Management of Emerging Public Health Issues and Risks

Multidisciplinary Approaches to the Changing Environment

Edited by
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Karine Weiss
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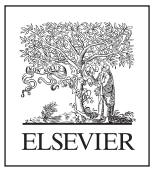
Benoit Roig
University of Nîmes, EA7352 CHROME, Nîmes, France

Karine Weiss
University of Nîmes, EA7352 CHROME, Nîmes, France

Véronique Thireau
University of Nîmes, EA7352 CHROME, Nîmes, France



ACADEMIC PRESS
An imprint of Elsevier

Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1650, San Diego, CA 92101, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

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Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-0-12-813290-6

Publisher: Andre Gerhard Wolff
Acquisition Editor: Kattie Washington
Editorial Project Manager: Jennifer Horigan
Production Project Manager: Swapna Srinivasan
Cover Designer: Matthew Limbert

Typeset by TNQ Technologies

CHAPTER

6 HUMAN SPACES AND NONHUMAN SPECIES: SOCIAL REPRESENTATIONS OF THE RISK OF INVASION

Patrick Rateau, Margot De Battista, Karine Weiss
University of Nîmes, EA7352 CHROME, Nîmes, France

CHAPTER OUTLINE

1. THE PERCEPTION OF BIOLOGICAL INVASIONS: A MATTER OF SOCIABILITY

Attention to climate change arises partly from the awareness of the extent of the interactions between human activities and the environment. One of the six big changes is the spread of certain species away from their natural habitats; these are called biological invasions (Vitousek et al., 1997). This concerns the plant area as well as the animal field. In France, invasive plant species belonging to a high variability of taxa were identified (Muller, 2000). This country is ranked fourth for the number of exotic plant species in the list of the 49 European countries included in a study published in 2008 (Lambdon et al., 2008). In the animal field, the proliferation of the gelatinous zooplankton is a striking example. These organisms have been found in all of the oceans from the equator to the poles for hundreds of thousands of years. But some of its representatives (like jellyfish and ctenophores) have the ability to

Management of Emerging Public Health Issues and Risks. https://doi.org/10.1016/B978-0-12-813290-6.00006-8

reproduce very fast and to proliferate. The scale of this phenomenon (in terms of organisms and species) highly concerns all of the actors in the marine environment. Furthermore, for about 30 years, it has been mobilizing the scientific community (Mills, 2001; Attrill et al., 2007) with the aim of understanding more profoundly the elements that triggered this proliferation.

The invasive species issue leads to a significant scientific uncertainty. Indeed, natural ecosystems are very complex and difficult to study, in particular the complexity of the spatial and temporal dynamics that are not very well known and thus poorly controlled. This scientific ambiguity legitimizes the use of various criteria to evaluate the quality of the ecosystems and the actions to implement means to preserve or restore them. Those different criteria lead to various conclusions and then to different management choices. In this way, the same problem can be addressed with different actions depending on the temporal and territorial contexts it emerges from (Ravet, 1971; Strand, 2002; Binimelis et al., 2007).

Perceptions are the most dissimilar in these contexts of scientific uncertainty—each person interprets reality differently depending on their experience (Pahl-Wost, 2006). That is why it is necessary to take into account the perceptions of each person in order to construct consistent and meaningful management strategies on a social level. Indeed, environmental actions based on individual actions have proved their effectiveness. This is even truer for the fight against invasive species, which requires global and coordinated action. To highlight the variability of the perceptions relative to invasive species and develop a social project to address them are two of the more crucial inputs of the human and social sciences. Small, but growing, interest has been apparent for about 10 years. Although the questioning is sometimes related to the invasive species in general (Kowarik and Schepker, 1998; Daehler, 2008; Andreu et al., 2009), it often focuses on a specific species. However, general information can be collected from these studies relative to the perception of invasive species. In particular, they provide some details in answer to the following questions: How would invasive species be an environmental concern? What would make invasive species a concern? Who is concerned about invasive species?

Those studies have highlighted that perceptions highly depend on:

- Species: the perception of a given invasive species seems to result from the balance between the costs and benefits generated by the species.
- A land: the perception of invasive species is based on a strong cultural component. Indeed, to social actors, an invasive species can be considered as a part of the local heritage, and thus can be valued and preserved. Therefore, any perception study must be anchored on a given land.
- Knowledge: a high perception variability relative to invasive species and management actions to implement seems to be induced by knowledge available on the species. Therefore, any perception study must target specific social actors and evaluate their knowledge on the species (reproduction process, impacts of colonization, etc.). It is only with this information that the perception results will bring concrete details in response to the motivations to act of each individual. This information is then likely to lead to an informed and concerted management policy.

In addition to the accuracy of these points, those studies show that biological invasions involve important issues for the population concerned. Portrayed by the media and the daily communications,

the reactions to a biological "proliferation" define it as a social object, and thus as a social representation object. Two elements are indicative:

- Any biological invasion phenomenon gives rise to controversy, and even conflicts: between the social groups involved (technicians, managers, or users of the affected territory), and between expert knowledge (scientific knowledge) and common sense. Therefore, the invasion issue allows the various social categories to identify themselves in relation to each other depending on their perceptions of the invasion.
- Any environmental object depends on descriptive knowledge and on evaluative knowledge. The evaluative knowledge is built from standards and beliefs that play a crucial role in the species representations, its proliferation, and the means required to fight against it.

Finally, the invasion of a nonhuman species within a human territory provides a lot of emotions, whether anger, concern, or fear. We know that emotions are not always relative to reality but to the perception that we have of reality (Rateau and Moliner, 2009; Delouvée et al., 2013). In that way, individuals will not react depending on the reality described and analyzed by biologists, but depending on their perceptions of the spread and on the representation of the species they share. But here too, those perceptions and representations are a matter of sociability and communication. The same invasion can take on a different meaning depending on the group that is facing it. For example, it can be viewed as the result of unsafe practices, as a technical issue subject to the laws of probability, or as a punishment of certain excesses. What the environmental movement sees in a biological invasion is different from what is interpreted by Millenarianism, what is shown by science, or what is claimed by the affected populations. It is not about attributing a cause or a moral responsibility of the actors. It is about considering the given proliferation as an event.

In any case, to the populations concerned by that risk, biological invasions are a matter of social representations. The purpose of this chapter is to illustrate how those social representations massively intervene in the management of the biological invasions issue. For that purpose, we will present two examples: the spread of jellyfish in the Mediterranean area, and the colonization of knotweeds (*Fallopia*) in the Rhône department (highly invaded) and the Gard department (less invaded).

2. WHAT IS MEANT BY SOCIAL REPRESENTATIONS?

At the origin of the theory of social representations (for an exhaustive presentation see Lo Monaco et al., 2016) we find that "there are no clear-cut boundaries between the exterior universe and the inner universe of the individual or group. The subject and the object are not fundamentally distinct" (Moscovici, 1984). Social representations give a common reference framework to the group, which allows them to understand and explain reality, and thus show an "organised example of knowledge, beliefs, opinions, images and attitudes shared by a group about a given social object" (Dany and Apostolidis, 2002).

As a "form of socially developed and shared knowledge, with practical implications, which contributes to the construction of a common reality for a social group" (Jodelet, 1989), social representations can be seen as ideological formations (Rouquette, 1998) bundling and organizing value systems (Márquez and Friemel, 2005). Related to "knowledge, theory, beliefs and attitude," a social representation expresses "a value system and control the implementation of a global ethic. (…) It can be

found in ideological productions of a given culture as well as in certain individual or minority idiosyncrasies" (Rouquette, 1994). Social representations are not reflections of a certain reality, but meaningful structures. The meanings developed are based on contingent factors (immediate context, nature, constraints, and purposes of the situation) and on general factors (social context and social issue, social status, etc.).

The collective elaboration of social representations is built on a double process: anchoring and objectification. In that way, when it comes to a complex social object, the objectification will allow the selection and the decontextualization of the constituent parts of this object. This results in a coherent and illustrated set, outlining the object in a concrete and selective way. The anchoring will allow the social representation to find root in a preexisting system of thoughts. Those processes result in a knowledge system integrated in a value system, depending on the history and the social and ideological context (Abric, 1994).

Amongst the different directions raised by the social representations theory, the structural approach (Abric, 1987, 1994; Rateau and Lo Monaco, 2016) suggests that a social representation builds a set of organized and structured items. Social representations are characterized as sociocognitive structures regulated by two distinct but complementary entities: the central system (or core) and the peripheral system. The central core is the unifying and stabilizing element of the representation and determines its organization and significance. It consists of consensual and nonnegotiable stable beliefs, unconditionally linked to the object. It constitutes a cognitive filter through which social reality is perceived and evaluated. It also helps to determine behaviors and positions by providing an interpretation and a categorization system. The peripheral system consists of conditional beliefs allowing individual modulations of the common framework defined by the central beliefs. Those constitutive elements seem to be the most concrete part of the representation and are intermediaries between the central core and the concrete situation. This position ensures both the protection function of the central core and the regulation function of the representation by adapting to the dynamics of the context. In accordance to the central system, the peripheral system can also intervene in the determination of the evaluations and social practices. The analysis of complementarity between the central system and the peripheral system provides an understanding of both the content and the structure, and of the dynamic of social representations.

From a methodological point of view, a social representation study requires to identify two things: its content (information, opinions, beliefs, attitudes, etc.) and its structure (Abric, 1994, 2003; Moliner et al., 2002; Lo Monaco and Rateau, 2016).

In this way, a social representation study will never consist of a random series of opinions or some incoherent collection of attitudes, behaviors, and points of view. A social representation is an organization whose content and structure both need to be found. But beyond this inner organization, some rules and configurations reveal its building and its composition. It is this "building space of the acting knowledge" that Rouquette (1997) suggested to model.

3. A BUILDING SPACE OF THE ACTING KNOWLEDGE

Firstly, the acting knowledge will be defined as the one that the actors express in their discourses and behaviors. It differs from the informed or instrumentalized knowledge that always tends to express itself in a formatted and coherent manner (a scientific paper, a political speech, or an academic lecture).

This building space is defined by three cognitive dimensions:

- An *identification* dimension (ID) estimated on a range from "I feel personally exposed" (ID+) to "everyone is exposed" (ID−) passing through a series of more or less specified groups (my family, the inhabitants of my neighborhood, of my region, the French people, the Europeans, etc.). This graduated identification must be decoupled from categorization, especially when I think about a "stranger" group. This is why we need to distinguish between "this does not concern me specifically but concerns others of which I am not" and "this does not concern me specifically but concerns everyone, of whom I am." The first set refers to a continuity of belonging and the second one to a discontinuity. It is the option of continuity that will be considered here.
- A *valuation* dimension expressing the importance of the object evaluated on a range from "it is a matter of no importance" (VAL−) to "it is a matter of life and death" (VAL+) with all possible intermediaries.
- Finally, a third dimension refers to the *perceived capacity to act toward the object* (PCA). It is a subjective gradation that goes from the feeling of being powerless toward the object to the feeling of being in full control of it (scaled from "I cannot do anything about it" (PCA−) to "it fully depends on me" (PCA+). Once again, all the intermediaries are possible between those two extremes ("my action has little weight," "my action is decisive," etc.).

According to Rouquette, any thematic object (considered as a referent of the discourse or as a referent of the behaviors) can be located at the intersection of these three dimensions. Of course, the same object can be located differently according to the periods, the individuals, and the group. But the system of identification of these situations remains the same. Let us consider smoking, for example—as far as I am concerned directly, and in the matter of life or death, I have a possible action by stopping smoking. But since it concerns a very large part of the population and constitutes a general problem of society of which I recognize the paramount importance, I may be led to think that I can personally do nothing about it. On the contrary, I can consider that I perform a possible educational action in a formal framework (for example, an association for the fight against tobacco) or informal (for example, I put pressure on my relatives to make them quit smoking).

This framework allows us to specify the cognitive configuration of an object of fear, such as a biological invasion.

We can assume that such an object is characterized by a sense of helplessness experienced in the situation (PCA−) associated with a strong valorization of the issue (VAL+)—I am afraid when I do not control what happens or what may happen and when the issue is important to me (an aversive issue, obviously, in the context that concerns us). By exclusion, any situation involving a low aversive concern (the object has a small negative impact) and any situation referring to a feeling of control (my estimated possibility of control of this object is total) does not correspond to a fear situation. It is the same thing for a situation with a strong negative impact that I think I can control.

Moreover, as the work of Rimé (2005) has very clearly shown, all important emotions tend to be shared with others. The sharing of negative emotions, for example, expresses the need to find a social support; it compensates for the psychological destabilization produced by an aversive and disruptive event. Sharing a negative emotion mostly means wanting to integrate a community of belonging with its values and its relationships, to reassure oneself. Consequently, the study of social representations of biological invasions cannot ignore social belongings and affiliations.

4. THE JELLYFISH INVASION[1]

The mass standing and development of gelatinous zooplankton is a major obstacle to tourist and commercial activities (fishing, fish farming, etc.). Furthermore, questions arise amongst local populations about the rhythmicity of the appearances of these proliferations and their dangerousness. Are the origins of these punctual mass appearances connected to human activities? (eutrophication, overfishing, climate change, etc.)? What are the impacts of these mass developments on the functioning of aquatic ecosystems? Will these proliferations continue, intensify? Can we predict the appearances of these gelatinous organisms? These questions are the source of this multidisciplinary research program that was pursuing two objectives:

- From a biological point of view, the purpose was to identify the different species, their seasonal frequencies of appearance, and their geographic distribution in order to understand how they interact with the environment;
- From a psychological point of view, the purpose was to identify the concerns of the actors of the marine field and the problems caused by the presence of these organisms (Lassarre et al., 2012; Rateau et al., 2012; Rateau, 2013).

4.1 POPULATION AND METHOD

Our general approach was to analyze and compare the psychological processes of various populations affected by the proliferation of jellyfish (N = 317) based on a questionnaire. Four populations were selected:

- Decision makers (N = 25): population of an institutional nature including local elected officials allowed to make environmental decisions and their advisers (land managers, water agency, etc.)
- Maritime professionals (N = 30): population working in affected areas whose activities are directly touched (fishermen and shellfish farmers)
- Tourism professionals (N = 59): population working in affected areas whose activities are directly touched (hotels, restaurants, merchants)
- Users (N = 203): tourists and users of affected lagoon and coastal areas (bathers, boat owners, anglers).

Based on a wide questionnaire aiming to meet the several purposes of the study, three components were directly connected to the present issue:

- The first component aimed to identify the anxiety level generated by the mention of a confrontation with a school of jellyfish. For that purpose, we used 20 items from the French version of the State/Trait Anxiety Inventory (STAI; Spielberger et al., 1970). Each item was associated with a 4-point Likert scale (1 = Not at all; 2 = A bit; 3 = Moderately; 4 = A lot). The STAI consists of different scales to evaluate state-anxiety (STAI Y-A) and trait-anxiety (STAI Y−B). We have used only the 20 propositions of the first series to assess what the persons feel when jellyfish are mentioned. The STAI has been calibrated at French standards. The scores of the

[1]This research was cofinanced by the Total Foundation and the Ministry of Ecology, Energy, Sustainable Development and Land and Sea Planning, under the research program of Liteau.

different French groups are between 20 and 80 on our scale. The scores are classified in five levels: higher than 65 (very high anxiety), from 56 to 65 (high anxiety), from 46 to 55 (moderate anxiety), from 26 to 45 (low anxiety), lower than 35 (very low anxiety); 46 is considered as the limit between an anxious and a "normal" state.

- The second component aimed to evaluate the level of involvement in the proliferation of jellyfish based on the three-dimensions model suggested by Rouquette (1997): the perceived capacity to act, the personal identification, and the valuation of the object. Each dimension was evaluated with a 10-point Likert scale: from "it concerns only me" to "it concerns everyone" for the identification scale; from "this is a minor issue" to "this is a major issue" for the valuation scale; from "I cannot do anything about it" to "it all depends on me" for the perceived capacity to act scale.
- The third component aimed to identify both the content and the structure of the social representation associated with jellyfish. It was composed of two steps. Firstly, the participants had to proceed to a hierarchical evocations technique (Abric, 1994). They had to mention five words or expressions coming to their mind when thinking about jellyfish. In a second step, they had to hierarchize their words or phrases from the most to the least important to define jellyfish (from 1 = "Very important" to 5 "Unimportant"). Thirdly, the participants were subjected to a Test of Context Independence (Lo Monaco et al., 2008). For each of their words or phrases, the participants had to indicate if it would "always, in any case without exception" define the jellyfish.

The first step brought to light the content of the representation associated with jellyfish (the evocations) and provided a better understanding of its structure. A frequency/importance level analysis arising from a combination of the medium frequency of appearance of each response and its average rank of importance was considered to provide structural hypothesis. Evocations with high frequency and strong importance are seen as being potentially part of the central core of the representation (Abric, 1994).

The purpose of the second step was to confirm this hypothesis. Considering that a central element is "trans-situational," it should be characteristic of the object of representation regardless of the situation. Therefore, when a word obtains a percentage of unconditional answers close to 100%, it is considered as a central element of the representation.

4.2 RESULTS

- The STAI scale. For the overall population, the mean on the STAI scale is 57.30 (Standard Deviation = 13.82). It confirms that the jellyfish provide a high level of anxiety according to the French sample calibration. Furthermore, this anxiety level does not change depending on the gender, age, or socioprofessional category of the participants. The results confirm those of Davey et al. (1998) indicating that jellyfish generate a shared sense of threat.
- Social representations. First, we have focused on the 1570 evocations generated by the word "jellyfish." Following a lemmatization, this corpus was reduced to 134 different semantic units. Two indices were calculated on this basis (Flament and Rouquette, 2003):
  - A diversity index provided by the division between the number of different units and the total number of evocations. Here we obtained an index of 0.08, indicating a high convergence of the evocations. It is the sign of a representation highly centered on a low number of elements.

- A scarcity index taking into account the number of hapax (evocations that appear only once) divided by the number of different semantic units. An index of 0.47 is obtained. It is the sign of a low interindividual variability of the evocations. It reinforces the diagnosis of a strongly structured representation.

We then proceeded to a "frequency/rank of importance analysis of the semantic units that have a frequency of appearance higher than 10 (84% of the corpus). For each of them, we have estimated a Test of Context Independence score. Any semantic unit that has received an unconditional response rate near 100% (Kolmogorov−Smirnov test, see Lo Monaco et al., 2008 and the chapter of Valette et al., in this book) has been considered as part of the central core of the representation. The results can be found in Table 6.1:

Table 6.1 shows that the potential central core of the representation is built around four items: the *fear* caused by the object, its *disgusting* and *irritating* nature, and the presence of *tentacles*. In this central area, other words appear as well: *burn* and *sting* (close to the *irritating* nature), *sticky* (probably close to the *disgusting* nature), and *heat*, seen as the causal factor in the appearance of jellyfish. Therefore, the general tone of the evocations of the centrality area is highly negative; with the exception of the element *heat* (related to a causal dimension), all of the other terms refer to negative aspects. In addition, in the first periphery area (Table 6.1, top right), the words *inconvenience*, *pain*, *danger*, and *swimming prohibited* are mentioned. Those terms lays greater emphasis on the aversive tone of the representational universe associated with jellyfish.

Next, we proceeded to a correspondence factor analysis (CFA), including all the semantic units considered here (cf. Deschamps, 2003; Lo Monaco and Guimelli, 2008). The three dimensions of the

Table 6.1 Rank/Frequency Analysis of the Evocations Generated by the Word "Jellyfish"

	Low Rank (<3.2)	**High Rank (≥3.2)**
High frequency (>37)	Burn (125; 2.26) Heat (50; 3.06) Sticky (146; 3.15) **Fear** (95; 2.63) Sting (158; 2.25) **Disgusting** (42; 2.97) **Tentacles** (40; 3.18) **Irritating** (65; 2.53)	Color (68; 3.43) Maritime (60; 3.41) Beauty (57; 3.47) Inconvenience (56; 3.22) Pain (54; 3.51) Danger (42; 3.29) Swimming prohibited (37; 3.32)
High frequency (≤37)	Invasive (27; 2.83) Flight (24; 3.20) Strange (18; 2.58) Fishing issue (16; 2.50) Garbage (12; 2.93)	Ugliness (20; 3.50) Water (17; 3.31) Beach (17; 4.05) Dirty (17; 2.18) Filaments (15; 3.40) Year of the Jellyfish (film) (15; 4.16) Summer (14; 4.07) Care (13; 3.92)

In Brackets: Frequency and Average Rank of Each Evocation; Bold and Underlined: Evocations Identified as Central in the Test of Context Independence.

involvement, separated according to their respective mean value (low/high), have been introduced as supplementary variables in the analysis, as well as the four types of population observed (decision makers, users, tourism professionals, maritime professionals).

The two factors identified explain 87.16% of the total inertia (60.12% for the first factor, 26.04% for the second one). To build the factorial graphic (Fig. 6.1), only the variables whose contribution to the inertia of each factor exceeded the average of the contributions of all the variables on these factors were retained. Only the variables *fear*, *irritating*, and *PPA* have been represented, for reasons that will be discussed later.

Here is what we learn from Fig. 6.1:

- First, we can see that the dimension relative to the perceived possibility to act does not significantly contribute to the inertia of the factors identified for the analysis. Overall, it is extremely low. In other words, jellyfish bring a generalized sense of powerlessness.
- Then, we can see that two elements identified as central in the social representation do not contribute either to the inertia of the two retained factors: the *fear* and the *irritating* aspect of jellyfish. Consequently, those two elements are transverse to both populations and cognitive dimensions studied. In other words, it reflects aspects that we will consider as principal elements of the social representation of jellyfish (Rateau, 1995; Brissaud and Moliner, 2004).
- Beyond the consensus about fear and the irritability of jellyfish, we note that the social representation is modulated by both the social groups observed and the levels of identification and valorization stated. Schematically, the first factorial axis opposes negative characteristics (top of graph) to positive characteristics (bottom of graph).

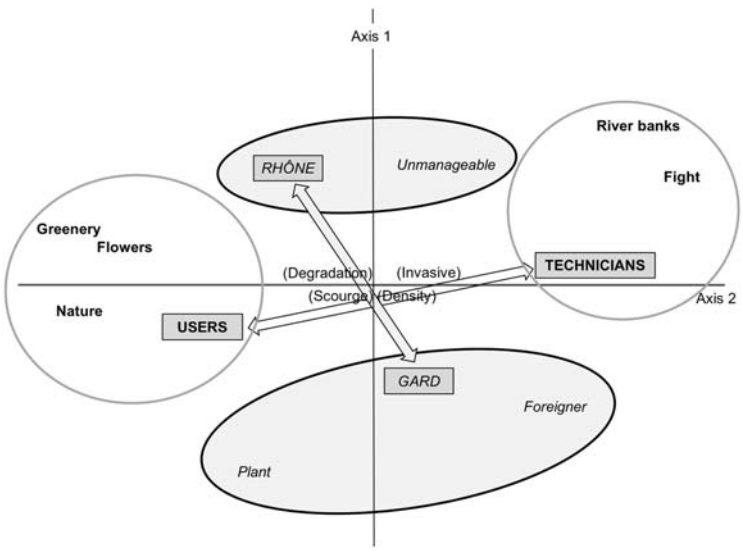

FIGURE 6.1

Vector graphic of the evocations and supplementary variables. Bold and underlined: central items. Text boxes, uppercase: dimensions of the involvement. Text boxes, uppercase, and italic: populations studied.

The first characteristics seem to be associated with maritime professionals who define themselves as the most concerned (IDE+) and to users who strongly value the object (VAL+). Each person evaluates the object depending on their practices: the *inconvenience* associated with the *prohibition on swimming* generated by the *invasion* of jellyfish or the *users*, and the fact that they are *garbage* destroying *fishing material* for the *maritime professionals*.

The second characteristics are more associated with tourism professionals who define themselves as not greatly concerned (IDE−) and to the elected officials and decision makers to whom jellyfish are not a major issue (VAL−). Again, the role of the practices is clear. Therefore, to the *elected officials* and *decision makers* to whom the issue is not that important, the fear of jellyfish is tempered by their positive aspects, relating to their *beauty* or their *color*—elements that they could use to reassure users and encourage larger use of their territories! To the *tourism professionals* not directly concerned, jellyfish reflect their geography and season of predilection: the *beach*, *summer.*

In summary, and without detailing the information provided by the graph, we note that jellyfish generate a generalized sense of fear by their irritating nature. But the apprehension raised by this object of fear is modulated by the intervention of cognitive and social dimensions. Indeed, it appears that the most negative perception of jellyfish is developed by fishermen, with a high identification, and users, with a high valorization. Furthermore, the decision makers who do not greatly value the object, and the tourism professionals who define themselves as being not greatly concerned, develop more positive perceptions.

In other words, these results indicate that jellyfish seem to be subject to a fear collectively shared. But this fear is highly modulated by the strong determinants of the personal implication of belongingness.

5. THE PROLIFERATION OF KNOTWEEDS[2]

The hybrid complex from the genus *Fallopia* is part of the most invasive plants widespread in Europe. For instance, *Fallopia japonica* is invasive in 40 countries (Lambdon et al., 2008). This species was imported from Japan for the first time in England by the Von Siebold and Co. horticultural company between 1825 and 1848, and has spread via its commercialization. Consequently, it became sympatric with *Fallopia sachalinensis,* also imported into England from Sakhalin Island in the second half of the 19th century. This resulted in the crossbreeding of those two species during the 1880s (Bailey and Conolly, 2000). The three species are currently present in France. In particular, the fluvial areas of the Loire department and the Rhône department are overgrown by the hybrid (Bailey and Wisskirchen, 2006). In these overgrown habitats, the specific plant diversity is reduced, as well as the specific abundance and wealth of the invertebrates (Gerber et al., 2008). The nutritional composition of the soil is also highly degraded (Dassonville et al., 2007).

The management of knotweeds is problematic and generates several questions in the fields of science and rivers management: Should we act to fight against the spread of the plant? In that case, what would be the most efficient technique? The attempts to fight against the plant are widely employed in the field. But the control or the eradication of *Fallopia* is very difficult to achieve,

[2]This research was cofinanced by the French National Center for Scientific Research and the National Institute of Science and Technology for the Environment and Agriculture, under the Interdisciplinary Research Program "Ingecotech," Axe Ingeco "ecological engineering."

especially concerning *Fallopia* x *bohemica*. Removing the plants and using herbicide are often implemented (Bailey et al., 2009). However, the methods used vary considerably. Without efficient techniques, the management of *Fallopia* mostly fails. In addition, this management can cause various negative side effects: mowing the stems, removing rhizomes, and bringing motor vehicles on the lands trigger the proliferation of the plant. With no way to fight against it, the "nonintervention" could be considered as the best management approach to limit the spread; indeed, the absence of intervention prevents fragments of stems and rhizomes from propagating.

The aims of this study were to understand the fears and information needs of various populations concerned differently by the proliferation of the knotweed on sites more or less affected. We focused particularly on the interindividual and intergroup variability of the representations and knowledge of *Fallopia*. The goal was to identify the individual and collective factors that motivate (or do not motivate) action and guide the choice of the technique retained for the fight against knotweeds. Here, we present only some of the data from this broader research.

5.1 POPULATION AND METHOD

We wanted to highlight the link between the perception of the proliferation of *Fallopia* and the results of the ecological observations made by the teams of biologists. For that purpose, we surveyed individuals from two different sites:

- One from the Lyon region (Vernaison) in an area highly overgrown by knotweeds.
- One from the west of the Gard department (basins of the Vidourle and of the Hérault) in which the knotweed appear.

We also wanted to compare the sociopsychological processes of various populations concerned by the proliferation of *Fallopia.* We studied two samples (Fig. 6.2):

- "Actors": river managers, technical and scientific agents.
- "Users": residents (farmers and breeders) and fishermen.

As far as possible, the investigators tried to question people of various ages.
These two criteria led to a survey plan composed of four cells (see Table 6.2).
The techniques used are exactly the same as those used in the previous study about jellyfish:

- Measure of anxiety with the Spielberger STAI test
- Measure of the level of involvement with Rouquette's three-component model (1997)
- Hierarchical evocations related to the inductor item "knotweed"
- Context independence test

Furthermore, the answers have been subject to a correspondence factor analysis.

5.2 RESULTS

5.2.1 Psychological Risk Assessment

This assessment was made with two main measures: the emotional level and the psychological involvement.

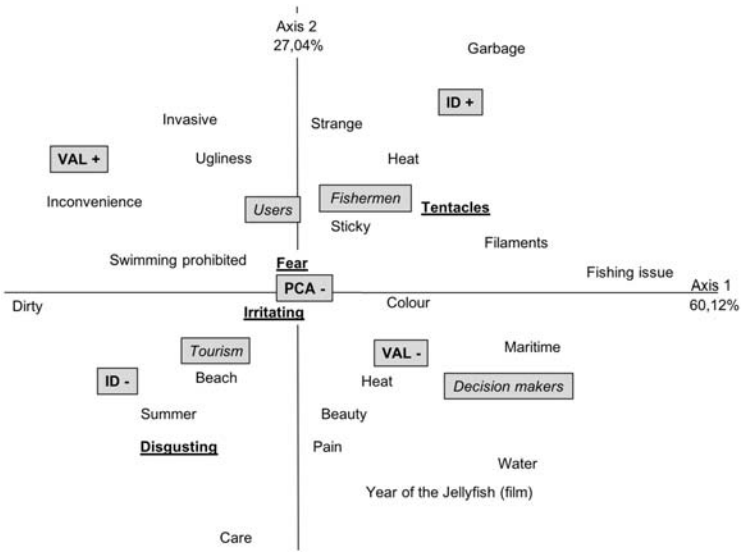

FIGURE 6.2

Factorial structure (CFA) of the associations made according to the site and status of the participants. In brackets: central items. Text boxes, uppercase: status. Text boxes, uppercase and italic: sites.

Table 6.2 Number of Participants per Status and Sites

	Rhône	Gard	Total
Users	30	27	**57**
Engineers	17	20	**37**
Total	**47**	**47**	**94**

- The emotional level (or stress) has been measured with the STAI scores.
  Let us recall that the maximum score possible for this test is 80, and that the score of 46 is seen as the limit between an anxious state and a "normal" state.
  Here, the mean score is 43.93 with a standard deviation of 13.13. Therefore, the emotion level is low. It goes without saying that, unlike with jellyfish, the presence of knotweeds is not a direct threat for the physical or moral integrity of the participants, for instance, and thus generates a low level of anxiety. However, the data distribution shows that a quarter of the participants (26.11%) are scored higher than 55, which is the sign of a high or very high level of anxiety.
- The measures of the psychological involvement show that if the issue tied to the presence of *Fallopia* is seen as quite important (VAL mean = 5.92/10), the level of personal identification appears as low (IDE mean = 1.65/10) and barely favorable to the implementation of an individual action (PPA mean = 3.69/10).

Therefore, the spread of knotweeds is perceived as important, but the populations feel unable to act individually. These circumstances are conducive to a relatively important emotional level. Indeed, stress is often generated by the gap perceived between the risk and the ability to face it.

5.2.2 The Social Representation of Knotweeds

Each participant had to indicate five free associations to the generic term "knotweeds." Therefore, we expected a theoretical corpus of $94 \times 5 = 470$ evocations. Some answers being missing, the final corpus stood at 426 associations.

Firstly, a lemmatization of this corpus (i.e., grouping of words from the same word family to semantic units) allowed us to obtain a corpus of 83 different semantic units.

The *diversity index* (the total number of units [n = 82] divided by the total of the evocations [n = 426]) is low (0.19). It shows a strong convergence in the answers and the sign of a representation heavily built around a small number of elements.

The *scarcity index* (the total of number of hapax [n = 49] and the total number of units [n = 82]) is 0.59. It indicates a certain interindividual variability, which is the sign of a relative dispersion of the social-representational elements within the sample.

Only units with a frequency of appearance equal or higher than 8 (14 units covering 78% of the total corpus of evocations) were retained. This corpus was divided depending on the median of the distribution of the appearance frequencies of each unit (median = 20) and depending on the median of their rank of importance, (median = 3).

We recall that this double division allows us to distribute the units into four categories. Those characterized by a high frequency and a low average rank (i.e., a high importance) are seen as part of the centrality area of the representation (Abric, 2003).

For each of these units perceived a priori as central, we have finally considered the proportion of "yes" answers obtained with the context independence test.

These proportions have been compared to a centrality threshold provided by the Kolmogorov–Smirnov test; threshold: $1 - (1.36/\sqrt{N}) \times 100$. Units with a proportion higher than the calculated threshold are identified as part of the central core and are marked in bold in Table 6.3.

Table 6.3 Distribution of the Semantic Units Relating to Their Frequency and Mean rank.

	Low Rank (<3.00)	**High Rank (≥3.00)**
High frequency (>20)	**Invasive** (90; 1.92) **Density** (34; 2.94) **Degradation** (21; 2.57) **Scourge** (21; 2.76)	Water (29; 3.20) Unmanageable (25; 3.08)
Low frequency (≤20)	Flowers (17; 2.53) Plant (12; 2.45) Nature (8; 2.87)	Foreigner (19; 3.00) Beauty (15; 3.13) Fight (9; 3.22) Greenery (9; 3.44) River banks (9; 3.88)

In bold: Elements With a Proportion of "Yes" Answers Significantly Higher Than the Threshold Provided by the Kolmogorov–Smirnov Test.

We note that the potential core is built around four elements: the *invasive* aspect of knotweeds, the *density* of its influence, the fact that it participates in the *degradation* of the environment and biodiversity, and that it is a *scourge*, an important threat.

Therefore, the general tone of the evocations of the centrality area is largely negative since all the terms seen as central within the representation reflect clearly aversive aspects. In addition, in the first periphery area (high frequency/high average rank), we note the notion of *unmanageability* of the *Fallopia*. However, in peripheral area, this tone is tempered by the words *beauty*, *flowers*, or *nature*. We note the presence of the word *foreigner* as well, relatively common and important in the associations collected.

We wondered whether or not this global social representation, studied on the sample as a whole, was modulated depending on the place of belongingness of the participants and the status retained for the study (engineers and users). For that purpose, we have proceeded to a CFA on the 14 semantic units considered during the first analysis. The two sites and the two categories of social actors were added as additional variables. Apart from the four elements considered as central, only the variables and the observations whose contribution to the inertia of each factor has exceeded the average of the contributions of all the variables on these factors were retained.

Factor 1 (Fig. 6.2, Axis 1) strongly opposes two categories: "engineers" and "users." Those two modalities enlighten 95% of the inertia of the factor. This "structuring" opposition is clearly related to the influence of social practices on the representations, and to the anchoring phenomenon.

Factor 2 clearly expresses an opposition of sites between "the Rhône" and "the Gard." Overall, those two modalities contribute to 94% of the inertia of this factor. Under the contents associated with these variables, all of the evidence demonstrates that knotweeds seem to be perceived as far less problematic on Gard territories than on Rhône territories.

Another type of graphic representation (Fig. 6.3) provides better perception of the organization of the representational contents according to the oppositions observed on the factors.

In Fig. 6.3, we can see that users are sensitive to the "bucolic" aspect of knotweeds. They praise the beauty of the flowers of the *Fallopia*, the greenery of the plant, and the fact that it is a "natural" element

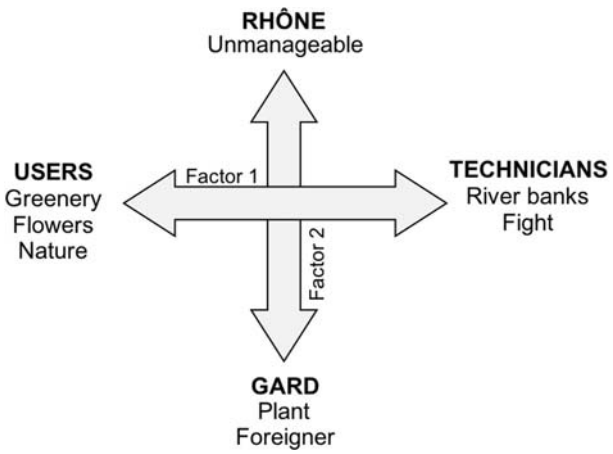

FIGURE 6.3

Summary of the CFA.

in the environment. Therefore, they are greatly opposed to engineers, who associate knotweeds to bank slumping and the constant fight they involve.

The second factor shows a clear opposition between the Rhône site, where knotweeds are highly considered as unmanageable, and the Gard site, where *Fallopia* is "only" seen as a foreign plant.

Therefore, we can see four different modes of apprehension completely consistent with the problems of the sites and the status of the actors.

We can also observe that the four elements previously identified as central (*Invasive*, *Density*, *Scourge*, *Destruction*) do not contribute to the inertia of the factors. They are then commonly shared by all of the actors and sites and constitute the structuring basis of the shared representation of knotweeds.

6. GENERAL DISCUSSION

Our psychosocial study aimed to understand the fears and information needs of various populations differently concerned by the proliferation of biological species on more or less affected sites. Linking two fundamental psychological processes (social representations and stress) appeared to be particularly fruitful to reach these objectives.

Firstly, the results of the investigation have highlighted the representational universe of the invasive species studied as well as the mediator, emotional, and cognitive and social processes that regulate the relation to the social object.

There is a close connection between the psychosocial processes that we have exposed and the reality of the presence of jellyfish on the territories. The social representations study shows a clear contrast between "infested" sites and those that are less affected. And we also note important differences between the territories in terms of stress and damage assessment. Ultimately, we observe a good fit between the reality of the invasion and the psychosocial reactions.

Furthermore, we can see that the representations, emotions, and actions are highly connected to the social belongingness of the persons surveyed and thus to their practices. Regarding the stress model, the environment is a field made of constraints, but of resources as well. Action is a way to manage a situation perceived as "risky," whether it is really dangerous or only uncomfortable. To face it, the individual has both environmental and personal resources (skills, social support, finances). The damage and risks perceived are directly connected to the activities of the surveyed persons.

Around a common core made up of the "fear" generated by jellyfish and the degradations caused by knotweeds, the social representations of professionals are opposed to those of users. On the one hand, aversion to the invasive species is linked to the job and its economic (for jellyfish) and environmental (for knotweeds) consequences. On the other hand, in the representation of jellyfish, it is the fear of injury and pain that is expressed by sea users, and in the representation of knotweeds, it is its bucolic and natural aspect that is expressed by strollers.

The practices and skills of land professionals allowed them to manage the jellyfish and knotweed issue without stress. However, users feel more helpless and thus stressed by the proliferation of jellyfish.

On another level, the knowledge of psychological processes underlying the discourses and actions concerning invasive species should allow for better communication between scientists and the populations concerned. Therefore, we can see that the alarmist talk of some media has a low influence on the social representations and the cognitive and emotional processes of the individuals. The reality of

the damage they see and the reality of their practices seem to be strong instruments to measure the impact of the phenomenon on the public. This social talk is in consonance with the objective reality of the proliferations measured by experts. It also explains more clearly the stress felt than the perception of the biological phenomenon itself.

REFERENCES

Abric, J.-C., 1987. Coopération, compétition et représentations sociales. Delval, Cousset.

Abric, J.-C. (Ed.), 1994. Pratiques sociales et représentations. Presses Universitaires de France, Paris.

Abric, J.-C. (Ed.), 2003. Méthodes d'étude des représentations sociales. Érès, Toulouse.

Andreu, J., Vilà, M., Hulme, P.E., 2009. An assessment of stakeholder perceptions and management of noxious alien plants in Spain. Environmental Management 43, 1244−1255.

Attrill, M.J., Wright, J., Edwards, M., 2007. Climate-related increases in jellyfish frequency suggest a more gelatinous future for the North Sea. Limnology and Oceanography 52 (1), 480−495.

Bailey, J.P., Conolly, A.P., 2000. Prize-winners to pariahs—a history of Japanese knotweed s.l. (Polygonaceae) in the British Isles. Watsonia 23, 93−110.

Bailey, J., Wisskirchen, R., 2006. The distribution and origins of Fallopia × bohemica (Polygonaceae) in Europe. Nordic Journal of Botany 24, 173−199.

Bailey, J.P., Bimova, K., Mandak, B., 2009. Asexual spread versus sexual reproduction and evolution in Japanese Knotweed s.l. sets the stage for the "Battle of the Clones." Biological Invasions 11, 1189−1203.

Binimelis, R., Monterroso, I., Rodriguez-Labajos, B., 2007. A social analysis of the bioinvasions of Dreissena polymorpha in Spain an Hydrilla verticillata in Guatemala. Environmental Management 40, 555−566.

Brissaud, A., Moliner, P., 2004. Représentation sociale et système de catégories. Le cas des hommes politiques. Les Cahiers Internationaux de Psychologie Sociale 64, 13−20.

Daehler, C.C., 2008. Invasive plant problems in the Hawaiian Islands and beyond: insights from history and psychology. In: Tokarska-Guzik, B., Brock, J.H., Brundu, G., Child, L., Daehler, C.C., Pysek, P. (Eds.), Plant Invasions: Human Perception, Ecological Impacts and Management. Backhuys, Leiden, pp. 3−19.

Dany, L., Apostolidis, T., 2002. L'étude des représentations sociales de la drogue et du cannabis: un enjeu pour la prévention. Santé Publique 14 (4), 335−344.

Dassonville, N., Vanderhoeven, S., Gruber, W., Meerts, P., 2007. Invasion by Fallopia japonica increases topsoil mineral nutrient concentrations. Ecoscience 14, 230−240.

Davey, G.C.L., McDonald, A.S., Hirisave, U., Prabhu, G.G., Iwawaki, S., Jim, C.I., Merckelbach, H., de Jong, P.J., Leung, P.W.L., Reimann, B.C., 1998. A cross-cultural study of animal fears. Behaviour Research and Therapy 14, 29−66.

Delouvée, S., Rateau, P., Rouquette, M.L. (Eds.), 2013. Les Peurs Collectives. Erès, Toulouse.

Deschamps, J.-C., 2003. Analyse des correspondances et variations des contenus des représentations sociales (Dir.). In: Abric, J.-C. (Ed.), Méthodes d'étude des représentations sociales. Érès, Ramonville Saint-Agne, pp. 179−200.

Flament, C., Rouquette, M.-L., 2003. Anatomie des idées ordinaires. Comment étudier les représentations sociales. Armand Colin, Paris.

Gerber, E., Krebs, C., Murrell, C., Moretti, M., Rocklin, R., Schaffner, U., 2008. Exotic invasive knotweeds (Fallopia spp.) negatively affect native plant and invertebrate assemblages in European riparian habitats. Biological Conservation 141, 646−654.

Jodelet, D., 1989. Les Représentations Sociales. PUF, Paris.

Kowarik, I., Schepker, H., 1998. Plant invasions in northern Germany: human perception and responses. In: Kowarik, I., Williamson, M. (Eds.), Plant Invasions: Human Perception, Ecological Impacts and Management. Backhuys, Leiden, pp. 109−120.

Lambdon, P.W., Pysek, P., Basnou, C., Hedja, M., Arianoutsou, F., Jarosik, V., Perg, J., Winter, M., Anastasiu, P., Andriopoulos, P., Bazos, I., Brundu, G., Celesti-Grapow, L., Chassot, P.H., Delipett-Rou, P., Josefsson, M., Karkl, S., Klotz, S., Kokkoris, Y., Khün, I., Merchantel, H., Perglovà, I., Pino, J., Vilà, M., Zikos, A., Royl, D., Hulmel, P.E., 2008. Alien flora of Europe: species diversity, temporal trends, geographical patterns and research needs. Preslia 80, 101−149.

Lassarre, D., Rateau, P., Dias, P., Lepage, J., 2012. The perception of jellyfish blooms in the French Mediterranean lagoons. In: Proceedings of the 22nd Conference of the International Association for People-Environment Studies, Glasgow (Scotland), 24−29 June 2012.

Lo Monaco, G., Delouvée, S., Rateau, P., 2016. Les représentations sociales. Théories, méthodes et applications. De Boeck, Bruxelles.

Lo Monaco, G., Guimelli, C., 2008. Représentations sociales, pratique de consommation et niveau de connaissance: le cas du Vin. Les Cahiers Internationaux de Psychologie Sociale 78, 35−50.

Lo Monaco, G., Lheureux, F., Halimi-Falkowicz, S., 2008. Le test d'indépendance au contexte (TIC) : une nouvelle technique d'étude de la structure représentationnelle. Swiss Journal of Psychology 67 (2), 119−123.

Lo Monaco, G., Rateau, P., 2016. Méthodes d'étude de la structure des représentations sociales. In: Lo Monaco, G., Delouvée et, S., Rateau, P. (Eds.), Les représentations sociales. Théories, méthodes et applications. De Boeck, Bruxelles, pp. 135−144.

Márquez, E., Friemel, E., 2005. Activation des Schèmes Cognitifs de Base et Actualisation des Valeurs Associées au Travail. Papers on Social Representations 14, 1−28.

Mills, C.E., 2001. Jellyfish blooms: are populations increasing globally in response to changing ocean conditions? Hydrobiologia 451, 55−68.

Moliner, P., Rateau, P., Cohen-Scali, V., 2002. Les représentations sociales. Pratiques des études de terrain. Presses Universitaires de Rennes, Rennes.

Moscovici, S., 1984. Préface. In: Herzlich, C. (Ed.), Santé et maladie : analyse d'une représentation. EHESS, Paris.

Muller, S., 2000. Les espèces végétales invasives en France: bilan des connaissances et propositions d'actions. Revue d'écologie − Terre Vie, supplément 7, 53−69.

Pahl-Wost, C., 2006. The importance of restoring the multifunctionality of rivers and floodplains. Ecology and Society 11 (1), 10.

Rateau, P., 1995. Le noyau central des représentations sociales comme système hiérarchisé. Une étude sur la représentation du groupe. Les Cahiers Internationaux de Psychologie Sociale 26, 29−52.

Rateau, P., 2013. Les dimensions sociocognitives des peurs collectives. In: Delouvée, S., Rateau, P., Rouquette, M.L. (Eds.), Les Peurs Collectives. Erès, Toulouse, pp. 49−67.

Rateau, P., Moliner, P., 2009. Représentations sociales et processus sociocognitifs. Presses Universitaires de Rennes, Rennes.

Rateau, P., Lo Monaco, G., 2016. La théorie structurale ou l'horlogerie des nuages. In: Lo Monaco, G., Delouvée et, S., Rateau, P. (Eds.), Les représentations sociales. Théories, méthodes et applications. De Boeck, Bruxelles, pp. 113−129.

Rateau, P., Lassarre, D., Dias, P., Lepage, J., 2012. Implication, objet de peur collective et représentations sociales. Le cas de la prolifération des méduses. 9ème Congrès International de Psychologie Sociale en Langue Française, Porto (Portugal), 1−4 July 2012.

Ravet, J., 1971. Scientific Knowledge and its Social Problems. Clarendon Press, Oxford.

Rimé, B., 2005. Le partage social des émotions. PUF, Paris.

Rouquette, M.-L., 1994. Sur la connaissance des masses. Essai de psychologie politique. Presses Universitaires de Grenoble, Grenoble.

Rouquette, M.-L., 1997. La chasse à l'immigré. Violence, mémoire et représentations. Mardaga, Sprimont.

Rouquette, M.-L., 1998. La Communication Sociale. Dunod, Paris.

Spielberger, C.D., Gorsuch, R.L., Lushene, R.E., 1970. The State-Trait Anxiety. Inventory: Test Manual. Consulting Psychologist Press, Palo Alto, CA.

Strand, R., 2002. Complexity, ideology and governance. Emergence: Complexity and Organization 4, 164−183.

Vitousek, P.M., D'Antonio, C.M., Loope, L.L., Rejmanek, M., Westbrooks, R., 1997. A significant component of human- caused global change. New Zealand Journal of Ecology 21, 1−16.