

ROUNDTABLE SESSION 2 DOES LEGISLATION WORK IN PROTECTING VULNERABLE SPECIES?

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ABSTRACT

As a result of discussions held at the Innsbruck CRAYNET meeting and the answers given to a subsequent questionnaire sent out to the National Co-ordinators of the 11 countries/regions, it is clear that most European countries aim at trying to protect their indigenous crayfish species (ICS) from overexploitation, habitat modification, pollution, and spread of non-indigenous crayfish species (NICS) and crayfish plague.

Two detailed case studies are given for Austria and England plus a summary of the questionnaires. These clearly illustrate the different attitudes of countries to protecting and managing their ICS and NICS. The situation is highly complex and differs depending upon whether or not there is a tradition for eating crayfish. Consequently, harmonisation of national and regional regulations for ICS and NICS in Europe may not be possible in the short term.

In many cases legislation has not prevented further destruction of populations of ICS and the spread of NICS. However, without such legislation the situation could have been a lot worse and some ICS could already have become critically endangered. The continued efforts by the crayfish community and national authorities have resulted in a scenario where there are still some countries without NICS, and in most European countries there are specific areas with numerous, viable populations of ICS that are considered valuable and are protected by the authorities as well as by local people. The situation has recently been improved by providing protection for *Austropotamobius torrentium* under Annex II of the EU Habitats Directive. A major objective must be to develop methods for eradicating nuisance populations of NICS before they spread any further.

Key-words: Europe, legislation, crayfish, indigenous, non-indigenous, EU Habitats Directive.

TABLE RONDE 2

LA LÉGISLATION RÉUSSIT-ELLE À PROTÉGER LES ESPÈCES VULNÉRABLES?

RÉSUMÉ

A partir des discussions menées lors du congrès CRAYNET d'Innsbruck puis des réponses collectées à partir d'un questionnaire remis aux coordonnateurs nationaux

des 11 pays membres de CRAYNET, il est clair que la plupart des pays européens ont pour volonté d'essayer de protéger leurs écrevisses indigènes (Indigenous Crayfish Species, ICS) de la surexploitation, des modifications de l'habitat, de la pollution, et de la dissémination des écrevisses non indigènes (Non Indigenous Crayfish Species, NICS) ainsi que de la peste de l'écrevisse.

Deux cas d'étude détaillés relatifs à l'Autriche et l'Angleterre sont présentés ainsi qu'un résumé des questionnaires. Ces analyses illustrent clairement les attitudes différentes des pays en ce qui concerne la protection et la gestion de leurs ICS et NICS. La situation est très complexe et diffère en fonction de l'existence ou non d'une tradition de consommation des écrevisses. En conséquence, l'harmonisation des lois au niveau national et régional concernant soit les écrevisses indigènes (ICS) ou les écrevisses non indigènes (NICS) en Europe semble ne pas être possible à un court terme.

Dans la plupart des cas la législation n'a pas empêché la destruction de nouvelles populations indigènes et la dissémination des écrevisses non indigènes. Cependant, sans une telle législation, la situation aurait pu être pire et quelques espèces indigènes auraient même pu être carrément en danger. Les efforts continuels de la part des milieux concernés par les écrevisses et des instances nationales se résument en un scénario où quelques pays sont exempts d'écrevisses exotiques, et avec où il subsiste encore dans la plupart des pays des zones privilégiées avec des populations indigènes nombreuses et viables, de réelle valeur et protégées autant par les autorités que par la population locale. La situation a été récemment améliorée par l'inscription d'*Austropotamobius torrentium* dans l'annexe II de la Directive Habitat de l'Union Européenne. Un objectif majeur doit être de développer des méthodes d'éradication des populations nuisibles d'espèces non-indigènes (NICS) avant qu'elles ne s'étendent davantage.

Mots-clés : Europe, législation, écrevisse, indigène, non-indigène, Directive Habitat.

INTRODUCTION

Most countries in Europe have legislation that is aimed at trying to protect their indigenous crayfish species (ICS) from overexploitation, habitat modification, pollution, and the spread of non-indigenous crayfish species (NICS) and crayfish plague (VIGNEUX *et al.*, 2002). However, is there any evidence that such protection measures actually work in the long-term?

During this roundtable session two case studies were outlined. First, the situation in Britain (England, Scotland and Wales), where there is a single ICS (*Austropotamobius pallipes*) and four NICS, and the laws are generally the same for the three countries. No harvesting of ICS is permitted. The other two countries forming the British Isles, i.e. Northern Ireland and the Irish Republic also have a single ICS but no NICS. The laws governing ICS are generally similar to those in Britain. Second, the situation in Austria, where there are four ICS (*Astacus astacus*, *A. leptodactylus*, *Austropotamobius pallipes* and *A. torrentium*) and two NICS, and nine states each with their own laws. Limited harvesting of ICS is allowed in some states. These two examples illustrated how difficult it would be to harmonise national and regional regulations for ICS in Europe as proposed by VIGNEUX *et al.* (2002).

Contributions from the audience confirmed the diverse nature of crayfish legislation in Europe. It was decided that in order to get more answers to the question "Does legislation work in protecting vulnerable species?" a questionnaire would be devised asking for details in each country covered by CRAYNET. The results are analysed below.

ANALYSIS OF QUESTIONNAIRES

Eleven countries/territories are covered by CRAYNET and each has a National Co-ordinator: Austria (Leopold FÜREDER and Manfred PÖCKL), Finland (Ari MANNONEN), France (Paul HAFFNER, Pierre NÔEL and Catherine SOUTY-GROSSET), Germany (Ralf SCHULZ), Ireland (Julian REYNOLDS), Italy (Francesca GHERARDI and Pietro Angelo NARDI), Norway (Trond TAUGBØL), Poland (Przemyslaw SMIETANA), Spain (José CARRAL), Sweden (Lennard EDSMAN), the U.K. (actually four countries: England, Northern Ireland, Scotland and Wales) (David HOLDICH).

The main aims of the legislation in the countries covered by CRAYNET are to protect and conserve ICS, to use ICS (and NICS) in a sustainable way, and to stop the further spreading of NICS.

Based on the answers to the questionnaires Table I has been constructed to show the occurrence of ICS and NICS in the eleven countries/territories covered by CRAYNET. This shows the same pattern as in HOLDICH (2002, 2003). There is some debate concerning the status of *Austropotamobius italicus*, i.e. is it a sub-species of *A. pallipes* or is it a species in its own right? GRANDJEAN *et al.* (2002) state it should be considered a true species with three sub-species. *Austropotamobius italicus italicus* occurs in Italy (= *A. pallipes italicus*) and Spain (= *A. pallipes lusitanicus*); *A. italicus carinthiacus* in Austria and Switzerland (= *A. pallipes carinthiacus*); and *A. italicus carsicus* in the Balkans (= *A. pallipes carsicus*). Although TRONTELJ *et al.* (2005) have cast doubt on the specific status of *A. italicus*, FRATINI *et al.* (2005) have recently confirmed the presence of *A. italicus* in Italy, as well as four sub-species, i.e. *carinthiacus*, *carsicus*, *italicus* and a new sub-species, *meridionalis*. If *A. italicus* is accepted then it does pose some problems from a legislative point of view, as it is only the species *pallipes* that is protected by the EU Habitats Directive. Consideration may also need to be given to protecting *A. italicus*.

Table I

Occurrence of indigenous and non-indigenous crayfish species in the 11 countries/territories covered by CRAYNET.

Tableau I

Présence des différentes espèces natives et étrangères d'écrevisses dans les 11 pays membres du réseau CRAYNET.

Country	ICS	NICS
Irish Republic	APP	–
United Kingdom	APP	ASA, ASL, PFL, OCL, PCC
Norway	ASA	–
Sweden	ASA	PFL
Finland	ASA	ASL, PFL
Spain	APP-API (?)	PFL, PCC
France	APP-API (?), ASA, APT	ASL, PFL, OCL, PCC
Italy	APP-API (?), ASA, APT	ASL, PFL, OCL, PCC
Austria	APP-API (?), ASA, APT, ASL (eastern part)	ASL (western part), PFL, OCL
Germany	APP, APT, ASA,	ASL, PFL, OCL, PCC, OCI
Poland	ASA, ASL	PFL, OCL

APP = *Austropotamobius pallipes*, API = *Austropotamobius italicus*, APT = *Austropotamobius torrentium*, ASA = *Astacus astacus*, ASL = *Astacus leptodactylus*, PFL = *Pacifastacus leniusculus*, OCL = *Orconectes limosus*, PCC = *Procambarus clarkii*, OCI = *Orconectes immunis*.

Crayfish are amongst the most widely transported and introduced freshwater organisms – this has been happening since ancient times, and in many cases what are referred to as “native” or “indigenous” crayfish have probably been introduced in relatively recent times (see HOLDICH, 2002). For example, in the Republic of Ireland and Norway there are no NICS, and only one species of ICS. The only ICS in the Republic of Ireland is the white-clawed crayfish, *Austropotamobius pallipes*. Genetic similarities with populations in western France have been found, so it could have been brought to the island by the first human settlers (GOUIN *et al.*, 2003), as may also be the case in the U.K. (GRANDJEAN *et al.*, 1997). The only ICS in Norway is the noble crayfish, *Astacus astacus* (L.), but again this has been introduced (SKURDAL *et al.*, 1999). Some signal crayfish, *Pacifastacus leniusculus* specimens have, however, been trapped in a border lake with Sweden, so Norway may not remain free of NICS for much longer.

Most of the countries covered by CRAYNET are centralistically constituted and therefore the legislation is the same throughout the country. Germany and Austria are federalistically constituted (Federal Republics by Constitution) and, hence, considerable differences may be found between the different Provinces within the same country. In Spain there are so-called Comunidades Autónomas and differences between Provinces relating to crayfish legislation exist. According to Angelo NARDI there are also some differences at the level of Provinces in Italy.

The import of all live crayfish from abroad, including EU-member states, is banned by more or less effective customs legislation by the Republic of Ireland, Norway, Sweden, Finland, Spain, France and Poland, but not by Italy, Austria and Germany. In the U.K. crayfish from EU-member states can currently be imported, but their subsequent distribution is controlled. In Ireland Fisheries Acts prevent importation of NICS from abroad for sanitary reasons (transmission of microbial disease to salmonids), but they could be successfully challenged. In France sanitary rules of the Rural Code (Article 244, 245) forbid the introduction of animals not represented in this country, but in reality the enforcement is difficult. The problem in France is that *Astacus leptodactylus* (an introduced species) is classified along with native species by the Environment Ministry, and thus legislation for ICS also refers to the narrow-clawed crayfish. Consequently this species is found alive in French markets. Freshwater crayfish from America, however, have to be killed and cooked before they are imported into France. In Poland special permission from authorities at the Ministry level is needed to import alien species (not only crayfish).

However, aquarist centres and pet shops often try to circumvent import legislation. For example, a species of the Australasian crayfish genus, *Cherax*, was recently found on sale in a pet shop in southern Ireland (J.D. REYNOLDS, pers. comm.). In the U.K., Ireland and the Nordic countries customs legislation usually seems to be more effective and better controlled. The desire of Germany to raise a ban for the import of live crayfish was rejected by the EUROPEAN COURT OF JUSTICE (1994) with the argument that within the EU there is a free movement of goods, labour and traffic, the so called Principle of Free Trade. However, Sweden, who once had a ban on crayfish imports and then revoked the ban because of such rules, has now re-imposed the ban without opposition from traders (EDSMAN, 2004)!

In most of the CRAYNET countries Fisheries Acts as well as Conservation Acts work together in order to fulfil the above mentioned aims. In those countries where freshwater crayfish have no or limited commercial (economic) importance, the conservation and protection of ICS is mainly regulated by Conservation Acts.

In each of the countries/territories covered by CRAYNET it is not allowed to introduce NICS into the wild or to stock them into natural watercourses or water bodies except for some states in Germany. In the federal state Rhineland-Palatinate NICS can be freely introduced. In all other German federal states except for Bavaria the introduction is

possible with permission. In Sweden and Finland permits are issued by regional authorities for stocking *P. leniusculus*, but only into those locations where signal crayfish populations have already been established legally and if the introduction does not directly threaten populations of *A. astacus*. In most of the countries there are specific laws to control the spread of NICS. In France, NICS have to be killed if fished, but as authorisations can be given for rearing NICS in closed ponds, escapes, accidental release and the spread of the crayfish plague by fishermen cannot be effectively controlled.

Except for the NICS-free countries, the Republic of Ireland and Norway, NICS are believed to be a pest, at least in some regions of the respective countries. Germany again has a special position as the German nature conservation law and German species protection decree protect all species that are able to reproduce successfully. In some federal states catching of NICS is even regulated by a minimum catching size and a restricted catching season. On the questionnaire sent to Sweden both choices were crossed: NICS are a pest, and NICS are not a pest (maybe because they also can be wisely used and money can be made out of them).

With the exception of the Nordic countries that have a well-known tradition in harvesting and eating crayfish (crayfish parties), the commercial importance of freshwater crayfish is limited. In Norway the *A. astacus* fishery makes a profit of approximately 1 million € per year, and there are no NICS in Norway. In Sweden and Finland business is based on both *A. astacus* and *P. leniusculus*. In Sweden, the sales per year are approximately 30 million €. Two-thirds of the total catch per year is based on the signal crayfish, but the price for the noble crayfish is twice that for the signal. People should be convinced for economical reasons that it is better to conserve and stock populations of ICS and stop the further invasion of NICS. The arguments are that in Nordic countries, at least, ICS pay better and are as productive as NICS (in the Swedish case: *P. leniusculus*). The gross value estimated in Finland for 2004 is 4.5 million € for ICS and 2.5 million € for NICS. In Finland ICS have a higher value (both total and price/kg), but NICS have a higher volume.

Crayfish are also considered to be of limited commercial importance in France, Spain, Italy, Poland, Germany and Austria, whereas little economic importance is reported for them from the Republic of Ireland and the United Kingdom. There is no real modern tradition for eating crayfish in England and much of the NICS that are harvested are exported. In Ireland the ICS was formerly farmed and fished under licence. In Spain wild populations of *P. clarkii* are harvested, but as there are no official statistics it is difficult to express the economic value of this enterprises, although it is thought to be high as large quantities are exported.

In some countries, there are laws designed to control the spread of crayfish plague. Most effective are those from the U.K. and from the Nordic countries (see papers in GHERARDI and HOLDICH, 1999). Despite having many crayfish plague outbreaks in the 1980s and early 1990s, the U.K. has only had three outbreaks (the latest in September 2004), so the legislation governing crayfish movements and keeping of stock have worked to a limited extent. In Norway all catching or fishing equipment and boats must be disinfected or totally dry before being used in another water body. Additionally, it is not allowed to empty water from one watercourse into another. It is not allowed to stock or move crayfish between water bodies without permission. The corresponding laws in Sweden are similar. All crayfish traps have to be disinfected before being moved. The regional authorities can declare a site as plague struck: no fishing, transportation or keeping of live crayfish is allowed; everything that is moved from the area has to be disinfected. Laws designed to control the spread of crayfish plague do also exist in Finland and Spain, whereas this does not seem to be the case in Ireland, France, Italy, Austria, and Poland. The European directive 91/67/EWG may serve as an appropriate instrument for prohibiting the trade of

infected crayfish. In Germany this European directive is represented by the National Fish epidemic decree, but up to now it has not been applied on crayfish.

In the Republic of Ireland, the U.K., Norway, Sweden, Spain, France and Poland NICS are not usually (or only occasionally) found in the aquarium trade, or at least NICS are sold illegally in these countries except Poland. In Italy, Austria, Germany and Finland NICS are regularly and legally sold at pet shops, and the species diversity of NICS found there is usually very high. People are not allowed to keep NICS in the home aquaria and garden ponds in the Republic of Ireland, the U.K., Norway, Sweden, Spain and France. As an exception to the strict regulations in the U.K., it is allowed to keep the Australian red claw crayfish, *Cherax quadricarinatus*, in covered, heated tanks. Its survival in the wild is very unlikely. In Italy, Austria, Germany, Finland and Poland people are allowed to keep any species of freshwater crayfish, ICS or NICS.

Legislation that regulates hobbies and private matters, such as the keeping of pets, are problematic for several reasons. The general public are usually not aware of their rights and duties and have to be informed regularly, especially when new Acts are added or old ones are revised. On the other hand, any regulation is just as good as its enforcement and control. We personally doubt if there are public or private officers who have the power and knowledge to control NICS in a private aquarium or garden pond. It would be some orders of magnitude easier to control the animal trade at registered pet shops because the dealers must have a special examination and a trade licence. When a new regulation is going to forbid people from keeping NICS in the private aquarium we expect that most people will do nothing if they have already kept their NICS-pets BEFORE the regulation comes into force, and if they are not regularly informed that they are violating a law. We expect that not many people would kill their NICS-pets. There might be a considerable number who will rescue their pets and give them their "freedom" in natural watercourses and other water bodies. This appears to be the source of the populations of *Orconectes limosus* appearing for the first time north of London (U.K.) (J. ENGLAND, pers. comm.) and of *Procambarus clarkii* and *Orconectes immunis* in Germany (DEHUS *et al.*, 1999). If NICS are able to establish reproductive populations in streams and rivers, ICS might be in great danger by being threatened by new pathogenic agents, parasites, diseases and competition (HOLDICH, 1999).

Of the European ICS only *A. pallipes* was listed in Annex II of the EU Habitats Directive until recently (see below). Member states have to nominate SACs ("Special Areas of Conservation") and protected water bodies for this species and thus guarantee its "favourable conservation status" within the NATURA 2000-network. There are over 40 SACs containing white-clawed crayfish in the U.K., but only six have been set up specifically for this protected species. There are 14 SACs in the Republic of Ireland, covering rivers and lake complexes across this country, around 165 in France (see also <http://natura2000.environnement.gouv.fr/especes/1092.html>), and some protected sites in Northern Italy, e.g. the Provinces of Milano (LIFE 2000 NAT/IT/007 159) and Brescia (LIFE 2003 NAT/IT/000147). No information was available from Spain. The white-clawed crayfish is the most rare ICS in Austria and Germany. In Austria it is restricted to the northwest of North-Tyrol and southwest Carinthia: Gitschtal, Drautal, Gailtal. Both regions are covered by NATURA 2000, although the Tyrolean populations are not the cause for the nomination of this special SAC because they were introduced in the 1920s. A more detailed account of the situation in Austria is given as Case Study 2 below. Recently, *A. torrentium* has been given the same protection as *A. pallipes* under Annex II of the EU Habitats Directive. However, existing member states do not have to set up new protected areas for it, but new members must consider it in their conservation plans even if they do not also have *A. pallipes*.

It has been repeatedly suggested during CRAYNET Conferences to ask the European Commission, the General Management for the Environment, and the Topic Centre in Paris

that other highly endangered freshwater crayfish species, ICS, should be listed in Annex II of the EU Habitats Directive. This has had an effect as *Austropotamobius torrentium* has now been added (see above). Much more difficult would be to list *A. astacus* in Annex II because it has some commercial importance, and crayfish farmers and fishermen are afraid of having severe restrictions when harvesting and producing this natural resource for culinary purposes or (re)-stocking. An additional problem, as mentioned above, is the designation of *Austropotamobius italicus* as a true species, when formerly it was listed as sub-species of *A. pallipes*. However, as pointed out above there is some discussion over the validity of the species.

Trond TAUGBØL and Julian REYNOLDS from the two countries with no NICS present, Norway and the Republic of Ireland, respectively, think that their legislation works well in protecting vulnerable ICS. The strict legislation in Norway is the main reason why there are no NICS in this country. The most important thing is that legislation has been in place BEFORE the NICS arrived. Often, like in the U.K., legislation is coming too late, when the damage has already occurred and then the situation is more difficult to control. A more detailed account of the situation in England is given as Case Study 1 below.

Ireland has been successful in not permitting farms to produce *P. leniusculus* to be set up despite strong pressure from entrepreneurs. Under the Wildlife Acts and the EU Habitats Directive Irish populations of *A. pallipes* are believed to be optimally protected. A disadvantage is that global protection might reduce familiarity by the public. Limited and controlled exploitation of the only Irish ICS species may soon be allowed, and a sanitary law with the aim of protecting the white-clawed crayfish from crayfish plague may soon come into force.

In Sweden almost everything is covered by the legislation today. The import of live crayfish into Sweden has been stopped (EDSMAN, 2004). In autumn 2004 legislation for specially protected areas for *A. astacus* will come into force. The work with regional plans has been going on for six years. A stronger punishment for illegal introductions, however, is needed, and people violating the law have to be prosecuted.

The major advantages of the Finnish legislation is to maximize the commercial value on the short term, the major disadvantage is that ICS are marginalized on the long term. An action plan to wisely use and protect ICS is urgently needed.

In Spain a modern national legislation should replace many different Provincial laws.

The representatives of France see an error in the fact that persons in charge of controlling NICS entering the country (airports with veterinary service) are not able to recognise the species involved. *A. leptodactylus* should not be classed as ICS by the Environment Ministry and not be imported alive into France.

The Italian representative demands that the import of live NICS and their commercialisation (crayfish and fish) should be stopped in Italy. The habitats of ICS should effectively be conserved and restored. Fisheries management has to be improved.

In Germany a harmonisation of national legislations (German nature conservation law, German species protection) and legislations of the different federal states (Fishery laws) is needed to effectively protect native crayfish species. A listing of NICS in the German species protection decree or a consequently execution of the National fish epidemic decree are possibilities to restrict the farming and trading of live NICS.

In Poland *A. astacus* was added to the national Red Data Book in 2004 and there is a project to establish the noble crayfish as a protected animal. On the other hand there is, unfortunately, a growing interest in farming *P. leniusculus*. Presently, the level of

knowledge of crayfish species is relatively low and has urgently to be improved. Rangers, local administrators, policemen, anglers, water owners and the public have to be trained in identifying crayfish species. An example to show that the Polish legislation has worked well is that local fishermen have actually stopped the translocation of *O. limosus*. An intensive structural change in the villages and countryside in Poland is taking place since the integration into the EC. Each person who wants to rent a water body from the Governmental Agency has to submit a project of water management.

Summing up, the representatives of CRAYNET think that legislation is an important prerequisite in conserving indigenous species of crayfish and stopping NICS from further spreading, but legislation will only work well in combination with some other measures. The dissemination of information and education to the general public (including children), local administrators and representatives of the government is extremely important. No legislation can be effective if local people are very eager to act in opposition to what the legislation commands. Legislation cannot achieve much, if it contradicts the sense of justice. If legislation works well and is understood by local people anybody violating the law, e.g. by releasing NICS into the wild without having official permission, has to be successfully prosecuted. The image and status of the ICS must be enhanced in comparison with NICS, especially in those countries where freshwater crayfish are of some commercial importance and entrepreneurs like to make profit out of NICS. Finally, it is important that the authorities act more quickly in response to threats to ICS. Sometimes it can take many years before such threats, e.g. the introduction of invasive and disease-carrying species such as *P. leniusculus*, are taken seriously and then it is often too late, and much money has to be spent trying to rectify the problem.

CASE STUDY 1: England

As an example of the legislative complexity governing crayfish protection and management the history of what has happened in England is outlined below.

The white-clawed crayfish, *Austropotamobius pallipes*, was first mentioned in the English literature in the 16th century. It appears to have been wide spread in England during the 19th and 20th C. There was limited harvesting from rivers and lakes, much of which was consumed at a local level by the public.

However, there were many population crashes the R. THAMES catchment from the 1880s to 1930s and porcelain disease was one of the causes suggested (DUFFIELD, 1933, 1936). As such populations recovered naturally it is unlikely that crayfish plague was involved.

With the publication of HUXLEY's book (e.g. 1981 edition) the white-clawed crayfish became a popular animal and was used extensively in laboratories, i.e. as a standard invertebrate for dissection

The white-clawed crayfish is generally accepted as an indigenous species in England, but its origins are unknown (HOLDICH, 2002). Genetic evidence suggests that it may have been relatively recently introduced from France (GRANDJEAN *et al.*, 1997).

The white-clawed crayfish is now one of the most protected animal species in England (HOLDICH *et al.*, 2004; SIBLEY 2004) and the public is well informed about its vulnerable state and threats to its survival, and yet populations continue to be wiped out. In the case of pollution this is usually by accident and is not the sort of event that can be legislated for.

From having no NICS in the early 1970s, NICS now occupy more 10 km squares than ICS, a slow process that has been going on since the 1980s both naturally and

unnaturally (HILEY, 2003a; SIBLEY, 2003), and which seems likely to continue despite the current legislation outlined below

In the 1970s the narrow-clawed crayfish, *Astacus leptodactylus*, was imported from mainland Europe for culinary purposes. It escaped or was introduced into rivers and canals and also became established in lakes and reservoirs, mainly in and around London. A few attempts have been made to farm it but none have been successful

In the late 1970s and early 1980s the signal crayfish, *Pacifastacus leniusculus*, was introduced for farming purposes from both Sweden and USA. This was done with government approval under a farming diversification scheme and after completely erroneous advice that the indigenous crayfish was on the verge of extinction in England (a fact subsequently shown not to be true by workers at the University of Nottingham, e.g. HOLDICH and REEVE, 1991)!

From 1979 and into the 1980s there were warnings from scientists about the introduction of signal crayfish and the impact it might have on white-clawed crayfish due to crayfish plague (BOWLER, 1979; MARREN, 1986). The government was told about what had happened in mainland Europe due to the spread of crayfish plague carried by NICS such as signal crayfish.

As predicted, in the early 1980s crayfish plague started to wipe out populations of white-clawed crayfish and by the early 1990s many populations had been eliminated all over the country (ALDERMAN, 1993, 1996; HOLDICH, 2003).

From the early 1980s onwards populations of signal crayfish began developing in the wild. Some mixed white-clawed and “plague-free” signal crayfish populations developed, but after a few years the signals had eliminated the white-clawed crayfish due to competition (e.g. HOLDICH and DOMANIEWSKI, 1995).

In 1981 the Wildlife & Countryside Act was implemented, but protection for the white-clawed crayfish was not included.

In 1982 the 1979 Bern Convention was implemented. This required that the white-clawed crayfish be protected from exploitation.

In 1984 the noble crayfish, *Astacus astacus* was introduced at one site for farming purposes, subsequently it escaped into the wild but has not since spread very far (HOLDICH *et al.*, 1995).

In the 1980s the red swamp crayfish, *Procambarus clarkii*, was found in ponds in London. They had probably been dumped there from restaurants and aquaria (HOLDICH *et al.*, 1995). They were shown to be breeding in the late 1990s (RICHTER, 2000).

During the 1980s the proponents of crayfish farming tried to make the case that Britain had had crayfish plague as long as mainland Europe, and that it was not introduced with the recent imports! This view was supported by various Swedish academics and astacologists, but was dismissed by British scientists.

During the 1980s the scientists continued to lobby Government and successfully made the case that all NICS, even if they don't carry crayfish plague, were a threat to the white-clawed crayfish as they are superior competitors.

In 1986 the Government decided that white-clawed crayfish was at risk from crayfish plague and from competition from NICS. It decided to make it a protected species under Schedule 5 of the Wildlife and Countryside Act – the protection took place from 1988, but this only applied to “taking” and “sale”, i.e. it cannot be harvested or sold. From that date licences were required from English Nature to carry out surveys and move specimens under threat from development.

It was shown the late 1980s that signal crayfish in Britain were definitely acting as vectors of crayfish plague (ALDERMAN *et al.*, 1990).

Over 90 “crayfish farm sites” based on signal crayfish had been set up by 1992. However, production was low and no accurate figures were ever produced, although as much as 250 and as little as 7 tonnes per annum have been quoted (ROGERS and HOLDICH, 1995).

Then in 1992 *Pacifastacus leniusculus*, *Astacus leptodactylus* and *Astacus astacus* were all placed on Schedule 9 of the Wildlife and Countryside Act, which effectively classified them as pests and banned their introduction into the wild. However, at that stage there was no accepted definition of the wild – this made it difficult to enforce the law! *Procambarus clarkii* had not at that time been proved to be breeding in the wild and so was not classified as such.

It is presumed that sometime during the 1990s the spiny-cheek crayfish, *Orconectes limosus*, was introduced. A number of populations quickly developed north of London and in the Midlands. They were possibly introduced by fishermen, or as unwanted pets as they had been found to be on sale in some aquarist centres. It was found to be breeding in the early 2000s.

In 1993 crayfish outbreaks were still occurring randomly.

In 1994 “The Conservation (Natural Habitats, and c.) Regulations” were implemented in response to the 1992 EC “Habitats Directive” and a number of SACs were planned for the white-clawed crayfish in England.

In 1994 the National Rivers Authority published an educational booklet on the biology of ICS and NICS - 1000s of copies were distributed.

In the Government’s 1994 “U.K. Biodiversity Action Plan”, the white-clawed was identified as a priority species for which a “Species Action Plan” was needed. This was done and widely distributed. Various regional authorities subsequently modified The Species Action Plan to suit their own situations, and conditions were imposed on developers whose operations might affect local populations of ICS.

After further lobbying from scientists the Government decided that further protection was needed from all NICS and introduced an Act of Parliament – the “Prohibition of Keeping of Live Fish (Crayfish) Order 1996”. This banned the keeping of all NICS, i.e. narrow-clawed, noble and red swamp, anywhere in England, and banned the keeping of signal crayfish in “no-go” areas where there were “good” populations of white-clawed crayfish (ROGERS and HOLDICH, 1997). “Go” areas were where signal crayfish were prevalent with little hope of eradicating them. The distinction between “no-go” and “go” areas was based on postal codes rather than river catchments.

The above Order does, however, allow the keeping of the Australian red claw crayfish, *Cherax quadricarinatus*, in covered, heated tanks as a means of appeasing the aquarium trade.

Also in 1996 the Government issues guidelines for hotels and restaurants on keeping and disposing of NICS used for human consumption.

In 1999 the Environment Agency published a more comprehensive educational booklet on the biology of crayfish, how to identify them, and threats to the indigenous species. 1000s of copies were distributed and as a consequence of this and media coverage the public became aware of the threats being posed to the indigenous crayfish.

In 1999 the first confirmed crayfish plague outbreaks occurred since 1993 (HOLDICH, 2003).

In 2000 another crayfish plague outbreak was confirmed (HOLDICH, 2003).

In 2000 the Government finally introduced a definition of the “wild”, i.e. *any natural watercourse or other water body from which crayfish can escape and move to another watercourse*. This makes it effectively uneconomical to set up any new crayfish farms, as crayfish must be kept in covered tanks and not be allowed to escape into neighbouring watercourses.

In 2003 in a review of salmon and freshwater fisheries, the Government classified crayfish as “fish” under the “Salmon & Freshwater Fisheries Act 1975”. A bylaw was introduced that regulated trapping for any species of crayfish. In “no-go” areas licences were only to be issued for the purposes of fisheries management, conservation and scientific research. In “go” areas trapping for commercial purposes could also be authorised. Licences also needed to remove crayfish during surveying.

In 2003 the Environment Agency introduced a bylaw that made it an offence to use crayfish or any part of them as bait. This bylaw aimed to reduce the risk of spreading disease and NICS.

At a local level the “Town & Country Planning Act” required local planning authorities to ensure that no harm came to the white-clawed crayfish during developmental work, e.g. building, road widening, bridge repairs, river and lake dredging. This meant that surveys must be undertaken if white-clawed crayfish are known in the area. If they are found then mitigation measures must be put in place. This has resulted in much more knowledge of crayfish being obtained at a local level as well as keeping many ecologists in business!

Despite all this legislation the number of 10 km squares occupied by NICS in England became greater than the number occupied by white-clawed crayfish for the first time in 2003 (SIBLEY, 2003). However, there are still many large populations of white-clawed crayfish in England, and no outbreaks of crayfish plague have been confirmed since 2000, although there have been some large-scale mortalities due to pollution.

By 2003 only five crayfish farm sites remained producing 0.25 tonnes of signal crayfish per annum. In addition, some 20-30 former farm sites having feral populations were being harvested. The decline in farming was due to increased legislation and the fact that larger harvests of narrow-clawed and signal crayfish could be obtained from the wild (ROGERS and HOLDICH, 1995). There is no real modern tradition for eating crayfish in England so much of the product is exported to mainland Europe.

In 2003 an updated database of crayfish distribution was completed (SIBLEY, 2003). This is accessible on the Internet at the 10-km² level and at a more detailed level for registered personnel (HARDING and COOPER, 2003).

In 2004 the red swamp and spiny-cheek crayfish still had **not** been placed on Schedule 9 of the Wildlife & Countryside Act, despite the fact that they are breeding in the wild.

In December 2004 the Environment Agency is to ask the Government to modify the CRAYFISH BYLAWS under the Water Resources Act 1991, the Environment Act 1995 and the Salmon and Freshwater Fisheries Act 1975. If accepted, the changes will result in more control over the use of and type of traps used to catch NICS in England and Wales. Currently, these only apply to the EA Thames Region. It will, however, mean that it is easier for people to obtain permission to trap in “go” areas. In “no-go” areas (see above) permission will only be given to trap NICS for scientific, conservation or fisheries management purposes. All traps must in future have an identification tag attached to them, and any trap where the inner entrance is greater than 95 mm must have otter guards fitted. It is likely that where water voles are known to be present the regional authorities will insist on water vole friendly traps being used.

In September 2004, an outbreak of crayfish plague was confirmed for the south of England, the first in this area since 1993.

Does the legislation work in protecting the white-clawed crayfish in England?

If it had not been for the legislation that has been implemented since the mid-1980s then it is possible that the white-clawed crayfish would have been eliminated from most areas by now. However, even with the high level of legislation the species faces possible extinction in England within 30 years due to the continued spread of NICS and random outbreaks of crayfish plague (SIBLEY, 2003). Most worrying is the finding that the latest NICS to invade England, the spiny-cheek crayfish, can breed in the late summer months, possibly indicating that it can breed twice a year as has been found some parts of Canada (HAMR, 2002).

The future? If NICS continue to spread then further protection will be needed for the white-clawed crayfish in England in addition to the SACs that have already been set up. This could include setting up populations that are protected from threats, either based on already existing isolated populations or on new, i.e. introduced, isolated populations. Methods need to be found for eliminating nuisance populations of NICS, and more prosecutions need to be brought against people who are contributing to their spread.

CASE STUDY 2: Austria

From the above survey of legislation in 11 European countries/territories, we can see some deficits in Austria: **(a)** the import of all live crayfish from abroad, including EU-member states, should be banned. Hopefully the European Court of Justice is not going to reject this desire as has happened with the Federal Republic of Germany (EUROPEAN COURT OF JUSTICE, 1994). In other countries this ban as worked well as outlined above. **(b)** We have to design laws to control the spread of crayfish plague, good examples being the Nordic countries and the U.K. **(c)** the high diversity of NICS species being offered in the aquarium trade, including *P. clarkii*, has – in collaboration with the Chamber of Commerce – to be screened for possible competitors for our ICS when released into the wild by hobby aquarists who give their pets their “freedom” if not desired any longer. Warm water species that have no chance to survive under natural conditions in Austria can further be traded and kept. **(d)** In collaboration with CRAYNET the European Commission, the General Management for the Environment, and the Topic Centre in Paris, asked to list *A. torrentium* in Annex II of the EU Habitats Directive. This has had an effect as *A. torrentium* has recently been added.

In Austria four species of ICS (*A. pallipes*, *A. torrentium*, *A. astacus*, *A. leptodactylus*) and two species of NICS (*P. leniusculus*, *O. limosus*) occur. Their general distribution was mapped by PÖCKL (1999a). The narrow-clawed crayfish is only regarded to be indigenous in the very eastern part of the country (east of 16°E) with a pannonicly-influenced climate: in the Provinces of Lower Austria, Vienna and Burgenland near the border to Hungary and Slovakia. Its occurrence in the other six Provinces is, however, exclusively man-made and must be regarded as non-indigenous.

The most rare ICS in Austria is *A. pallipes*. It is restricted to the northwest of North-Tyrol (waters at the “Außerfern-area” (drainage system of the River Lech) near Reutte visited during the field trip of the 3rd CRAYNET Conference held in Innsbruck) and in southwest Carinthia: Gitschtal, Drautal, Gailtal. Both regions are covered by NATURA 2000, although the Tyrolean populations are not the cause for the nomination of this special SAC because they were artificially introduced in the 1920s. The Carinthian waters are also protected by the EC Habitats Directive and are part of a SAC area. Financial support from the LIFE-programme has been used for habitat improvements, artificial breeding in the laboratory to maximise survival rate, and stocking some isolated water bodies (PETUTSCHNIG, 2000).

We have good reasons now to believe that at least the survival of the natural populations of *A. pallipes* are secured for the future, provided that further conservation management is continued.

Austropotamobius torrentium is the most frequently found ICS species in Austria, indicating good habitat quality in running waters (see PÖCKL and STREISSL, 2005). Two species of NICS from North America, *O. limosus* and *P. leniusculus*, both introduced by crayfish farmers in the 1970s, have escaped and established wild, breeding populations. In contrast to *O. limosus* that has just a few populations that are not spreading actively, *P. leniusculus* is an invasive species – a range expansion of up to 2,4 km year⁻¹ is reported from England (BUBB *et al.*, 2005) – and has been widely introduced through Austria. It is the major threat to *A. astacus* as their habitat requirements are very similar.

In Austria, legislation referring to crayfish is written at federal, national and international levels (PÖCKL, 1999b), and a draft program for the conservation of native crayfish species in Austria is given by PÖCKL (2002). Each of the nine Federal States (Bundesländer) of the Republic of Austria has its own sovereignty over lawmaking for fishery, hunting, nature conservation, animal welfare, and a variety of other matters. The release of alien crayfish, spreading aphanomycosis and endangering ICS is not only a violation of the respective Fisheries Acts as well as the Acts on Conservation, but can also be prosecuted by Articles 182, 183 of the Penal Code (Strafgesetzbuch, StGB). Despite the spreading of *P. leniusculus* and *O. limosus* being forbidden by law, signal crayfish continues to be spread, and nobody has yet been fined or imprisoned for this.

Nature Conservation Acts are stricter than the Fisheries Acts. In the Federal States of Tyrol and Vienna, native crayfish are strictly preserved in their natural habitats. It is generally prohibited to catch, kill, buy, keep, transport, and sell specimens from free-living populations. These strict regulations are adequate for the two Federal States where there are just a few populations of indigenous crayfish that should be preserved *in situ*, but cannot be a model for the remaining States, otherwise fishermen and the public would forget these animals forever. As fishermen would prefer a catchable signal crayfish population rather than a totally protected noble crayfish population, illegal introductions of *P. leniusculus* would be a temptation, if *A. astacus* were totally protected.

In the Fishery Regulations of each of the Federal States (Fischereiverordnungen der Bundesländer) the closed season and the minimum body length of freshwater crayfish are given. According to the Fishery Regulation of Tyrol and Vienna there is a closed season for both sexes of ICS the whole year round. The closed season for females also extends throughout the year in Lower Austria, Upper Austria, Styria, and the Burgenland, and for males it varies between one and four months. In Salzburg male *A. astacus* has no closed season (females having a closed season 01/10-31/07). The minimum body length of male *A. astacus* and *A. leptodactylus* that can be harvested is 12 cm in most of the Federal States. However, in the Burgenland for any crayfish species it is 14 cm, and the closed season 01/08-30/06. As there are few specimens exceeding 14 cm this regulation can be interpreted as a closed season throughout the year. Male *A. torrentium* larger than 12 cm can be harvested in Lower and Upper Austria, with a closed season 01/10-31/05. In Styria male *A. torrentium* have the same closed season, but can be harvested with a total length exceeding 10 cm.

In Austria, freshwater crayfish were very popular for human consumption until the 19th century, with documentation of crayfish extending over a long period of time. The oldest record dates back to 1321 (FÜREDER and MACHINO, 1999). A very well known picture amongst astacologists, dating from 1504, depicts the nocturnal catching of crayfish under the orders of Emperor Maximilian I (see front cover of *Freshwater Crayfish 1* from 1973).

Nowadays the tradition of crayfish eating for culinary purposes is not very popular in Austria and has almost been forgotten, undoubtedly due, in part to the dramatic decrease in crayfish distribution and abundance. Undoubtedly, Salzburg is the most traditional Federal State in this respect. Most people know from their childhood of water bodies with dense crayfish populations, but from where the animals have since disappeared. However, live crayfish (especially *A. leptodactylus* and *P. leniusculus* imported from abroad) can still be bought from fish shops and markets. More and more restaurants nowadays offer crayfish as a delicacy.

In our opinion, exploitation and protection of this valuable biological resource is no contradiction. If local people are allowed to trap crayfish, if children grow up with the magic of catching crayfish by hand, they will also be interested in protecting the crayfish populations against extermination.

EC Directive 91/67/EEC for fish diseases is applicable for protecting ICS in Austria. This directive provides the legal context for areas or regions without a history of diseases to become acknowledged, disease-free zones with defined import-export rules. Fish may not be brought into these areas either for fish farms or for stocking in natural waters, unless they also come from a recognised disease-free area. This helps prevent the transmission of diseases through the country. This directive also covers crayfish plague. Plague-free regions can be protected by allowing the import of live crayfish only into regions that are certified as plague-free. The crayfish plague must also be recognised as a notifiable disease in Austria. The procedure is still going on and will hopefully soon be successfully concluded. A good progress in diagnostic techniques is currently being made by advanced students at the University of Veterinary Sciences, Vienna, and indigenous and alien stocks can be quickly and effectively tested for *Aphanomyces astaci* (HOCHWIMMER and LICEK, pers. comm.). The Federal States involved with such regulations must be prepared to monitor stock movements and, when necessary, take action to prevent the spread of the disease in the case of an outbreak.

During the past six years a considerable effort has been made in Austria to inform the public about the crayfish situation. Recent publications include the semi-scientific book *Flusskrebse Österreichs* (EDER and HÖDL, 1998), and in the Series *Red Data Book on Selected Animal Groups of Lower Austria* the volume titled *Flusskrebse und Süßwassergarnelen* (PEKNY and PÖCKL, 2000). Special exhibitions on crayfish were shown in various Provincial Capitals: Linz, Salzburg, St. Pölten, Klagenfurt. PETUTSCHNIG (2002) has made people aware of the crayfish situation in Carinthia and FÜREDER (2002) has written a book about the crayfish in Tyrol (Austria, Northern Italy). The *Österreichische Naturschutzband* produced a special volume on crayfish titled "*Scherenritter*" in its periodical *Natur und Land* (ÖSTERREICHISCHER NATURSCHUTZBUND, 2000, 2002).

A public information campaign has been started. Two brochures directed to different interest groups have been published, a third one is planned. In the first one (PÖCKL and PEKNY, 2001) landowners, fishermen, anglers and aquaculturists were the target group. Everybody with an angling licence, approximately 45,000 anglers in Lower Austria received a leaflet. As a result, anglers learnt more about crayfish, crayfish plague and the problem with NICS during their training course. The second leaflet (PÖCKL *et al.*, 2003), *Flusskrebse in Österreich*, is a waterproof identification folded card with high quality colour photographs and a sketch drawing to show the differential characteristics. Armed with these pictures that can be taken in a vest-pocket into the field, most people should have little difficulty in identifying the common species found throughout Austria (and Western Europe). This leaflet was sponsored by seven of the nine Federal States, by various Fisheries Agencies, by WWF-Austria and the Österreichische Naturschutzbund. In total 120 000 leaflets were printed and distributed throughout Austria.

A third leaflet will be directed to aquarists, the ornamental pet trade (*P. clarkii* is sold in aquarist shops as “Red Lobsters”, the diversity of NICS in the aquarium trade is high), to people with artificial garden ponds, and to gastronomists. Hopefully the Chamber of Commerce, section of pet registered shop dealers, can be convinced to sponsor this campaign.

By producing these leaflets we follow successful examples in other European countries: Excellent leaflets have been produced already, e.g. by the National Rivers Authority of the U.K. and the Environment Agency for England and Wales. *Freshwater Crayfish in Britain and Ireland* is a 17-page booklet prepared by David HOLDICH and David ROGERS. The Fischereiforschungsstelle des Landes Baden-Württemberg, Germany, also produced good leaflets. *Flusskrebse in Baden-Württemberg: Gefährdung und Schutz* and *Achtung lebende Flusskrebse* were written by Peter DEHUS. Recently, a brochure with many colour photographs was produced by the Association des Astaciculteurs de France (LAURENT, 2001), and another high-quality booklet has been produced by the Landesfischereiverband Bayern and Bayerisches Landesamt für Wasserwirtschaft (BOHL *et al.*, 2001).

The international association “*forum flusskrebse*”, a branch of the International Association of Astacology, which brings together German speaking astacologists, crayfish farmers, landowners, fishermen, researchers, conservationists and managers, was founded at the beginning of 2002. The permanent secretary is managed by Jürgen PETUTSCHNIG, Institut für Ökologie und Umweltplanung, with other officers being Max KELLER, Birgit OIDTMANN, Reinhard PEKONY, Claudia KLOS, Ralf SCHULZ, Thomas STUCKI and Gerhard WOSCHITZ. Because of his challenging job and personal reasons Manfred PÖCKL is no longer on the board of “*forum flusskrebse*” but will occasionally assist with scientific and practical advices.

An active and co-operative attitude and effort with the managing authorities supplying sound information, support for restocking and restoration, and describing possibilities for exploitation, for example, are major factors shaping the attitude for indigenous species of crayfish.

Legislation will only work well in combination with some other measures, of which regular public information campaigns are amongst the most important ones. Hopefully we reach a huge number of people for the sake of our vulnerable species of indigenous crayfish.

Presently we cannot stop the further spreading of NICS in those watercourses where they are already established. Therefore streams, rivers, lakes and ponds with healthy and strong populations of ICS deserve our special attention and successive conservation measures. Additionally, it is important to produce ICS in the laboratory (maximising survival rates) and stock the juveniles in isolated water bodies to have gene pools for the future.

CONCLUSIONS

The two case studies above plus the summary of the questionnaires clearly illustrate the different attitudes of countries to protecting and managing their ICS and NICS. The situation is highly complex and differs depending upon whether or not there is a tradition for eating crayfish. It would appear that all countries/territories involved in CRAYNET are highly motivated to protect their ICS in the face of the threat from NICS and crayfish plague, and most are doing a good job at informing the public and relevant authorities of the situation. Legislation is in place in most countries to protect ICS, but in many cases it has not prevented further destruction of populations of ICS. However, without such legislation the situation could be a lot worse and the predictions of TAUGBØL and SKURDAL (1999) might come about, i.e. almost all watersheds in Europe suitable for crayfish are inhabited

by NICS, and all ICS are considered critically endangered and survive in a few protected localities within national parks/restricted areas. We would hope that the continued efforts of the crayfish community would lead to a situation as outlined by TAUGBØL and SKURDAL (1999) where there are still some countries without NICS, and in most European countries there are specific areas with numerous, viable crayfish populations considered as valuable and protected by the authorities as well as by local people.

It would be excellent to harmonise national and regional regulations for ICS in Europe as proposed by VIGNEUX *et al.* (2002), but considering the legislative diversity between countries this might not be achievable in the short term. A first success was the protection for *Austropotamobius torrentium* under the EU Habitats Directive, Annex II. However, existing member states do not have to set up new protected areas for it, but new members must consider it in their conservation plans even if they do not also have *A. pallipes*. Protection may also have to be considered for *A. italicus*, when molecular geneticists sort out its status. The second step should be to develop methods for eradicating nuisance populations of NICS before they spread any further, although as was shown in the review by HOLDICH *et al.* (1999), little progress has been made in this field. However, since that review various projects have been funded in the U.K., at least, to assess the effectiveness of pheromones in increasing trap captures (STEBBING *et al.*, 2004) and various biocides (HILEY, 2003b) on *Pacifastacus leniusculus* populations in enclosed waterbodies.

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