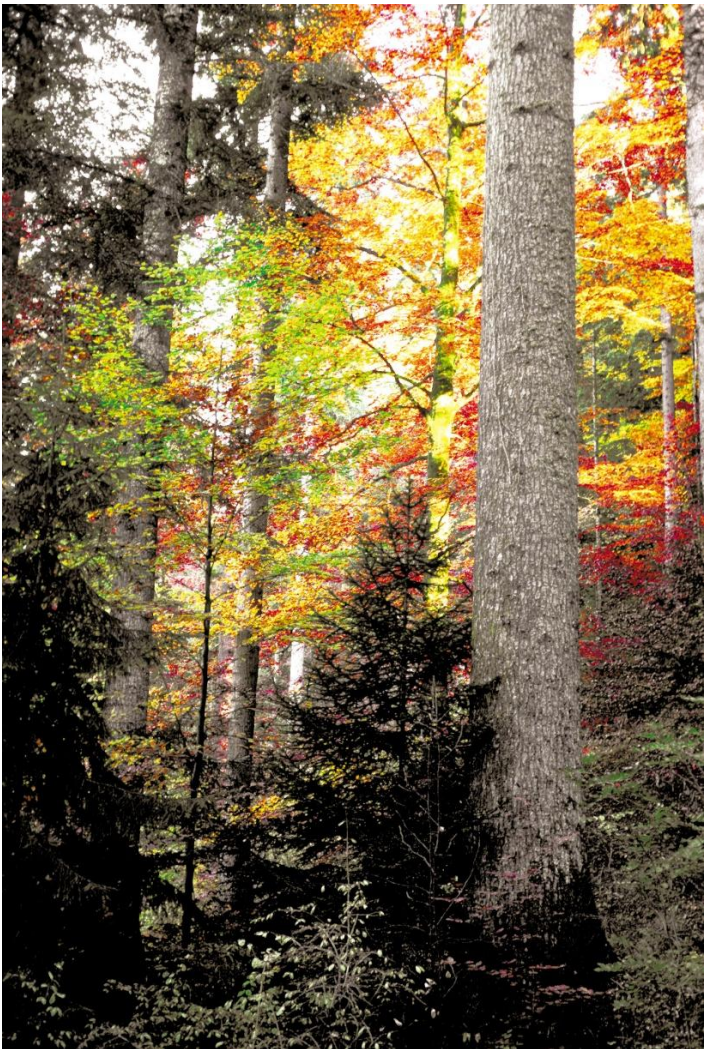
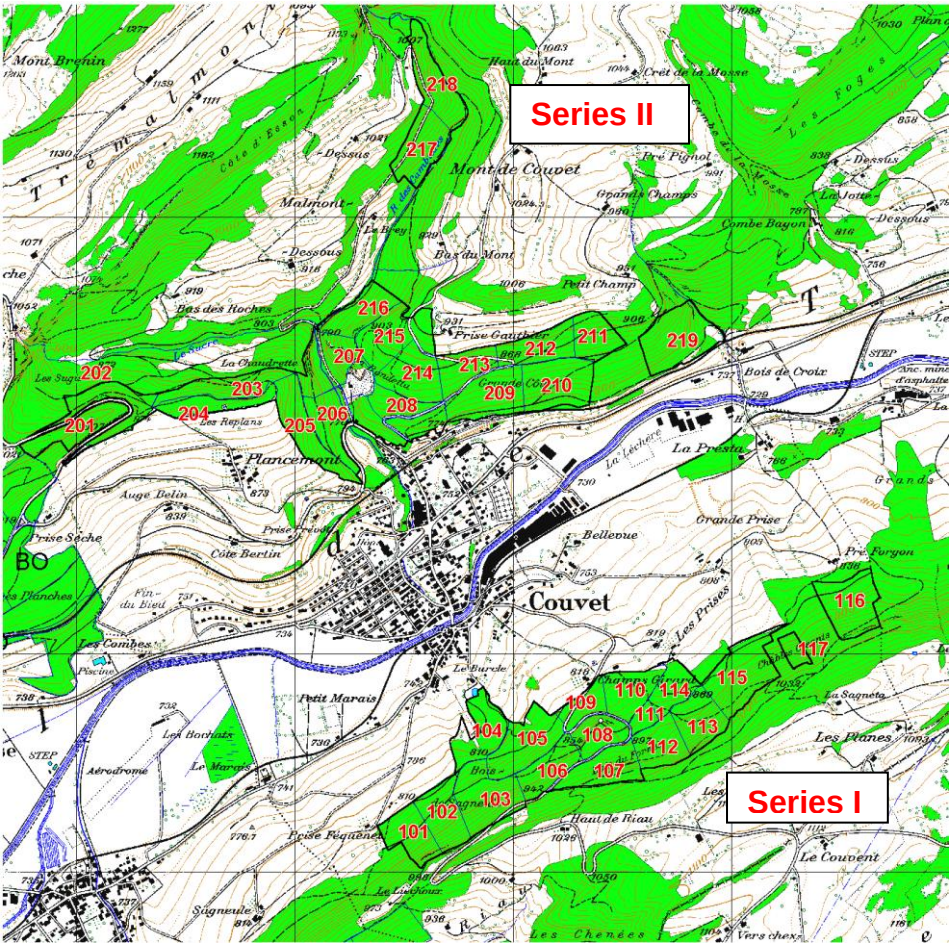
CLASSICAL PLENTER SYSTEM AND CONTROL METHOD IN THE COMMUNAL FORESTS OF COUVET



Canton Neuchatel **Forest District of Val-de-Travers**

Situation map and compartments

scale 1 : 35'000



1. SILVICULTURAL METHODS

1.1 Previous Management

Until 1869 most forests in the Canton of Neuchatel, as also the forests of Couvet, were used in a very extensive fashion. The method in use was a primitive form of selection cutting, whereby simply the largest trees were harvested, with no thought for silvicultural considerations. Forest management was in the hands of the communal authorities. Feeling unsure, the authorities already sought the advice of the public forestry service.

The first Forest Act of Canton Neuchatel, dating from 1869, installed a forest management system and attempted to obtain some sort of order in forest exploitation. The forestry service, inspired by the classical methods applied in Germany at the time, started converting the forests into even-aged stands by regeneration cuts (clear-strip system). Luckily, apart from a small area, the forests of Couvet were not submitted to this treatment, the reason being that the stand structure – with old-growth reserves distributed all over the area – was not suitable for a rapid change in management.

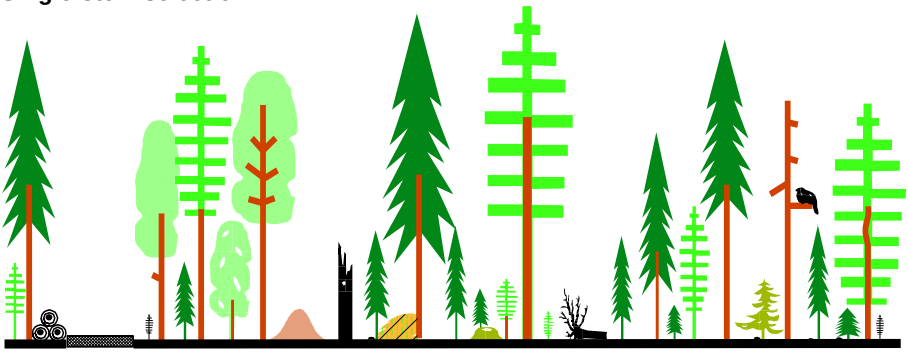
1.2 Present Silvicultural Methods

From 1881 onwards – on initiative of an eminent forester, Henri BIOLLEY – the classical German silvicultural methods were completely abandoned to be replaced by a management system inspired by the laws of nature: the selection system that was later improved to become what is now known as the classical plenter system.

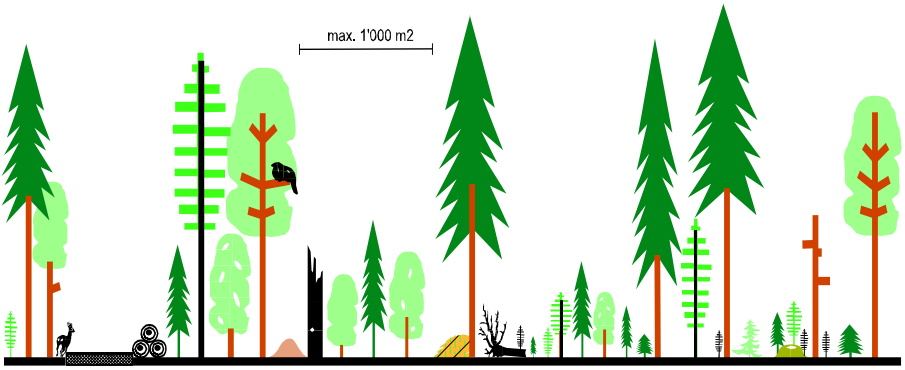
At that time, the forests of Couvet were a mosaic of more or less irregular and mixed stands, but also of even-aged stands. Henri BIOLLEY immediately began converting them into selection forests. This process that started in 1881 has not been completed up to this day; it is a task that takes a long period of time. Yet gradually selection-type forests are being established in all compartments.

The silvicultural method using the plenter system, as applied in Couvet, does not follow rigid rules. It varies according to circumstances, depending on the site, origin and structure of a stand, but also on the stage of growth. Whereas single-stem selection is the most common (i.e. cuts of low intensity on large areas at intervals of 6-8 years), the silviculturist and manager may sometimes also resort to group selection in order to favour natural regeneration.

Single-stem selection



Group selection



Grandeur des ouvertures laissant la place de 5 à maximum 20 perches candidates regroupées.

The size of the gaps leaves room for a group of 5-20 stems of pole wood at most.

2. FOREST MANAGEMENT

2.1 Control Method

The control method was developed by the French forester GURNAUD. It was put into practice in the forests of the Travers Valley by Henri BIOLLEY. It was chosen as being the most suitable as a guide to silvicultural management and most of all as a means to verify the results of the conversion into selection stands at regular intervals.

The most important elements of the control method are:

- **full callipering of all stands (100% cruise)**
- **before harvest, measurement on standing tree**
- **use of a single standard tariff for volume determination**
- **delimitation into permanent compartments.**

The control method was first introduced in Couvet in 1890. These communal forests are therefore rightfully considered as the cradle of the controlled classical plenter system. The methods and techniques used have remained unchanged for over a century. The information gathered is therefore of great value, as it allows direct comparisons.

The classical plenter system and the control method are closely linked. The judicious use of both these techniques is the surest way of reaching the management objectives.

2.2 Management Objectives

BIOLLEY clearly defined the management objectives. They are to produce

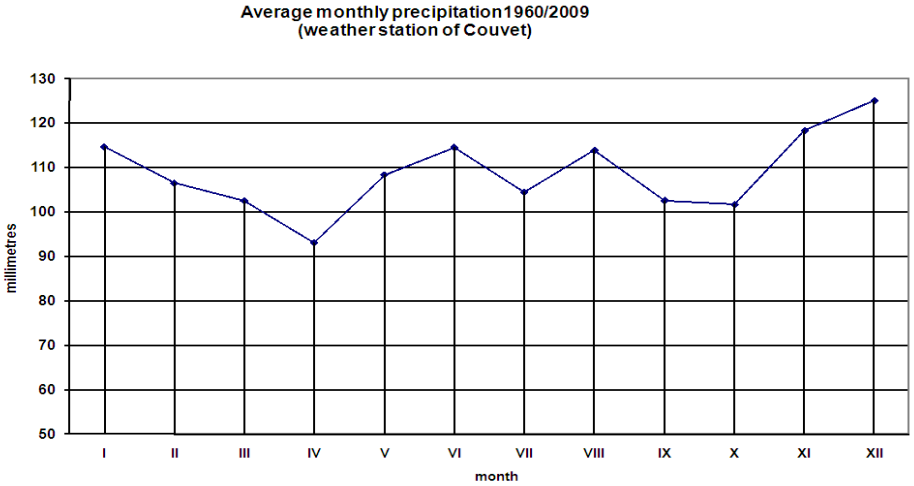
- **continuously**
- **the highest possible quantity**
- **in the best possible way / with the highest possible quality**

using the resources provided by nature – soil, atmosphere and stand (the "forestry triptych").

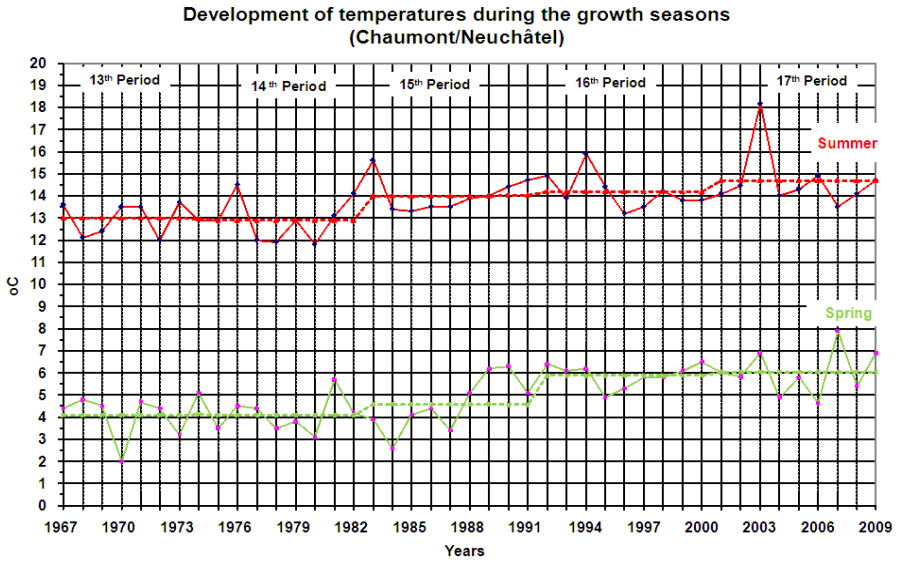
Optimising production and seeking a maximum of benefits (multiple uses of forests) are still the main objectives of a modern high quality silvicultural management (sustainable forest management).

3. GENERAL INFORMATION

3.1 Climate



During these 30 last years, the climate warming in Val-de-Travers is undeniable.The mean periodical temperature has increased of nearly 2,0 ^{o}C during the vegetation period.



annual precipitation : 1'300 mm (average 1960/2009)
mean annual temperature: 7,0 °C
vegetation period: relatively short (approx. 5 months and a half)

3.2 Forest Area

Starting with 138 ha in 1890, the communal forests of Couvet now cover a total of 180 ha, divided into two management areas (series), corresponding to the two sides of the valley.

To ensure objectivity, the following comparisons refer uniquely to the initial forest area of 138 ha.

3.3 Series I (south of the village)

Area: 55 ha divided into 13 compartments (without the acquisitions made since 1890).

Location: north-facing slope, of medium gradient in the bottom half, but steep and even precipitous in the upper half.
altitude from 760 to 1020 m.

Geological substrate :
molasse covered by glacial deposits from the Alps in the lower part;
Upper Jurassic (Malm) partially covered by calcareous scree material in the upper part.

Soil: carbonated humous soil and rendzina in higher altitudes

Natural forest communities:
Abieti-Fagetum petasitetosum and elymetosum until 900 m above sea level;
Dentario-Fagetum between 900 and 1000 m above sea level.

3.4 Series II (north of the village)

Area: 83 ha divided into 16 compartments (without the acquisitions made since 1890).

Location: slope mostly south-facing, inclination ranging from medium to steep with rocky escarpments;
altitude from 770 m to 1060 m.

Geological substrate: Upper Jurassic and Cretaceous

Soil : calcareous brown soil

Natural forest communities:
south-facing: Dentario-Fagetum
south-west facing: Carici-Fagetum
east-facing: Abieti-Fagetum festucetosum and Adenostylo-Fagetum

4. DEVELOPMENT OF STANDS IN MANAGEMENT SERIES I

4.1 Development Table

Standing stock and size classes

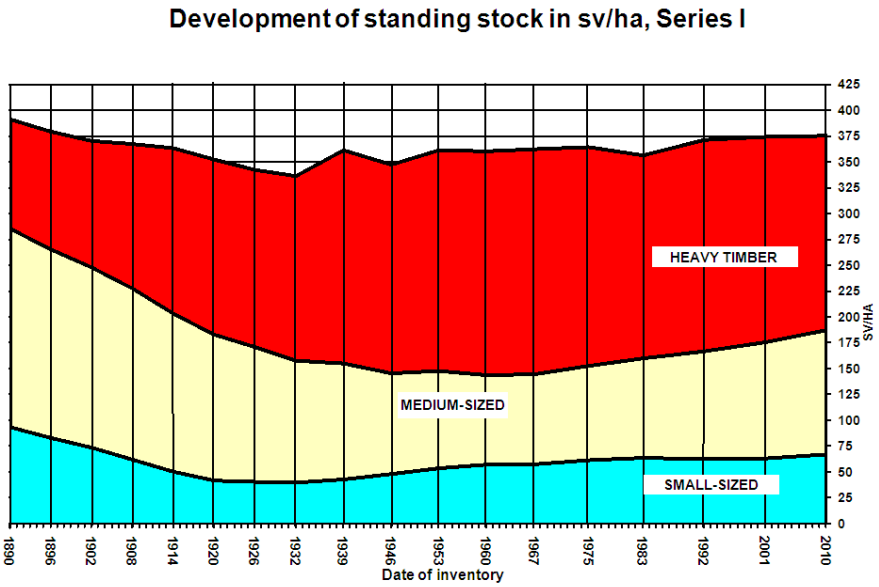
inventory date	1890	1896	1902	1908	1914	1920	1926	1932	1939	1946	1953	1960	1967	1975	1983	1992	2001	2010
standing stock in sv/ha	**392**	**380**	**371**	**368**	**364**	**353**	**343**	**337**	**362**	**348**	**362**	**361**	**363**	**365**	**357**	**372**	**375**	**376**
number of stems/ha	**354**	**336**	**305**	**279**	**251**	**229**	**219**	**212**	**216**	**218**	**232**	**240**	**246**	**253**	**253**	**259**	**266**	**274**
average stam sv	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.4	1.4	1.4	1.4	1.4
small-sized wood in % of vol.	**24**	**22**	**20**	**17**	**14**	**12**	**12**	**12**	**12**	**14**	**15**	**16**	**16**	**17**	**18**	**17**	**17**	**18**
medium-sized wood in % of vol.	**49**	**48**	**47**	**45**	**42**	**40**	**38**	**35**	**31**	**28**	**26**	**24**	**24**	**25**	**27**	**28**	**30**	**32**
heavy timber in % of vol.	**27**	**30**	**33**	**38**	**44**	**48**	**50**	**53**	**57**	**58**	**59**	**60**	**60**	**58**	**55**	**55**	**53**	**50**
fir in % of number of stems	58	59	60	59	59	59	58	57	56	54	55	54	55	56	56	53	**50**	**50**
spruce in % of number of stems	42	41	40	38	37	36	35	35	34	32	29	27	25	24	24	24	**26**	**26**
deciduous sp. in % of number	0	0	0	3	4	5	7	8	10	14	16	19	20	20	20	23	**24**	**24**
fir in % of volume	67	67	66	67	66	65	65	63	63	62	62	62	62	61	60	58	**55**	**56**
spruce in % of volume	33	33	34	32	32	33	33	34	33	33	32	30	30	31	31	30	**30**	**27**
deciduous sp. in % of volume	0	0	0	1	2	2	2	3	4	5	6	8	8	8	9	12	**15**	**17**

Key: small-sized wood — diameter categories 20-25-30 cm
medium-sized timber — diameter categories 35-40-45-50 cm
heavy timber — diameter categories 55 cm and above

callipering threshold: 17.5 cm
diameter classes of 5 cm
sv (sylve): unit of volume for standing timber

4.2 Standing Stock

The standing stock was progressively reduced from 392 sv/ha in 1890 to 352 sv/ha in 1932. This was necessary in the course of conversion to selection forests. The varied structure having been obtained, the standing stock was slowly and gradually increased. It reached its optimum in 1953 (362 sv/ha). Since then the silviculturists have deliberately stopped this increase in order to ensure permanent natural regeneration.



The marked increase in standing stock as measured in 1992 (372 sv/ha) is the result of a remarkable and unexpected growth in stands which at that time were already showing certain signs of decline. The spectacular current increment between 1992 and 2009 did not allow the standing stock to be reduced to the level of 360 sv/ha determined for Series I.

4.3 Distribution in Size Categories

The distribution in size categories has considerably changed since 1890. Whereas small-sized wood fell from 24% to 18%, and medium-sized timber from 49% to 32%, heavy timber increased from 27% to 50%.

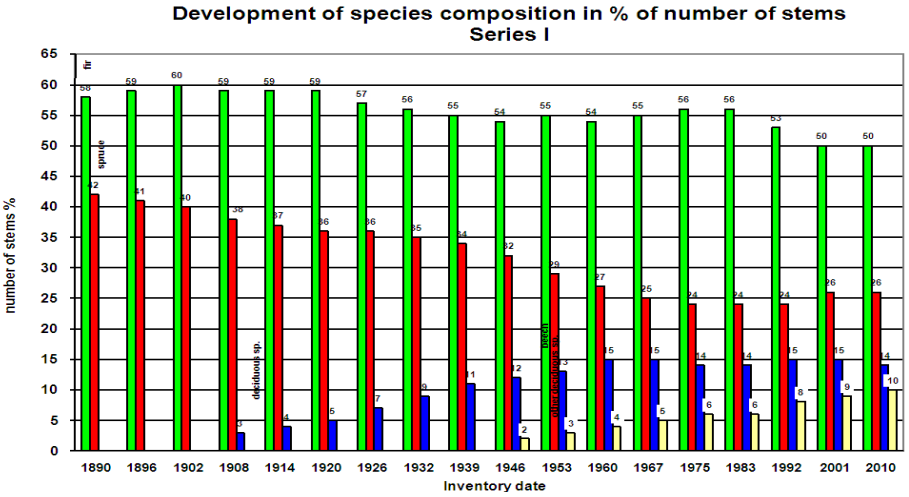
The predominance of heavy timber can be explained by the fact that in selection forests the increment increases with growing diameter. Up to this day the financial return from heavy timber justified the increase in this size category. For the last fifteen years however the forest manager and silviculturist has intensified the cuts of very heavy timber (∅ 80 cm and above) in response to the present market demands for medium-sized timber. The proportion of heavy timber has thus dropped from 60% to 50%.

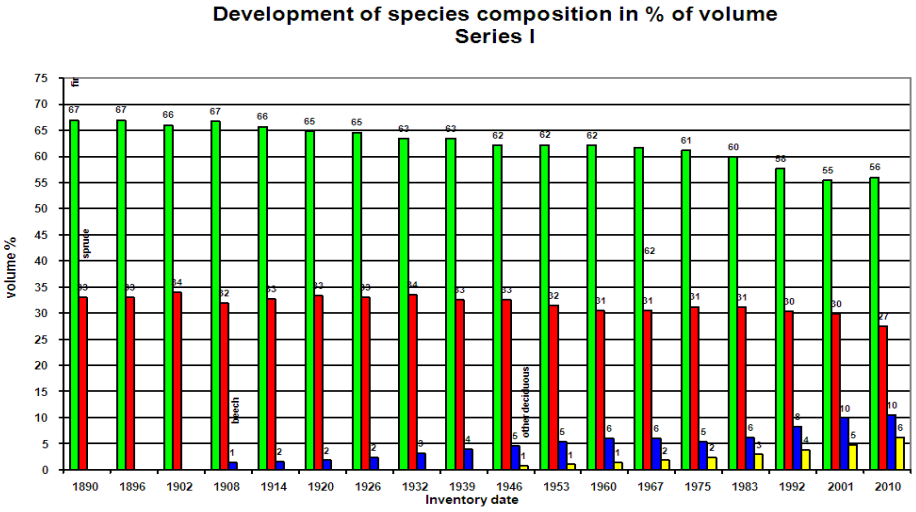
The determination of the optimal distribution in size categories and the establishment of the right proportions are the two major challenges facing the forest manager. Theoretically a balance will be reached when the renewal of each size category is ensured by a continuous and regular ingrowth and when production can not be further improved in quantity and quality by increasing the standing stock. The fluctuations in increment interfere with this and make matters very complex.

4.4 Species Composition

The share of beech and of other deciduous species has been progressively increased to improve biological activity in the soil and to ensure the good functioning of the eco-system. It has now reached 24% of the stems and 17% of the volume. This development took place at the expense of fir (principal species) and of spruce, for which the good conditions for growth on this shady north-facing slope are due to the practice of group selection.

Within 120 years, the relative share of fir/spruce/beech has changed from 67/33/0% to 56/27/17% as related to volume, and from 58/42/0% to 50/26/24% as related to number of stems.





4.5 Increment

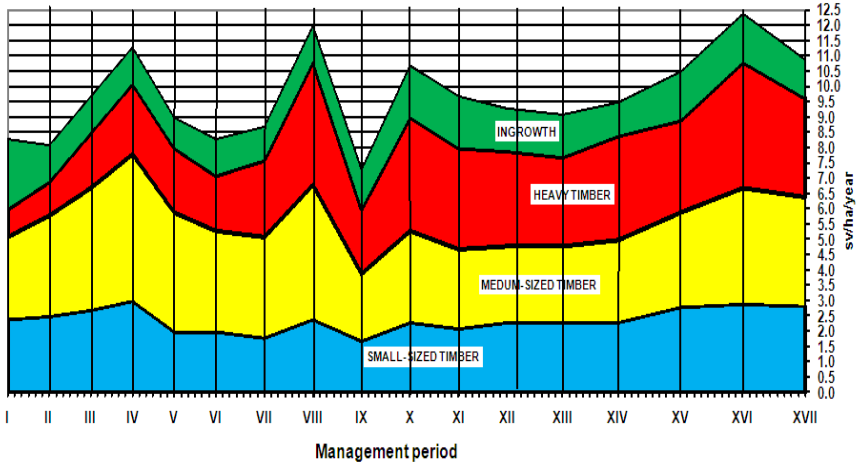
Current increment and yield in sv/ha/a (1890 to 2009)

Management period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
increment small-sized wood	2.4	2.5	2.7	3.0	2.0	2.0	1.8	2.4	1.7	2.3	2.1	2.3	2.3	2.3	2.8	2.9	2.8
increment medium-sized timber	2.7	3.3	4.0	4.8	3.9	3.3	3.3	4.4	2.2	3.0	2.6	2.5	2.5	2.7	3.1	3.8	3.6
increment heavy timber	0.9	1.1	1.8	2.3	2.1	1.8	2.5	4.0	2.1	3.7	3.3	3.1	2.9	3.4	3.0	4.1	3.2
current increment	**6.0**	**6.9**	**8.5**	**10.1**	**8.0**	**7.1**	**7.6**	**10.8**	**6.0**	**9.0**	**8.0**	**7.9**	**7.7**	**8.4**	**8.9**	**10.8**	**9.6**
in % of initial volume	1.6	1.8	2.3	2.7	2.2	2.0	2.2	3.2	1.7	2.7	2.2	2.2	2.1	2.3	2.5	2.9	2.6
ingrowth	**2.3**	**1.2**	**1.2**	**1.2**	**1.0**	**1.2**	**1.1**	**1.2**	**1.3**	**1.7**	**1.7**	**1.4**	**1.4**	**1.1**	**1.6**	**1.6**	**1.3**
total increment	**8.3**	**8.1**	**9.7**	**11.3**	**9.0**	**8.3**	**8.7**	**12.0**	**7.3**	**10.7**	**9.7**	**9.3**	**9.1**	**9.5**	**10.5**	**12.4**	**10.9**
harvest aim	7.3	8.2	7.9	9.6	10.5	9.7	10.2	8.8	9.1	9.7	9.1	10.6	10.6	10.6	9.2	9.3	10.5
effective yield	10.5	9.4	10.3	11.7	11.0	10.2	9.8	8.3	9.4	8.5	10.0	9.0	8.9	10.5	9.8	11.6	10.8

During the past 120 years the current increment of the initial stock varied between 6,0 et 10,8 sv/ha/a (8,4 sv/ha/a on average). Additionally there has been an average in-growth of 1,4 sv/ha/a. The disturbed balance between game population and forest vegetation, caused by the over-abundance of roe deer since 1970, has not yet had any effect on renewal, but this will certainly soon be noticeable.

The total average increment of the stands in Series I is of 9,8 sv/ha/a.

Annual increment in sv/ha/a, Series I



5. Stand Development in Management Series II

5.1 Development Table

Standing stock and size classes

inventory date	1890	1896	1902	1908	1914	1920	1926	1932	1939	1946	1953	1960	1967	1975	1983	1992	2001	2010
standing stock in sv/ha	**232**	**246**	**255**	**257**	**265**	**265**	**269**	**269**	**275**	**269**	**276**	**284**	**293**	**301**	**310**	**332**	**354**	**364**
number of stems/ha	307	320	314	294	278	264	266	268	256	249	251	255	264	281	291	301	313	308
average stam sv	0,8	0,8	0,8	0,9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	0,9	1.1	1.1	1.1	1.2
small-sized wood in % of vol.	**43**	**39**	**36**	**32**	**28**	**26**	**25**	**26**	**24**	**24**	**23**	**22**	**23**	**24**	**24**	**23**	**23**	**21**
medium-sized wood in % of vol.	**49**	**51**	**53**	**53**	**54**	**53**	**52**	**49**	**48**	**47**	**45**	**43**	**42**	**40**	**40**	**39**	**38**	**39**
heavy timber in % of vol.	**8**	**10**	**11**	**15**	**18**	**21**	**23**	**25**	**28**	**29**	**32**	**35**	**35**	**36**	**36**	**38**	**39**	**40**
fir in % of number of stems	22	20	22	24	24	25	25	24	25	28	32	36	39	43	42	42	42	**43**
spruce in % of number of stems	60	60	57	52	50	48	47	46	44	40	34	31	28	25	23	21	19	**18**
deciduous sp. in % of number	18	20	21	24	26	27	28	30	31	32	34	33	33	32	35	37	39	**39**
fir in % of volume	29	27	28	31	31	32	33	33	32	33	38	36	38	40	40	42	43	**46**
spruce in % of volume	59	60	59	55	54	52	49	47	46	44	37	40	38	38	37	33	30	**27**
deciduous sp. in % of volume	12	13	13	14	15	16	18	20	22	23	25	24	24	22	23	25	27	**27**

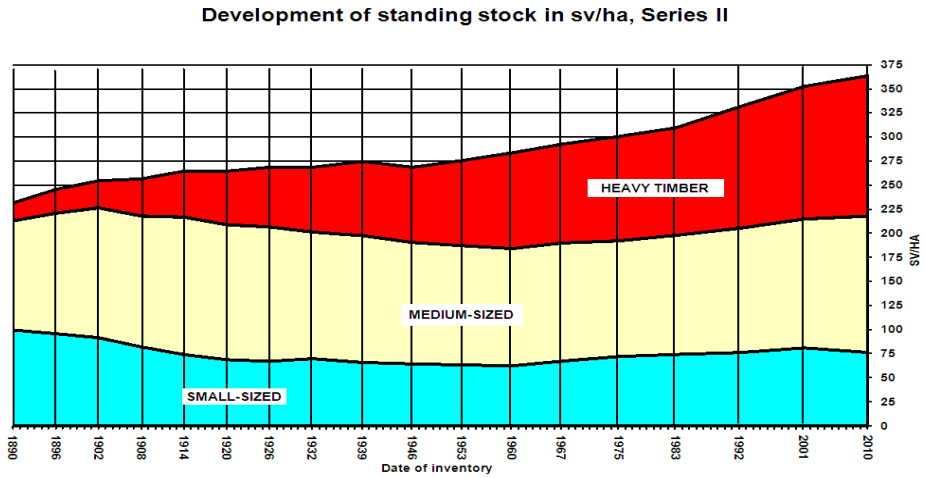
Key: small-sized wood — diameter categories 20-25-30 cm
medium-sized timber — diameter categories 35-40-45-50 cm
heavy timber — diameter categories 55 cm and above

callipering threshold: 17.5 cm
diameter classes of 5 cm
sv (sylve): unit of volume for standing timber

5.2 Standing Stock

The standing stock has been progressively increased from 232 sv/ha in 1890 to 364 sv/ha at the present time. This is certainly above the optimal balance. The increase in standing stock has been accelerated by the spectacular current increment in the last management period.

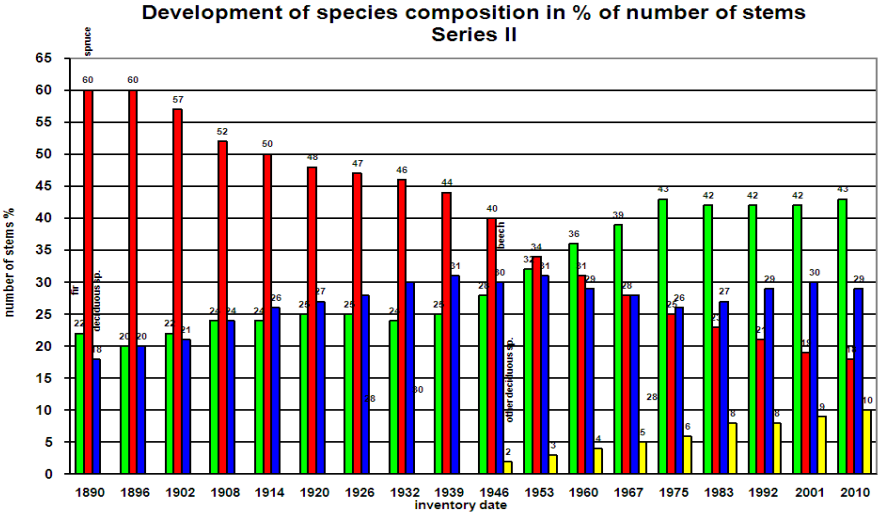
Until 1856 the greater part of Series II was wooded pasture and forests open to grazing by cattle. The objective of silvicultral treatment was to convert this patchy forest, in which numerous spruce trees were affected by rot, into a selection forest. For sanitary reasons it has been necessary to temporarily reduce the proportion of spruce, and replacing it with deciduous species and fir.

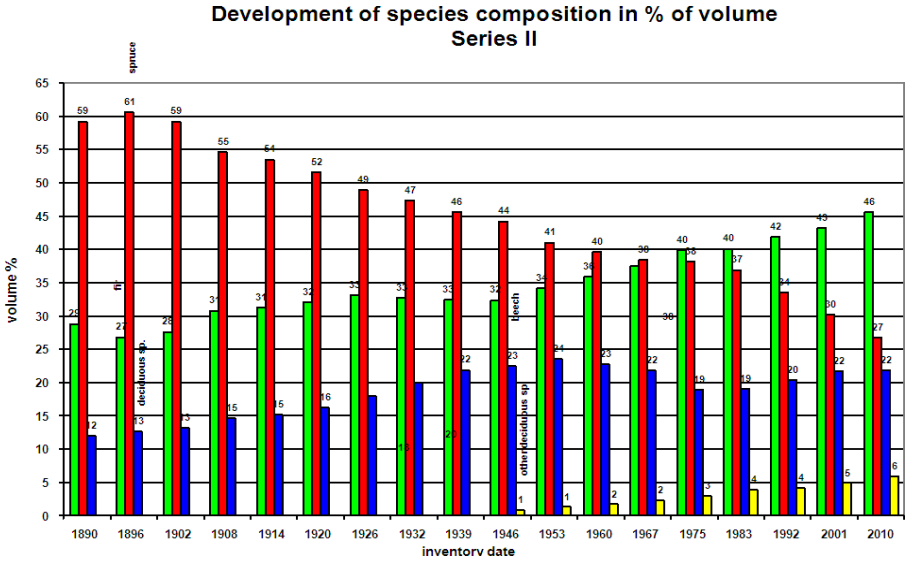


5.3 Distribution of Size Categories

In this series the proportion of small-sized wood has decreased from 43% to 21%, the medium-sized timber from 49% to 39%. Heavy timber has increased from 8% to 40%. The balance between size categories has been almost reached here; the situation must however still be improved in a number of compartments. The proportion of heavy timber is less high than in Series I because of the far less favourable site conditions.

5.4 Species Composition





Since management began the ratio of beech and other deciduous trees has doubled both in relation to number (from 18% to 39%) and to volume (from 12% to 28%). The group selection system has permitted an increase in the proportion of beech and of other light-demanding species, which are of cultural as well as of economic significance in this series.

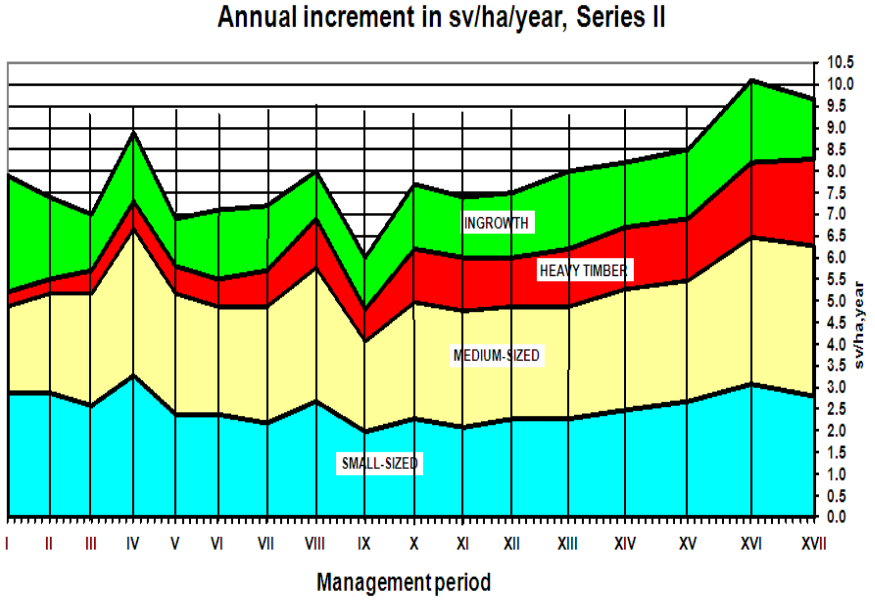
5.5 Increment

The increment of the initial stock has varied between 4,8 and 8,3 sv/ha/a (6,4 sv/ha/a on average). The increase in standing stock led to an appreciable rise in wood production, without any negative effects on regeneration. The development of the current increment is analogous in both management series.

With an average ingrowth of 1,6 sv/ha/a the regeneration of these stands seem to be ensured. Yet appearances are deceptive; an entire generation of young firs and maples are disappearing because of browsing by deer. In a couple of decades this will lead to a decrease in ingrowth.

Current increment and yield in sv/ha/a (1890 to 2009)

Management period	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
increment small-sized wood	2.9	3.1	2.6	3.3	2.4	2.4	2.2	2.7	2.0	2.3	2.1	2.3	2.3	2.5	2.7	3.1	2.8
increment medium-sized timber	2.0	2.3	2.6	3.4	2.8	2.5	2.7	3.1	2.1	2.7	2.7	2.6	2.6	2.8	2.8	3.4	3.5
increment heavy timber	0.3	0,3	0,5	0,6	0,6	0,6	0,8	1.1	0,7	1.2	1.2	1.1	1.3	1.4	1.4	1.7	2.0
current increment	**5.2**	**5.7**	**5.7**	**7.3**	**5.8**	**5.5**	**5.7**	**6.9**	**4.8**	**6.2**	**6.0**	**6.0**	**6.2**	**6.7**	**6.9**	**8.2**	8.3
in % of initial volume	2.2	2.2	2.2	2.8	2.3	2.1	2.1	2.5	1.7	2.3	2.1	2.1	2.1	2.2	2.2	2.5	2.3
ingrowth	**2.7**	**1.9**	**1.3**	**1.6**	**1.1**	**1.6**	**1.5**	**1.1**	**1.2**	**1.5**	**1.4**	**1.5**	**1.8**	**1.5**	**1.6**	**1.9**	**1.4**
total increment	**7.9**	**7.6**	**7.0**	**8.9**	**6.9**	**7.1**	**7.2**	**8.0**	**6.0**	**7.7**	**7.4**	**7.5**	**8.0**	**8.2**	**8.5**	**10.1**	**9.7**
harvest aim	3.8	4.7	6.8	6.0	7.1	6.3	5.8	6.6	6.4	6.7	6.3	6.3	6.3	6.3	6.4	7.0	8.1
effective yield	5.6	5.7	6.6	7.4	7.1	6.5	7.1	7.2	6.8	6.7	6.7	6.3	7.0	6.7	7.1	7.7	8.7

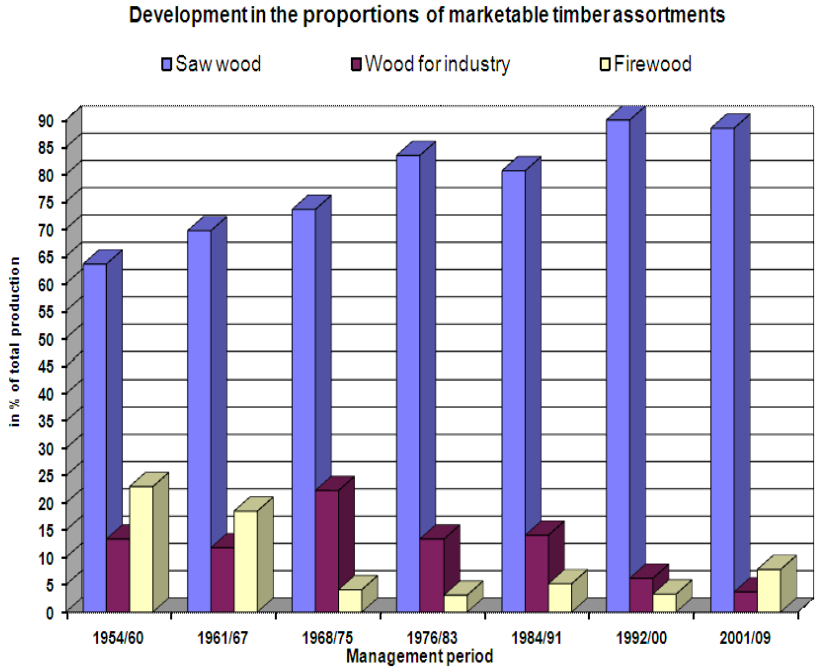


The total average increment of the stands in Series II is of 8,0 sv/ha/a.

6. WOOD PRODUCTION AND FINANCIAL YIELD

6.1 Wood Production

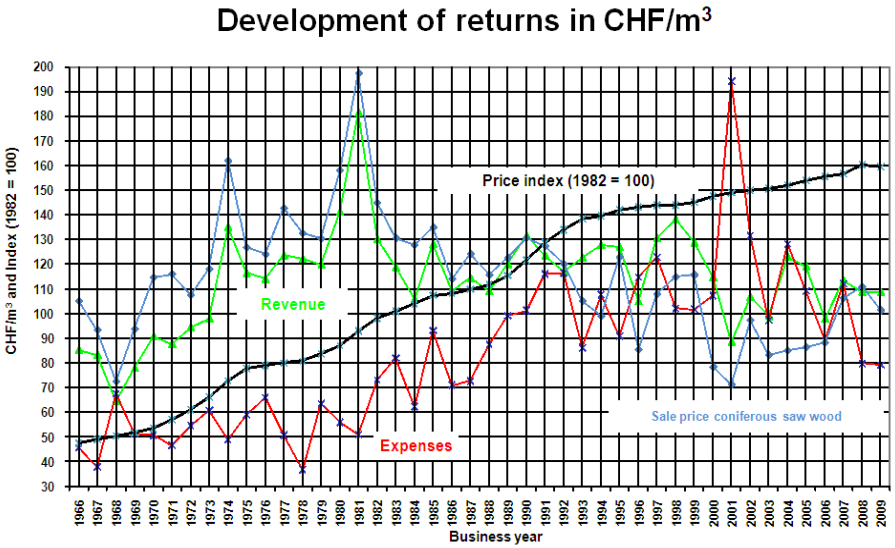
Management period	1954/60	1961/67	1968/75	1976/83	1984/91	1992/00	2001/09
	%	%	%	%	%	%	%
Saw wood	63.6	69.7	73.6	83.5	80.7	90.5	88.5
Wood for industry	13.4	11.8	22.3	13.4	14.1	6.2	3.7
Firewood	23.0	18.5	4.1	3.1	5.2	3.4	7.8
Coniferous	78.1	73.8	70.3	85.0	88.1	88.6	84.4
Deciduous	21.9	26.2	29.7	15.0	11.9	11.4	15.6
Average volume of harvested stem	sv 1.48	sv 1.68	sv 1.69	sv 1.94	sv 1.40	sv 1.68	sv 1.92



During the last period (2001/2009) the average annual yield on the 180 ha of communal forest amounted to 1'440 m^3, or 8,0 m^3/ha.

Thanks to the treatment with the plenter method, applied now for over a century, and by increasing the average stem volume, the distribution within the marketable assortments has improved. Over 85% of the total yield put on the market is now saw wood, compared with 50% in the first management period.

6.2 Financial Yield



The graph above illustrates the rapid and progressive decrease in the financial yield of the communal forest enterprise of Couvet since 1981. This critical development is the result of the fall in sales prices for wood products on one hand and of the rapid increase in expenses due to the rise in the wages of the forestry workforce.

In the 5 past business years, from 2005 to 2009, the net average profits were as follows:

	CHF/annum	CHF/m^3	CHF/ha
GROSS INCOME	174'521.-	109.-	970.-
TOTAL EXPENSES	149'743.-	94.-	832.-
NET RETURNS	**24'778.-**	**15.-**	**138.-**

area: 180 ha
yield: 1'600 m^3/a

Structure of Expenses (2005 – 2009)

	CHF/m^3	%
Cutting and harvesting	55.-	59
Maintenace of roads	5.-	5
Care of young forest	5.-	5
Managementcost (engineer and ranger)	18.-	19
Social functions	11.-	12
Total expenses	**94.-**	**100**

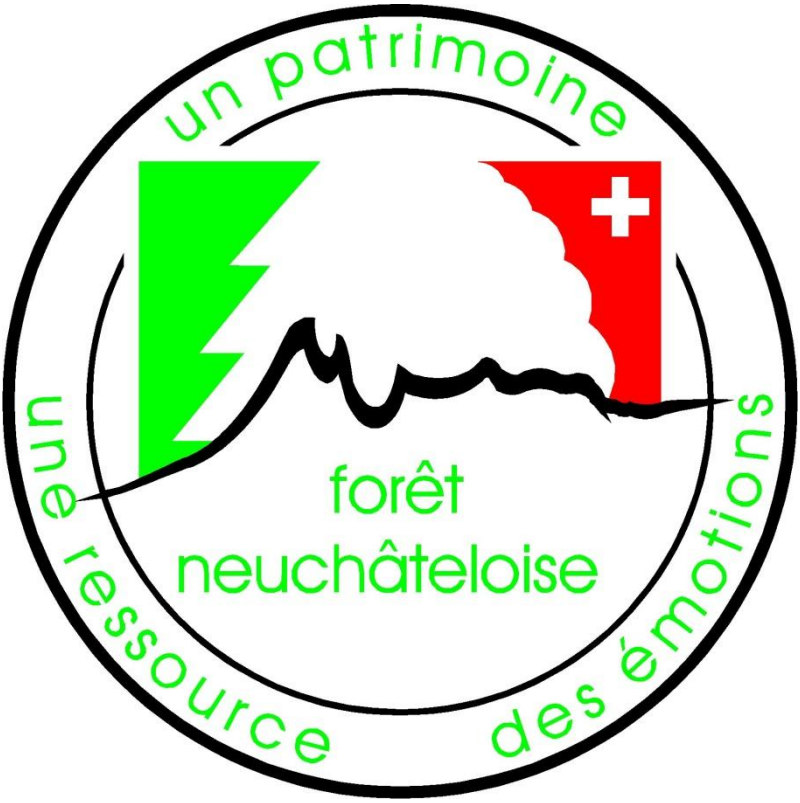
Structure of Income (2005 – 2009)

	CHF/m^3	%
Proceeds of wood-sale	87,40	80
Sundry income (subsidy)	21,60	20
Gross income	**109.-**	**100**

J.-M. Oberson
Forestry engineer
Forest District of Val-de-Travers

Fleurier, September 2010

Translated by Evelyn Coleman, Forestry engineer, 3233 Tschugg


un patrimoine
une ressource
des émotions
forêt
neuchâteloise