

Management of the marine biodiversity in coastal areas through the French

ZNIEFF network

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Abstract

The first ZNIEFF program (Natural Zones of Ecological, Faunistic and Floristic Interest) was launched in the 80's along the French Mediterranean coast in Provence-Alpes-Côte d'Azur region (PACA) and in Corsica. This first program proposed a bibliographical inventory of the areas of special interest, according to fauna and flora. In 1996, these inventories were updated following a new methodology. A in situ inventory of species and habitat was carried both in and out of the first-generation ZNIEFF areas. The inventory was not complete but species have been selected according to 7 criterions: (i) legislative protection (French and European laws), the known degree of (ii) rarity, (iii) endemism, (iv) dynamic, (v) abundance, (vi) patrimonial interest, and (vii) functional interest. According to the value of these criterions, the species were considered as : determinant or remarkable. For the habitat, the same procedure was followed using 6 criterions: (i) vulnerability, (ii) heritage value, (iii) rarity, (iv) aesthetic value, (v) economic value, and (vi) speed of regeneration. A ZNIEFF area is proposed if at least one determinant species and one determinant habitat are observed. The usefulness of this database is discussed and compared to Natura 2000 network.

Introduction

The inventory of the ZNIEFF (Natural Zones of Ecological, Faunistic and Floristic Interest) was launched in 1982 under the initiative of the ministry of the environment, design and coordinated at a national level by the Fauna and Flora Secretariat of the Paris Muséum National d'Histoire Naturelle (MNHN). Its main objective was to create an inventory of the areas of high ecological interest for the national territory in order to provide a decision tool for all the authorities and managing organisations.

This inventory carried out by scientists according to a national methodology setup in mainland France (and later applied to overseas départements), validated by the MNHN and its scientific and administrative partners, was completed gradually between 1988 and 1995. In total, 13 400 ZNIEFF have thus been identified, described and digitized over the whole national territory.

A ZNIEFF means a "sector of national territory for which the scientific experts have identified remarkable elements of the natural heritage". Two main types of ZNIEFF have been identified: those of type I that contain at least one specie or habitat of remarkable interest or that is rare, and those of type II which because of the richness of the natural heritage that they hold stand out from the rest of the territory.

The Provence Alpes Côte d'Azur (PACA) region was the first to present, in 1988 a real network of Land ZNIEFF and Marine ZNIEFF. This first generation of Marine ZNIEFF designated 94 sites in the PACA region. For each of these sites, the geographical boundaries were delineated and a record was made describing the main characteristics of the zone: habitat, species, morphologic description, human activities and development measures (Anonymous, 1988). In 1991 the inventory of the ZNIEFF zones for Corsica was published using the same model,

The production of these first inventories of Marine ZNIEFF was under the responsibility of the Regions (PACA Region, Corsica Region). The Ministry of the Environment then requested a general inventory of the Marine ZNIEFF which was coordinated from 1990 by the Natural Heritage Service and the laboratory of Marine Invertebrates Biology and Malacology of the Paris Muséum National d'Histoire Naturelle (Dauvin, 2000). It was subsequently extended to overseas départements in 1995 (Guillaume & Doumenc, 2000).

From 1992, following the success of the first inventory as a source of information in decision making, it was necessary to update, improve the consistency, and widen the scope of this document. To achieve this update, discussions were engaged either at a regional level (CSRPN; Conseil scientifique régional du patrimoine naturel) or at a national level (Department of Natural Heritage at the MNHN). In order to codified and transpose the methods used for land to the sea, a certain amount of documents have been produced regarding specifically the marine environment. Of all these documents, the typology of the Marine ZNIEFF (Dauvin *et al.*, 1994) is definitely a major publication. In this document a precise typology of habitats of the Mediterranean sea and the Atlantic and a list of key species of these habitats, is proposed.

The main complaint expressed concerning the first generation of ZNIEFF was the theoretical aspect of the inventory. Indeed the inventory was determined, after the analysis of the existing bibliography related to the various zones or the knowledge,

published or not, of scientists. The zones were exclusively selected according to the knowledge previously acquired, whether published or not, but not with an actual on-site assessment. The lack of ZNIEFF status did not mean then that the zone was not eligible to be classified but rather that the knowledge was insufficient to evaluate objectively its status

In 1995, an update of the ZNIEFF inventory was launched by the Ministry of the Environment according to a more precise and updated methodology. The status of a zone was then chosen in view of an *in situ* assessment: inventory of habitats but also of species. This update program had three main purposes: (i) to know as precisely as possible the natural heritage of the maritime and land territory, (ii) to provide access to the scientific inventory for managers in a practical way, and (iii) to sensitize the actors of the environment to the richness of the natural heritage.

The inventory of the ZNIEFF has to be an instrument for creating dialogue and warning in the integrated management of the territory.

Results

The characteristics of the marine environment

In France, the basis of the ZNIEFF program has always concerned essentially the terrestrial zones. Characteristics of the marine environment, in comparison with the terrestrial environment, have required appropriate adjustments of the method. Collecting data *in situ*, in the Mediterranean Sea is done in two ways, whether snorkelling and scuba-diving or with the use of sampling or measuring equipments from a boat. Therefore, precise locations of sampling sites are much more occasional than on land. Furthermore, the coverage of the site is much less dense, less precise and observations or samples much less frequent than in the terrestrial environment. It is also globally less exhaustive.

Even if a number of inventories are available for the marine environment, they are often less complete, less frequent and concerning the localisation, less precise than on terrestrial land. However there is a good knowledge of the biocenosis of the coastal marine environment due to numerous unpublished works (thesis, report, mission notes and dives) and maps of some habitats and their evolutions are pretty well documented (especially *Posidonia* meadows).

In conclusion, we can acknowledge that in the marine environment compared to the terrestrial environment, (i) data is less abundant and precise in relationship to the topography and (ii) knowledge is less consistent at a specific level but globally better for the habitats.

The update of the inventories

To achieve the update of the first generation of Marine ZNIEFF and avoid an approach purely bibliographical, the first step consisted in defining lists of species and habitats to look for in priority. This was done because it was unconceivable to achieve this new inventory in a reasonable time if it was to proceed and record exhaustively all the species present regardless of their taxonomic level.

The criteria selected to identify the key or remarkable species have been largely debated and confronted with criteria used for the definition of the SPAPIM (Specially Protected Areas of Mediterranean Importance defined in the framework of the Barcelona Convention; PNUE CAR/ASP, 1999). The SPAMI list includes sites which are of importance for conserving the components of biological diversity in the Mediterranean; contain ecosystems specific to the Mediterranean area or the habitats of endangered species; are of special interest at the scientific, aesthetic, cultural or educational levels (Article 8(2) of the 1995 Protocol Concerning Mediterranean Specially Protected Areas and Biological Diversity in the Mediterranean; Rais *et al.*, 2003).

During a first phase, lists of species were established looking at animal and vegetal species mentioned in the conventions and protection acts. To these lists, specialists of the various taxonomic groups have added other species considered important for the ecological characterisation of the state of the environment. They were required not to narrow the lists to the most interesting species, but to produce, for the group they were in charge of, the most extensive list possible. These lists, developed at first for the PACA region have hence been adopted or are being produced in the other French Mediterranean regions. In a second phase, these lists have been analysed using various criteria to identify, within the most cited species, the most remarkable or significant ones.

Establishing the criteria for the selection of species

Six criteria have been chosen: (I) rarity and threats; (II) endemism; (III) evolution of the number of individuals of each species; (IV) abundance; (V) natural heritage interests and (VI) functional interests. For each of these criteria, a semi-quantitative scale was proposed in order to evaluate its relative importance. Whatever the criterion is, the smaller the values are, the more sensitive the species are in relationship to this criterion. On the contrary, the higher the values are, the less the species are sensitive or of interest.

(I). Grades in relationship to rarity and threats :

- 0: considered as presumably lost
- 1: endangered
- 2: vulnerable due to its biological and ecological characteristics
- 3: endangered due to human action
- 4: rare
- 5: not rare and not endangered

(II). Grades in relationship to the concept of endemism:

- 1: Species endemic for the PACA region
- 2: Species for which the PACA region contains an important percentage of the Mediterranean area of distribution
- 3: Species present in the PACA region but for which the area of distribution is the occidental Mediterranean region
- 4: Species present in the PACA region, but for which the area of distribution is the Mediterranean region and the close Atlantic region
- 5: Species non endemic to the Mediterranean region and the close Atlantic

(III). Grades in relationship to the level and the evolution of the number of individuals of each species

- 0: Species for which the populations are constantly supplied by the mean of genitors outside the PACA region

- 1: Specie for which the number of regional genitors or the populations are at a critical level
- 2: Specie procreating exceptionally or very occasionally in the PACA region
- 3: Specie for which the number of regional genitors or populations are undergoing a strong or continuous decline in time in the PACA region and thus are reaching a critical level to survive in this region
- 4: Specie for which the number of regional genitors or populations are stable.

(IV). Grades in relationship to the class of abundance for the number of individuals:

- 1: Population with rare or isolated individuals
- 2: Population unique and secluded
- 3: Population scattered
- 4: Population abundant and dense

(V). Grades in relationship to natural heritage interests:

- 1: Symbolic interest ;
- 2: Economical interest ;
- 3: Landscape interest ;
- 4: Pedagogical interest ;
- 5: Aesthetic interest (collections...) ;

(VI). Grades in relationship to the functional interests:

1. Role of protection in regard to other species;
2. Role of coastline stabilization;
3. Role of habitats;
4. Indicator of the environment;

These criterions are then assessed for each of the species previously chosen. The analysis of the values recorded for each criterion allows subsequently to decide the status or importance of each species. They have been classified in three categories: (i) Determinant, (ii) Remarkable and (iii) Others. The determinant species are the ones for which the values chosen for the various criterions are always low (1 to 2). The remarkable species are the ones for which a part of the values are low. The species are classified in the last category if all the values are high and if the species are not protected by law. In practice, all the species protected by law whether French or European found themselves in the category Determinant or Remarkable. It is clear that it must exist in some zones much more species of natural heritage than the ones listed. The lists available are still very incomplete. However it is anticipated that these lists can change with time and acquired knowledge.

Establishing the criterions for the selection of habitats

As with species, habitats have been analyzed with a similar procedure. The criterions used are the following: (I) vulnerability, (II) natural heritage value, (III) rarity, (IV) aesthetic value, (V) economical value, (VI) speed of regeneration. The various semi-quantitative grades chosen are thus for the habitat criterions:

(I). Vulnerability: ability of the habitat to maintain its structures and functions throughout damaging influences whether potential or existing.

- 1: strong vulnerability;
- 2: intermediate vulnerability;
- 3: low vulnerability.

(II). Natural heritage value: habitat within the regional or national natural heritage that represents an element of unique value as the occurrence of a determinant specie or an outstanding structure (cliff, cave, ...) or a singular ecological situation (merging of two water masses, area of high density).

- 1: strong natural heritage value ;
- 2: intermediate natural heritage value ;
- 3: low natural heritage value.

(III). Rarity: habitat more or less frequently uncovered by the surveys:

- 1: habitat known in one or very few numbers of sites in the whole Mediterranean region;
- 2: habitat rare or unusual in most of the Mediterranean countries because being endemic or highly scattered.
- 3: habitat not rare or not unusual.

(IV). Aesthetic value: habitat of high aesthetic and landscape value:

- 1: Landscape of high aesthetic value ;
- 2: Landscape of intermediate aesthetic value ;
- 3: Common landscape.

(V). Economical value: habitat of high economical importance, whether directly because of its richness and can be an important fishing site or indirectly because of its high importance in the trophic network of the whole biological cycle.

- 1: high economical value ;
- 2: intermediate economical value;
- 3: low economical value.

(VI). Speed of regeneration after destruction.

- 1: regeneration requiring a time length longer than a century;
- 2: regeneration requiring an time length of 10 to 100 years;
- 3: regeneration requiring an time length between 1 to 10 years.

As for the species, these criterions allowed the classification of the various habitats in three major categories:

- Determinant Habitats (D) : habitats where conservation is a prerequisite and for which the only existence requires the creation of a ZNIEFF. Many criterions are of grade 1.
- Remarkable Habitats (R) : habitats requiring a special attention and management. The occurrence of many remarkable habitats can suggest the creation of a special protected area. Only one of the criterions is graded 1.
- Not Eligible Habitats (NR) : habitats showing no characteristics of rarity or vulnerability and for which the natural heritage value, the aesthetic and economical importance are low and speed of regeneration is short. No criterion is graded 1.

Some of these criterions like aesthetic value or economical importance are questionable in the strict frame of the inventory of the Natural Zones of Ecological, Faunistic and Floristic Interest (ZNIEFF). For example, the economical value was contested by the CSRPN PACA. Nevertheless it is interesting, considering the management recommendations required by the descriptive documents of the ZNIEFF zones, to take into account such characteristics.

The field work

In the PACA region, the work of inventory of the ZNIEFF was facilitated by the existence of a first inventory (Anonymous, 1988). For each zone, passed works, were studied. This included, published or unpublished documents, inventory of species when available and lab data made available by some scientists, as well as information gathered from divers (in opposition to the terrestrial environment, in the temperate marine environment, information given by amateurs are very rare and often imprecise). Data available was analyzed according to the chosen criterions (see above): species or habitats remarkable or determinant.

Following on, each zone was assessed *in situ* during one or many dives during which habitats and species were recorded. New zones (not being part of the inventory of the ZNIEFF first generation) were also visited to produce similar records of species and habitats.

Whether it is for an old ZNIEFF first generation or for a newly prospected zone, the maintenance of an existing ZNIEFF or the adoption of a new ZNIEFF second generation was decided in regard to the number of species and habitats considered as determinant or remarkable. Theoretically, the occurrence of only one determinant specie and one determinant habitat is enough to decide the status of ZNIEFF. The boundaries of the zone are then identified in the field as the limit of the distribution of the specie or the habitat. These boundaries cannot usually be followed during a dive and practically the boundaries chosen are the ones delineating a consistent zone according to the hydrology or the morphology. At depths, if no ecological or biological limit was found, zones were automatically stopped on the 50 m isobath. Indeed, the knowledge available for bigger depths is insufficient and the exploration in scuba-diving too inefficient beyond 50 m in regard to the time spent at depth.

Classification of Marine ZNIEFF in type I or II

The ZNIEFF have been classified in two major zone types. Zones of type II are large groups, rich or little modified or providing important biological potentials. Zones of type I are sectors of limited surface areas, defined by the presence of species, associations of species or habitats which are rare, determinants or typical of the natural heritage at a national or regional level. (Maurin *et al.*, 1997).

It is obviously much harder to identify in the marine environment a small zone of type I than on land. If the zone is of small size and of major interest, we have therefore chosen to put it entirely in category I. For the large zones, even if they are of major interest, we have placed them in category II with sub-zones of type I when they contain rare or remarkable habitats in a consistent manner over small surface areas.

Validation and diffusion of the Marine ZNIEFF

The ZNIEFF in its whole is actually coordinated by the Paris Muséum National d'Histoire Naturelle (MNHN). After the production of a field inventory, the ZNIEFF network of a region or département is investigated initially by the Regional Scientific Committee of Natural Heritage for the concerned region. Afterwards, at a national level, the ZNIEFF inventory is validated by the MNHN. It is only after these two phases of validation that the inventory is made available to the public through de Regional

The setting up of the Natura 2000 network is based on the Habitat Directive and the Bird Directive, both of them edited by the European Community. The implementation of Natura 2000 network owes a lot to the work done for the update of the Marine ZNIEFF, especially concerning the Mediterranean Sea. At an international level it is also the framework of the Marine ZNIEFF (extended to the whole Mediterranean Sea) that was adopted for the creation of the SPAMI (Specially Protected Areas of Mediterranean Importance) under the area of application of the Barcelona Convention (PNUE CAR/ASP, 1999). Some international organization as INOC (Inter-Islamic Sciences and Technology Network on Oceanography) are also currently planning to develop such as approach in the eastern Mediterranean Sea.

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