

# Hunting Rights and Conservation: The Portuguese Case

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**Abstract** - Hunting and game-preservation are interrelated. There are two fundamental traditions in the legislation on hunting property rights: the Romanic tradition and the Germanic one, with different consequences in terms of resources use and conservation.

The Economic Theory of Common Resources has been applied to provide conclusions about the management and conservation of hunting resources. In this paper, we derive a model of hunting management, adapting the Gordon/Schaefer fisheries model. The conclusions of the model are confronted with Portuguese hunting regulation.

**Keywords** - "Tragedy of the Commons", hunting, game-preservation, *res-nullius*.

## 1. Introduction

Hunting (whether for food or for sport) marked all the periods of History, in all latitudes, cultures and civilisations (Carmo, 2000). But the traditional obscurity of this sector leads to the relative poor attention, in the context of the Natural Resource and Environmental Economics: despite the social and economic importance of the sector in countries like Portugal, the literature on hunting is scarce.

In a relevant paper from the 90s, Hasenkamp (1995) derived a model of hunting management and conservation and concluded that hunting and game-preservation were interrelated: hunting must respect the intentions of game-preservation, and game-preservation must rely on hunting as one method to achieve its intentions. In the paper, the Economic Theory of Common Resources is applied to the problem to provide conclusions. What is curious is that these conclusions are reflected in the existing relevant legal hunting setting in Germany. That is, German Law contains regulation that confronts the hunter with the objectives of hunting preservation and held him the responsibility for pursuing these goals.

By the contrary, in Portugal (and other Latin countries), the fundamental debate in this domain always turn around the overexploitation of hunting resources and the dissatisfaction of hunters with hunting regulation, especially with that relates to hunting property-rights and access conditions to hunting grounds.

Our issues are the following: What are the differences between Portuguese regulation and the

Germanic one? With respect to hunting regulation, is the legislator confronted with different conceptions or principles? What difference does it make? What are the economical effects of this possible distinct legal tradition?

The structure of the paper is the following:

First, we compare two conceptions of hunting property rights: the Roman conception and the German conception.

Then, we derive a model of hunting management and conservation. Analysis of the model leads us to conclude about the relation between the property-rights regimes and the efficient use of hunting resources.

Finally discussion of Portuguese hunting regulation takes us to conclude about our Roman tradition and hunting management consequences.

## 2. Romanic Versus Germanic Legal Tradition

Ortega y Gasset formulated the hypothesis of being printed, in the man's sub-conscience, his hunter past.

The juridical evolution of the property-rights regimes of hunting and the discipline demanded for the activity can help to understand the attitudes of the legislator and the proposed regulation. Along the centuries, two systems, or conceptions, about hunting property-rights, were confronted: the Roman conception and the Germanic conception.

The Roman conception states that the wild animals constitute *res nullius*, things without owner that all men can appropriate by *ocupatio*, the only title of property acquisition on the hunted wild animal. To this conception, the classification of *free land* implicates that the hunter has the freedom of access to the hunting resources in other's land, although respecting imposed norms.

Of course, as the agriculture was organised, the idea of game reserve appeared. And, as a consequence, the twin idea of extending an ownership right to the wild animals living in someone's land was developed. But, indifferent to such habits, the Roman law maintained to the whole wild animal the consideration of freely access. The property of the wild animal owes to the hunter who captured it, to the land's owner being just reserved the right of excluding others from hunting in their lands. It's the recognition of "*res- nullius*" nature of hunting resources and hunt as a national value.

This attitude is understandable. Romans saw the activity in a circus perspective. This attitude made hunting a “frivolous” occupation, not an economic activity. Hunting was identified with the imperial virtues of physical and paramilitary education. Hunting, horse-seated, was a distinctive form of the resistance to the barbarian activity of hunting “as massacre” (Carmo, 2000). This vision was incompatible with the private property. On the contrary, it suggested a noble fight between the man and the wild nature. And, only if nature was identified with something of absolutely free, this fight made sense in ethic terms.

The Germanic conception considers the right of hunting due to a privilege (feudal type) of the landlord. Hunting right is clearly linked to the property right on land. The landowner is entitled of disposing of what is “*his property*”, including the hunt.

There has been an important debate among defenders of the two conceptions.

The defenders of the Roman regime oppose the argument that the Germanic conception is artificial in its foundations. It does not solve the management and conservation problem in the areas of small property because the hunt has natural mobility and can be born and feed in a hunting ground, live in another and be captured elsewhere. So, the determination of the property is impossible.

They also argue that, to be applied with the whole rigidity, this conception would result in the complete extinction of all the free lands, transforming the territory in an immense game reserve where the hunters without land would not have access. This could be identified as a “true abuse of right”. In the extreme situation, the “owner” could impede the access and could, also, destroy or take advantage of the resources, attempting against a public wealth that imported to safeguard. So, the Government must limit such ends.

By the contrary, the Romanic conception sees hunt as a common, res-nullius good; the property right appears in the own moment of the capture. This conception has, to its favour, some arguments of value:

- The mobility of the hunt inter-properties as a gift of nature;
- The private property carries out a social function and it can be the case that the Government wants the landowners to support the social costs of creating the species destined to collective use.

The defenders of the German conception put in evidence the problem of the conservation of the species. The rationale of this argument approaches, in essence, the theoretical economic discussion of the Natural Resource Economics when approaching the Common Property problem and the so-called “Tragedy of the Commons”. The exploitation in

regime of open access will lead, unavoidably, to the situation of overexploitation of the resources, due to the non-existence, or vague stance, of property rights.

On the contrary, to the defenders of the privatisation of hunting, the optimal solution can arise by trusting in the private owner interest. Landowners will use the resources in an inter-temporal logic that intends to maximise the present value of benefit stream of hunting, along the time. In his land, each landlord can work as a “sole owner” promoting the efficiency in the resource exploitation and conservation.

This is what we intend to demonstrate with the formal bioeconomic model of hunting management that we develop and present in the next point.

### 3. A Model of Hunting Management

To suit the purpose of modelling hunting activities and exploring the issues of hunting resources management and conservation, Hasenkamp (1995) adapted the model of Dasgupta and Heal (1979).

Our proposal is different. We adapt the Gordon/Schaefer model. Becoming from Fisheries Economics, this is a very useful model to explain the market characteristics and agents behaviour, in the general common property case.

In this presentation we only approach the static version of the model to highlight the fundamentals of hunting mismanagement when we consider the open access situation. A dynamic version of the model – forthcoming - will help, also, the correct explanation of possible regulation solutions for the common property problem. These economic tools switch, in its essence, the traditional answers, to the externalities problem, of Pigou and Coase.

The central point in the Gordon (1954) paper is that fish are difficult to observe (except upon capture) and mobile (often travelling great distances). Consequently, these resources have provided excellent examples of resources in which the costs of attempting to establish property rights are perceived as exceeding, by a wide margin, the benefits that might be derived there from.

Gordon argues that, if a common property fishery is subject to no government regulation and the fishing industry is competitive, there will be inevitable market failure: the fishery will be expanded to the point that economic overfishing and overcapacity will occur (Munro, 1982).

The similarities with the hunting case are obvious.

Suppose a large area, for example, a municipality. We assume that the disposable land is subject to two different activities: agricultural use and hunting.

If we want to design an acceptable economic model of hunting, we must introduce, in its foundation, a biological model of hunting resources growth.

In the Gordon article, the underlying biological foundation is a variant of Schaefer (1957) model. In our model, the populations' dynamics can, also, be easily described with a "Macro-Biological Approach". A hunting resource population or biomass will, if not subject to human capture, grow, in terms of weight, both as a consequence of the recruitment of new individuals and as the result of the growth of individual wild animals in the population. Natural mortality will act as a check on growth. If we assume stable environmental conditions (especially, if we do not introduce men as predators), along the time, the biomass will approach a natural equilibrium level at which net growth is zero.

If we do not attempt to distinguish among the factors influencing net growth, the growth of the biomass can be viewed as a function of the biomass itself, and the population dynamics can be modelled by a very simple differential equation:

$$G(x) = \dot{x} = \frac{dx}{dt}$$

$x$  denotes the biomass and  $G(x)$  represents the regeneration capacity associated with every level of the stock.

The relation between the rate of growth and the level of the stock is not monotonic. As in the Schaefer model, we'll have a quadratic function:

$$G(x) = r x (1 - x/K)$$

$K$  denotes the carrying capacity and  $r$ , constant, denotes the intrinsic growth rate.

When integrated, we are facing the popular Lotka/Volterra logistic equation of population dynamics.

When we introduce the men action of capture/hunting, the first equation is modified:

$$dx/dt = G(x) - H(t)$$

$H(t)$  denotes the hunting rate.

The hunting production function is given by:

$$H(t) = h F(t) x(t)$$

$F(t)$  denotes the venation/hunting effort at time  $t$  (a kind of "capital-jelly" measure of the flow of

labour and capital services devoted to hunting activities; this could be evaluated, for example, in terms of hunting hours), and  $h$ , constant, denotes a capture-ability coefficient measuring the different capture conditions between hunting grounds.

If the resources are being captured in a sustainable basis, then  $dx/dt = 0$  and  $H(t) = G(x)$ .

Hence,  $G(x)$  can be viewed as the sustainable yield associated with a given biomass level. This also drives us to the well-known "Maximum Sustainable Yield" Principle proposed by biologists as an orientation rule for resource use. The growth rate is a quadratic function. So, there is a stock where the regeneration capacity is maximised, and that is the stock that makes possible to maintain indefinitely a maximum capture rate. The management objective should be to drive the biomass to that level and, afterwards, to capture, every year, the associated growth of the stock.

Since  $H(t)$  is a function of  $F$ , as well as  $x$ , one can establish the sustainable yield/ venation effort relationship:  $Y = \alpha F - \beta F^2$ ,

$Y$  denotes sustainable physical yield, with  $\alpha = hK$  and  $\beta = h^2 K/r$ .

In fact, if capture is taking place on a sustainable basis we have:

$$h F x = G(x) \text{ and } h F x = r x (1 - x/K).$$

Then, we can derive the expression  $x = K (1 - h/r F)$  and, by substitution, we find an equation expressing sustainable yield as a function of  $F$ :

$$Y = h F K (1 - h/r F) = h K F - (h^2 K/r) F^2$$

With the biological model complete, we can introduce prices and costs.

We assume that both the demand for captured hunting resources and the supply of hunting effort are perfectly elastic.

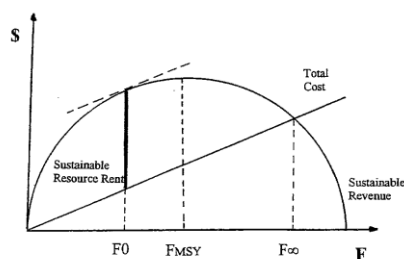
The cost function can be expressed as the simple equation:

$$C = c F$$

We assume that the total cost is linear with effort. The constant  $c$  denotes unit cost of effort.

Sustainable revenue is represented by  $pY$ , where  $p$  is the unit price of hunting. It has, also, a quadratic form. Note that total cost is to be interpreted as the total cost of capturing the sustainable yield.

We can now solve, graphically, the model and analyse the behaviour of the "industry" (see Figure 1):



**Figure 1**

The main conclusions are:

- If hunting was managed by a “sole owner”, the hunting would be stabilised at the point where sustainable resource rent (sustainable revenue less total cost) is maximised, that is,  $F_0$ . In this situation, hunting resources are managed in a socially optimal manner and, at that point, the marginal cost and the value of the marginal product of venation effort are equal. If hunting effort expands beyond  $F_0$ , overexploitation of the resources occurs.
- If hunting activities take place in a regime of Open Access, that is, in a *res nullius* basis, and if hunting is unregulated and competitive, there is no landlord to appropriate the resource rents generated by hunting. Thus, if hunting was at the point where resource rents are maximised,  $F_0$ , the “industry” would be enjoying super-normal returns and new hunters would be attracted to enter the hunting ground. Hunting effort will expand, leading to overexploitation of biomass. In this case, hunting would not be in equilibrium until it had expanded to the point where total costs are equal to total revenues, that is, until resource rent had been fully dissipated. At this point,  $F_\infty$ , the marginal social cost is different from private marginal cost. This “bionomic equilibrium” (as Gordon used to call it) reflects the existence of externalities in the hunting process, and it’s a case of market failure.

Note, also, that even the principle of “full resource utilisation”, proposed by the biologists, is, possibly, less-conservationist than it is pretended (and needed). In fact, the level of venation effort associated with maximum sustainable yield ( $F_{MSY}$ ) can be higher than the effort associated with the “economic optimum” ( $F_0$ ).

The central idea can be stated as follows:

In conditions of free access and competition the market leads to non-optimal solutions in resource use. The “*res nullius*” nature of the property-rights regime and the presence of externalities in the capture, and their effects, especially the complete dissipation of resource rents and the dynamic effects on the stocks, lead to market equilibrium solutions that implicate overexploitation and overcapacity.

There is nothing like an “invisible hand”, in such case. Some kind of regulation is needed. Agents must internalise the external effects. Otherwise resources will be overexploited and, perhaps, irreversibly becoming extinct. In this sense, it seems that the followers of German conception are in the right side. But of course there are also other dimensions of the problem that must be discussed. One of them is the equity issue.

#### 4. The Portuguese Case

The Portuguese case is curious. Hunting was always practised in Portugal and covered by the Latin jurisprudence, although hunt resources have been considered as inherent to the land’s domain. To this jurisprudence wild animals are things without owner that all men can appropriate by *ocupatio*. This is the only title of acquisition of the property on the hunt.

This tradition of open access is the root-cause of hunting depletion. But, at the same time, the legislator sees it as a form of giving the hunters without land the possibility of enjoying this activity. This is compatible with the Portuguese tradition that attributes something like a universal privilege to the right of hunting. Our legislators wrapped up in the discussion between Romanic and Germanic conceptions. The confrontation between the defenders of these regimes impresses because it’s a case of a country where the tradition of “the freedom of hunting” almost attributed a *personality right* to the right of hunting. That is, the issue of equity is also considered in the Portuguese legislation. In fact, the capacity of entering one’s land only to capture wild animals which “have no owner, only pertaining to *Free Nature*”, give the common people/hunter the sensation that they are equal face to the gifts of Nature.

Note also that the Portuguese tradition is, obviously, Roman, but it doesn't stop revealing interesting and original signs.

After some original mixtures (even introducing some reserve areas), with the approval of the *Civil Code of Seabra* (1868) the Romanic tradition was absorbed in a very clear mode. In the title I (article 383) and in the title III (of the territory occupation), hunting is designed as *res-nullius*. The Code settles down the legal principle that “it is bid to all, without distinction, to hunt the wild animals, in conformity with the administrative regulations that determine the way and the time of hunting”.

The article 388 of the Code recognised the property-right to the hunter, after having captured the animal. But, the hunting sector was complemented later with hunting regulation, national and municipal regulations, consisting of hunting seasons, prohibitions of destruction of nests and habitats, fines, and so on.

The actual Portuguese Hunting Law (1999) is a compromise between the Roman tradition and the necessity of hunting preservation.

In the context of evident overexploitation of hunting resources, the legislator maintained the free access principle in the so-called municipal hunting zones. This principle is also guaranteed in the designed national hunting zones but, for these areas, the fundamental characteristic is the state management with conservation and scientific research purposes.

At the same time, the hunting legislation created associative and tourism-hunting zones where the access rules are restricted. The objective is to hold the hunters the responsibility to achieve the objectives of sustainable use and protection of the species.

Focusing on the types of property-rights relevant to common property (see Coelho, Filipe and Ferreira, 2010) it seems that we are now trying a perfect mixture of “res-nullius”, “res-publica” and “res-communes”.

Especially this last proposal, switching the ideas of Elinor Ostrom, seems to have a great domain for future development. Ostrom studies are fundamental in the substitution of the “Tragedy” metaphor to the more interesting “Drama of the Commons”. Of course we’ll have tragedies, in the free access situation, but sometimes we’ll have also reasons to laugh. Ostrom stresses that a commons can be well governed and that most people, when presented with a resource problem, can cooperate and act for the common good. “Co-management” and self-regulation are the keys for sustainable resource management. That is also the case for hunting.

## 5. Final Remarks

Our research suggests the following final remarks:

Despite the traditional “opacity” of hunting world, this is a fertile field for Social Sciences investigation, Economics included. A fundamental problem stands in the fact that there is an “unfortunate tradition”, even in theoretical grounds, of failing to recognise the critical distinction between the *true* common property (res communes) and non-property (res nullius). This situation blurs analytical and prescriptive clarity. Property refers not to an object but rather to the benefits’ stream that arises from its use. In the essence of property concept there is a social relation. So, there’s nothing inherent in the resource itself that determines absolutely the nature of the property rights. The use of the term “Commons”, in reference to resources as the hunting case, is ambiguous.

The only thing that we can positively affirm is that, in conditions of open access and competition, the hunting market leads to non-optimal solutions in resource use. The “res nullius” nature of the property

regime and the presence of externalities in the process of capture, lead to the complete dissipation of resource rents. So, the market will be driven to hunting equilibrium solutions that result in overexploitation of hunt resources and overcapacity (that is, “the Tragedy of the Commons”).

Portugal has a long Roman tradition in legal hunting setting. This tradition of open access is the root-cause of hunting depletion. But the legislator sees it as a form of giving the hunters without land the possibility of enjoying this activity. This is compatible with the Portuguese tradition, which almost attributes a *personality right* to the right of hunting. The actual Portuguese Hunting Law (1999) is a compromise between the Roman tradition and the necessity of hunting preservation, maintaining hunting zones where the principle of free access still remains but creating, at the same time, other hunting zones where hunting rights are privatised.

Nowadays the sector of hunting in Portugal is confronted with two contradictory situations. By one side, the number of the hunters is diminishing. From the beginning of the century, the sector lost almost 90.500 hunters. The number of hunters in 2011/2012 is 133.242. The owners of hunting licence are now inferior in around 5.400 than the last year. These hunters pay around 60 euros to get the licence. In the hunting season of 1999/2000 the number of hunters with licence was 223.740. That is, perhaps, a good news in terms of conservation purposes, in the sense that this could be interpreted as a reduction in the venation effort with possible better results in the capacity of regeneration of the species.

But another fact is posing some doubts about the capacity of the sector to get a sustainable use of the resources (note that this sector represents potential revenue of 300 million euros, by year): hunters are getting older. For a universe of around of 287.000 potential hunters, only 1000 have less than twenty years. 109.000 have already more than 61. This reflects the difficulties of refreshing the oldest generations of hunters with new hunters with skills and information on subjects related to the nature conservation and the optimal inter-temporal use of natural resources.

## References

- [1] Alchian, A. and Demsetz, H. (1973), "The Property Rights Paradigm", *Journal of Economic History*, Vol. 33, Nº 1, pp 16-27.
- [2] Barros, H. (1949), *História da Administração Pública em Portugal nos séculos XII-XV*, Tomo VI, Sá da Costa, Lisboa.
- [3] Berck, P. (1979), "Open Access and Extinction", *Econometrica*, Vol. 47, Nº 4, pp 877-882.
- [4] Bishop, R. (1978), "Endangered Species and Uncertainty: The Economics of a Safe Minimum

- Standard”, *American Journal of Agricultural Economics*, Vol.60, Nº 1, pp 10-18.
- [5] Bromley, D. (1991), “Testing for Common versus Private Property: Comment”, *Journal of Environmental Economics and Management*, Vol. 21, Nº 1, pp 92-96.
- [6] Brown, Jr, G. and Goldstein, J. (1984), “A Model for Valuing Endangered Species”, *Journal of Environmental Economics and Management*, Vol. 11, Nº 4, pp 303-309.
- [7] Buschena, D., Anderson, T. and Leonard, J. (2001), “Valuing Non-Marketed Goods: The Case of Elk Permit Lotteries”, *Journal of Environmental Economics and Management*, Vol. 41, pp 33-43.
- [8] Carmo, M. (2000), *O Problema da Caça no Alentejo (1901-1975)*, Tese de Mestrado, Faculdade de Letras/ Universidade de Lisboa.
- [9] Ciriacy-Wantrup, S. (1957), *Conservacion de los Recursos, Economia y Política*, Fondo de Cultura Economica, México.
- [10] Clark, C. (1990), *Mathematical Bioeconomics, The Optimal Management of Renewable Resources*, 2nd Edition, Wiley-Interscience Publication, John Wiley and Sons.
- [11] Clark, C. and Munro, G. (1975), “The Economics of Fishing and Modern Capital Theory: A Simplified Approach”, *Journal of Environmental Economics and Management*, Vol. 2, Nº 2, pp 235-244.
- [12] Coelho, M.(2009), “Roman Legal Tradition and the Mismanagement of Hunting Resources”; *Proceedings do 15º Congresso da APDR (Associação Portuguesa de Desenvolvimento Regional), 1º Congresso de Desenvolvimento Regional de Cabo Verde, 2º Congresso Lusófono de Ciência Regional, 3º Congresso de Gestão e Conservação da Natureza*, Cidade da Praia, Cabo Verde.
- [13] Coelho, M. (2003), “The Economics of Hunting: Roman Law vs German Law”, ISEG/UTL, Departamento de Economia, Seminário do Departamento Nº 25/ 2003.
- [14] Coelho, M. (2003), “Sobre Comuns e Tragédias – Recursos Naturais e Direitos de Propriedade”, *Proceedings do V Encontro de Economistas de Língua Portuguesa*, Recife, www.decon.ufpe.br/veelp
- [15] Coelho, M. (1999), *A Tragédia dos Comuns Revisitada, A Pesca do Bacalhau na Terra Nova: Consequências do Regime das 200 Milhas*; ISEG/UTL, Lisboa.
- [16] Coelho, M. , Filipe, J. and Ferreira, M. (2010), “On Commons, Anticommons and Tragedies”, Romão, Silva E Ferreira (orgs.) *Homenagem ao Professor Doutor Adelino Torres, Coleção Económicas*, Nº 14, II série, pp.587-600.
- [17] Conrad, J. (2000), “Wilderness: options to preserve, extract, or develop”, *Resource and Energy Economics*, Vol. 22, pp 205-219.
- [18] Dasgupta, P. and Heal, G. (1979), *Economic Theory and Exhaustible Resources*, Cambridge University Press.
- [19] Demsetz, H. (1967), “Toward a Theory of Property Rights”, *American Economic Review*, Vol57, pp 347-359.
- [20] Faucheux, S. and Noel, J. (1995); *Economia dos Recursos Naturais e do Meio Ambiente*, Instituto Piaget.
- [21] Filipe, J., Coelho, M. E Ferreira, M. (2007), *O Drama dos Recursos Comuns. À procura de soluções para os ecossistemas em perigo*, Edições Sílabo, Lisboa.
- [22] Fisher, A., Krutilla, J. (1985), “Economics of Nature Preservation”, in Kneese, A. and Sweeney, J. (eds.), *Handbook of Natural Resource and Energy Economics*, Vol. II, North-Holland, Amsterdam.
- [23] Fisher, A., Krutilla, J. and Cicchetti, C. (1972), “The Economics of Environmental Preservation: A Theoretical and Empirical Analysis”, *American Economic Review*, Vol. 62.
- [24] Gordon, H. S. (1954), “The Economic Theory of a Common Property Resource: The Fishery”, *Journal of Political Economy*, Vol. 62, pp 124-142.
- [25] Hardin, G. (1968), “The Tragedy of the Commons”, *Science*, Vol. 162, pp 1243-1247.
- [26] Hasenkamp, G. (1995); “The economics of hunting, game-preservation and their legal setting”, *European Journal of Political Economy*, Vol. 11, pp 453-468.
- [27] IUCN (2001), *The Red List of Threatened Species*, <http://www.redlist.org/info>
- [28] Milon, J. and Clemmons, R. (1991), “Hunter's Demand for Species Variety”, *Land Economics*, Vol. 67, Nº 4, pp 401-412.
- [29] Munro, G. (1982), “Fisheries, extended jurisdiction and the economics of common property resources”, *Canadian Journal of Economics*, Vol. 15, Nº 3, pp 405-425.
- [30] Myers, N. (1989), “A Major Extinction Spasm: Predictable and Inevitable?” in Western, D. and Pearl, M (eds.), *Conservation for the Twenty-first Century*, Oxford University Press, pp 42-49.
- [31] Naughton-Treves, L. and Sanderson, S. (1995), “Property, Politics and Wildlife Conservation”, *World Development*, Vol. 23, Nº 8, pp 1265-1276.

- [32] Neher, P. (1974), "Notes on the Volterra - Quadratic Fishery", *Journal of Economic Theory*, Vol. 8, pp 39-49.
- [33] Neher, P. (1990), *Natural Resource Economics: Conservation and Exploitation*, Cambridge University Press.
- [34] Paulo, A. and Vieira, N. (1988), *Gestão Cinegética*, Direcção Geral das Florestas.
- [35] Pearce, D. and Moran, D. (1994), *O Valor Económico da Biodiversidade*, Instituto Piaget.
- [36] Pearce, D. and Turner, R. (1990), *Economics of Natural Resources and the Environment*, Harvester Wheatsheaf.
- [37] Rosário, L. (1984), *A Fiscalização da Caça em Portugal*, Direcção Geral das Florestas.
- [38] Rosário, L. E Barreto, L (S/d), *O Ordenamento Cinegético no Contexto dos Problemas de Ordenamento do Território*, Direcção Geral das Florestas.
- [39] Schaefer, M. (1957), "Some Considerations of Population Dynamics and Economics in Relation to the Management of the Commercial Marine Fisheries", *Journal of the Fisheries Research Board of Canada*, Vol. 14, pp 669-681.
- [40] Schlager, E. and Ostrom, E. (1992), "Property-Rights Regimes and Natural Resources: A Conceptual Analysis", *Land Economics*, Vol. 68, Nº 3, pp 249-262.
- [41] Seabright, P. (1993), "Managing Local Commons: Theoretical Issues in Incentive Design", *Journal of Economic Perspectives*, Vol. 7, Nº 4, pp 113-134.
- [42] Smith, R. and Shogren, J. (2002), "Voluntary Incentive for Endangered Species Protection", *Journal of Environmental Economics and Management*, Vol. 43, pp169-187.
- [43] Smith, V. L. (1968), "Economics of Production from Natural Resources", *American Economic Review*, Vol. 58, Jun, pp 409-431.
- [44] Smith, V. L. (1975), "The Primitive Hunter Culture, Pleistocene Extinction and the Rise of Agriculture", *Journal of Political Economy*, Vol. 83, Aug., pp 727-755.
- [45] Tietenberg, T. (2003), *Environmental and Natural Resource Economics*, sixth edition, Addison Wesley Longman, Inc.
- [46] Tisdell, C. (1991), *Economics of Environmental Conservation*, Elsevier Science Publishers, Amsterdam.
- [47] Weitzman, M. (1974), "Free Access vs. Private Ownership as Alternative Systems for Managing Common Property", *Journal of Economic Theory*, Vol. 8, Nº 2, pp 225-234.
- [48] Wilen, J. (1985), "Bioeconomics of Renewable Resource Use", in Kneese, A. and Sweeney, J. (eds.), *Handbook of Natural Resource and Energy Economics*, Vol. I, North-Holland.
- [49] Wilson, E. (1989), "Conservation: The Next Hundred Years", in Western, D. and Pearl, M. (eds.), *Conservation for the Twenty-first Century*, Oxford University Press, New York, pp 3-7.

## Regulation

- [50] Lei de Bases da Caça (Lei Nº 173/99 de 21 de Setembro) , Diário da República- I Série- A, pp. 6532-6541
- [51] Decreto-Lei Nº227-B/2000 de 15 de Setembro – Diário da República- I Série-A, pp 4946(2)-4946(31).