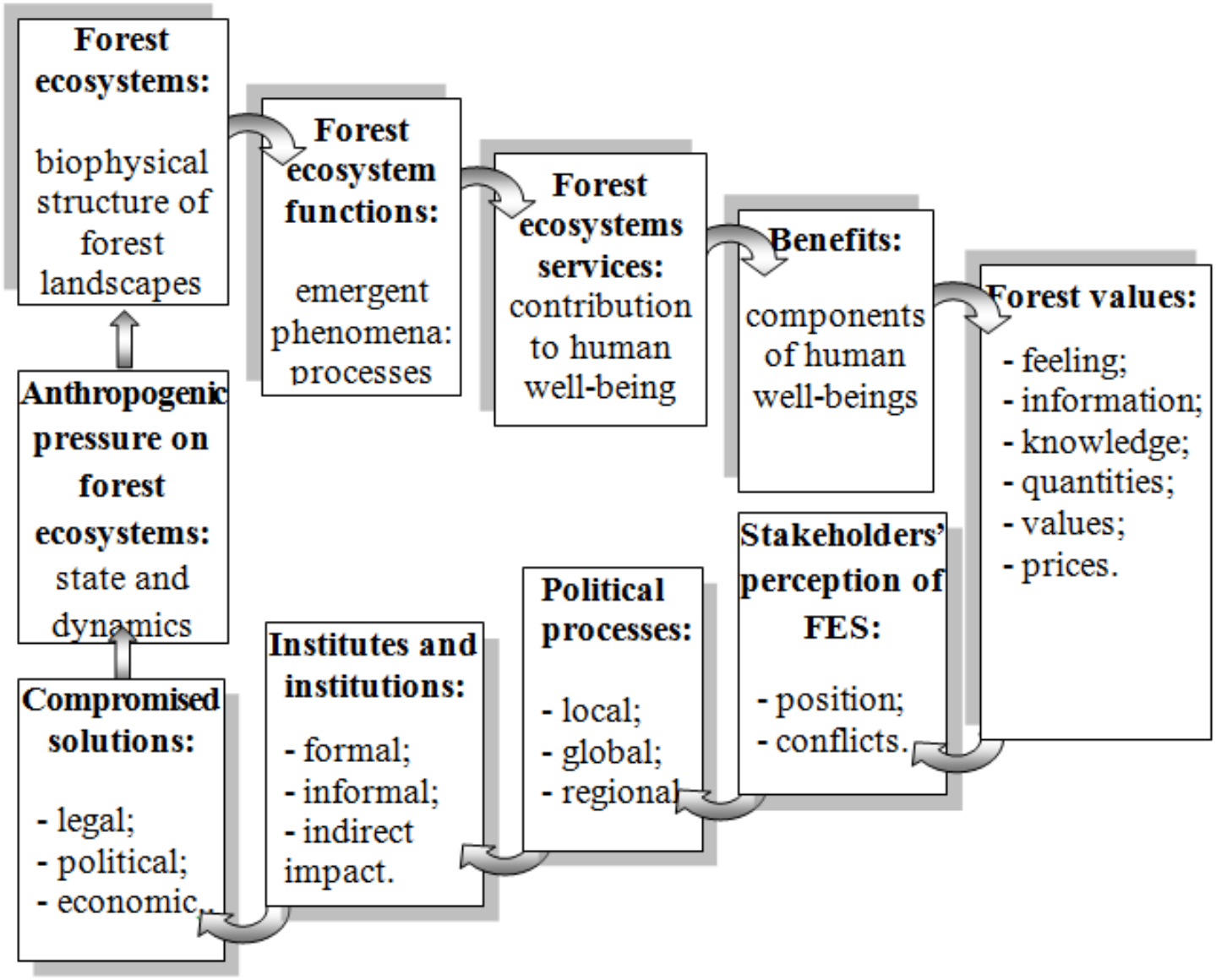
BENEFITS OF SECONDARY SPRUCE FOREST CONVERSION

- Increased productivity and biomass (*Piotto, 2008; Pretzsch et al., 2010 i 2014*);
- Reducing the financial risk through diversification of timber products (*Hildebrandt and Knoke, 2009*);
- Increasing the recreational value of forests (*Norman et al., 2010; Grilli et al., 2014*);
- Improved hydrological regime, and increased water supply *(Kulchytskyy-Zhyhaylo and Kulchytska-Zhyhaylo, 2011);*
- Reducing the risk of windfalls (*Schutz et al., 2006*);
- And fires (*Gonzalez et al., 2006*);
- Better resistance to drying (*Merlin et al., 2015*)
- Reduced risks of pathogens' impact (*Parpan, 2014)*;
- Improve soil conditions (*Brandtberg et al., 2000; Prescott, 2002*);
- Enhanced biodiversity (*Lindenmayer and Hobbs, 2004; Carnus et al., 2006; Brockerhoff et al., 2008*).

The difficulty associated with an evaluation of these benefits

- the main difficulty is the nature of these benefits.
- In recent discourses of economic analyses of forest projects, the ecosystem services concept *(MEA, 2005; TEEB, 2008)* is widely thought as the most relevant instrument for identification of benefits associated with a conversion project.
- Implicit nature of a significant part of forest ecosystem services (FES), non-rival and non-excludable from the ecological economics perspective *(Daly and Farley, 2011)*, causes market failures, resulting in the incapacity of markets to signal their scarcity and to provide market incentives to regulate their supply *(Nijnik and Miller, 2014).*
- This also makes it impossible to measure part of the FES value by means of traditional economic methods.

CASCADE MODEL OF FOREST DECISION-MAKING: FES PERSPECTIVE *(ZAHVOYSKA, 2014)*



Common International Classification of Ecosystem Services *(CICES, 2013)*

- ***Ecosystem services*** – contribution that ecosystems make to human well-being, i.e. outputs that directly affect the human well-being.
- Section: Provisioning

  1.1 Nutrition;

  1.2 Materials;

  1.3 Energy.
- Section: Regulation & Maintenance

  2.1 Mediation of waste, toxics and other nuisances;

  2.2 Mediation of flows;

  2.3 Maintenance of physical, chemical, biological conditions.
- Section: Cultural

  3.1 Physical and intellectual interactions with biota, ecosystems, and land-/seascapes;

  3.2 Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes.

Stakeholders' preferences on FES produced by pure *vs.* mixed forest stands

- Stakeholders' preferences concerning forest stands were identified using a survey;
- Our questionnaire applied CICES (2012);
- The questionnaire composed of subsections:
  - 1st subsection included questions about professional background of respondents;
  - 2nd subsection was dedicated to respondents' identification of the importance of FES; a
  - 3rd subsection dealt with a comparative evaluation of a quality of FES provided by pure secondary *vs.* mixed stands.
- A 5-point Likert scale was used for FES quality evaluation.

Stakeholders' preferences of FES produced by pure *vs.* mixed forest stands

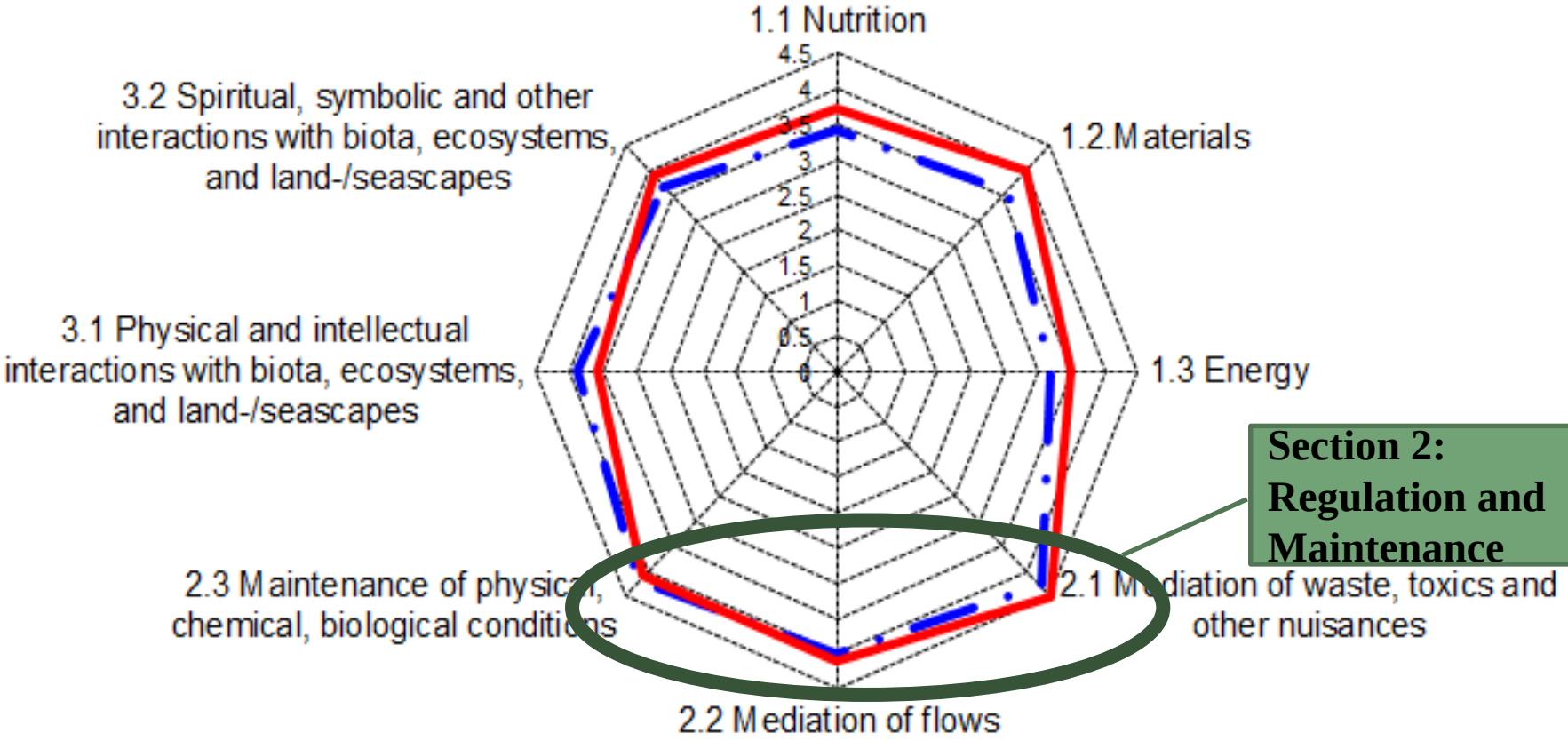
- We run the survey and approached two groups of stakeholders:
  - Scientists and
  - Forest enterprise employees.

- We conducted 20 interviews that lasted from 15 to 25 min. each.

EXPERT' PERCEPTIONS OF FES

(CICES CLASSIFICATION, LIKERT SCALE):

(*ZAHVOYSKA AND PELYUKH, 2015*)



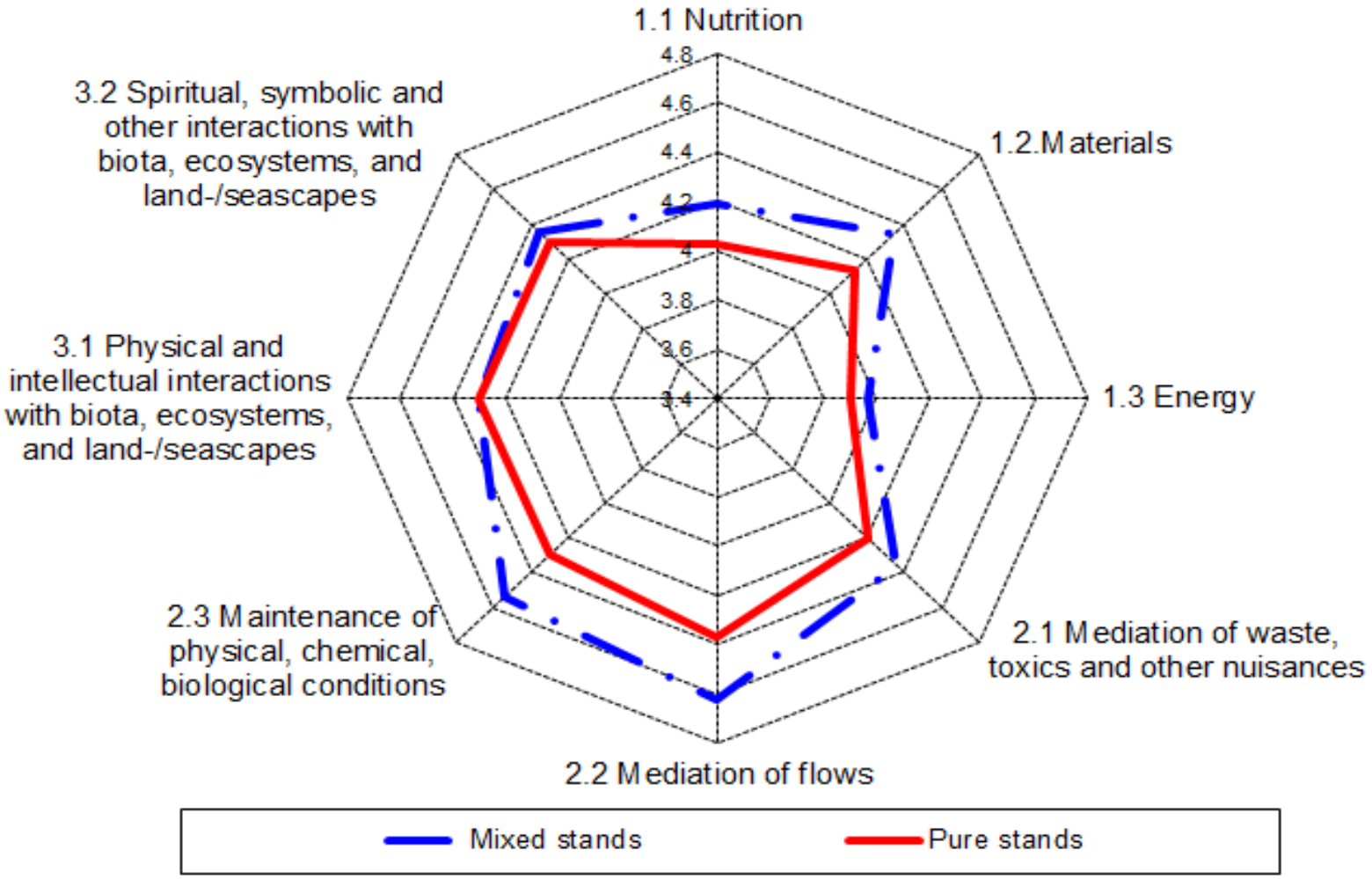
(*Zahvoyska and Pelyukh, 2015*)

COMPARISON OF MIXED *VS.* PURE STANDS

Section: Regulation & Maintenance			Mixed	Pure
Mediation of waste, toxics and other nuisances	Mediation by biota	Bio-remediation by micro-organisms, algae, plants, and animals	4,6	4,4
		Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	4,5	4,5
	Mediation by ecosystems	Filtration/sequestration/storage/accumulation by ecosystems	4,5	4,5
		Dilution by atmosphere, freshwater and marine ecosystems	4,0	4,0
		Mediation of smell/noise/visual impacts	4,1	4,1
Mediation of flows	Mass flows	Mass stabilisation and control of erosion rates	4,6	4,6
		Buffering and attenuation of mass flows	4,0	4,0
	Liquid flows	Hydrological cycle and water flow maintenance	4,8	4,6
		Flood protection	4,8	4,5
	Gaseous / air flows	Storm protection	3,4	3,4
		Ventilation and transpiration	4,2	4,2
Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal	4,9	4,7
		Maintaining nursery populations and habitats	4,9	4,5
	Pest and disease control	Pest control	4,6	4,4
		Disease control	4,6	4,4
	Soil formation and composition	Weathering processes	4,5	4,3
		Decomposition and fixing processes	4,5	4,2
	Water conditions	Chemical condition of freshwaters	4,0	4,0
		Chemical condition of salt waters	3,4	3,4
	Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations	4,9	4,5
		Micro and regional climate regulation	4,8	4,4

PERCEPTION OF FES BY SCIENTISTS

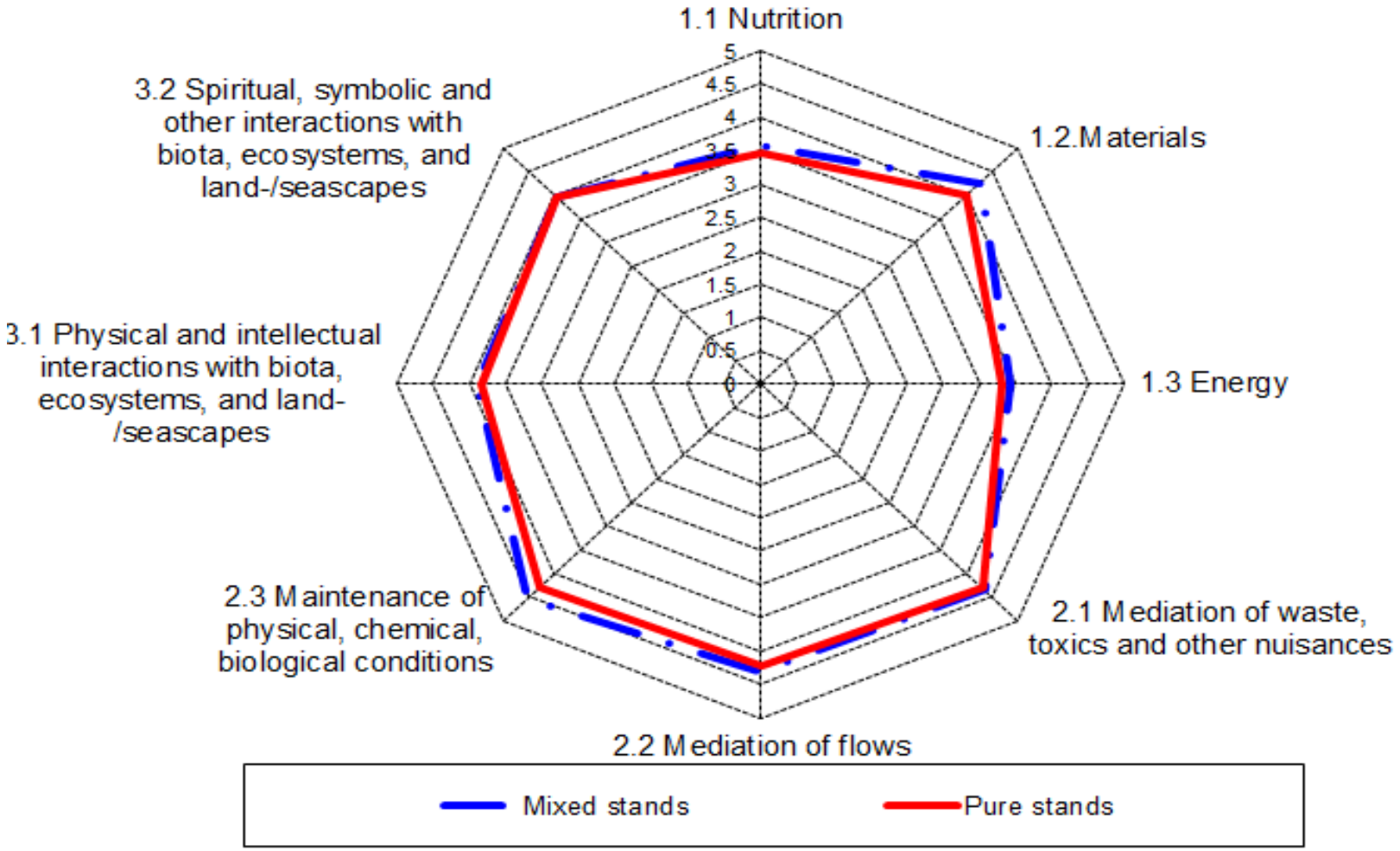
(CICES classification, Likert scale):



(*Zahvoyska and Pelyukh, 2015*)

PERCEPTION OF FES BY FOREST ENTERPRISE EMPLOYEES

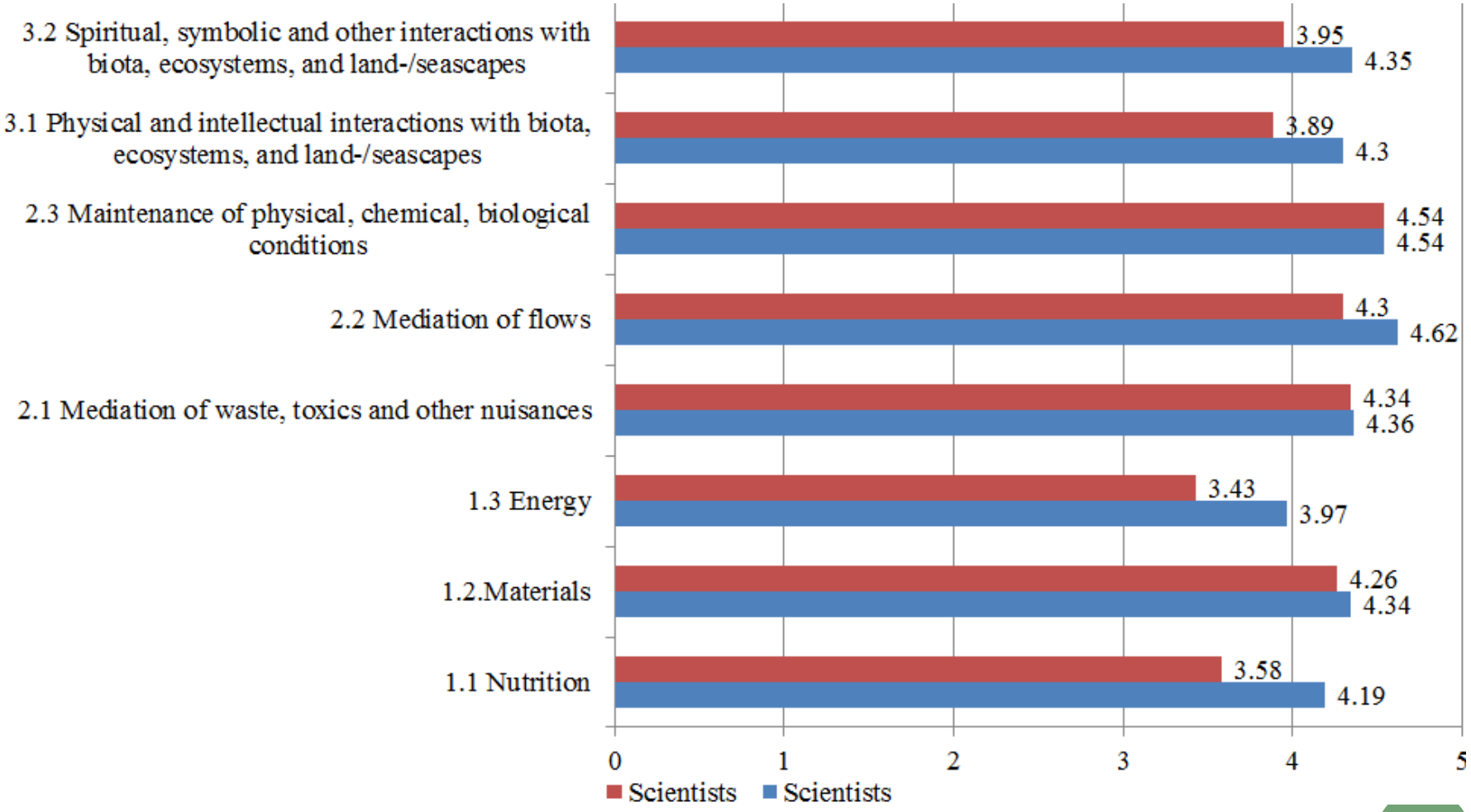
(CICES classification, Likert scale):



(*Zahvoyska and Pelyukh, 2015*)

COMPARISON OF PERCEPTIONS FES OF MIXED STANDS

(CICES classification, Likert scale):



(*Zahvoyska and Pelyukh, 2015*)

COMPARATIVE EVALUATION BY RESPONDENTS' OF FES PROVIDED BY PURE SECONDARY *VS.* MIXED STANDS (CICES, 2012) AND LIKERT SCALE

(*Zahvoyska and Pelyukh, 2015*)

COST-BENEFIT ANALYSIS (CBA)

- Hanley and Spash (1993), Cost-benefit analysis:

Cost of the project / activity is a reduction of the number or deterioration in the quality of goods and services available to the public or higher prices for them, that arises from the project;

- *FAO* and the *World Bank* recommend to use of CBA to examine the benefits of forest projects to society.

Initial data for the CBA of the project of conversion: Case study of the State enterprise "Rakhiv Forestry"

Location of the project:

- planted area of 1 ha
- *Picea abies* (L.) Karsten
- Rakhiv Forestry State Enterprise Shchaul forest enterprise, Ukrainian Carpathians.

Characteristics of the site:

- plantation age 62 years;
- general stock 302 m^3/ha;
- project implementation period - 80 years;
- Conversion process included selective thinning and target diameter harvest.

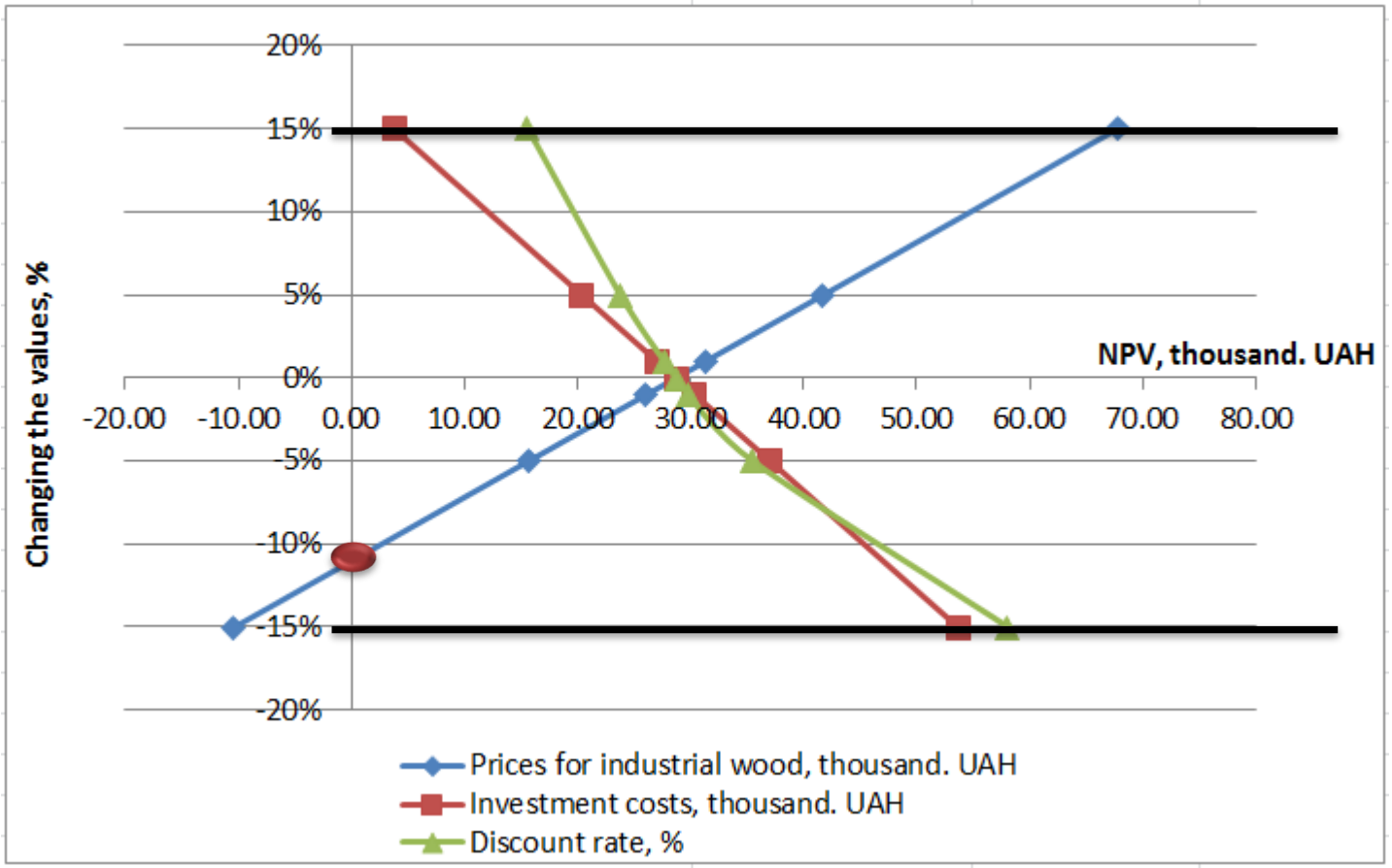
MAIN RESULTS OF THE EXTENDED COST-BENEFIT ANALYSIS OF THE FOREST CONVERSION

Shchaul forest enterprise

- Rate of discount d=10% for financial analysis and d=6% for economic analysis;
- In extended cost-benefit analysis such items were included:
  - Prevention of soil erosion
  - Avoided costs on forest biological protection
  - Benefits from carbon sequestration.

№	Type of analysis	Net present value, thousand. UAH	Internal rate of return, %	Payback period, years
1	Financial Analysis	1,94	12	31
2	Economic Analysis	10,40	31	5

SENSITIVE ANALYSIS OF THE PROJECT. THE SPIDER DIAGRAM



Conclusions

- Findings from this research provided indication that conversion of even-aged secondary spruce stands in the Ukrainian Carpathians into mixed, uneven-aged woodlands is likely a timely, complex and beneficial process.
- Benefits of the conversion are numerous and multifaceted. Mainly they strengthen each other and create synergies.
- However, the efficiency of conversion depends on a variety of factors, and first of all on the expertise of a staff who design and implement the conversion procedure and on availability of the investments.

REFERENCES

Carnus, J.M., Parrotta, J., Brockerhoff, E.G. et al., 2006. Planted forests and biodiversity. Journal of Forestry 104, 65-77.

Krynytskyy, G.T., Chernyavskyy, M.V., Derbal, Y.Y., 2014. Close to nature and multifunctional forest management in the Carpathian region of Ukraine and Slovakia. PE "Kolo", Yzhgorod.

Grilli, G., Paletto ,A., de Meo, I., 2014. Economic valuation of Forest Recreation in an Alpine Valley. Baltic Forestry 20(1), 167-175.

Haines-Young, R., Potschin, M., 2012. Common International Classification of Ecosystem Services (CICES, Version 4.1). European Environment Agency.

Hanley, N., Spash, C., 1998. Cost-Benefit Analysis and the Environment. Edward Elgar, Cheltenham.

Hensiruk, S.A., 1992. Forests of Ukraine. Naukova dumka, Kyiv.

Hildebrandt, P., Knoke, T., 2009. Optimizing the shares of native tree species in forest plantations with biased financial parameters. Ecological Economics, 68 (11), 2825-2833.

Kramarets ,V.A., Krynytskyy, H.T., 2009. Assessment and possible threats to the survival of the spruce forests of the Carpathians in connection with climate change. Scientific Journal of UNFU 19.15, 38-50.

Layard, R., Glaister, S., 1996. Cost-Benefit Analysis. Cambridge University Press, Cambridge.

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington.

Nijnik, M., Oskam, A., Nijnik, A., 2012. Afforestation for the provision of multiple ecosystem services: A Ukrainian Case Study. International journal of forestry research 1, 1-12.

Parpan, V.I., Shparyk, Y.S. et al., 2014. Forest management peculiarities in secondary Norway spruce (Picea abies (L.) H. Karst.) stands of the Ukrainian Carpathians. Proceedings of the Forestry Academy of Sciences of Ukraine 12, 178-185.

Pearce, D.W., Turner, R.K., 1990. Economics of natural resources and the environment. Harvester-Wheatsheaf.

Pretzsch, H., Biber, P., Schutze, G., Uhl, E., Rotzer, T., 2014. Forest stand growth dynamics in Central Europe have accelerated since 1870. [WWW Document]. Available from: http://www.nature.com/naturecommunications .

Pretzsch, H., Block, J., Dieler, J., 2010. Comparison between the productivity of pure and mixed stands of Norway spruce and European beech along an ecological gradient. Annals of Forest Science 67, 712–723.

Soloviy, I.P., Chernyavskyy, M.V., 2011. Ecological and economic assessment of transformation cutting in the context of close to nature forestry. Environmental, Economic and Social Impact of Inefficient and Unsustainable Forest Practices and Illegal Logging in Ukraine Proceedings of the International Scientific Conference. December 2–3, Lviv. Green Cross Society, Liga-Press, 219-224.

TEEB, 2010.The Ecological and Economic Foundations . P. Kumar (Ed.). Earthscan, London.

Zahvoyska L.D., 2015. Theoretical approaches to determining economic value of forest ecosystems services: benefits of pure stands transformation into mixed stands. Proceedings of the Forestry Academy of Sciences of Ukraine 12, 201-209.

Zahvoyska L., Pelyukh O., 2015. DPSIR approach as a tool for the forest decision-making. Proc. of the International Scientific and Practical Conference "Factors for sustainable development of the modern state in terms of innovative economy", Dnipropetrovsk, Ukraine. – P. 33-37.

Zahvoyska L., Pelyukh O., 2016. Comparative analysis of stakeholders' perceptions of services from pure and mixed stands in the context of ecosystem services paradigm. Proceedings of the1st International Scientific and Practical Conference, Rivne, Ukraine, 21-22 April 2016. – P. 157-159.

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Thank you for your attention!