Environmental Conservation (2016) **43** (3): 284–293 © Foundation for Environmental Conservation 2016 doi:10.1017/S0376892916000047

Beyond segregative or integrative models for protected areas: a case study of French nature reserves

CLARA THERVILLE[123]*, LIVIO CASELLA-COLOMBEAU[1], RAPHAËL MATHEVET [1] AND FREDERIC BIORET[2]

[1]*CEFE UMR 5175, CNRS, 1919 route de Mende, 34293 Montpellier Cedex 5, France,* [2]*EA 2119 Géoarchitecture, Université de Bretagne Occidentale, CS 93837, 29238 Brest cedex, France and* [3]*Réserves Naturelles de France, 6 bis rue de la Gouge BP 100, 21803 Quetigny cedex, France*

Date submitted: 9 April 2015; Date accepted: 10 January 2016; First published online 3 March 2016

SUMMARY

Initially conceived as human-exclusion zones (the segregative model), protected areas are more and more often established within a management framework that integrates conservation and development projects with multiple partnerships and encourages engagement with local stakeholders (the integrative model). In this study, we investigated the conservation attitudes and practices of management staff in the network of nature reserves (NRs) in France. We found that conservation practices, such as law enforcement, habitat management, environmental education and partnerships, and the socio–cultural and psychological profiles of their managers show a wide distribution along a segregative to integrative gradient. Our results indicate that while the policy of these protected areas is still structured by a segregative cliché, in practice, many managers implement a more integrated approach. This coexistence of the two approaches reflects a general pattern of evolution of nature protection thought and the institutionalization of NRs, as well as demonstrating the adaptation of NRs to their local contexts and how they function, within the surrounding landscape, as a single but complex social–ecological system.

Keywords: attitude, France, integrated conservation, nature reserve, protected area, social–ecological system

INTRODUCTION

Protected areas (PAs), particularly national parks and nature reserves (NRs), are the main tool of nature conservation policies on a global scale. The discussion of their classification by the IUCN PA category system illustrates their diversity of approaches to nature conservation and complex features (Dudley *et al.* 2010). Both a means to safeguard threatened species or natural habitats and a social construct, a PA is simultaneously characterized by its purpose, its biodiversity conservation issues, its management system and governance, its human resources and funding, and its interdependency with the surrounding landscape (Zube & Busch 1990; Hansen & DeFries 2007; Dudley 2008; Bertzky *et al.* 2012).

Over the last 30 years, conservation policy concerning PAs has undergone a major paradigm transition (Phillips 2004; Locke & Dearden 2005), contrasting the traditional 'segregative' or 'fences and fines' model with a more modern 'integrated' model. While the former involves the exclusion of humans and their activities from PAs, the latter considers PAs as tools for the sustainable use of natural resources and the development of local communities. Three issues are usually cited to describe the transition: (1) an evolution in the perceived purpose of PAs from conservation to sustainable development; (2) an expanded conception of nature conservation from protecting a strictly limited area to considering it as part of its surrounding environment and landscape matrix; and (3) a broader consideration of the stakeholders involved, not just limited to the state, experts and environmentalists, but to all citizens in local communities and local authorities. In reaction to injustices and displacement of local people caused by a 'segregative' establishment of PAs in the developing world (Peluso 1993; Agrawal & Redford 2009), there has thus been an enlargement in PA governance systems that has developed towards the implementation of a sort of 'good governance', presented as more equitable and better accepted by local communities (Lockwood 2010). This transition to an integrative approach has been observed on a global scale (Phillips 2004), but also in Europe (Mose 2007) and France (Depraz 2008). Tools such as Integrated Conservation and Development Projects, Community-Based Conservation, French Regional Natural Parks as well as the Biosphere Reserves in the UNESCO Man and the Biosphere Program are illustrations of the diversity of tools now used in more integrative models of PAs.

Today, both models are still being implemented but are questioned by biological and social scientists (Locke & Dearden 2005; Brosius 2006). They are often considered from a static and binary perspective (Miller *et al.* 2011), implying that a specific tool should depend on one model or the other. However, a growing community of scholars consider PAs as complex and adaptive social–ecological systems (SESs) characterized by a set of interactions among humans and

*Correspondence: Dr Clara Therville Tel: +33 4 67 61 32 69 Fax: +33 4 67 41 21 38 e-mail: clara.therville@irstea.fr

Supplementary material can be found online at http://dx.doi.org/10.1017/S0376892916000047

between humans and biophysical components across multiple spatial and time scales (Berkes and Folke 1998; Ostrom 2009; Cumming *et al.* 2015). Applying the SES approach provides an opportunity to go beyond the static perspective usually associated with PA analysis and consider PAs not only as geographical and environmental entities but also as socio–political–historical constructs (Mathevet & Mauchamp 2005) with multiple dimensions and different scales that change in time. In this way, PAs should not be considered as either one model or the other, but to lie on a gradient between segregative and integrative approaches.

To explore this hypothesis, we focused on French NRs, which are one of the main regulatory tools for nature conservation in France along with national parks. Traditionally, the public image of an NR is that of a fenced-off human-exclusion zone (Depraz 2008; Therville *et al.* 2012). However, many NR managers now promote a more integrated approach (RNF 2008). Between the segregative cliché, that is to say the improper and over-generalized association of segregative characteristics with all NRs and their managers, and the more recent integrated approaches (Therville *et al.* 2012), our study aims to investigate if there was an observable transition in NRs from a segregative to an integrative model, and if so in what ways can this transition be portrayed. To this end, we applied statistical analyses on national datasets investigating two criteria: conservation practices and the attitudes of managers.

MATERIALS AND METHODS

NR network

French NRs were instituted by law in 1976 as important areas of natural heritage to be conserved and protected over the long term by specifically adapted rules and managed in cooperation with local stakeholders (Bioret *et al.* 2009). In the 40 years since this law, 310 NRs covering around 30 000 km² of marine and terrestrial habitats have been designated (IUCN France 2010). Since 2002, there are three categories of NRs: national nature reserves (NNR), regional nature reserves (RNR) and Corsican nature reserves (CNR). The supervisory authority, which could be national or regional government authorities, delegates NR management to a body that acts in cooperation with a management advisory committee and a scientific committee. In 2012, 20% of NNR and CNR managers were from national authorities, 50% from environmental NGOs and 30% from local authorities (Therville 2013). The three main official mandates of NR managers are (1) nature protection through enforcement and policing; (2) habitat management through ecological monitoring and management; and (3) administrative monitoring through the preparation of progress reports and management plans. Many NRs are also involved in raising public awareness for nature conservation, without being financially supported by the supervisory authorities. The managers' authority and funding depend on a supervisory authority, but they can also apply for a wide variety of complementary funds through private and public partnerships (MATE & DNP 1997). NRs present considerable diversity in terms of their protection aims and purposes (e.g. geological features, particular species, ecosystems, iconic landscapes, etc.), their form and size (from less than 1 ha to 2.7 million ha) and their management intervention strategies (from low intervention to high degrees of management). However, a typical NR is a rather small site (between 10 and 100 ha) focused on the protection of inland wetlands or temperate plain habitats with protected and/or threatened species and ecosystems, and managed by a NGO. NRs are located in a wide range of local contexts (Therville 2013). Some are in peri-urban environments with a high population density and subject to urban sprawl, whereas others are in more 'wild' or marginal rural areas, which are sparsely populated and subject to local issues such as forestry and livestock farming. Some NRs are located in highly touristic areas while others are in rural contexts that are intensively used for farming and/or hunting activities but are only marginally affected by tourism.

Survey

We investigated conservation practices and the attitudes of managers.

Conservation practices of NR management structures

To analyse conservation practices we used the national ARENA database (which records the activities of NRs) created by the French NR network. This database compiles yearly information about all NNRs and CNRs: their management structure, staff members, rules, partnerships and the actions carried out by the NRs. We obtained access to information for a 5-year period (2004–2008), and for each NR we selected the year of data with the most recent and complete information. At the time of the study, the database included only 165 NRs since RNRs were not integrated. The management body of 12 NNRs did not respond to the survey so our full dataset concerned 153 NRs (Table 1). The absence of RNRs may lead to a bias in the results because although the core missions are similar to those of NNRs, RNRs are more recognized as tools for local development by their regional supervisory authorities (IUCN France 2010). We thus restricted our analysis of the paradigm shift to those NRs with a common overall framework and goal.

We focused on conservation practices carried out by managers. The ARENA database reports on 76 types of action, classified into eight major categories: (1) ecological monitoring (22 forms of action), (2) habitat management (17 actions), (3) visitor reception, access and awareness raising (13 actions), (4) administrative monitoring (nine actions), (5) infrastructure maintenance (five actions), (6) data collection (four actions), (7) law enforcement (four actions), and (8) research (two actions; Table 1). Managers had to detail the actions they have carried out and rank their importance during the year by giving them a score from 3 to 1.

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

Table 1 Actions carried out by managers of French nature reserves, n = 153. Source: ARENA.

Type of action	*Number of reported actions*	*Mean investment in each type of action (% of the total declared actions)*	*Standard deviation*
Ecological monitoring	22	24.1	11.4
Habitat management	17	19.4	10.4
Visitor access, public awareness raising	13	17.9	10.9
Administrative monitoring	9	22.1	13.0
Infrastructure maintenance	5	4.9	6.0
Data collection	4	5.0	4.4
Law enforcement	4	5.2	7.7
Research	2	1.4	2.4

Social–psychological profile of NR managers

We supplemented the previous database with a national survey to gather information on the perceptions and attitudes of NR managers. The focus was on managers because NRs are often managed by structures hiring only a few employees (fewer than three in 60% of NNRs and CNRs). In these NRs, the manager plays a key role (Therville 2013). The questionnaire was distributed via the internet to 250 NRs in 2010, and 107 NR managers responded. First, we used the questionnaire to study the socio–cultural characteristics of the respondents, analysing the following variables that describe the managers and which may influence their attitudes: age, education, gender, past professional experience, involvement in extra-professional activities and region of origin. Some categories such as 'extra-professional activities' and 'perceived qualities' proposed a list of terms built from our knowledge of the NR network, pushing the managers to display characteristics associated with specific attitudes. Other categories such as 'profession' and 'kind of experience' were purely descriptive.

Second, to explore the managers' attitudes, we used concepts and methods, typically used in environmental social psychology, which allowed us to analyse values, attitudes, behaviours and their interactions (Ajzen & Fishbein 1977; Stern & Dietz 1994; Kaiser *et al.* 1999; Schultz 2011). An 'attitude' is defined as the degree of cognitive support for a certain behaviour. We used two kinds of methods proposed by environmental social psychologists to assess attitude.

The first method, which was based on the New Environmental Paradigm (NEP) and Likert-type scales (Dunlap & Van Liere 1978; Dunlap *et al.* 2000; Hawcroft & Milfont 2010), allowed us to discern anthropocentric, ecocentric or apathetic attitudes towards the environment (Thompson & Barton 1994). Managers were invited to express their level of agreement with statements reflecting three kinds of attitudes: segregative, integrative and apathetic (McFarlane & Boxall 2003). The response scale was from (-2) strongly disagree to (2) strongly agree. The proposed statements, rather exaggerated and *a priori* non-consensual, forced the managers to state their views clearly.

The second method was based on choice and ranking of words. The proposed terms were associated with a segregative or an integrative attitude. The respondents chose from a list of terms the three that were the most meaningful to them, ranking them from the most to the least significant and associating them with a score from 3 to 1. Terms that were not chosen were coded as 0.

Although we were concerned that primarily managers interested in integrated approaches would respond, the diversity of identified attitudes led us to believe that this potential bias was limited.

Statistical procedures

For each dataset (Table S1) we explored the relationships between the variables using two kinds of multivariate analysis (Chessel *et al.* 2004; Lê *et al.* 2008). Principal Components Analysis (PCA) was used for quantitative data. Non-symmetric Correspondence Analysis (NSCA), which gives more weight to the most quoted variables (Kroonenberg & Lombardo 1999), was used to analyse the managers' attitudes due to the high number of variables considered. The qualitative variables, whether nominal or ordinal, were numerically encoded in order to perform PCA or NSCA. The figures presenting the multivariate analyses illustrate only the main explanatory variables for each dataset. In the case of the NEP method, we compared the different attitudes using a Kruskal–Wallis test followed by a multiple comparison test (Tukey-HSD *post-hoc* test) due to the non-normality of the data (Siegel & Castellan 1988; Giraudoux 2012). All statistical analyses were carried out using 'R' software and the 'ade4' package.

RESULTS

NR conservation practices

The number of actions carried out in each NR varied between two and 59, with an average of 23. Ecological and administrative monitoring represented about 45% of the management actions, whereas research activities only represented 1.4% (Table 1). The PCA highlighted important differences between the NRs in terms of investment in the main categories of conservation practices (Fig. 1). The first two PCA axes explain 41.6% of the PCA inertia.

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

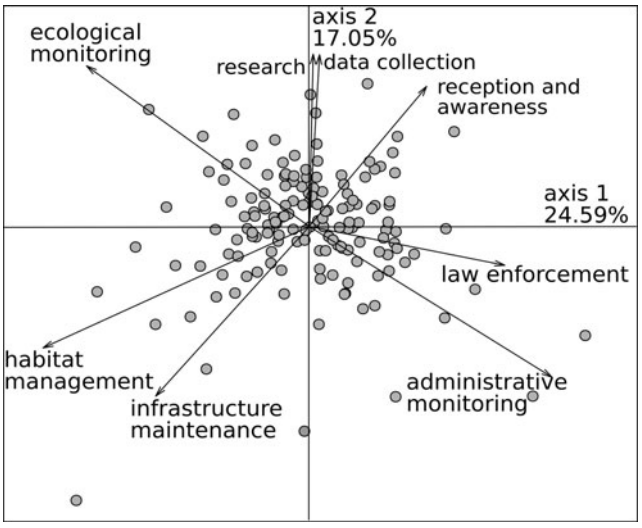

Figure 1 Principal Component Analysis on conservation practices carried out in the nature reserves. Only the variables whose contribution to axis construction was superior to the mean of all variable contributions are represented. n = 153 National nature reserve/Corsican nature reserve.

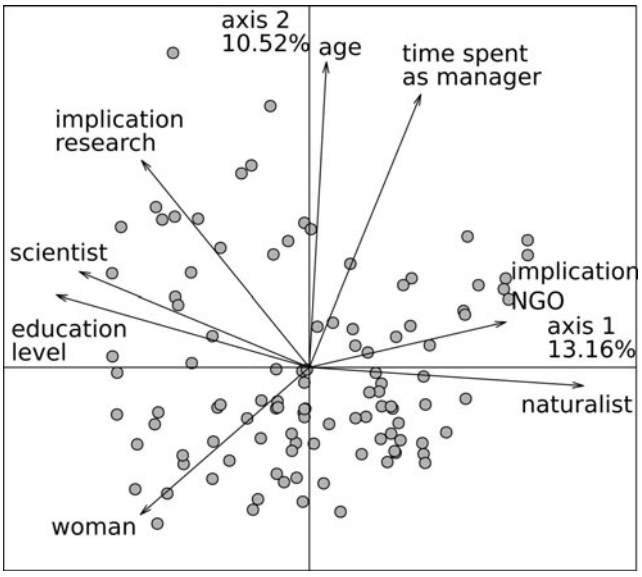

Figure 2 Principal Component Analysis on nature reserve managers' socio–cultural variables (Table S2). Only the variables whose contribution to axis construction was superior to the mean of all variable contributions are represented. n = 107 respondents.

The first axis distinguishes NRs that are more involved in ecological monitoring, habitat management and infrastructure maintenance (Fig. 1; left) from NRs that present an overall small total number of actions and that are more involved in administrative monitoring and law enforcement (Fig. 1; right). The second axis distinguishes NRs that are characterized by a medium level of activity in ecological monitoring and data collection, and to a lesser extent in visitor access, raising awareness and research (Fig. 1; top). For the NRs located in the upper-right corner of the figure, actions linked to visitor access and environmental education are central, reaching up to 30% of the conservation practices.

NR managers

The majority of the respondents were male (71%) between the ages of 25 and 62 (average age of 40; Table S2). More than 50% were involved in extra-professional activities for environmental NGOs. The vast majority had studied life sciences (89%) to the level of Master or higher (84%). In 43% of cases, the respondents held other functions in the NR besides being the manager, often acting as rangers, educators or being part of the management body that employs them and acts on a larger scale than the NR. Most of the respondents had been managers for less than 5 years (46%), but 31% had been in their current position for more than 10 years; 61% had at least one role in PA management before becoming an NR manager.

We carried out a PCA to examine the relationships among these socio–cultural variables (Fig. 2). The first two PCA axes explain 24% of the PCA inertia. The first axis distinguished managers involved in environmental NGOs from those who emphasized their scientific capacities, were highly involved in research and had a high education level. The second axis separates older men who had occupied their job for a long time from younger men and women who represented a new generation of NR manager. These two axes highlight four socio–cultural profiles. The 'naturalist elders' (Fig. 2; top right) were older men who were involved in naturalist and nature protection NGOs, had a Bachelor's level of education, and mostly originated from the region of the NR to which they were assigned. They had mostly been in the post for a long time and considered their capacities as naturalists, and secondarily as teachers, as the fundamental assets for management of the NR. The 'scientists' (Fig. 2; top left) were also older men who had been in the post for a long time; however, they emphasized their capacities as scientists as key elements in NR management and were less likely to define themselves as teachers and naturalists than the average respondent. The 'managers' (Fig. 2; bottom right) were less clearly defined. They were mostly younger men with at least a Master's level of education who had been in the position for a shorter time, were involved in naturalist and nature protection NGOs, and primarily emphasized their capacities as naturalists. Lastly, the 'integrators' (Fig. 2; bottom left) were younger men and women who had been in the post for a shorter time and were less likely to define themselves as naturalists than the average respondent.

Attitudes towards NRs

The NEP and Likert-type scale method indicated a dominant discourse among managers, while the method based on choice and ranking of words revealed more heterogeneity among

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

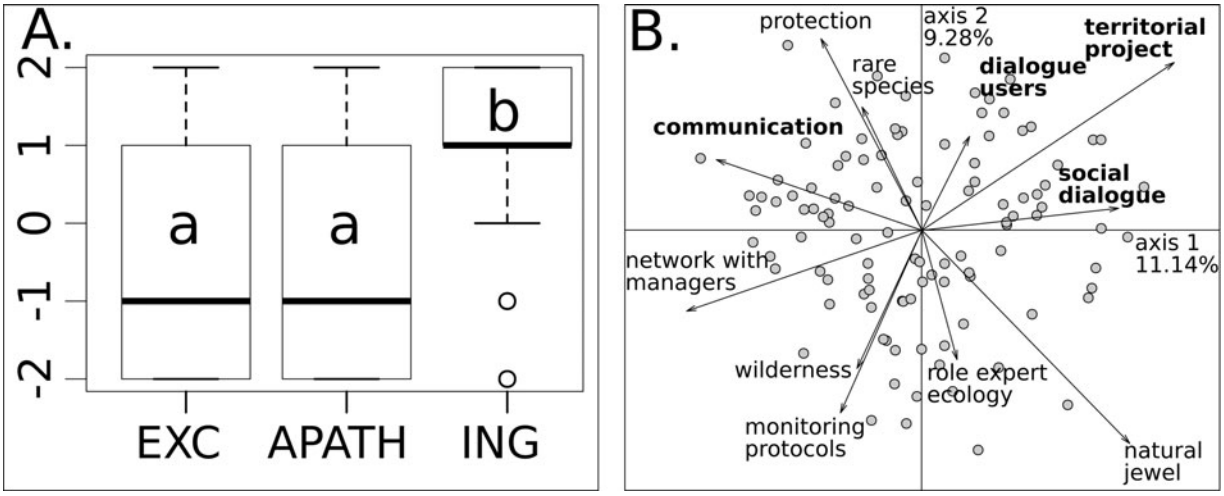

Figure 3 Managers' attitudes. (*a*) Results from the New Environmental Paradigm method (Table 2). Level of agreement (-2: strongly disagree; 2: strongly agree) to segregative (EXC), apathetic (APATH) and integrative (ING) statements. The letters indicate the significant differences between groups according to a Tukey-HSD *post-hoc* test ($p < 0.05$). (*b*) Results from the choice and ranking of EXC and ING items (Table 3). Non-symmetric Correspondence Analysis on all the items. Only the items whose contribution to axis construction was superior to the mean of all item contributions are represented. Integrative terms are shown in bold. n = 107 respondents.

managers' attitudes and positions regarding segregative and integrative approaches to conservation (Fig. 3).

A shared discourse

The NEP method (Table 2) showed the degree of agreement was negative for segregative and apathetic statements (-0.51 and -0.68 respectively), and positive (1.02) for integrative statements (Fig. 3 *a*; Tukey-HSD *post-hoc* test: $p < 0.001$).

Heterogeneous attitudes

The method based on the choice and ranking of segregative or integrative words showed that the managers' responses were much less homogeneous (Table 3); only one term ('protection') was selected by more than 80% of the respondents. By contrast, eight out of 29 terms were selected by less than 20% of the respondents. The results of the NSCA (Fig. 3 *b*) helped to clarify the differences in the managers' attitudes. The first two axes explained only 20.4% of the NSCA inertia. The uniform distribution of the respondents in the NSCA plane highlights the difficulty in identifying clear patterns. The right side of the first axis discriminates integrative terms that are weakly institutionalized and marginal such as 'social dialogue', 'territorial project' and 'dialogue with users'. The managers that selected these terms had an integrative vision, focused on the surrounding landscape and inter-sectoral policies. The left side of the first axis (Fig. 3 *b*) distinguished segregative and integrative terms commonly used by managers to describe their activities and were characteristic of the prevalent vision of NRs held by the NR network: 'protection', 'rare species', but also 'networking with other managers' and 'communication' with a diversity of stakeholders. The managers that selected these terms had a traditional view of the perceived core mission of managers. However, they also showed a modern attitude characterized by an emerging willingness to integrate other concerns such as social issues and to be connected to a larger diversity of stakeholders. The terms below the second axis (Fig. 3 *b*) are archetypes of a segregative attitude: 'natural jewel' and 'wilderness' reflected these managers' vision of an NR, and 'role of expert in ecology' and 'implementation of monitoring protocols' were selected as the most important actions. The managers that selected these terms also emphasized networking with other managers of natural areas.

DISCUSSION

In French NRs, the segregative model is more of a cliché than a reality. We highlight considerable heterogeneity in the conservation practices of NRs and in the socio-cultural profiles and attitudes of their managers, indicating a more complex reality than the traditional segregative–integrative dichotomy would portray (Phillips 2004). This heterogeneity reflects a general pattern in the evolution of environmental protection in France and the ability of conservation management in NRs to adapt to local contexts and to function as part of wider SESs.

The evolution of nature conservation policies in France

To explain the diversity in NR conservation practices and in managers' attitudes, it is necessary to analyse the socio–political–historical construction of environmental public policy in France, and particularly of NR policy. Until the beginning of the 20th century, nature conservation in

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

Table 2 Items used in the New Environmental Paradigm method to define managers' attitude (-2: completely disagree to 2: completely agree). APATH = Apathetic; EXC = Segregative; ING = Integrative.

Item	*Attitude*	*Mean*	*Standard deviation*
Man in nature			
1. The natural spaces which remained wild have more value than the spaces which were anthropized	EXC	0.44	1.24
2. Human development and nature conservation are incompatible	EXC	− 0.78	1.05
3. To protect natural heritage implies to protect the history and the culture of a site	ING	1.17	0.76
4. To take into account human development has to be a priority	ING	0.25	1.16
5. We wonder far too much about the place of man in nature	APATH	− 0.66	1.22
6. The link between conservation and development does not really interest me	APATH	− 1.57	0.77
Man in nature reserve			
7. To maintain open habitats in a nature reserve, it is much simpler for a manager to manage their own herd than to form a contract with a local farmer	EXC	− 0.785	1.08
8. Nature conservation and opening to the general public are irreconcilable	EXC	− 1.15	0.9
9. Environmental education has to be a priority mission of the nature reserve	ING	0.82	1.13
10. A nature reserve has to be environmentally responsible (sorting of waste, reducing environmental impact, etc.).	ING	1.73	0.51
11. In a nature reserve, activities such as reaping, grazing, fishing, hunting can be practiced as long as they do not threaten biodiversity	APATH	1.22	0.95
12. The opening of the nature reserve for educational purposes: why not, as long as it does not ask for too much energy	APATH	− 0.14	1.36
Nature reserve in a social–ecological system			
13. The objective of a nature reserve is to protect nature, not to focus on local development	EXC	0.83	1.08
14. We could very well do without the consultation of local stakeholders	EXC	− 1.61	0.68
15. Managing to protect the natural heritage involves visibility in local governance processes	ING	1.38	0.67
16. A nature reserve can represent an essential driver of local development	ING	0.79	0.96
17. There is no interest in developing activities beyond nature reserve boundaries	APATH	− 1.38	0.7
18. With neighbours of a nature reserve, status quo is the best strategy and everybody should mind their own business.	APATH	− 1.52	0.62

France was rooted in resource preservation, romantic and naturalist sensitivities, colonialist experimentation and NGO involvement (Larrère *et al.* 2009). The main regulatory tools of French conservation policy were implemented later: national parks in 1960 and NRs in 1976. In retrospect, the segregative cliché associated with NRs is understandable. The law that established them was elaborated during a period of industrial and ecological disasters (Carlson 1962; Meadows *et al.* 1972) and the governance was characterized by a sovereign, centralized state based on segmentation and specialization (Cans 1994; Charvolin 2003). Those who were first involved in the implementation of NR policy (national governmental agencies or nature conservation NGOs) supported the idea of a state-administered zone managed by experts (Therville *et al.* 2012). The first NRs, in line with the original PAs in France and elsewhere (Runte 2010), were mostly large sites of several thousand hectares that protected iconic mountainous landscapes; created in the 1970s, they were managed by national governmental agencies.

Since the 1980s, French nature conservation policy has developed a more integrated approach. This transition was influenced by social discord (events of May 1968), decentralization, the development of a more integrated and larger vision of nature conservation and the aim of sustainable development. PA management has broadened its conservation aims, with a shift to governance systems that include stakeholders with different interests, including local authorities (Larrère *et al.* 2009, Mathevet *et al.* 2010, Therville *et al.* 2012). This enlargement in NR governance systems has contributed to the diversification in managers' profiles that we observed. At the same time, following the growing awareness of the under-representation of certain natural habitats, the NR network has experienced a gradual diversification in its conservation interests (Therville 2013). In the 1980s, natural caves or other geological features became integrated. Since the 1990s, the protection of fluvial, marine environments and French Overseas Territories has involved the creation of larger NRs: an increasing proportion is larger than 100 ha.

This history of the NR network is demonstrative of the establishment of conservation policy in France, which reveals three general features: (1) the collective nature of these policies – between different sectors and between the state and civil society; (2) the hybrid and transversal policy content resulting from these collectives; (3) and the weakness of these policies which were built upon compromises with more powerful state bodies (Lascoumes 1994; Charvolin 2003). Social science studies demonstrate a specific French model, which is based

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

Table 3 Definition of managers' attitudes. Items used in the method based on choice and ranking of words (0: not quoted; 1 to 3: from the least to most important). Response rate associated with each item. EXC = Segregative; ING = Integrative.

Item	*Attitude*	*Responses*				
		0	*1*	*2*	*3*	*% quoted*
Man in nature: which words in this list best reflect what a nature reserve is to you?						
Wilderness	EXC	67	13	16	11	37
Natural jewel	EXC	65	8	9	25	39
Rare species	EXC	65	11	27	4	39
Protection	EXC	16	9	25	57	85
Natural laboratory	EXC	82	17	5	3	23
Cultural heritage	ING	103	4	0	0	4
Social–ecological system	ING	96	7	2	2	10
Sustainable development	ING	93	11	3	0	13
Education	ING	79	16	11	1	26
Ecosystem services	ING	83	11	9	4	22
Man in nature reserve: for nature reserves created more than 5 years ago, among these actions, which have become increasingly important over time in your opinion?						
Implementation of monitoring protocols	EXC	55	12	12	28	49
Partnership with scientists	EXC	85	8	8	6	21
Ecological engineering	EXC	88	5	6	8	18
Regulation of invasive species	EXC	91	7	4	5	15
Law enforcement	EXC	92	7	4	4	14
Public receiving	ING	80	13	10	4	25
Environmental education	ING	81	11	10	5	24
Socio–economical monitoring	ING	104	1	1	1	3
Social dialogue/mediation/territorial coordination	ING	55	12	19	21	49
Support for human activities on surrounding territories	ING	95	5	6	1	11
Communication	ING	88	6	8	5	18
Nature reserve in a social–ecological system: when a manager develops actions beyond the nature reserve boundaries, what are its main objectives?						
Communication for the nature reserve	ING	56	17	15	19	48
Role of expert in ecology	EXC	69	13	15	10	36
Networking with other managers	EXC	46	14	23	24	57
Export of management methods	EXC	76	10	10	11	29
Dialogue with users	ING	72	12	12	11	33
Implication in the elaboration of territorial planning documents	ING	82	12	5	8	23
Visibility to local decision makers	ING	80	13	11	3	25
Development of a territorial project	ING	55	15	16	21	49

on a compromise among different objectives, spaces and stakeholders with diverse interests (Charles & Kalaora 2003; Larrère *et al.* 2009).

Our results show that conservation practices in NRs now well exceed the core mission established by the state, mainly of ecological and administrative monitoring, habitat management and law enforcement. We found that visitor access and public awareness are significant categories of action, despite the lack of financial resources for these missions. These categories suggest the existence of complementary resources as well as diversified roles and legitimacies of NRs. This can be explained by an historical and paradoxical aspect to NR policy, particularly in the case of NNRs. While the state has refocused NNRs on traditional core missions such as law enforcement, the management of NRs has been delegated to local organizations whose employees rely on private interests and laws (Therville *et al.* 2012). So although the official aims of NRs are more rooted in the segregative model, their institutional organization is increasingly modelled on an integrative paradigm.

In addition, NRs are subject to socio–cultural influences. Our results show that NR managers are not a homogeneous social group, either in terms of socio–cultural characteristics or in terms of attitudes held. This heterogeneity reflects the diversity of organizations and their associated cultures involved in NR management (e.g. NGOs, local authorities, national government agencies) and their social representations and socio–professional status. The managers' socio–cultural profiles reveal an evolution in the profession, from skilled naturalists to expert negotiators able to develop bridging organizations (Brown 1991; Granjou *et al.* 2010). The managers' culture, knowledge and perception of their role have progressively changed with the emergence and expansion in the NR network of concepts such as 'management' in the 1980s and 'integration' in the 1990s (Therville *et al.* 2012). Their contrasting attitudes are not simply defined

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

along a segregative–integrative axis, but also according to an institutionalized identity claimed at a national level by the NR network (Therville *et al.* 2012), which consists of a mixture of protection, ecological monitoring, networking, environmental education and communication. Our results identified managers that fell on either side of this reference group, who demonstrated an attitude that was more or less open to an integrated approach.

Nonetheless, the results obtained through the NEP method illustrate a common attitude of NR managers that is close to the dominant discourse of most of the French and European conservation organizations (Phillips 2004): they strongly supported integrative statements and massively rejected apathetic and segregative statements. Several studies in political ecology have illustrated the existing gap between the support of stakeholder groups for 'integrated' discourses and the practices implemented. They have also underlined that strategic interests are part of mainstream positioning (Gautier & Benjaminsen 2012; Robbins 2012), as suggested for the NR network in the following quote: 'we had the idea that we would not achieve anything if we stayed stuck among naturalists, birds and plants in our own land estates (. . .) It had to be in a culture, in a shared project' (interview with an NR manager, leader in the NR network, 2010). Another manager stated that 'if you are well integrated, things can happen, if the people around you are convinced of the interest of the conservation project, they will be its first guardians (. . .) It is the NR life insurance' (interview with an NR manager, 2010). The issue for NRs is often to seek reinforcement, access financial resources and social support and avoid marginalization.

NRs as part of a larger SES

An analysis of the NR network on a national scale is not sufficient to explain the observed diversity both in conservation practices and managers' attitudes. This heterogeneity also needs to be understood in terms of local context. NRs and their managers must have a level of adaptability to their local conditions, interacting in complex SESs (Ostrom 2009; Palomo *et al.* 2014; Cumming *et al.* 2015). The heterogeneous investments of NR managers in different types of conservation action and their various attitudes are related to variable local social–ecological interdependencies (Therville 2013).

In the actual conservation practices of NRs, managers have long implemented integrative actions, whether consciously or not. Negotiation, a contractual approach and compromise are part of their daily routine. As described previously, this can be partly explained by features of French conservation policy associated with decentralization and the use of contractual tools. But the need for local adaptation and cooperation with stakeholders is also linked to social–ecological interdependencies between PAs and the surrounding landscape and to their spatio–temporal variability (Thompson *et al.* 2011). Any PA, in its multiple dimensions (physical space, rules, resources, influence, monitoring, etc.), is shaped by and itself shapes the SES of which it is a part (Mathevet *et al.* 2016).

Given the complexity of these interdependencies, enforcement policies, although essential, appear to be insufficient to assure long-term conservation. The proposed procedures, objectives and resources of an organization do not always allow a worker to achieve his or her goals, and social scientists have shown that there is a discrepancy between mandated and actual work (Dejours 2003). We observed this situation with NR managers who perceived that they need to go beyond the regulatory framework and resources provided by the supervisory authority in order to achieve their conservation goals (Therville *et al.* 2012). One manager commented that 'we under-estimate human labour behind our scientific missions. If you want to propose an action, you will meet different stakeholders, discuss, adapt your idea (. . .) It is not considered (. . .) while it is essential' (interview with an NR manager, 2010). This extension beyond mandated actions requires taking into account and adapting to interdependencies between NRs and the surrounding landscape, which is necessary for the conservation of biodiversity in the long term. The need to adapt to local conditions can also partly explain potential incongruence between a manager's attitude and his or her implemented conservation practices. For example, the proximity of a dense urban population requesting access to natural spaces can lead a manager who is culturally attached to a segregative model to invest in visitor reception, access and awareness raising (Therville 2013). This attitude may also evolve in time, shaped by local working conditions. The practices and attitudes of a site or manager should be regarded as path dependent, adaptable and situated in their local conditions as well as influenced by the evolution of PA policies.

BEYOND A SEGREGATIVE–INTEGRATIVE DICHOTOMY

Our case study on French NR policy provides pertinent perspectives for other PAs around the world. First, there is an intrinsic diversity and coexistence of segregative and integrative models, both in terms of conservation practices and attitudes. This coexistence brings into question the view of segregative and integrative approaches as a dichotomy (Miller *et al.* 2011; Linnell *et al.* 2015). Our results can be partly explained by trends in nature conservation policies in France and on a global scale (Dearden *et al.* 2005; Bertzky *et al.* 2012) associated with the appearance of new norms, making integrative approaches more desirable and leading to a general evolution of pre-existing tools towards integrative models. Along this segregative–integrative axis, the debate often focuses on the best strategy to adopt, implying that a specific tool should necessarily depend on one model or the other, and that one or the other should be chosen, whereas they could be complementary options (Linnell *et al.* 2015). This leads to excessive generalization of these models and to their interpretation as opposing ideologies. The limitations

https://doi.org/10.1017/S0376892916000047 Published online by Cambridge University Press

of this dualism are numerous. Given the existing diversity of nature conservation tools in France, it is not possible, for example, to formally associate them with the PA typology of the IUCN, whether in terms of the degree of naturalness or the institutional arrangements or purposes (IUCN France 2010). Second, for NRs as well as for other PAs on a global scale, this study highlights issues of context dependency and indicates that some nuance is required to question the relevance of one model over the other. Our results show that, in France, the segregative model is more of a cliché than a reality. There is a gap between the widespread perception of nature as 'set apart' and the observed diversity of integrated practices in the NR network. One significant influence of the segregative cliché is linked to cultural and social representations where the opposition between humans and nature and between conservation and development holds a major place. This limits the social acceptance of PAs and the legitimacy of managers to implement integrated strategies. Significant investment by managers is thus required to consider the complexity of the interdependencies between PAs and their surroundings.

In a similar way, the development of an integrative approach by NR managers but also by other PAs managers must be associated with strategic and normative issues. In our findings, NRs and their managers were not situated clearly at either end of the segregative–integrative axis, but somewhere in between, depending on their socio–historical and geographical variables. While the NRs presented features associated with both models, they could not be strictly associated with one or the other.

Our work thus outlines important lessons for future studies to deal with the duality and static approaches usually applied to PAs around the world. The multiple aspects that characterize nature conservation tools need first to be considered: their purposes (the sectoral aspect), the areas concerned with nature conservation issues (the spatial aspect), and the stakeholders involved (the institutional arrangement aspect). Moreover, qualitative localized monographs, mobilizing both ecological and social sciences, should study PAs coupled with their surrounding landscape as complex and context-dependent SESs. PAs are social–ecological constructions that mirror the social interactions between humans and between humans and nature in complex systems. As such PAs need to be considered according to local institutional arrangements and the spatio–temporal variability of the entire SES that the PA is part of.

ACKNOWLEDGEMENTS

This study was carried out through a CIFRE industrial research agreement. The authors thank Réserves Naturelles de France (RNF), the Agence Nationale de la Recherche et Développement, the Regions Nord-Pas-de-Calais, Languedoc-Roussillon and Bretagne, the Fondation de France, the French Ministry of Research and the French Ministry of Ecology and Sustainable Development. The authors are particularly grateful to RNF, which provided us with access to the ARENA database. This work was also financed by the EU FP7 SCALES Project ('Securing the Conservation of Biodiversity across Administrative Levels and Spatial, Temporal and Ecological Scales'; Project #226852, AA).

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S0376892916000047

References

Agrawal, A. & Redford, K. (2009) Conservation and displacement: an overview. *Conservation and Society* **7**(1): 1–10.

Ajzen, I. & Fishbein, M. (1977) Attitude–behavior relations: a theoretical analysis and review of empirical research. *Psychological Bulletin* **84**(5): 888–918.

Berkes, F. & Folke, C. (1998) Linking social and ecological systems: management practices and social mechanisms for building resilience. Cambridge, UK: Cambridge University Press.

Bertzky, B., Corrigan, C., Kemsey, J., Kenney, S., Ravilious, C., Besançon, C. & Burgess, N. (2012) Protected Planet Report 2012: Tracking progress towards global targets for protected areas. Gland, Switzerland: UICN; and Cambridge, UK: UNEP-WCMC.

Bioret, F., Estève, R. & Sturbois, A. (2009) Dictionnaire de la protection de la nature. [Dictionary of nature protection]. Rennes, France: PU Rennes.

Brosius, J.P. (2006) Common ground between anthropology and conservation biology. *Conservation Biology* **20**(3): 683–685.

Brown, L.D. (1991) Bridging organizations and sustainable development. *Human Relations* **44**: 807–831.

Cans, R. (1994) Les trois âges de la politique française de l'environnement. *Aménagement et nature* **116**: 23–26.

Carlson, R. (1962) Silent spring. Boston, USA: Houghton Mifflin.

Charles, L. & Kalaora, B. (2003) Assistance à la maîtrise d'œuvre pour la réalisation d'un cahier des charges en vue d'une enquête sur l'insertion des Parcs Nationaux dans leurs contextes locaux et régionaux. Paris, France: Ministère de l'écologie et du développement durable, Direction de la Nature et des Paysages.

Charvolin, F. (2003) L'invention de l'environnement en France – chroniques anthropologiques d'une institutionnalisation. Paris, France: La découverte.

Chessel, D., Dufour, A. B. & Thioulouse, J. (2004) The ade4 package – I: one-table methods. *R News* **4**(1): 5–10.

Cumming, G. S., Allen, C. R., Ban, N. C., Biggs, D., Biggs, H. C., Cumming, D. H., De Vos, A., Epstein, G., Etienne, M., Maciejewski, K., Mathevet, R., Moore, C., Nenadovic, M. & Schoon, M. (2015) Understanding protected area resilience: a multi-scale, social-ecological approach. *Ecological Applications* **25**(2): 299–319.

Dearden, P., Bennett, M. & Johnston, J. (2005) Trends in global protected area governance, 1992–2002. *Environmental Management* **36**(1): 89–100.

Dejours, C. (2003) L'Évaluation du travail à l'épreuve du réel: critique des fondements de l'évaluation. Versailles, France: INRA, Quae.

Depraz, S. (2008) Géographie des espaces naturels protégés. Genèse, principes et enjeux territoriaux. Paris, France: Armand Colin.

Dudley, N. (2008) Guidelines for applying protected area management categories. Gland, Switzerland: UICN.

Dudley, N., Parrish, J. D., Redford, K. H. & Stolton, S. (2010) The revised IUCN protected area management categories: the debate and ways forward. *Oryx* **44**(4): 485–490.

Dunlap, R. E. & Van Liere, K. D. (1978) The new environmental paradigm: a proposed instrument and preliminary results. *Journal of Environmental Education* **9**: 10–19.

Dunlap, R. E., Van Liere, K. D., Mertig, A. G. & Jones, R. E. (2000) New trends in measuring environmental attitudes: measuring endorsement of the new ecological paradigm: a revised NEP scale. *Journal of Social Issues* **56**(3): 425–442.

Gautier, D. & Benjaminsen, T. A. (2012) Environnement, discours et pouvoir: L'approche political ecology. Versailles, France: Quae.

Giraudoux, P. (2012) Package "pgirmess" R-Cran Project. [www document]. URL http://cran.r-project.org/web/packages/pgirmess/pgirmess.pdf

Granjou, C., Mauz, I. & Cosson, A. (2010) Les travailleurs de la nature: une professionnalisation en tension. *SociologieS*. [www document]. URL http://sociologies.revues.org/3296

Hansen, A. J. & DeFries, R. (2007) Ecological mechanisms linking protected areas to surrounding lands. *Ecological Applications* **17**(4): 974–988.

Hawcroft, L. J. & Milfont, T. L. (2010) The use (and abuse) of the new environmental paradigm scale over the last 30 years: a meta-analysis. *Journal of Environmental Psychology* **30**(2): 143–158.

IUCN France (2010) Les espaces protégés français: une pluralité d'outils au service de la conservation de la biodiversité. Paris, France: Comité français de l'UICN.

Kaiser, F. G., Wolfing, S. & Fuhrer, U. (1999) Environmental attitude and ecological behaviour. *Journal of Environmental Psychology* **19**(1): 1–19.

Kroonenberg, P. M. & Lombardo, R. (1999) Nonsymmetric correspondence analysis: a tool for analyzing contingency tables with a dependence structure. *Multivariate Behavioral Research* **34**(3): 367–396.

Larrère, R., Lizet, B. & Berlan-Darqué, M. (2009) Histoire(s) et mémoires des parcs nationaux. In: *Histoire des parcs nationaux. Comment prendre soin de la nature?*, ed. R. Larrère *et al*. (Coord.), pp. 23–41. Versailles, France: Quae.

Lascoumes, P. (1994) L'éco-pouvoir. Paris, France: La découverte.

Lê, S., Josse, J. & Husson, F. (2008) FactoMineR: an R package for multivariate analysis. *Journal Statistical Software* **25**(1): 18.

Linnell, J. D. C., Kaczensky, P., Wotschikowsky, U., Lescureux, N. & Boitani, L. (2015) Framing the relationship between people and nature in the context of European conservation. *Conservation Biology* **29**(4): 978–985.

Locke, H. & Dearden, P. (2005) Rethinking protected area categories and the new paradigm. *Environmental Conservation* **32**(1): 1–10.

Lockwood, M. (2010) Good governance for terrestrial protected areas: a framework, principles, and performance outcomes. *Journal of Environmental Management* **91**(3): 754–766.

Mathevet, R. & Mauchamp, A. (2005) Evidence-based conservation: dealing with social issues. *Trends in Ecology and Evolution* **20**(8): 422–423.

Mathevet, R., Thompson, J., Delanoë, O., Cheylan, M., Gil-Fourrier, C. & Bonnin, M. (2010) La solidarité écologique: un nouveau concept pour une gestion intégrée des parcs nationaux et des territoires. *Natures, Sciences, Sociétés* **18**(4): 424–433.

Mathevet, R., Thompson, J., Folke, C. & Chapin III, F. S. (2016) Protected areas and their surrounding territory: social–ecological systems in the context of ecological solidarity. *Ecological Applications* **26**(1): 3–15.

McFarlane, B. L. & Boxall, P. C. (2003) The role of social psychological and social structural variables in environmental activism: an example of the forest sector. *Journal of Environmental Psychology* **23**(1): 79–87.

Meadows, D., Meadows, D., Randers, J. & Behrens, W. (1972) The limits to growth: a report for the club of Rome's project on the predicament of mankind. New York, USA: Universe Books.

Miller, T. R., Minteer, B. A. & Malan, L.-C. (2011) The new conservation debate: the view from practical ethics. *Biological Conservation* **144**(3): 948–957.

Ministère de l'Aménagement du Territoire et de l'Environnement (MATE) and Direction de la Nature et des Paysages (DNP) (1997) Fiche de synthèse sur les réserves naturelles. Paris, France: RNF.

Mose, I. (2007) Protected areas and regional development in Europe. Towards a new model for the 21st century. Aldershot, UK: Ashgate Publishing Limited.

Ostrom, E. (2009) A general framework for analyzing sustainability of social–ecological systems. *Science* **325**(5939): 419–422.

Palomo, I., Montes, C., Martín-López, B., González, J. A., García-Llorente, M., Alcorlo, P. & Mora, M. R. G. (2014) Incorporating the social–ecological approach in protected areas in the Anthropocene. *Bioscience* **64**(3): 181–191.

Peluso, N. (1993) Coercing conservation?: the politics of state resource control. *Global Environmental Change* **3**(2): 199–217.

Phillips, A. (2004) Turning ideas on their head: the new paradigm for protected areas. *Environmental History* **9**(1):173–198.

RNF (2008) CR du groupe Développement Durable des Territoires du 1er Septembre 2008. Paris, France: RNF.

Robbins, P. (2012) Political ecology: a critical introduction, 2nd edition. Oxford, UK: Blackwell Publishing.

Runte, P. (2010) National Parks: The American Experience. Lanham, USA: Taylor Trade Publishing.

Schultz, P. W. (2011) Conservation means behavior. *Conservation Biology* **25**(6): 1080–1083.

Siegel, S. & Castellan, N. J. (1988) Nonparametric statistics for the behavioral sciences. New York, USA: MacGraw Hill International.

Stern, P. C. & Dietz, T. (1994) The value basis of environmental concern. *Journal of Social Issues* **50**(3): 65–84.

Therville, C. (2013) Des clichés protectionnistes aux approches intégratives: l'exemple des réserves naturelles de France. PhD thesis. Brest, France: Université de Bretagne Occidentale.

Therville, C., Mathevet, R. & Bioret, F. (2012) Des clichés protectionnistes aux discours intégrateurs: l'institutionnalisation de Réserves Naturelles de France. *Vertigo* **12**(3). [www document]. URL http://vertigo.revues.org/13046

Thompson, J. D., Mathevet, R., Delanoë, O., Gil-Fourrier, C., Bonnin, M. & Cheylan, M. (2011) Ecological solidarity as a conceptual tool for rethinking ecological and social interdependence in conservation policy for protected areas and their surrounding landscape. *Comptes-Rendus de l'Académie des Sciences, Série Biologies* **334**(5–6): 412–419.

Thompson, S. C. G. & Barton, M. A. (1994) Ecocentric and anthropocentric attitudes toward the environment. *Journal of Environmental Psychology* **14**(2): 149–157.

Zube, E. H. & Busch, M. L. (1990) Park–people relationships: an international review. *Landscape and Urban Planning* **19**(2): 117–131.