Tab. S1 – Synoptic of changes in coppice management in connection with the system of values of human society**.**

	1940s -50s	**1960s**	**1960s-70s onwards**
Driver	Fossil fuel increased availability and affordability	Fuel-wood crisis coupled with rural and mountain depopulation.	Conflicting societal demands: urban citizen unaware of traditional rural practices and techniques, and attracted by the myth of "wilderness".
Effects on management	Release of pressure on coppices: increase of conventional rotations, cessation of litter and dead twigs/branches collection, decrease of grazing.	– Neglect of coppice woodlands or their transformation (mainly in the case of European beech) to compound coppices or conversion (through different approaches depending on the dominant species, but mainly through thinning in the case of beech) to high forest; – Increase of woodland area due to secondary succession occurring on former crop fields and meadows.	– Obstacles to coppice silviculture particularly in protected areas due to conservation measures. – Forest Service advice and later on several formal regional regulations towards restrictive prescriptions such as increase of rotations, release of a much larger number (140-200 instead of 50-60) of standard trees per hectare on cut areas, coupe size (1-10 hectares); – Convergence of management of public and private entrepreneurs.
Effects on forest structure and ecology	– Increase of stem sizes and of standing volumes per hectare; – Soil fertility enhancement; – positive effects on soil erosion control and stream-flow regulation.	– Enhanced competition of stools and stool shots particularly in low fertility sites, canopy closure and exclusion of shade intolerant species, increase of disturbance risk (e.g., fire, stand stability); – Unpredictable pathways of successional stages, depending on legacies and landscape structure.	Overstocking with standards, negatively affecting stools re-sprouting capacity and ultimately forest regeneration.
Effects on landscape structure and ecology	Positive effects on soil erosion control and stream-flow regulation.	– Convergence in forest structure leading to dominance of senescent woodlands and loss of the earlier stages of typical forest ecosystems; Challenges to future forest management for landscape governance (e.g., floods, soil erosion, and sedimentation control in river basins); – Woodland expansion and changes in landscape structure, unpredictable effects on meta-population dynamics of ungulates and top-carnivores (possible undesired effects on woodland ecology and conflicts generation).	Convergence in forest structure leading to dominance of senescent woodlands and loss of the earlier stages of typical forest ecosystems.
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Tab. S2 – Synoptic of novel approaches to coppice silviculture in Italy.

		Groups of standards selection	**Single-tree-oriented silviculture for coppices**	**Early and frequent thinning in sweet chestnut coppices**	***Governo misto* (Mixed management)**
Species		Oaks, mixed tree species woodlands	Oaks, beech, sweet chestnut, mixed tree species woodlands	Sweet chestnut woodlands	Oaks, beech, mixed tree species woodlands
Aims/Rationale		Ensure individual tree and stand mechanical stability, protect soil from erosion while providing sufficient light for stem growth, enhance tree species diversity while tending for more commercially valuable timber.	Tend a limited number of target standard trees for the production of large-diameter stems.	Combine production, socio-economic structure, historical values, ecological functionality.	Builds on the notion that both vegetative and regenerative reproducing trees may coexist in some unexploited forest in Europe (Koop 1987) which are thought to enhance forest resilience.
Operation		– Density and arrangement can be varied to account for terrain/site and stand, on average: 100 m2 groups of 25-30 individuals, - regularly spaced 15-20 m distance within the cut block (10-15% cover); – Groups should be bounded by the more mechanically stable trees and wherever possible include sporadic tree species.	Early selection of target trees, frequent crown thinning (*dètourage*), andmaintenance of selected trees free growth over the full rotation. Thinning applied at two main phases of stand development, i.e., qualification (selection of straight stems at maximum height growth) and sizing (differentiation of stem diameter increments and tree crowns). Thinning in the qualification phase is meant to control trees limiting the growth of target trees. Thinning (form above) during sizing is meant to maintain the crowns of target trees free.	– Increase of rotation time (from 12-24 to 30-50 years). – Selection and tending of stems by means of early (starting at the age of 10 years) and frequent (every 6-7 years on average) thinning from below at medium to high intensities.	– Modification to compound coppice silvicultural system (in which on the same stand coexist a coppice (18-24 rotation) and 3-5 cohorts of standards of different ages and of density decreasing with age e.g., Perrin 1954, Nyland 2002, Piussi & Alberti 2015). – Novel technical prescriptions relate to the criteria for both recruitment and cutting of standard trees. Standards density is established in such a way that their crown cover is approximately 40%, and they are distributed in at least 3 diameter classes (cf. Piussi & Alberti 2015). Selective cuttings are introduced for older cohorts of standards. Such a criterion can also be extended to the coppice component.
Advantages	**Stand level**	– Valuable alternative to individual and uniform distribution of standards, in within-site heterogeneous conditions; – Favours both standards and coppice sprouts growth, thereby enhancing quality and quantity of harvested products; – Promotes the creation of	– Maintain or enhance biodiversity (namely tree species diversity and stand structural diversity); – Increase the commercial value of standard trees; – Suits different types of ownership, and can be applied to localized but favourable areas as an integration to the traditional coppice system within	– Improvement of stand productivity and stability; – Functionally appropriate to the biological characteristics of sweet chestnut and its coppice dynamics (i.e. shade-intolerant, fast growing, active social organisation, and tendency to create even-aged structures);	– Sustainable management of overstocked coppices, as much as of secondary woodlands colonising former croplands and meadows; – Favours both standards and coppice sprouts growth, thereby enhancing quality and quantity of harvested products. Moreover, it offers the opportunity to produce large timber

		microhabitats for plants and animals, thus boosting the benefits induced by isolated standards (Joys et al. 2004, Bardant & Aubert 2007); – Reduction of soil depletion, as well of the damages to remaining trees and stumps, also through the easing of both timber and firewood extraction; – High transferability potential.	the stand; – Appropriate for overgrown coppices and transitions between coppice and high forests where sporadic species (e.g., Acer spp., Sorbus spp, Fraxinus spp., Prunus spp, Tilia spp.), characterized by low competitive ability, can take advantage of periodic thinning; – In young coppices this approach is useful to stimulate the growth and to improve good quality timber production.	– This approach can be effectively combined with the single-tree-oriented silviculture strategy for the selection of crop trees, where there is scope for the production of large-diameter and valuable stems.	trees with shorter production cycles than in even-aged high forests (in particular in the case of oaks); – Higher margins to management flexibility, particularly suited to irregular structure conditions and uncertain market and climate perspectives. Better compliance with the criteria of sustainable forest management (SFM) (Farrell et al. 2000); – Reduction of soil depletion, as well of the damages to remaining trees and stumps, also through the easing of both timber and firewood extraction.
	Landscape level	– Improved ecological functioning and environmental services; – Increase of landscape micro-heterogeneity as clearings alternated with covered areas in the same woodland development stage, increase plant and animal diversity in woodlands; – A shifting mosaic of groups can be created by recruiting different groups at the completion of one or more underwood cycles; – Some groups can indefinitely be retained as dead wood and biodiversity islands; – Mitigation of the visual impact of coppicing.	– Improved ecological functioning and environmental services; – Increase of landscape micro-heterogeneity (particularly in combination with group selection of standards) ; – Creates more articulated market conditions at landscape and regional levels; – Forest tree diversity also enhances aesthetic and tourist appreciation, particularly during Spring and Autumn.	– Improved ecological functioning and environmental services; – Increase of landscape micro-heterogeneity (particularly in combination with group selection of standards); – Creates more articulated market conditions at landscape and regional levels; – Lengthening of rotation time has the potential to increase carbon storage and enhance the aesthetic value.	– Improved ecological functioning and environmental services; – Increase of landscape micro-heterogeneity (particularly in combination with group selection of standards). In mixed management in addition – About 50% of canopy is permanent, as in uneven-aged high forest.

Challenges		Qualified manpower and an efficient forest road network are a precondition.	– Suits the best conditions within a site (e.g. high fertility, potential for dispersal and establishment of sporadic tree species); – Qualified manpower in all operation phases and an efficient forest road network are a precondition.	– This is not an extensive silvicultural method but instead suits high fertility sites, with a sufficient stools stocking; – Qualified manpower and an efficient forest road network are a precondition.	– Not suitable for small holdings (< 5000 m^2) and for self-consumption; – Qualified manpower and an efficient forest road network are a precondition.
Reference Project/Norm		LIFE99 ENV/IT/000003 "SUMMACOP: Sustainable and multifunctional management of Umbria coppices".	LIFE09 ENV/IT/000087 "P.Pro.SPO.T.: Policy and Protection of Sporadic tree species in Tuscany forests".	FP4-INCO IC15980149 "CHESUD: Integrated study of factors involved in degraded chestnut forest in Central and Mediterranean Europe. Biological criteria for a sustainable development".	Piemonte Regional Forest Law 4/2009 "management and economic promotion of forests.
Project/Norm main results		LIFE99 ENV/IT/000003 [online 15 February 2016] URL: http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.createPage&s_ref=LIFE99%20ENV/IT/000003&area=2&yr=1999&n_proj_id=1302&cfid=34228&cftoken=f9e7618a3a201a08-90DBC9FB-C741-EBE3-AA3EEFE2E8A09920&mode=print&menu=false – Approach adopted within regional legislation of the Marche (D.G.R. 2585 of 21/11/01) and Umbria Regions (D.G.R. 1622/02); – Increase of woody species diversity.	LIFE09 ENV/IT/000087 [online 15 February 2016] URL: http://www.pprospot.it/english-products.html – Typical values for the silvicultural parameters, e;g;, return period for tree-oriented thinning, duration of transition period, and the number of target trees per hectare to be initially selected and target tree yield when the tree-oriented silviculture is fully operative; – 800 ha of forest managed according to the methodology; – 80 ha demonstration areas established to improve sporadic species; – Reports on: timber market for sporadic species; assessment of regional rules on forest protection; monitoring of silvicultural interventions; bird populations;	– Successful in the recovery of neglected woods with overstood stools and in maintaining a balanced dominant cohort. functionally responding to the biological characteristics of this species and coppice dynamics (i.e. shade-intolerant, fast growing, active social organisation, and tendency to create even-aged structures).	– Conservation measures for Natura 2000 sites in Piemonte prescribe mixed management to coppice; – This silvicultural approach is mandatory for oak coppices in this kind of sites; – A ten year long implementation of mixed management in European oak-hornbeam forest habitat types (9160 according to the EU Habitats Directive Annex I) within a Natura 2000 site (IT1120002 "Bosco della Partecipanza di Trino Vercellese") has proved effective in enhancing soil fertility and in controlling the invasion of black locust (Robinia pseudoacacia L.).

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Fig S1 – Neglected coppice woodland (Photo: Pelleri).

Fig. S2 – Conversion to high forest (Photo: Pelleri).

Fig. S3 – Spatial arrangement of standard trees: (a) uniform distribution; (b) group distribution (Photos: Pelleri).

Fig. S4 - Example of group standards selection in Umbria carried out during the SUMMACOP_LIFE III Project. Changes in crown cover from 2001 (a) to 2010 (b) are represented.

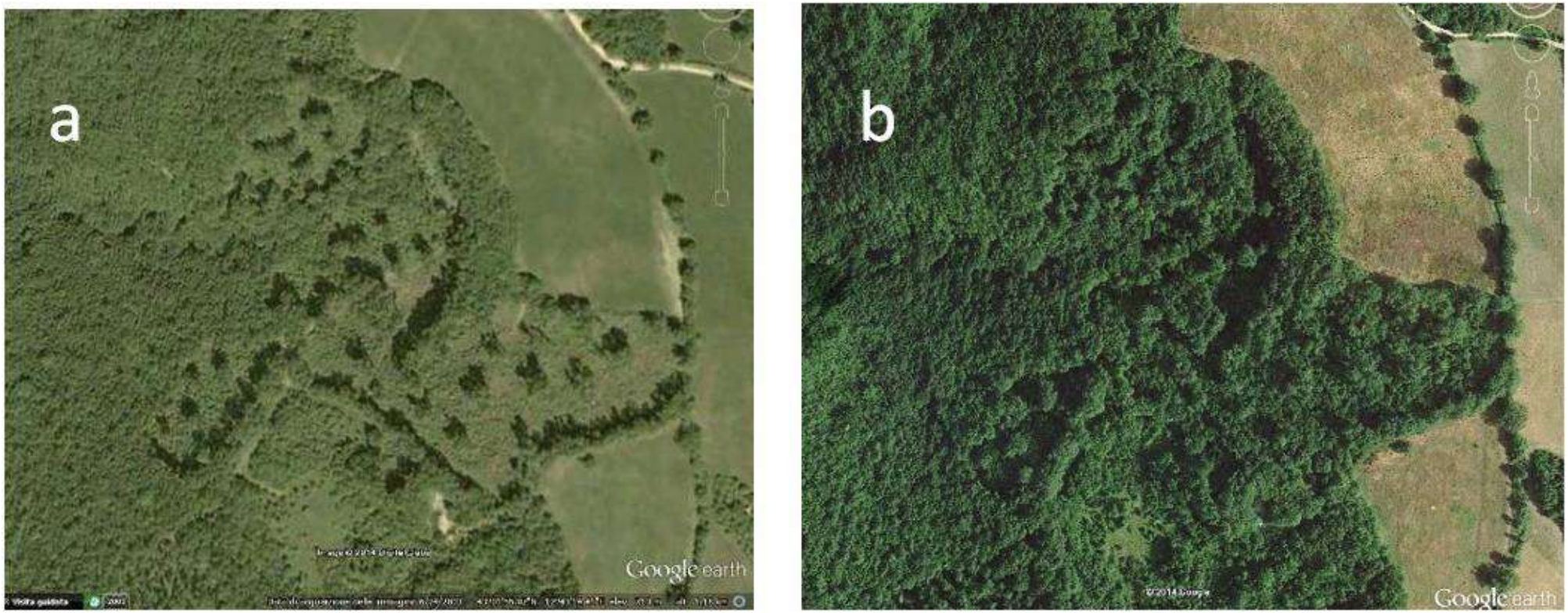

Fig. S5 – Single tree silviculture in coppice woodlands: a) example of target single tree in coppice (Photo woodland Pelleri); b) crown thinning scheme for target trees (courtesy Mori et al. 2014).

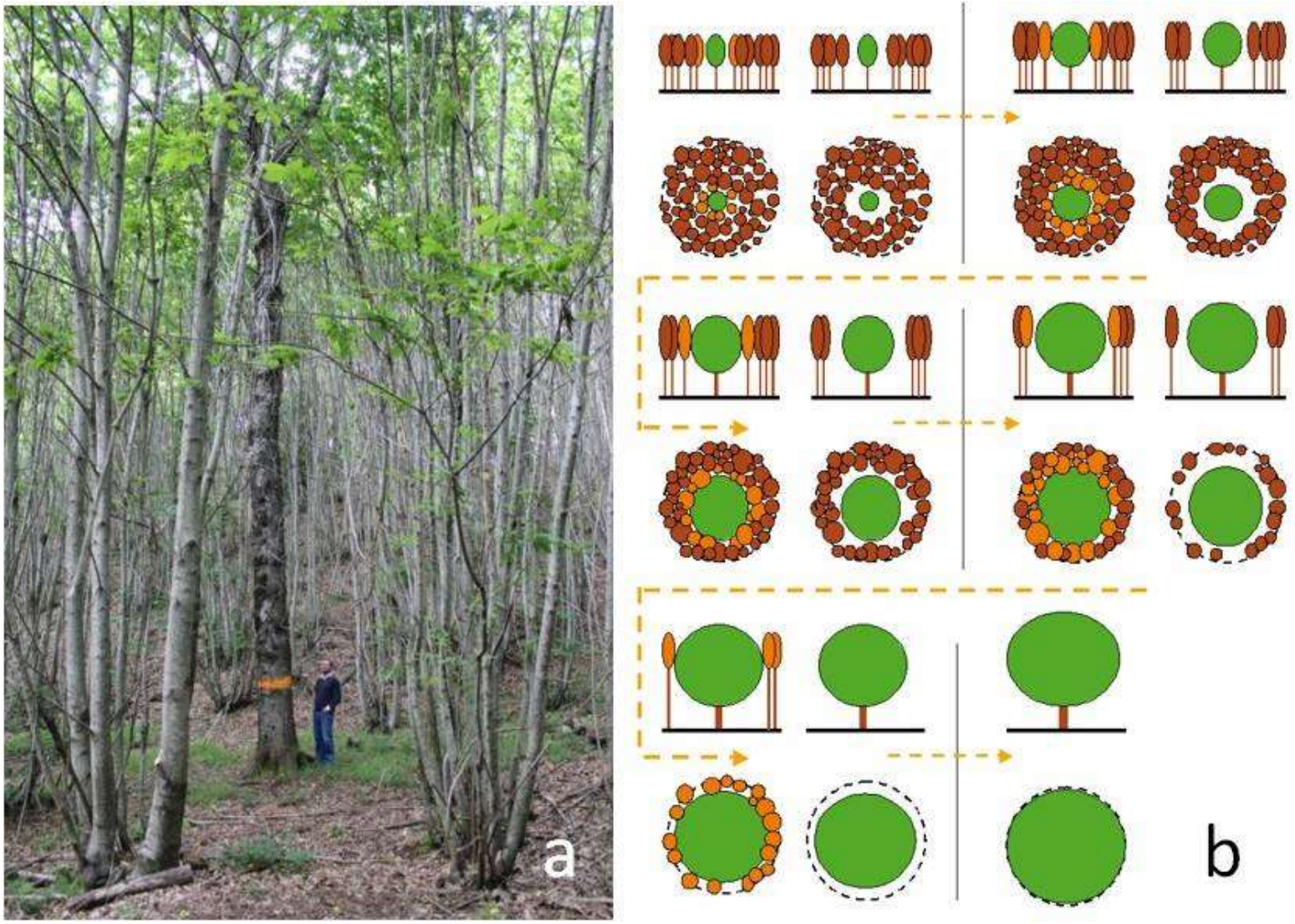

Fig. S6 - Novel silvicultural systems for sweet chestnut coppices, structure of the stands at: a) 10 years, b) 30 years and c) 50 years (Photos Manetti).