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Incentives for nature conservation in urban landscapes*

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Abstract

The aim of this article is to contribute to the development of ecological-economic incentives in conservation policy. Our approach uses strategies for establishing ‘habitat networks’ as an example to develop spatially-oriented incentives in urban landscapes. The incentives should ideally consider aspects both of ecological effectiveness and economic efficiency. Our understanding of ecological-economic incentives reaches beyond this stage: not only must economic incentives in environmental policy be based on ecological knowledge, but also, they have to consider social aspects of implementation and acceptance.

The ecological analysis of strategies for species protection in urban landscapes leads to management recommendations as a basis for the specification of environmental policy goals. Based on ecological knowledge, which shows where to invest scarce resources, the economic perspective aims at analysing and evaluating environmental policy instruments for their suitability and efficiency. The ecological and economic research is to be combined with a sociological approach, which investigates the choice and application of environmental policy measures as a system of social action. The analysis of problems of implementation and acceptance will be used to support the introduction of new instruments or to improve existing incentive systems related to nature conservation in urban landscapes.

For this purpose, a survey was carried out on the use of environmental policy instruments (regulation, planning, economic incentives, communication, information) in German cities in 1997. Furthermore, two existing economic instruments in German nature protection policy are analysed in detail: the compensation charge as part of the impact regulation and incentive programmes on the level of the German federal states that offer financial incentive measures for nature protection.

Key words: nature conservation policy, habitat networks, urban environmental policy, economic incentives, implementation

Contents

1 Introduction

Conservation problems have ecological, economic and social aspects and all three aspects must be included in problem solving. Mangel *et al.* (1996, p. 340) stress the 'increased recognition of the role of social and economic factors in determining whether a management regime will be successfully implemented, regardless of how sound it is scientifically'. In this context we present an interdisciplinary analysis aiming at incentives for nature conservation in urban landscapes. The ecological, economic and social research will be combined to find answers to the following questions: Which incentives or environmental policy instruments are suitable to promote innovative nature conservation policy? More specifically, what kind of incentives can be used for strategies aiming at habitat networks in urban landscapes? What are the problems of implementation and what can be possible ways of their elimination?

Habitat destruction and landscape fragmentation belong to the most important reasons for losses of biodiversity (Wilson 1988; Henle and Streit 1990). Hence, effective conservation strategies are needed which allow these negative effects to be effectively counteracted. One such concept is based on 'habitat connectedness' or 'habitat networks', the aim of which is the support of recolonisations as compensation for local extinction (Settele et al. 1996; Kleyer et al. 1996). An important question consists in determining the conditions under which habitat networks really lead to noticeable effects on species survival (Henle and Rimpp 1993). On the one hand there is much uncertainty concerning the ecological effectiveness of habitat connecting strategies. On the other hand the individuals' perception of their landscape determines the ecological effect, which can really be attained through a change in a landscape element. A mathematical model enabled us to analyse the ecological effectiveness of habitat connecting strategies and to deduce management recommendations.

Ecological findings are closely connected to economic research. The ability to distinguish between 'taboo' and 'sacrifice' corridors supports the finding of compromises between conservation interests and competing land use options. This precondition for trade-offs is especially important in densely populated areas. Knowing the ecological optimum increases the chances of investing scarce financial resources for nature conservation with maximum effects from an ecological and economic point of view. The economic perspective aims at analysing and evaluating environmental policy instruments for their suitability and efficiency. Conservation goals will be best achieved by an approach that uses the widest available range of appropriate measures and strategies. The dominant role of regulation and planning in conservation policy calls for an enhancement of approaches that take advantage of market forces (SRU 1996). Economic instruments in environmental policy make use of the price as the central steering mechanism in market economies and represent continuous incentives for innovations. Economic incentives will often be the least-cost means of achieving environmental objectives (OECD 1994). They can be used to solve economic optimisation problems in a static context, such as the internalisation of environmental externalities. However, they can also be designed for evolutionary strategies, e.g., so that they help to continuously adapt economic patterns of development to ecological patterns of development (Ring 1997).

A special emphasis will be placed on implementation, because environmental policy instruments or incentive systems can only take effect if they are adopted as actual, functioning policy (Mangel *et al.* 1996). For this reason, the ecological and economic research is to be combined with a sociological approach, which investigates the choice and application of environmental policy measures as a system of social action. The potentials and limits of implementing specific policy programmes are to be analysed. The exemplary investigation and classification of implementation deficits and problems of acceptance will be used to support the introduction of new instruments or to improve existing incentive systems related to nature conservation in urban landscapes.

2 Evaluating the ecological effects of certain landscape manipulations

Anthropogenic activities such as the development of urban regions have enormously accelerated habitat destruction and landscape fragmentation so that many species have become endangered. Conservation strategies are needed that allow these negative effects to be effectively counteracted. One such strategy is establishing ‘habitat networks’ to allow a species at least to persist in a metapopulation - a concept that was first introduced by Levins (1969): subpopulations live in isolated remnant habitats (so-called patches) with some probability for local extinction. By single dispersing individuals, however, an empty patch can be recolonised. This means that recolonisation compensates for local extinction.

Concerning the effectiveness, there are at least two serious problems with which conservational landscape management is confronted. First, in most cases, only a limited financial amount is available for conservation purposes. However, and especially in the context of habitat networks, there is a multitude of landscape elements (the individual patches; the individual corridors) towards which a change may be focused. Hence, guidelines are needed which allow management priorities to be set and scarce resources to be invested with maximum advantage for species survival. Second, especially in urban landscapes, there may be a lot of other land use options with which the conservation option has to compete. Sometimes different alternatives affect different landscape elements. Hence, in order to minimise negative ecological effects, guidelines are needed which enable decision-makers to determine which variant is better for the conservation goals of the urban region. Both problems, however, can only be solved if criteria and procedures are developed which allow each landscape element of interest to be evaluated in terms of its relative importance for species survival.

In that context, mathematical models may be useful. Models allow the metapopulation endangerment to be quantified theoretically and the key factors of influence to be revealed (e.g., Goel and Richter-Dyn 1972; Nisbet and Gurney 1982; Burgman *et al.* 1993; Hanski 1994; Wissel *et al.* 1994). Different scenarios of landscape management can be simulated (e.g., Verboom *et al.* 1993) and compared in terms of their effect on survival (e.g., Drechsler and Wissel 1997). This provides the basis for the guidelines needed (Frank 1998).

2.1 Recommendations for supporting species survival

In order to estimate the effects of habitat networks, we use a model that was originally developed for describing metapopulation dynamics (Frank and Wissel 1994; Frank 1998). This model allows metapopulation survival to be related to all relevant factors: the patch-specific subpopulation features, the spatial patch configuration, and the pattern of connectedness (which patches are connected by a corridor?). The mean lifetime T_m is used as a quantifier for survival. In order to demonstrate the range of questions the model applies to, we discuss three examples, in which guidelines are deduced either for maximising the advantage for nature protection (optimum habitat connecting management; optimal enlargement of area size) or for minimising the disadvantages of impacts (which corridors ought to be preserved, which can be sacrificed?). Our results apply to species that need a physical habitat-like corridor for reaching another patch in the landscape.

An ecologically optimal habitat connecting management

There is much uncertainty concerning the ecological effectiveness of habitat connecting management. On the one hand, there is a need for determining the conditions under which the establishment of corridors really leads to noticeable effects on species' survival. On the other hand, there is a widely used rule of thumb that recommends to connect 'as much as possible' (Wilson and Willis 1975). This rule makes the user believe that corridors are always advantageous, regardless of where they exist. In order to get some more insight into this problem, the following questions have to be answered: (1) Does the addition of corridors automatically lead to positive effects on species survival? and, in case the answer is 'no', (2) Which pattern of connectedness is optimal and upon which factors does it depend?

In order to approach the problem, we simulate the addition of corridors as a change in the patterns of connectedness (see pictogrammes I-IV in Fig. 1) and analyse the effect on survival. To get more insight into the role of the patches, two scenarios are compared that differ in the assumptions about the numbers of emigrants the inhabited subpopulations are able to emit. As one can see by comparing Figs. 1a and b, there is no general answer to the question whether adding corridors is advantageous for survival or not. As long as all subpopulations emit the same number of emigrants (Fig. 1a), the mean lifetime T_m increases when corridors are added. The complete pattern of connectedness (IV) is found to be optimal for survival. A totally different picture emerges when the peripheral subpopulations emit much fewer emigrants than the central one (Fig. 1b). The mean lifetime T_m even decreases when corridors are added. Hence, the basic pattern of connectedness (I) where each two patches are connected by exactly one path is found to be best for survival. To summarise, there are situations where the addition of corridors becomes detrimental for survival. Hence, the widely used rule of thumb 'As much as possible' is not valid in general. This indicates that more sophisticated guidelines for habitat connecting management are needed.

The following factors are found to be essential for the question which pattern of connectedness is actually optimal for survival (Frank 1998): the relative area size and habitat quality of the individual patches and, the species' characteristics concerning emigration and dispersal.

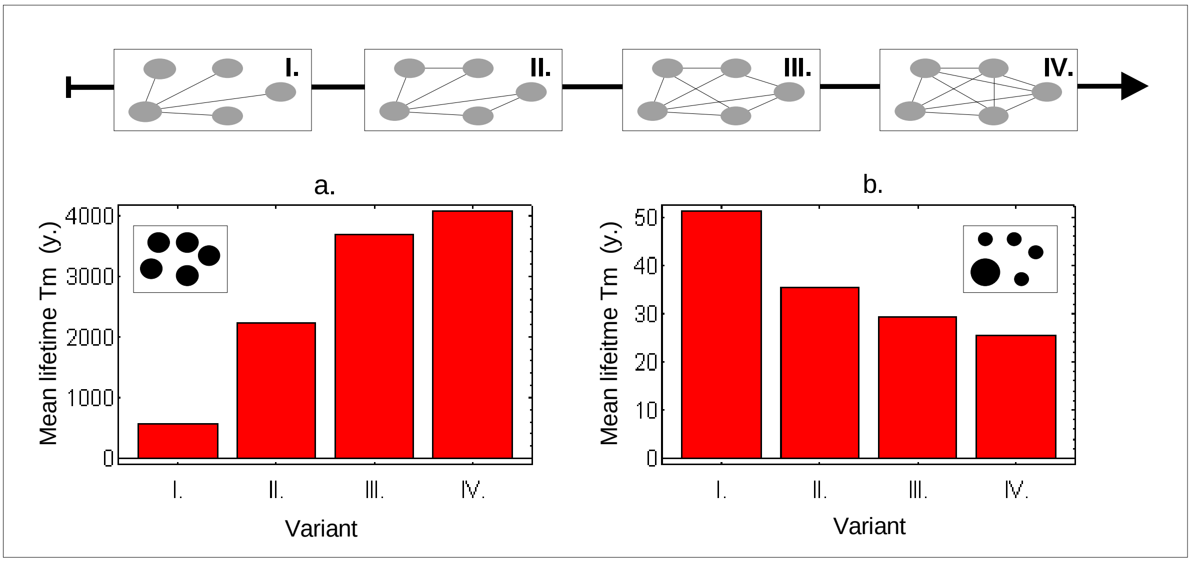

Fig. 1: An ecologically optimal habitat connecting management

The mean lifetime T_m of a metapopulation for four patterns of connectedness (see pictogrammes I-IV) for two different assumptions (a and b) concerning the numbers of emigrants the subpopulations are able to emit.

In contrast to this, all details of species' reproduction have been found to be of no relevance for the question of interest. These results unequivocally show that there cannot be any pattern of connectedness that is optimal for all species. Common guidelines for habitat management can only be deduced for classes of species with a common behaviour in emigration and dispersal. However, note that species' ecology and, hence, this classification may differ between landscapes!

In case all patches are of the same habitat type, a rule of thumb is: A pattern of connectedness is optimal for survival when both of the following conditions are met: (1) there are only corridors towards patches in a reachable vicinity and, (2) all corridors are placed according to the relative area size of the patches (the largest patches have the most corridors). Achieving exactly the optimum is doubtless impossible, but knowing the optimum enables the planner to determine where to invest scarce resources with maximum ecological effect.

Enlargement of the total area size: an alternative?

In a case as considered in Fig. 1b, financial resources ought not to be invested in the establishment of further corridors because negative effects on survival would be induced. In this case, a real advantage can only be attained if the patches themselves are either enlarged in size or improved in quality. However, whenever an amount of resources is invested for enlarging the total area size (of all patches), then we are concerned with the question where to place the investment to maximise the effects on survival. In order to get some insight into this problem, we compare three scenarios of distributing the resources over the individual patches where the increase in the total area size is in each case the same. Fig. 2a indicates that there are considerable differences between the scenarios concerning their effects on survival. The scenario '4:1' (four shares for the 'Large' and one share for each 'Small' patch; see the dashed line) is found to be the best, regardless of the total area to be distributed. Our model results also reveal that the optimum strategy is never general, but strongly dependent on the pattern of connectedness. Maximum effects on survival can be attained when all patches benefit according to their numbers of corridors.

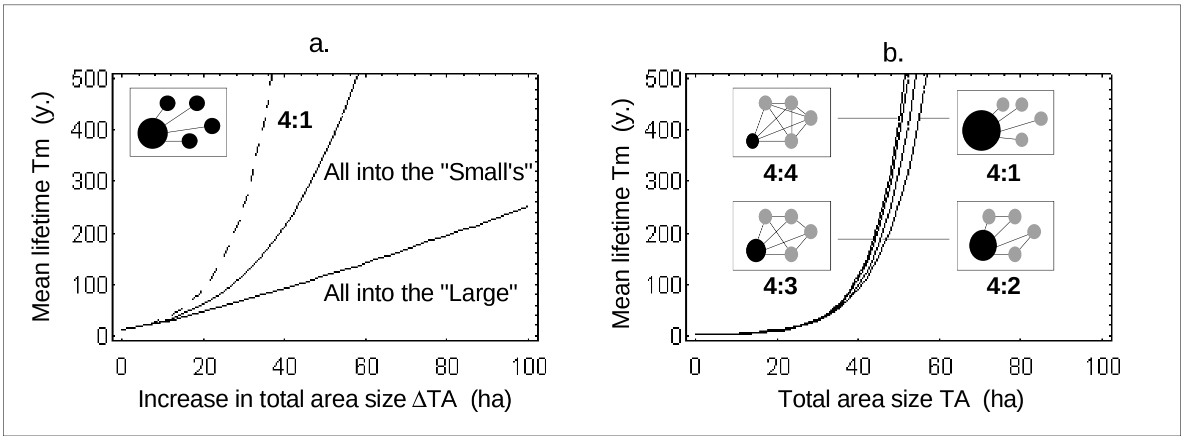

Fig. 2: Enlargement of the total area size: an alternative?

a) The mean lifetime T_m of a metapopulation with a pattern of connectedness as shown by the pictogramme versus the increase in the total area size ΔTA for different scenarios of distributing the area over the patches.
b) Mean lifetime T_m versus total area size TA under the precondition that the area is optimally distributed.

Fig. 2b shows the relationship between mean lifetime T_m and total area size TA that results when the area is optimally distributed, i.e., according to the pattern of connectedness. In spite of the differences between the patterns of connectedness under consideration, all curves are close to each other, i.e., the survival chance is nearly the same. All negative effects of missing corridors can be widely compensated by ensuring an adapted area distribution. In such a situation, it does not make any sense to establish further corridors. If the total area size is enlarged, much stronger effects on survival are attained. Fig. 2b also reveals that the total area size has to exceed a certain minimum, otherwise there is no chance of attaining really long times to extinction at all.

These results have serious consequences for conservation management: as long as some *basic* pattern of connectedness is ensured (for the definition see above), no financial amount ought to be invested in establishing further corridors. These resources ought instead to be used for enlarging the total area size, provided the ecologically important patches can be enlarged.

Which corridors should be preserved from elimination?

So far, we were concerned with questions of conservation planning and maximising survival. In reality, we are more often confronted with the opposite situation: there are land use options which, when realised, inevitably lead to the elimination of landscape elements. Hence, guidelines are needed which allow the variant to be determined that is least disadvantageous for species survival. In order to get some insight into the effect of corridor elimination, we consider the following situation: there is a habitat network with a pattern of connectedness as in Fig. 3a. There are two possible land use options each inducing the destruction of two corridors. In the two variants, different corridors are affected (compare the dashed lines in Fig. 3a).

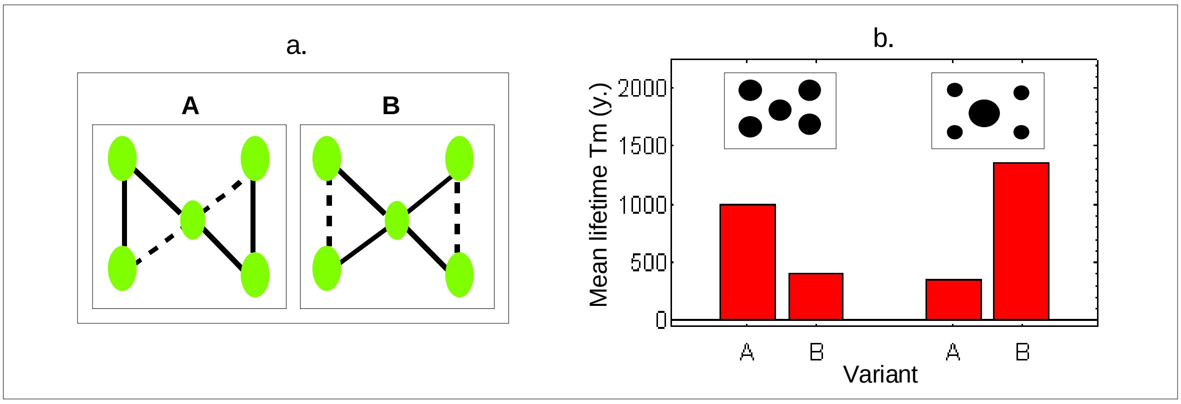

Fig. 3: Which corridors should be preserved from elimination?

a) Two possible land use options each inducing the destruction of two corridors.

b) The mean lifetime T_m of the metapopulation for both variants and two different assumptions concerning the relative area size of the patches.

Fig. 3b reveals that it makes a large difference for mean lifetime T_m which variant is realised. This indicates that the individual corridors are not equally important for species survival. Fig. 3b also shows that there is no general answer concerning which corridors have higher importance and, hence, ought to be preserved. As long as all patches have nearly the same area size (the left pair), variant ‘A’ with its high balance in the numbers of corridors is found to be less disadvantageous. In this case, the peripheral corridors are more important than the central ones and, hence, ought to be preserved. A totally different picture emerges when the central patch is much larger than the peripheral ones (the right pair). Now variant ‘B’ where the largest patch has the most corridors is found to be better. The peripheral corridors have lost their importance so that now the central corridors ought to be preserved.

To summarise, the relative importance of a particular corridor does not only depend on the characteristics of the directly adjoining patches, but on the network as a whole: Which sizes do the other patches have? How many corridors do additionally exist and where are they located? The optimum pattern of connectedness gives the scale for ranking the variants.

2.2 Lessons from the ecological insights

Priorities for conservation management

How should habitat networks be managed with maximum effects on species survival? This is the central ecological question underlying this article. In order to find an answer, several factors to which management can be focused (such as the pattern of connectedness, the area distribution, or the total area size) have been analysed in terms of their influence on survival. Based on the model results given in Sec. 2.1, the following list of priorities for an (ecologically optimal) management can be deduced:

1. The total area size of all habitat patches has to exceed a certain minimum, otherwise it does not make any sense to establish corridors between the patches at all. Whenever the financial amount is so small that this precondition cannot be met, all resources ought to be concentrated and exclusively invested in the largest habitats.
2. Whenever the minimum total area size is exceeded, a certain financial amount ought to be used for establishing a certain basic pattern of connectedness (for the definition see above) that is optimal for survival when the largest patches have the most corridors.

3. All remaining resources ought to be invested in enlarging the total area size, provided each patch can be enlarged according to its number of corridors.

The most important ecological result, however, is that conservation management (such as the establishment of further corridors or the enlargement of specified areas) does not automatically lead to positive effects on species survival. A real advantage can only be attained if management efforts are invested in the right place. Our model results also reveal what has to be found out about both species and landscapes in order to allow the right place to be determined and management priorities to be set. This increases the chance of investing scarce resources with maximum effects on species survival.

Options for a sustainable land use

Both areas and corridors may markedly differ in their importance for survival. However, a concrete landscape element can only be correctly evaluated if it is considered in the context of the whole network. Our model results also provide the criteria and a procedure for ranking the landscape elements according to their importance for species survival. The ability to distinguish between ‘taboo’ and ‘sacrifice’ elements allows us to identify the land use option that is least detrimental from the ecological point of view. This facilitates finding compromises between the conservation and the competing land use interests.

3 Social and economic aspects of nature conservation: Policy and instruments

The management recommendations for habitat networks represent a scientific basis for the specification of conservation policy goals. Based on ecological knowledge, which shows where to invest scarce resources (conditions of ecological effectiveness), social and economic research identify appropriate policy instruments and analyse conditions of their economic efficiency and implementation.

3.1 The role of implementation and acceptance

Measures of nature conservation and landscape protection can only show their effectiveness when they are put into practice. The initiation, development, passing and application of nature conservation and landscape protection programmes follows a complex, often tedious process, in which many individual and collective actors are involved. Social structures and political conditions affect the concrete set up of the separate activities as does the power distribution of the involved parties in the implementation process. Therefore, an analysis that only considers the ecological effectiveness or the economic efficiency of nature protection measures is too narrow. The ecological and economic approach should be amplified by a sociological approach, which analyses the political willingness and implementation process in a social perspective. Questions of implementation and social acceptance are of special importance in this case.

The implementation of political programmes

The term implementation indicates the putting into place of a binding political programme (Mayntz 1980). The implementation comes after the phase of politics formulation, that is the development, drawing up and passing of political action programmes. The separate phases of the so-called policy cycle can be analytically separated but in reality they are often mixed together. Laws, statutory orders, and administration instructions are part of nature conservation and landscape protection programmes. Political programmes are composed of (more or less precise) information about initial situations, goals, institutions (which will be commissioned with the implementation of the project) as well as information about the means and instruments for the realisation of these goals.

The implementation phase begins as soon as the political programme is finalised. It has been known that the effectiveness of environmental-political measures can be impaired by the specific conditions and forms of the programme implementation. During the course of the programme there can be wide ranging deviations from the envisaged programme goals, and there can be execution problems and deficits. Discrepancies between the norm and the reality, programme goals and those actually achieved give evidence that political programmes cannot entirely determine the results. The implementation plays a decisive part in the successes and failures of political programmes. The enacting of a political programme demands a multiplicity of concrete, context-specific measures and single case decisions of which not all are present in advance. Programme formulation and implementation are different parts of a sequential decision cycle (Luhmann 1971). The programme development means a programming decision; in this phase the laying down of the general programme direction and the framework conditions are set up. Programme implementation means, contrarily, a programmed decision. In this phase the establishment and concrete application of the given programme take place; here the scope of measures and single decisions in the public project area will be made. Programme implementation demands a piecewise interpretation of the rules and the need for additional translation, dissemination and specification.

Actors in the implementation process

An older model shows the programme formulation to be the work of the legislative body, and the programme implementation the work of the administration. This is not incorrect, but is not enough. Often a multiplicity of further actors (individual and collective) with different values, interests and preferences are tied into the policy cycle. This is the case for the programme formulation as well as for the carrying out of the programme. During the implementation of the programme the public administration and target groups meet and work together. It cannot be said that the administration has a one-sided control of the situation. More often the public administration is interested in close co-operation with the receiver (Benz 1994). Co-operative set-ups ensure acceptance, ensure the agreement of those affected by the decisions of the administration. In this way extra administrative costs due to political or internal conflicts can be minimised, as well as the time and cost of legal administrative contention processes. The present German nature protection law includes many hearings and participants´ proceedings; the programme implementation often takes on the form of a bargaining or negotiating process in which the separate actors endeavour to make their different interests heard. It is important that the deals in the implementation phase are differentiated partly from those in the legal phase. In the course of moving from the programme formulation to programme implementation, wide reaching changes of interests, participation and divisions of power occur (Bohnert and Klitsch 1980). For this reason it is not seldom that the losing groups during programme formulation succeed in improving their position or in changing their initial defeat into a victory in the following implementation phase. The change of interests and influence spheres in the course of the policy cycle explains why political programmes are often modified and altered during their implementation.

3.2 Environmental policy instruments: Local experiences

So far, the thoughts on the implementation and acceptance of political-administrative measures have been completely abstract from the differences between specific instruments. It might be supposed that connections or empirical regularities exist between the choice and the implementation of political instruments on the one hand, and implementation deficits and acceptance problems on the other hand. For our analysis it is necessary to know which instruments are actually used in environmental and conservation policy on a local level. Further, we look into the economic efficiency of environmental policy instruments in terms of their administrative costs and demands. From the viewpoint of nature protection laws it is relevant whether instrument-specific implementation deficits and conflicts exist. The careful analysis of instrument-specific implementation and acceptance problems are an important prerequisite, or first step, for the identification of possible departure points for a more effective implementation.

Survey on the use of economic incentives in local environmental policy

In 1997, a survey was carried out on the use of environmental policy instruments in German cities. The aim of the investigation was to get an inventory and analysis of economic incentives in environmental policy, how they are actually used and evaluated on a local and regional level. Furthermore, future operational fields for economic incentives should be detected by the local experts, with emphasis on nature conservation issues. The survey was based on a questionnaire that was sent to the head of the environmental offices in German cities with more than 200.000 inhabitants. A total number of 39 cities fell into this category, from which 17 cities decided to participate and returned their questionnaire (44%). The participation of cities related to their number of inhabitants was as follows: In the category 200.000 to 500.000 inhabitants, eleven out of 27 cities returned the questionnaire (41%). The next category, with inhabitants between 500.000 and one million, showed the highest relative feed-back: six out of nine cities participated in the survey (67%). Unfortunately none of the three cities over one million inhabitants sent back the questionnaire.

The role of different instruments in local environmental policy

The cities were asked what role different instruments play in their local environmental policy (Fig. 4). Out of 15 cities replying to this question, seven cities decided that the instruments regulation (command and control approaches), planning, but also information play a dominant role in the environmental policy of the city. Almost all other cities put the three instruments at least in the second strongest category, stating that they are one instrument among others. The instruments planning and information were assigned a minor role by only one city each. Following the three most important instruments, but considerably weaker in relevance, are communicative instruments (round tables, negotiation) and economic incentives. Most cities either use them as one instrument among others or perceive them as playing a minor role in their environmental policy. Only one city perceived economic incentives as being dominant in role, another one as playing no role.

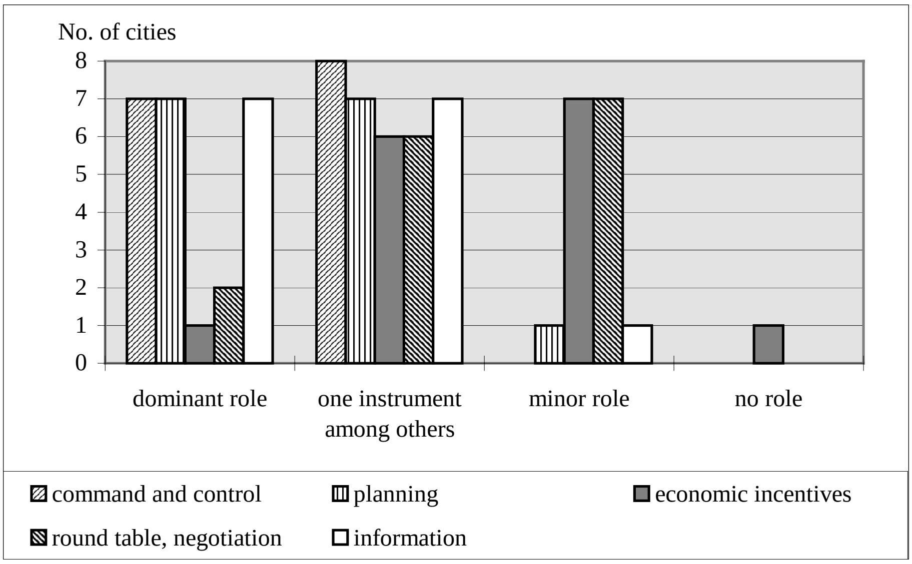

Fig. 4: Environmental policy instruments in German cities
(number of replying cities: 15)

The situation differs somewhat when looking at the role of environmental policy instruments implemented for nature conservation and landscape care (Fig. 5). Among the 13 cities replying to this question, the majority (seven to nine cities) indicated that all instruments are used as one instrument among others. Five cities still assigned a dominant role to regulation and planning. Information seems to be much less important for nature conservation than for environmental policy in general. Among the instruments playing a minor role, economic incentives lead the row, followed by round tables/negotiation and information.

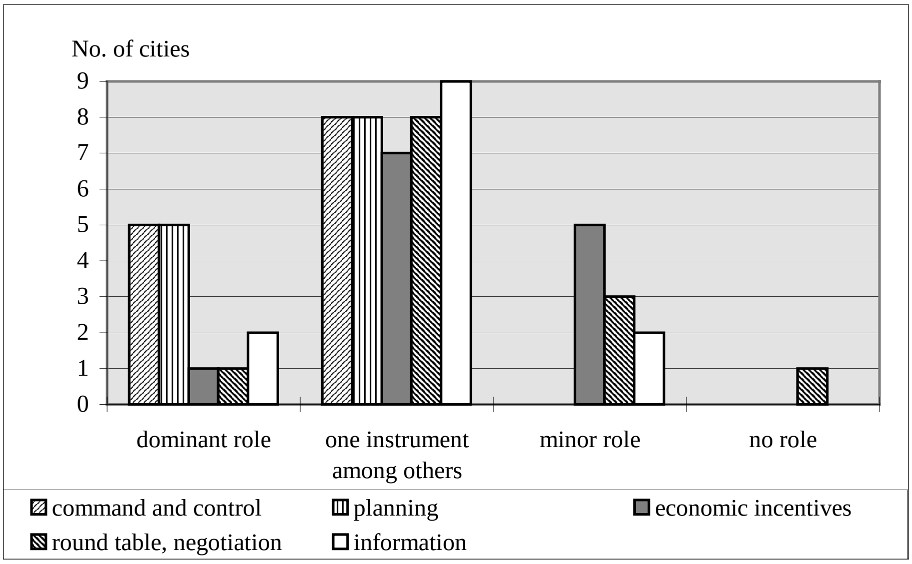

Fig. 5: Environmental policy instruments for nature conservation (number of replying cities: 13)

Administrative costs of economic incentives compared to those of regulation

Some questions were dedicated to administrative costs of economic incentives compared to those of regulation in water supply, sewage disposal, soil protection and nature conservation. Concerning the introduction and application costs of economic instruments, it can be clearly said that most cities simply do not know them (Table 1). The way German cities administrate their budgets does not allow them to specifically assign costs to single tasks like introducing or applying environmental policy instruments. Nevertheless, some cities tried to roughly estimate these costs. In most cases, introduction as well as application costs of economic instruments are estimated to be equal or lower than those of regulation. There were but a few cities that estimated these costs to be higher compared to the corresponding costs of regulative instruments. Given these estimations, administrative costs should be no obstacle to implement economic incentives in environmental policy where they are appropriate.

It can be noticed that there is even a stronger tendency for the application costs of economic instruments to be equal or lower than those of regulation. In only four cases, cities estimated them to be higher, compared to overall six cases with respect to introduction costs. Apparently administrative costs decrease, once economic incentives are introduced whereas the administrative costs of command and control instruments change less from introduction to application.

Table 1: Administrative costs of economic instruments compared to those of regulation

Introduction costs (number of replying cities: 11)

	higher	equal	lower	don't know
Water supply	1	3	2	5
Sewage disposal	1	3	2	5
Soil protection	2	2	2	5
Nature conservation	2	4	2	3

Application costs (number of replying cities: 12)

	higher	equal	lower	don't know
Water supply	-	3	3	6
Sewage disposal	1	3	3	5
Soil protection	1	3	2	6
Nature conservation	2	4	2	4

Further demands of economic incentives compared to those of regulation

Asked for further demands of economic incentives compared to those of regulation, the most distinctive answer related to a need for higher expertise in economics (Fig. 6). This could be a rather high barrier for introducing new economic incentives or improving existing ones on the local level, because most employees in municipalities tend to have a professional background in administrative fields, law, or with respect to environmental affairs, the sciences. Apart from economic knowledge, personnel requirements of economic instruments in environmental policy are estimated to be rather equal to those of regulation.

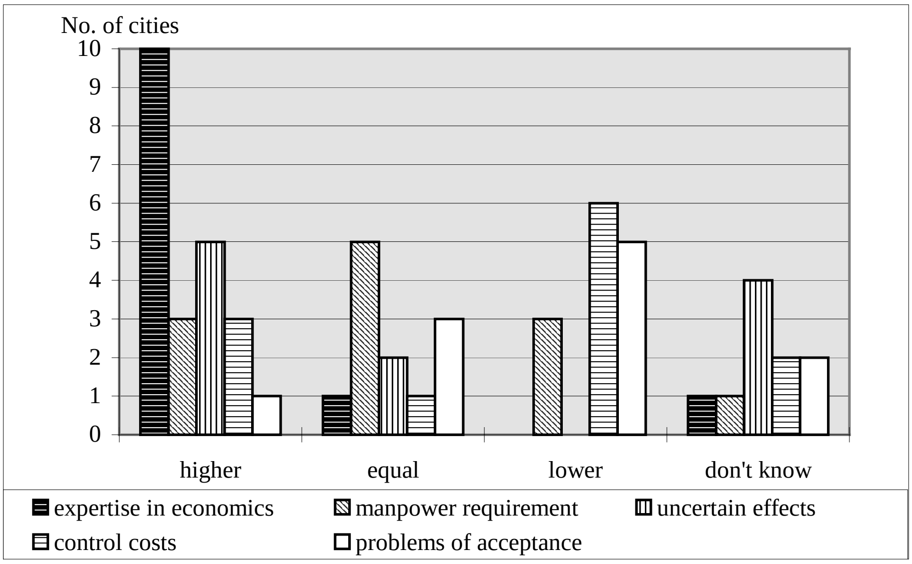

Fig. 6: Further demands of economic instruments compared to those of regulation (number of replying cities: 12)

The relationship between environmental aims and economic incentives as instruments to achieve them was indicated to be weaker than for regulation. This answer could be clearly expected, since the purpose of regulation lies in achieving specific environmental standards, whereas the cause-effect relationship of most economic incentives is due to a trial and error process. Thus, four cities were not able to give evidence of this relationship, six cities estimated these uncertain effects to be equal or higher for economic instruments compared to regulation. Both control costs and problems of acceptance are predominantly estimated to be equal or lower compared to those of regulation. This finding is especially important for designing and implementing new incentives. Most cities are convinced that economic incentives cause fewer problems of acceptance than regulatory approaches. Asked for their interest to implement economic incentives, many cities argued that citizens welcome these instruments for they can better accommodate the polluter-pays-principle than regulation. Once economic incentives are implemented, control costs are estimated in most cases to be lower than those of regulation. Control costs are strongly linked to administrative costs of application and the coherent answers to these two questions strengthen their evidence and relevance.

4 Economic incentives in nature conservation policy

Since the OECD (Organisation of Economic Co-operation and Development) has adopted the Polluter-Pays-Principle in 1972 as a background economic principle for environmental policy, economic instruments became more and more popular to achieve environmental objectives. Through the use of economic instruments such as charges, taxes or tradeable permits, the use of the environment can be integrated into the economic sphere by way of creating price signals (Turner and Opschoor 1994). A further strengthening of the role of economic incentives came through the Fifth Environmental Action Plan of the European Community (Commission of the EC 1992). Despite many efforts of environmental economists to promote economic incentives in environmental policy, mainly by stressing their economic efficiency (cost-saving aspects) compared to regulatory approaches, their actual implementation has been marginal. Nevertheless, many policy recommendations stress the need for innovative nature conservation policies in which economic incentives should be more and more integrated (OECD 1994; Tobey 1996; SRU 1996).

Looking at the implementation level of a nation like Germany, environmental and conservation policy predominantly use planning and regulatory instruments. Economic instruments often play a minor role (as our survey has shown), but at least, they seem to have more relevance in conservation policy than in environmental policy in general. Main experiences exist with two of these economic instruments, i.e., the compensation charge (‘Ausgleichsabgabe’) and incentive programmes for nature conservation (Hartje 1994).

4.1 The compensation charge

The compensation charge is part of the so-called impact regulation (‘Eingriffsregelung’), which is anchored in the German Federal Nature Protection Law (BNatSchG). It has been transferred with slight modification to the different nature protection laws of the states of the German republic. The impact regulation firstly aims at avoidance of adverse effects on nature and landscapes, secondly at compensation of unavoidable effects. In the latter case, the effects should be reduced as much as possible as well as be compensated for in material or monetary terms. The nature protection authorities then have to fix the compensation obligations. Material measures such as greening or the creation of comparable biotopes enjoy priority, i.e., measures that have a spatial and functional relation to the planned or enforced impact. When compensation measures of this type cannot be carried out, compensation payments must be made. Thus, the compensation charge is no independent environmental charge, rather it represents a compensation measure within the framework of the impact regulation.

Involved parties:Interventionist, authorities, and participating actors

During the execution of the impact regulation at least the three following groups are included. First is the client who intends to make an impact; second is the responsible authority, which checks the documents, carries out the participatory procedure, evaluates the detailed statements and, after weighing up all the information, makes a decision; third, there are the expert authorities for nature conservation. In accordance with rule § 29 BNatSchG, non-governmental organisations for nature conservation that are approved and registered by the federal or state environmental ministries are often involved. From a sociological point of view the impact regulation is a sign of increased flexibility of the nature conservation law. The regulation does not only differentiate between permitted and non-permitted impacts but also allows a decision making process, in which different interest groups can influence the ways and degrees of impact compensation.

Efficiency problems and implementation deficits

The compensation charge is a postoperative compensation measure. When allowed impacts occur the Federal Nature Protection Law and the corresponding regulations of the states' nature protection laws give priority to the settlement of material compensation measures before the payment of compensation (Marticke 1996, p. 387). Usually there is the obligation to physically compensate in the spatial vicinity of the actual impact. This can be a reason for inefficiency. As we have shown before, it is extremely important from an ecological point of view where nature protection activities occur. If compensation measures do not consider spatial ecological conditions, the financial investment is made in an inefficient way from an economic point of view. It could have a much higher effect if invested in another place. A similar obligation exists in the case of compensation payments. Often, the payments also have to be reused for nature protection activities close to the place where the impact has occurred. Therefore we recommend for purposes of ecological effectiveness and economic efficiency to reconsider and loosen the obligation of spatial connectedness between impact and compensation measures. Legal steps in this direction have now been taken: a law for the alteration of the building regulation and environmental planning came into force by 1 January

1998 (‘Gesetz zur Änderung des Baugesetzbuches und zur Neuregelung des Rechts der Raumordnung (BauROG)’) which allows this spatial argument to be considered.

In practice the compensation charge only possesses a reduced meaning (Hartje 1994, p. 346). The incentive and steering effect the charge could have from a macro-economic perspective is limited because the compensation payment does not consider the clients’ benefits of the impact (Burmeister 1988, p. 147). The replacement costs, the removal costs or the economic value of the areas used serve as criteria for the payment standards. However, large differences between the regulations of the different states exist. Nature conservation authorities also complain that the companies often achieve improved conditions through the negotiation process, which is in the area of responsibility of an authority without competence in conservation issues. The companies only have to threaten to transfer their investments to other places (Heidtmann 1993, p. 70). In these cases, the disadvantageous situation obviously becomes clear that the nature conservation authorities are not the primary responsible authorities to lead the procedure. They only take part in a so-called ‘piggy-back fashion’ (‘Hucke-Pack-Verfahren’; Burmeister 1988, p. 20). A further implementation problem is that, until now, there has been no consequential control of the regulating authority over the payment and following municipal use of the contribution. Thus, compensation payments are sometimes not imposed at all, or they only apply to the areas outside settlements (Lahl *et al.* 1992). Sometimes the money obtained is not passed on to the public treasury or it is not used for nature conservation purposes (Heidtmann 1993, p. 74).

4.2 Incentive programmes for nature and landscape protection

The compensation charge payments flow from potential or real users in the direction of the state or municipal budgets. The opposite is true for landscape protection programmes. Here the public purse offers financial incentive measures to support and stimulate landscape protection and nature conservation activities. The different programmes usually comprise detailed descriptions of the objectives of the programme and the purpose of allocation. Furthermore, application procedures, potential target groups, grant prerequisites as well as methods and extent of financing are elaborated. A complex relationship between the public and private participants developed out of the formal and informal contacts formed during the implementation of the incentive programmes.

Financial support for specific nature protection activities

Incentive programmes comprise exchange and regulation components (Hucke 1983). On the one side the exchange component consists in the voluntary decision of the potential programme target groups whether they take the financial offer or not; on the other side, undertaking specific nature protection activities, which lie in the public interest, are prerequisites for the reception of financial contributions. The allocation of the financial help is linked to encompassing preconditions and regulations that form the regulatory element. Financial incentive measures are interesting from the point of view of the target groups because they consist of money out of the public purse. The regulative conditions are accepted when the financial benefits outweigh the costs of the conservation activities. From the target groups' side of the programme there is, therefore, a generally positive basic attitude to this kind of financial instruments. The fundamental acceptance of the financial receiver explains the favouring of grant programmes by the executing authorities – the instruments are proved to be less conflict laden than bans, fees, or charges. This point of view has often been supported by the environmental authorities of the German cities (see Sec. 3.2). This does not mean that no acceptance problems and conflicts occur during the implementation of the incentive programmes; this is caused, among other things, through the refusals of grant applications; sometimes extremely detailed subsequent demands are required by the authorities.

In view of the future application of our results in the Leipzig area (Saxony, Germany), we made an investigation specifically aimed at incentive measures for nature conservation at the state level of Saxony. Several environmental and agricultural state programmes have been identified that might be suitable for the integration of spatially-oriented measures. Incentive measures for nature protection and landscape care (SMU 1997) and conservation contracting (SMU 1995) fall in the area of responsibility of the environmental ministry in Saxony whereas the cultural landscape programme is part of the incentive programme on environmentally friendly agriculture (SML 1995) and has been issued from the agricultural ministry. Especially the directive on incentive measures for nature protection and landscape care might be suitable to integrate the management recommendations concerning habitat networks. Among others, the allocation possibilities embrace measures for habitat management and landscape care, measures for biotope design, habitat networks, and measures for species protection. Therefore it seems to be a minor effort to further consider the management recommendations for habitat networks elaborated earlier in this article. However, the directive primarily applies to measures that are undertaken either in or adjacent to existing protected areas. It is the cultural landscape programme that applies to the rest of the areas, which are predominantly parts of open landscapes. In the latter programme, mainly extensification measures, but also a few biotope related measures can be financially supported. Therefore, an adaptation of incentive programmes both in the areas of environmental and agricultural affairs should be envisaged to include management recommendations for habitat networks.

Implementation problems and deficits

The implementation of incentive programmes can be divided in different phases: the phases of the concrete programme formulation and budgeting, the distribution of resources, the granting of resources as well as the resource use. Implementation problems and deficits occur in all phases. The programme set-up requires that many detailed decisions are made relating to the preconditions of grants and the specific regulations to be fulfilled by the target groups. These detailed decisions require an extensive knowledge, which, when not available, can cause certain forms of over- and under-regulation. There are similar questions when it comes to making decisions about the distribution of resources. Our ideas as presented in the first part of this text, make it clear that it is not the equally distributed financial help, but rather the locally specified grants that often prove to be better. The implementation problems in this phase are therefore caused by the existing resources being falsely situated or dispensed incorrectly.

The participation in incentive programmes is voluntary. Thus, the insufficient dissemination of knowledge about the incentive programme causes restrictions in the phase of granting of resources. Short term programmes have to deal with the problem of insufficient announcement. Longer term programmes have to deal with the problem that stable relationships between the authorities and already established clients can make it difficult for new applicants to enter the programme. The lack of personnel in the authorities makes the careful control of the resource use difficult. This is a reason why the success of incentive programmes may not depend on ecological effects, but, although rather paradoxically, often on the emptying of the grant bowl. In this way the contributions are paid, even when the agreed conservation activities in return for the payments never occur, or are incomplete. Once incentive programmes are enacted, administrations are prone to stick to them even in cases when much more effective possibilities for problem solving show up. Therefore it is necessary to keep a permanent alertness and adapt or change incentive programmes whenever innovative solutions can be integrated to make the programmes more ecologically effective or economically efficient.

5 Conclusion

As we have demonstrated in the present article, there are options to invest scarce resources with much higher effects for species survival than practised up to now. We have shown that the ecological effectiveness of a given financial effort for conservation activities strongly depends on the way these resources are allocated in spatial terms. Mathematical models can help both to quantify ecological effects and to reveal important relationships between habitats. This finally provides the basis for ecologically founded guidelines to effectively design economic incentives for conservation policy.

A survey on the use of different environmental policy instruments (regulation, planning, economic incentives, communication, information) in German cities has shown that regulation and planning dominate less in conservation than in general environmental policy and that there is a tendency that the different policy instruments analysed are on a more equal level in nature protection. As a result of our analysis of two policy instruments in German conservation policy, the compensation charge and incentive programmes, we recommend to reconsider and loosen the obligation of spatial connectedness between impact and compensation measures. Finally, we judge the incentive programmes to be suitable for integration of the management recommendations that have been identified concerning habitat networks.

To further promote the role of economic incentives or other instruments using market forces in conservation policy, implementation issues should be carefully considered. The present implementation practices cause specific barriers that decrease their effectiveness. Administrative implementation deficits may substantially add to the restricted steering and incentive effect that the compensation charge and incentive programmes exhibit so far. An important future task is to elaborate concrete proposals for the elimination of implementation and acceptance problems that would fundamentally improve the ecological effectiveness and economic efficiency of nature and landscape protection.

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