Price fluctuations in a coastal fishery in South-West Finland

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RÉSUMÉ

LES VARIATIONS DE PRIX DANS UNE PÊCHERIE CÔTIÈRE DU SUD-OUEST DE LA FINLANDE

Pendant le printemps, la relation entre l'offre et la demande hebdomadaires a un effet sur le prix du poisson, mais pendant les autres saisons le marché est déséquilibré. La recette d'un pêcheur est déterminée par la prise par unité d'effort et par le prix. A cause des changements saisonniers liés à la capturabilité des poissons, le revenu par unité d'effort peut augmenter quand les prix déclinent. Ainsi le revenu par unité d'effort est une variable pertinente et utile pour l'analyse de la stratégie de pêche des pêcheurs côtiers.

1. INTRODUCTION

A fisherman operates under the constraint of natural fluctuations in the catchability of fish species, which are reflected in the catches per unit of effort. These fluctuations are pronounced in artisanal fisheries, which use fixed gear such as gill nets and pound nets. Another constraint is due to the fluctuations in the demand for different species. In theory an equilibrium should develop between demand and supply, if the fishermen and fish merchants would operate in a perfectly open market. For various reasons the market may not be ideal in the economic sense (e.g. TOMEK and ROBINSON, 1982; LAWSON, 1984), and this affects the price forming mechanism. In this study we characterize the price fluctuations, examine their possible causes and speculate on their significance for a coastal small scale fishery.

2. MATERIAL AND METHODS

The data consisted of all individual transactions from 1982 to 1986 of four major freshwater species, i.e. pike, perch, pike-perch and bream of a whole sale fish merchant in SW Finland. The merchant purchased annually 20 to

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25 tonnes of each species except bream, for which the amounts were about 9 tonnes. Pike and bream are traded in different price classes. Pikes less than 2 kg in weight belong to class I and larger pike to class II. Bream of class I weigh more than 1.2 kg and those of class II less. These classes were treated separately.

Prices were deflated using a general cost-of-living index and also a whole sale price index. The price elasticity of the demand was analyzed assuming a constant elasticity within seasons using weekly data. This gives the following model :

$$\log(p) = a + b\log(v),$$

Where a and b are constants, p = price and v = the amount bought by the merchant. Several specifications for the amount of fish bought by the merchant were used, i.e. the quantity of a particular species, the total quantity of the four species and the total quantity lagged by one week. The seasons were defined as the quarters of the year.

The catch statistics compiled by the Finnish Game and Fisheries Research Institute refer to the sub-area 29 and the rectangle 50H1 of the international grid in the Baltic Sea. Data on the price of Baltic herring were obtained from recommendations on the price level set by the Finnish government. The Baltic herring was included because the herring is in practice the only species for which coastal fishermen receive financial support from the state budget.

The revenue per unit of effort (RPUE) was obtained by combining the average monthly catch per unit of effort for the statistical subdivision 29 with the average deflated monthly prices for the years 1982 to 1986.

3. RESULTS

3.1. Seasonal fluctuations in prices, demand and supply

The amount of fish bought by the merchant correlated with the catches for the statistical area, and also with the Finnish catch in the Baltic Sea, with coefficients of determination varying from 73 to 97 %, depending on species.

Time series methods were used to separate trends, seasonal fluctuations and random variations of monthly fixed prices (1980 level). The decomposition was done using the X-11 program of the US Bureau of Cencus (SAS, 1984). There were no strong trends in the prices, but the price of pike declined by approximately 20 % during the study period (Fig. 1).

The seasonal fluctuations of the prices ranged from +30% to -50% around the mean. The strongest fluctuations were observed in the cheapest species, i.e. bream and perch (Fig. 2). According to the monthly coefficients of variations the price of the cheaper fish also exhibits greater random variations than price of more expensive species (Fig. 3).

3.2. Purchased amounts and price

The relationship between the weekly average price and the amount of fish bought by the merchant was in most cases rather poor, even on a seasonally disaggregated level (Tab. 1). In the spring (April to June) significant correlations between price and amount bought were observed for all species (Fig. 4). The highest coefficients of determination were obtained for a model in which the predictor was the total purchased amount of the four species, lagged by one week (Tab. 2). The price of pike-perch was exceptional in that the best predictor was the total amount bought during the same week. In general, the demand appeared price elastic (Tab. 3).

3.3. Revenue per unit of effort

The RPUE exhibits seasonal fluctuations. A combination of the RPUE with the cumulative yearly value of the catch shows that most of the value is accumulated during periods of stable or increasing RPUE. The cumulative value also indicates that the fishing effort is small during the summer months. In many cases, the periods of strong accumulation of value coincide with periods of decreasing price or price minima (Fig. 2). During periods of slow value accumulation strong fluctuations in RPUE are observed (Fig. 5).

4. DISCUSSION

4.1. Supply and demand

The strong correlation between the reported catches and the purchases of fish by the merchant suggests that the amounts purchased correspond with the supply of fish. The prices appear largely demand controlled. Because the supply varies somewhat randomly, it is difficult to detect an equilibrium between demand and supply. Disequilibrium between prices, supply and demand has been frequently observed in agriculture (TOMEK and ROBINSON, 1982) and fisheries (RONDON, 1978 ; BOKSTAEL, 1983 ; LAWSON, 1984).

Disequilibrium between demand, price and supply may arise when market conditions are unpredictable. This does not seem to be quite true for the coastal fishery in SW Finland. The yearly fluctuations in the catch per unit of effort and in the price of the product follow fairly regular cycles. The conditions are thus predictable, and should allow an equilibrium price to develop. During spring time supply and demand appear to influence the price, and the quantity bought by the merchant explained 40 to 70 % of the variations in price (Tabs 1-2). Changes in the elasticity and in the general price level probably explain the variation between years.

The changes in catchability create a family of supply curves within the spring season. Although the demand exhibits some fluctuations due to e.g. the presence of substitutes, it is likely to be more stable within a season than the supply, and the fish merchant adjusts the prices in order to be able to sell the total amount the fishermen bring. Therefore the equilibrium points between supply and demand will lie on the demand curve.

The lag in the pricing is likely due to feed back from the whole sale markets of fish. The most expensive fish, the pike-perch, is less affected by this feed back. This suggests that the market for pike-perch is partly different from the market of the other species, and hence the pricing strategy for pike-perch is also different.

During other seasons of the year prices vary independently of the supply. During these periods independent events appear to determine demand and supply and disequilibrium conditions prevail. The variations in price are, however, small with typical coefficients of variation around the monthly average of 5 to 15 % (Fig. 3).

With the rapidly changing conditions for the production process during spring time, the price of the product is unlikely to be the correct variable for analyzing the fishing strategy. This study suggests that the RPUE is more important, especially in a coastal fishery which uses fixed gear for which the operating costs are relatively stable. The RPUE shows why fishing makes sense even with rapidly declining prices (Fig. 2). The RPUE cannot, however, be studied in isolation. The total effort and the variability of the RPUE also have to be taken into account. Because of difficulties in distinguishing directed effort for a particular species in a fishery based on monthly reporting the cumulative value of the catch was used as a measure of the fishing strategy (Fig. 2). During summertime high RPUEs can be obtained, but the variability of the RPUE is large (Fig. 5) and the fishing effort is low. The reduced effort is evidently due to a limited demand. Recreational fishermen, whose total catch of the species in question exceeds the commercial catch, fish mainly during the summer months (SALOJÄRVI and LEHTONEN, 1980).

The temporal distribution of effort is influenced by the part time nature of the coastal fishery. Of the fishermen living in SW Finland 69 % receive less than half of their income from fishing (Unpublished statistics of the Finnish Game and Fisheries Research Institute). Fishing is a part of the total work activity, and different activities are to some extent temporally segregated. Therefore the fishing strategy will not be determined exclusively by the profitability of fishing.

The mixed fishery for several of the species also affects the temporal allocation. Thus the RPUE suggests that a pure pike-perch fishery would be more profitable during autumn than during spring (Fig. 2), but by-catches of e.g. pike and perch probably reduce the difference.

The pricing is influenced by the market conditions. There are several fish merchants in the area, and different merchants pay different prices for the fish (SAARNI-VILO, 1989). This suggests that the merchants have different strategies for buying and selling fish, and hence individual fish merchants have some possibilities for price determination, which may partly explain the high price elasticity of the demand (Tab. 2).

In the herring fishery the price forming mechanism has been disrupted by subsidies. The objective has been to guarantee the herring fishermen a fair price and income, and to remove seasonal fluctuations in price which were considered problematic for the fishery (COMMITTEE REPORT, 1974). The subsidies have removed most of the seasonal fluctuations in prices, but at a considerable cost. From 1975 to 1978 the subsidies increased approximately three fold in real value and have since remained stable. In 1986 the price subsidies were approximately 25 percent of the total value of the herring catch. The subsidies have neglected the natural fluctuations in catchability and removed the feed back between price and supply. They may have aggravated marketing problems, by tempting the fishery to concentrate on periods of high catch per unit of effort, and a tendency to increase catches in spring has been observed in the Finnish herring fishery (R. PARMANNE, Finnish Game and Fisheries Research Institute, pers. comm.).

4.2. Trends

The average prices have remained relatively stable during the study period. This result agrees with an analysis of average prices reported by fishermen (RANTALA *et al.*, 1986). Minor differences arise if the prices are deflated using a whole sale index rather than a consumers' price index. The whole sale index deflation indicates, for example, sligthly increasing prices (10 %) for pike-perch. If the fishing costs have increased approximately according to the whole sale price index the fishermen's income level has remained stable. There are no indications of increasing catches or CPUE due to e.g. the introduction of new technology for these species in the 1980s (RANTALA *et al.*, 1988). At the same time the income level in e.g. the agricultural sector has increased (Central Statistical Office of Finland, 1986).

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Table 1 - The adjusted coefficients of determination for the price and demand using the model log(p) = a + blog(v), with v specified as the total amount purchased lagged by one week (data for 1982-86). For pike-perch the model using unlagged data is also presented. n = number of observations. * = parameters not estimable.

Species	Winter January-March		Spring April-June		Summer July-September		Autumn October-December	
	n	R^2	n	R^2	n	R^2	n	R^2
Perch	60	0.04	60	0.71	62	0.01	63	-0.07
Pike I	60	0.15	62	0.49	62	0.01	66	0.18
Bream I	55	0.06	53	0.42	37	-0.01	48	0.04
Pike II	60	0.01	62	0.37	60	0.05	66	-0.02
Bream II	57	0.11	57	0.35	46	<0.01	49	0.11
Pike-perch	.	*	45	0.52	51	-0.02	64	<0.01 (no lag)
Pike-perch		*	41	0.32	47	-0.02	64	0.07 (lag)

Table 2 - Coefficients of determination for the model log(p) = a + blog(v) for the spring season, with v=lagged total purchased amount. For pike-perch the model was fitted using unlagged data. n = number of observations.

	Perch		Pike I		Bream I		Pike II		Bream II		P-perch	
Year	R^2	n	R^2	n	R^2	n	R^2	n	R^2	n	R^2	n
82	0.70	12	0.80	12	0.40	12	0.74	12	0.37	12	0.67	8
83	0.86	11	0.81	11	0.68	8	0.78	11	0.43	10	0.58	8
84	0.56	11	0.67	11	0.75	8	0.41	11	0.59	10	0.90	8
85	0.83	10	0.81	12	0.56	10	0.53	12	0.77	9	0.92	7
86	0.87	12	0.78	12	0.79	11	0.46	12	0.47	12	0.51	10

Table 3 - The elasticity parameters (b) with associated standard errors from the models of Table 2.

Year	Perch b	Perch S.E.	Pike I b	Pike I S.E.	Bream I b	Bream I S.E.	Pike II b	Pike II S.E.
1982	-0.20	0.038	-0.15	0.022	-0.15	0.049	-0.16	0.027
1983	-0.16	0.020	-0.11	0.016	-0.13	0.031	-0.12	0.020
1984	-0.12	0.032	-0.15	0.031	-0.29	0.057	-0.09	0.033
1985	-0.13	0.019	-0.18	0.026	-0.17	0.046	-0.10	0.025
1986	-0.24	0.026	-0.09	0.014	-0.26	0.040	-0.06	0.019

Year	Bream II b	Bream II S.E.	Pike-perch b	Pike-perch S.E.
1982	-0.19	0.066	-0.08	0.004
1983	-0.19	0.063	-0.04	0.011
1984	-0.23	0.056	-0.08	0.009
1985	-0.18	0.033	-0.04	0.004
1986	-0.24	0.070	-0.05	0.015

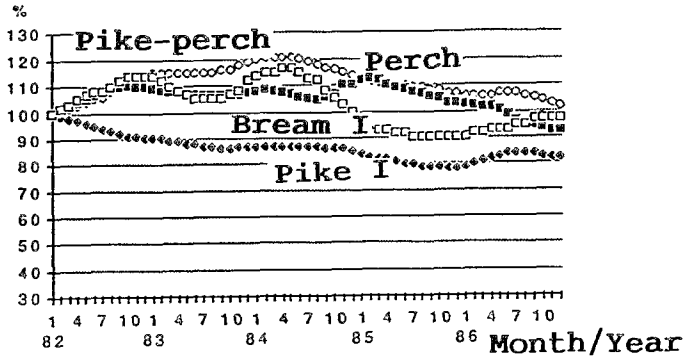

Fig. 1 - Trends in the prices from 1982 to 1986 based on a 22 month moving average using the X-11 procedure (SAS, 1984).

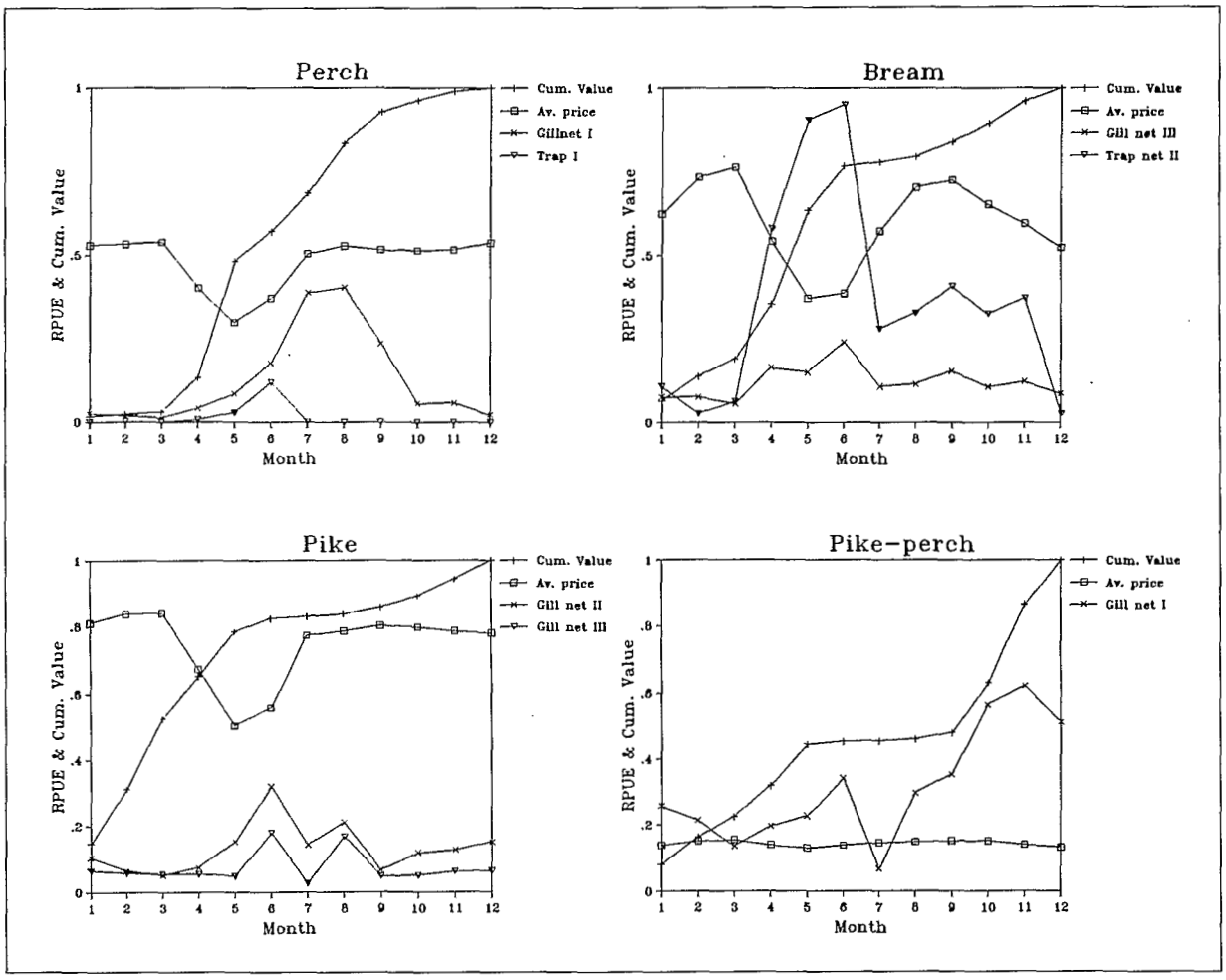

Fig. 2 - The cumulative value of the catch, the monthly price and the revenue per unit of effort (rpue) for perch, pike I, bream I and pike-perch as averages for 1982-86. The price is in FIM x 10^{-1} for all species except pike-perch for which it is in FIM*10^{-2}. The rpue is given in FIM x (gear x day)-1 x 10^{-1}. Gill net I have a bar length of 37 - 45 mm, gill net II a bar length of 46 - 65 and gill net III a bar length above 65 mm. Trap net I have a height < 1.5 m and trap net II a height > 1.5 m.

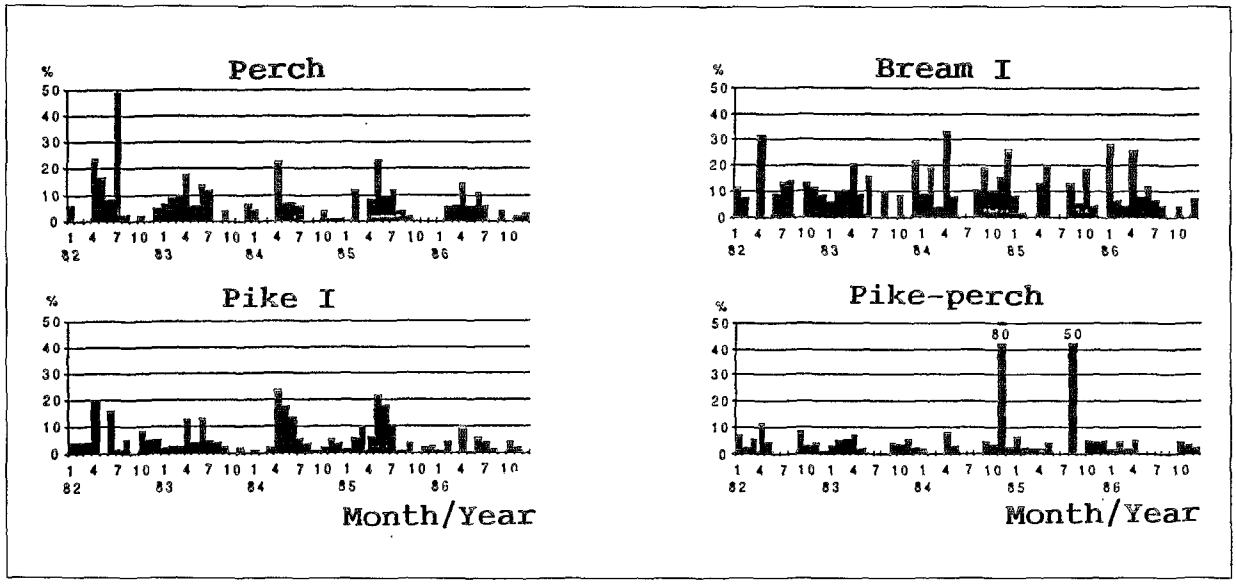

Fig. 3 - Coefficients of variation of the monthly prices.

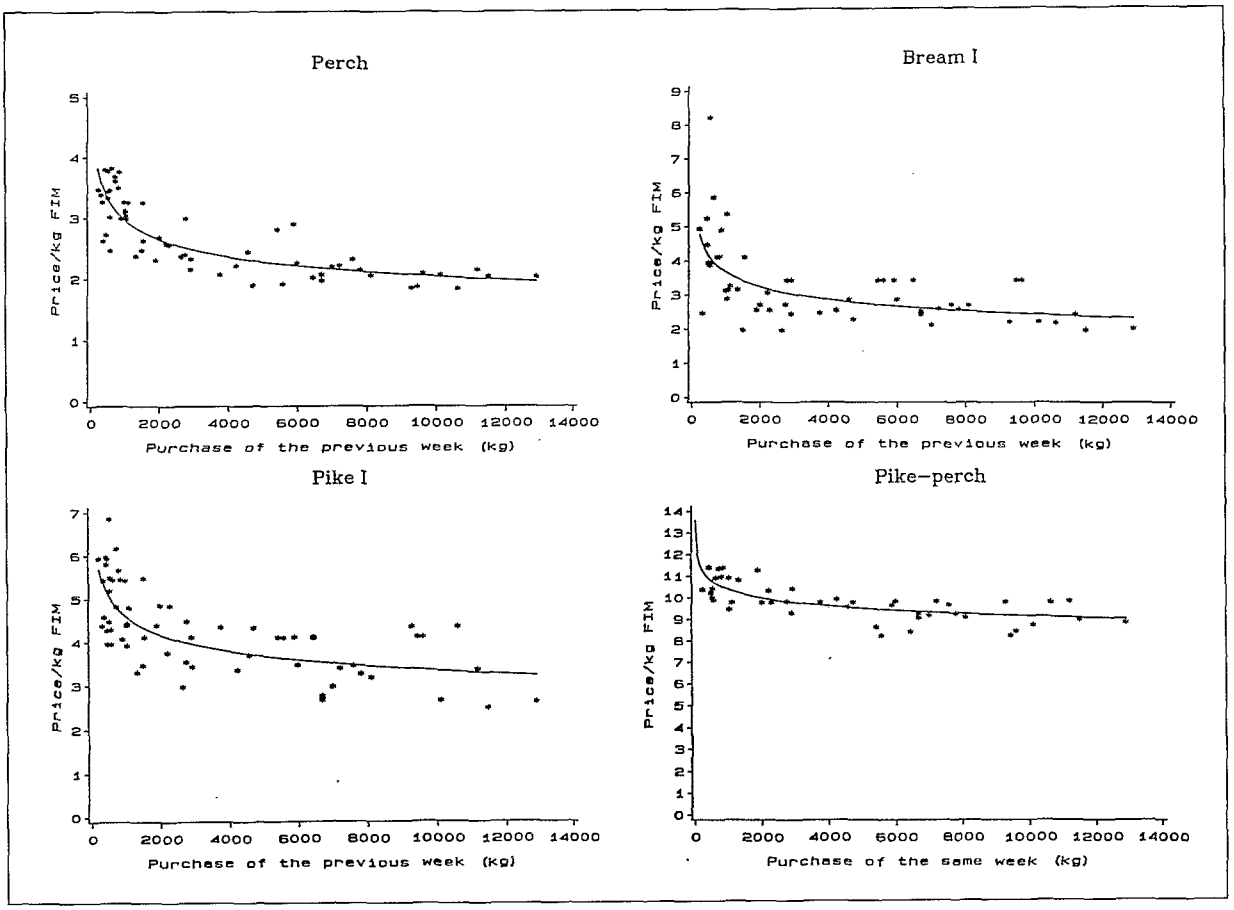

Fig. 4 - Relationship between amounts purchased by the fish merchant and the price. Solid curve = predicted values.

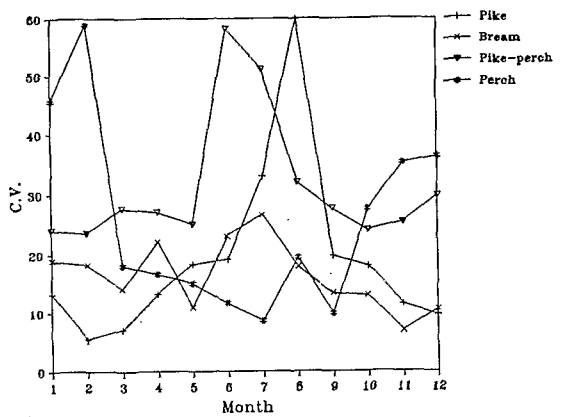

Fig. 5 - Coefficients of variation in percent of the five year monthly average RPUE values.