

# Quality of surface fresh waters needing protection or improvement in order to be support fish life: 12 years of monitoring pursuant to European Union Directive 78/659/EEC

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## Summary

To implement European Union Directive 78/659/EEC concerning the quality of fresh waters that require protection or improvement in order to support fish life, the Abruzzo Regional Council commissioned the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale' (by Regional Law No. 50 of 10 August 1994, to conduct a census of the surface freshwaters in the region, and to classify them. The authors describe the freshwater classifications obtained through monitoring campaigns conducted over a period of twelve years (1996 to 2008). The results indicate slight improvements in the quality of the water over time in terms of contamination by chemicals for which they were monitored; however, 14 stretches do not comply with the requirements of the European Union Directive.

## Keywords

Abruzzo, Cyprinid, Freshwater, Fish, Italy, Monitoring, Salmonid.

## Introduction

Effective protection of aquatic ecosystems must not only take into account ecological processes that guarantee functionality (14), but should also give due consideration to the environmental values that the European Union

has upheld in other legislation, such as Directive 78/659/EEC (8), which specifically relates to the quality of fresh waters that require protection or improvement in order to support fish life. In Italy, this Directive was transposed firstly by Legislative Decree No. 130/1992 (3) and secondly by Legislative Decree No. 152/1999 (5) (both of which have since been repealed) and, finally, by Legislative Decree No. 152/2006 (6), without undergoing any major changes.

Safeguarding freshwater fish is a major conservation priority because numerous species are endangered and establishing the causes of this situation is essential to prevent irreparable events, such as the extinction of certain species (7, 17, 23, 24).

This is largely due to inefficient management of the surface and groundwater networks and destruction of natural habitats (by channels, dams, weirs, excavations in river beds, water pollution and introduction of alien species), combined with fragmentation of responsibilities and resources and the late application or non-application of international directives, especially water framework Directive 2000/60/EC (10) and habitat Directive 92/43/EEC (9), in regarding to which Italy has been reprimanded or fined several times by the European Union.

The premise for the Directive is that 'it is necessary from the ecological and economic viewpoint to safeguard fish populations from various harmful consequences, resulting from the discharge of pollutant substances into the waters, such as, in particular, the reduction in number of fish belonging to a certain species and even in some cases the disappearance of a number of these species'. The aim of the Directive is to protect or improve the quality of those running or standing fresh waters which support or which, if pollution were reduced or eliminated, would become capable of supporting fish belonging to indigenous species, thereby offering a natural diversity, or the presence of species judged desirable for water management purposes by the competent authorities of member states (sections 1 and 3).

The Directive states that each member state shall designate fresh waters needing protection or improvement in order to support fish life, and then classify the said waters as salmonid, cyprinid, or non-conforming to the specified parameters (article 4).

Member states shall also establish programmes to reduce pollution and to ensure that designated waters conform within five years following designation (article 5).

Salmonid waters means waters which support or become capable of supporting fish belonging to the Salmonids (Salmonidae), with species such as salmon (*Salmo salar*), trout (*Salmo trutta*), grayling (*Thymallus thymallus*) and whitefish (*Coregonus*); cyprinid waters means waters which support or become capable of supporting fish belonging to the Cyprinids (Cyprinidae), such as pike (*Esox lucius*), perch (*Perca fluviatilis*) and eel (*Anguilla anguilla*) (sections 1 and 4).

Directive 78/659/EEC was repealed by Directive 2006/44/EC which places greater emphasis on guide limit values than mandatory limit values and no longer requires waters to be tested for metals, apart from zinc and copper.

The Abruzzo Regional Council suspended monitoring funds relating to Directive 2006/44/EC in 2007, and is still in default.

## Materials and methods

Pursuant to Regional Law No. 50 of 10 August 1994 (4), the Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale' (Istituto G. Caporale) was commissioned to conduct a census of the surface fresh waters in the region that required protection or improvement in order to support fish life, and to classify them. For the first designation, pursuant to section 5 of Legislative Decree No. 130/1992, priority was given to the watercourses that run through national parks and nature reserves, and regional parks and nature reserves. When the project was prepared, the heads of the Ecology Sector of the Abruzzo Provincial Council were contacted to obtain information, such as land registry maps of discharges and publications relating to fishery maps and any biological monitoring (extended biological index) performed on the watercourses.

In regard to regional parks and nature reserves, specific publications published up by environmental associations were consulted.

A useful contribution to locating these areas was given by the staff of the Parks and Reserves Sector of the Abruzzo Regional Council who supplied the list of sites of community interest (SCIs), identified in accordance with the selection criteria specified by Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

The search for the primary sites required a study of the Regional Countryside Plan, in particular of zone A<sub>1-2</sub> that features full and partial conservation.

The Regional Freshwater Commission approved the list of sampling points for the designation and subsequent classification of freshwaters pursuant to Legislative Decree No. 130/1992 at its meeting on 21 June 1996.

For each designated watercourse, a stretch was chosen and was identified by its geographic coordinates; at the most downstream point of the stretch, two monitoring campaigns were conducted from 1996 to 2007 to classify the fresh waters in Abruzzo that required protection or improvement to support fish life.

By processing the results of the monitoring programme, the waters were classified as 'salmonid', 'cyprinid' or 'non-conforming', in accordance with the criteria established by Legislative Decree No. 130/92, as amended.

Following this classification, the Abruzzo Regional Council, in its regional improvement plans, must implement specific programmes to maintain and/or improve the quality of the designated and classified waters so that they comply with the reference values reported in schedule I to Legislative Decree No. 130/92 as required by section 4.2, as amended.

The designated and classified surface watercourses are listed with the geographic coordinates at the beginning and end of the stretch in question.

Sampling for the purposes of the monitoring programme required by the project was performed at the point furthest downstream, indicated as the 'end' of the designated stretch.

Table I gives the list of designated surface waters in the Abruzzo Region.

For the purposes of classification of salmonid and cyprinid waters, monitoring lasted one year in compliance with the relevant standards. The watercourses in one of the four provinces of Abruzzo have been monitored and classified about once a year since 1996. By December 2007, each regional stretch had been classified twice.

At each sampling point, identified for all watercourses at the end of the designated stretch, the air and water temperatures were recorded weekly and a sample was taken monthly to test the following parameters in the laboratory:

- dissolved oxygen
- pH
- Suspended particles or suspended solids
- BOD<sub>5</sub> (biological oxygen demand)
- nitrites
- phenol compounds
- petroleum hydrocarbons
- non-ionised ammonia
- total ammonia
- total residual chlorine
- anionic surfactants

- arsenic
- cadmium
- chromium
- mercury
- nickel
- lead
- copper
- total zinc.

The methods used to determine these parameters are presented in Table II.

## Criteria adopted for classification of waters

The designated and classified waters are considered able to support fish life when the weekly samples (temperature) and monthly samples (chemical tests) taken at the same sampling point for a period of 12 months present quality parameter values that conform with the mandatory limits set out in Table I/B, Section B of Legislative Decree no. 152/2006, in regard to the following:

- 95% of the samples taken, in terms of the parameters pH, BOD<sub>5</sub>, undissociated ammonia, total ammonia, nitrites, total residual chlorine, total zinc, dissolved copper
- values specified for the parameters temperature and dissolved oxygen
- average concentration established for suspended solids in water.

Table III gives the guide values and limit values for each quality parameter, as specified in Table I/B of of Legislative Decree No. 152/2006.

For each watercourse that is monitored annually, if the results of the analyses fall within the limit values shown in part A of Table III, the waters are classified as 'salmonid'; if they fall within the limit values shown in part B of Table III, the waters are classified as 'cyprinid'; if they do not fall within the limit values of either part A or part B the waters are classified as 'non-conforming'.

Table I  
Designated surface waters in the Abruzzo Region

No.	Name of watercourse	Coordinates: start	Coordinates: end
1	Foro River	42°13'10"N – 01°41'53"E (bridge before Pretoro)	42°15'03"N – 01°44'08"E (bridge before Fara Filiorum Petri)
2	Salinello River	42°44'01"N – 01°06'50"E (approx. 3 km from Macchia da Sole)	42°44'33"N – 01°07'22"E (bridge on the Macchia da Sole-Garrufo Road)
3	Orfento River	42°09'41"N – 01°35'03"E (Caramanico, approx. 3 km from end of the Scalelle footpath towards the source)	42°09'46"N – 01°33'45"E (end of Scalelle footpath)
4	Avello River	42°08'52"N – 01°44'44"E (Avello bridge, Pennapedimonte)	42°07'17"N – 01°49'12"E (bridge on the Palombaro-Casoli Road)
5	Arno Rio	42°31'15"N – 01°05'59"E (bridge on the Via Crucis footpath, Pietracamela)	42°31'57"E – 01°05'57"E (bridge on the Intermesoli-Pietracamela Road)
6	Chiarino River	42°29'47"N – 00°58'28"E (approx. 2 km upstream of the point of inflow into Lake Provvidenza)	42°30'17"N – 00°57'45"E (from the SS 80 Road immediately after Lake Provvidenza bridge)
7	Mavone River	42°29'36"N – 01°09'57"E (bridge upstream of Fano di Corno, Cerchiara Road)	42°30'17"N – 01°11'39"E (footbridge 500 m from Isola del Gran Sasso towards Fano di Corno)
8	Aventino (Palena) River	41°55'02"N – 01°41'43"E (bridge on the SS 84 Palena-Pizzoferrato Road after the Forchetta Pass)	41°58'31"N – 01°40'42"E (approx. 300 m after Palena, on the Palena-Roccaraso Road (yellow sign next to dirt track on the left))
9	Sangro(SS 16 Road)	42°14'04"N – 02°05'23"E (purification plant)	42°13'47"N – 02°05'07"E (bridge on SS 16 road)
10	Campotosto Lake	42°31'44"N – 00°55'05"E (start of Stecche Bridge)	42°13'47"N – 02°05'07"E (bridge on SS 16 Road)
11	Pescara(Springs)	42°09'54"N – 01°22'11"E (springs)	42°10'05"N – 01°22'18"E (in the regional park, Pescara-Rome motorway bridge)
12	Sangro (Lake Serranella)	42°07'26"N – 01°55'28"E (near the confluence of the Sangro and Aventino Rivers)	42°07'48"N – 01°55'53"E (lower boundary of the regional park)
13	Tavo River	42°26'26"N – 01°27'58"E (leaving Lake Penne)	42°26'09"N – 01°28'02"E (approx. 1 km downstream)
14	Orta River	42°05'29"N – 01°34'53"E (bridge on road leading from Passo San Leonardo to Santa Eufemia)	42°08'35"N – 01°33'13"E (bridge before entering San Vittorino)
15	Nora River	42°20'46"N – 01°26'43"E (bridge on Vicoli-Civitella Casanova Road)	42°21'30"N – 01°29'40"E (bridge on Catignano-Penne Road)
16	Fiumetto or Chiarino River	42°32'56"N – 01°11'46"E (Colledara)	42°33'07"N – 01°13'24"E (on the Tossicia-Castiglione Della Valle Road)
17	Fino River	42°28'57"N – 01°37'02"E (approx. 1 km from the fork to Castiglione Messer Raimondo – unpaved road on left)	42°28'59"N – 01°38'00"E (bridge on the Cappelle-Città Sant' Angelo Road)
18	Lavino River	42°14'38"N – 01°34'06"E (Decontra, highest part of the regional park)	42°14'48"N – 01°33'50"E (Decontra, the lowest part of the regional park)
19	Vera River(Springs)	42°22'16"N – 01°00'25"E (near springs)	42°22'07"N – 01°00'49"E (approx. 500 m downstream)

Table I (contd)  
Designated surface waters in the Abruzzo Region

No.	Name of watercourse	Coordinates: start	Coordinates: end
20	Sinello Brook	42°09'01"N – 02°11'37"E (fork to Pollutri, on road leading from SS 16 Road to Gissi)	42°09'52"N – 02°11'34"E (bridge on SS 16 Road)
21	Lo Schioppo River	41°51'06"N – 00°57'09"E (The Grancia, from the waterfall to the first bridge after the campsite)	41°51'21"N – 00°58'19"E
22	Tordino River	42°37'45"N – 01°09'10"E (Valle San Giovanni, bridge after the fork leading to Varano)	42°37'28"N – 01°10'07"E (Valle San Giovanni, at the end of the unpaved road opposite the cemetery)
23	Vomano River	42°36'33"N – 01°15'31"E (Villa Vomano, Montorio direction, bridge after the fork leading to Miano)	42°36'47"N – 01°15'47"E (Villa Vomano, Montorio direction, bridge before the fork leading to Miano)
25	Aterno (Vittorito) River	42°07'03"N – 01°22'12"E (near bridge on Raiano-Vittorito Road)	42°07'14"N – 01°22'20"E (approx. 1.5 km upstream of bridge)
25	Sagittario (Pratola Peligna) River	42°04'56"N – 01°26'26"E (bridge on Pratola Peligna-Sulmona SP Road)	42°06'35"N – 01°25'32"E (bridge on road leading from SS 17 Road to tollbooth of Pescara-Rome motorway)
26	Tirino River	42°16'54"N – 01°20'07"E (Capo d'Acqua)	42°15'10"N – 01°21'04"E (near San Pietro Church in Oratorium)
27	Sagittario (Villalago) River	42°56'21"N – 01°23'15"E (at the end of the closed road that runs down to the river after the first house in the village)	41°56'36"N – 01°22'41"E (bridge over lake near San Domenico hermitage)
28	Tasso River	41°51'29"N – 01°26'34"E (approx. 2.5 km from fork before Scanno)	41°52'56"N – 01°26'17"E (sinkhole)
29	Sangro (Scontrone) River	42°11'08"N – 01°32'12"E (at exit of Barrea Dam)	41°45'01"N – 01°36'53"E (bridge on road leading from SS 83 Road to Villa Scontrone)
30	Sangro (Mozzagrogna) River	42°11'08"N – 02°01'46"E (on gravel road leading from Castello di Sette under the dual carriageway viaduct)	42°11'07"N – 02°01'20"E (bridge on road leading to Mozzagrogna)
31	Rio Verde Rio	41°51'49"N – 01°52'50"E (on road leading to Pescopennataro from Rosello-Agnone Road)	41°54'05"N – 01°52'41"E (bridge on Borello-Rosello Road)
32	Turcano Brook	41°54'17"N – 01°54'06"E (Rosello)	41°53'52"N – 01°54'15"E (bridge on Rosello-Roio del Sangro Road)
33	Trigno River	41°50'56"N – 02°08'28"E (access from dirt track on the right-hand side of the Trigno 2 viaduct, west-east direction of the SS 650 Road)	41°51'27"N – 02°08'53"E
34	Aventino (Lettopalena) River	41°58'40"N – 01°40'53"E (bridge on road leading to Lettopalena from SS 84 Road)	42°00'59"N – 01°42'50"E (le Acque Vive – Taranta Peligna)
35	Aterno (Molina) River	42°08'27"N – 01°17'35"E (bridge on SS 5 Road)	42°07'55"N – 01°18'44"E (ENEL power station)
36	Vetioio River	42°21'54"N – 00°54'20"E (spring, exiting from lake)	42°21'50"N – 00°54'36"E (before bifurcation of watercourse)

Table II  
Parameters, methods and equipment

Parameters	Methods and equipment
Temperature (air and water)	Thermometry Melchioni portable thermometer Range of measurement: -40/+50°C Resolution: 0.1°C
pH	Potentiometry Hanna Instrument pH-meter HI 8417
Dissolved oxygen	Volumetry (Winkler method) (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 4120, Method A1) Detection limit: 0.5 mg/l
Suspended particles or suspended solids	Gravimetry Filtration through a 0.45 µ filter membrane, drying at 105°C and weighing (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 2090, Method B) Detection limit: 1.30 mg/l
BOD <sub>5</sub> (biochemical oxygen demand)	Volumetry (Winkler method) Determination of oxygen dissolved before and after 5 days' incubation in the dark at a temperature of 20°C The value is the difference between the two readings (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 5120) Detection limit: 0.64 mg/l
Total phosphorus	Spectrophotometry Spectronic spectrophotometer – Genesys 2 Phosphomolybdic acid method in the presence of ascorbic acid, after mineralisation. (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 4110, Method A2) Detection limit: 0.003 mg/l
Nitrites	Spectrophotometry Spectronic spectrophotometer – Genesys 2 N-1-naphthylethylenediamine and sulphanilamide method (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 4050) Detection limit: 0.01 mg/l
Phenol compounds	Spectrophotometry Spectronic spectrophotometer – Genesys 2 Folin-Ciocalteu method Detection limit: 0.021 mg/l
Petroleum hydrocarbons	Visual inspection Unit of measurement: presence/absence
Non-ionised ammonia	Spectrophotometry Spectronic spectrophotometer – Genesys 2 Nessler reagent method Determination of the non-ionised component on the basis of temperature and pH according to the table in note 10, Table 5/B of Legislative Decree No. 152/1999 (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 4030, Method A2) Unit of measurement: mg/l
Total ammonia	Spectrophotometry Spectronic spectrophotometer – Genesys 2 Nessler reagent method (APAT IRSA-CNR water analysis methods, Volume II 29/2003, 4030, Method A2) Unit of measurement: mg/l Detection limit: 0.49 mg/l
Total residual chlorine or total active chlorine	Colorimetry N-N diethyl-p-phenylenediamine (DPD) method (Carlo Erba Idrimeter) Detection limit: 0.1 mg/l
Anionic surfactants	Spectrophotometry Spectronic spectrophotometer – Genesys 2 Methylene blue method (IRSA-CNR water analysis methods, 5150 – Publication No. 2, 1994) Unit of measurement: mg/l Detection limit: 0.12 mg/l

Table II (contd)  
Parameters, methods and equipment

Parameters	Methods and equipment
Arsenic	Atomic absorption spectrophotometry Perkin-Elmer Analyst 300 spectrophotometer IRSA method 29/2003 Unit of measurement: µg/l Detection limit: 2.5 µg/l
Cadmium	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 910:94 Unit of measurement: µg/l Detection limit: 0.5 µg/l
Chromium	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 912:94 Unit of measurement: µg/l Detection limit: 1 µg/litre
Mercury	Atomic absorption spectrophotometry Perkin-Elmer Fims 100 spectrophotometer UNICHIM method No. 922 (1994) Unit of measurement: µg/l Detection limit: 0.2 µg/l
Nickel	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 915:94 Unit of measurement: µg/l Detection limit: 2 µg/l
Lead	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 916:94 Unit of measurement: µg/l Detection limit: 2.5 µg/l
Copper	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 917:94 Unit of measurement: µg/l Detection limit: 5 µg/l
Zinc	Atomic absorption spectrophotometry Perkin-Elmer 4100 ZL spectrophotometer UNICHIM M method, U. 905:94 Unit of measurement: µg/l Detection limit: 20 µg/l

## Results

Table IV compares the classification of the waters in the two monitoring campaigns performed on each stretch, the first relating to the campaign conducted between 1996 and 1998 (11) and the second to four campaigns (2002-2003, 2004-2005, 2006 and 2007) (12, 13, 14, 15, 16), in each of which different stretches were monitored until the entire campaign had been repeated.

Table IV also indicates whether the quality of the waters has improved or deteriorated over time.

During the first monitoring campaign in which the sampling points were monitored between 1996 and 1998, nine stretches were classified as salmonid, two as cyprinid, and all the other twenty-five as non-conforming. Salmonid waters were only found close to springs, apart from the Pescara Springs, which were classified as non-conforming due to the dissolved oxygen values.

During the second monitoring campaign in which the sampling points were monitored between 2002 and 2007, seventeen stretches were classified as salmonid, five as cyprinid and the other fourteen as non-conforming.

Table III  
Guide values and limits for each parameter determined for salmonid waters and cyprinid waters

Parameter	Guide value	Mandatory value
<b>A Salmonid waters</b>		
Water temperature (maximum) (°C)	/	21.5
Dissolved oxygen (mg/l)	≥9 (50% of samples) ≥7 (100% of samples)	≥ 9 (50% of samples)
pH (number)	6-9	/
Suspended particles (mg/l)	25	60
Mean value 100% of samples		
BOD <sub>5</sub> (mg/l)	3	5
Total phosphorus (mg/l)	0.07	/
Nitrites (mg/l)	0.01	0.88
Phenol compounds (mg/l)	0.01	/
Petroleum hydrocarbons (mg/l)	0.2	None
Non-ionised ammonia (mg/l)	0.005	0.025
Total ammonia (mg/l)	0.04	1
Total residual chlorine (mg/l)	/	0.004
Anionic surfactants (mg/l)	0.2	/
Arsenic (µg/l)	/	50
Cadmium (µg/l)	0.2	2.5
Chromium (µg/l)	/	20
Mercury (µg/l)	0.05	0.5
Nickel (µg/l)	/	75
Lead (µg/l)	/	10
Copper (µg/l)	/	40
Zinc (µg/l)	/	300
<b>B Cyprinid waters</b>		
Water temperature (maximum) (°C)	/	28
Dissolved oxygen (mg/l)	≥8 (50% of samples) ≥5 (100% of samples)	≥7 (50% of samples)
pH (number)	6-9	/
Suspended particles (mg/l)	25	80
Mean value 100% of samples		
BOD <sub>5</sub> (mg/l)	6	9
Total phosphorus (mg/l)	0.14	/
Nitrites (mg/l)	0.03	1.77
Phenol compounds (mg/l)	0.01	/
Petroleum hydrocarbons (mg/l)	0.2	None
Non-ionised ammonia (mg/l)	0.005	0.025
Total ammonia (mg/l)	0.2	1
Total residual chlorine (mg/l)	/	0.004
Anionic surfactants (mg/l)	0.2	/
Arsenic (µg/l)	/	50
Cadmium (µg/l)	0.2	2.5
Chromium (µg/l)	/	100
Mercury (µg/l)	0.05	0.5
Nickel (µg/l)	/	75
Lead (µg/l)	/	50
Copper (µg/l)	/	40
Zinc (µg/l)	/	400

BOD biological oxygen demand



Table IV  
Comparison of classification of waters in the two monitoring campaigns performed for each  
watercourse

No.	Name of watercourse	First monitoring campaign	Second monitoring campaign	Improvement/ deterioration
1	Foro River	Non-conforming (1996-1998)	Salmonid (2002-2003)	Improvement
2	Salinello River	Salmonid (1996-1998)	Salmonid (2006)	Unchanged
3	Orfento River	Non-conforming (1996-1998)	Salmonid (2004-2005)	Improvement
4	Avello River	Non-conforming (1996-1998)	Cyprinid (200-2003)	Improvement
5	Arno Rio	Salmonid (1996-1998)	Salmonid (2006)	Unchanged
6	Chiarino River	Salmonid (1996-1998)	Salmonid (2006)	Unchanged
7	Mavone River	Non-conforming (1996-1998)	Non-conforming (2006)	Unchanged
8	Aventino (Palena) River	Salmonid (1996-1998)	Salmonid (2002-2003)	Unchanged
9	Sangro(SS 16 Road)	Non-conforming (1996-1998)	Cyprinid (2002-2003)	Improvement
10	Campotosto Lake	Salmonid (1996-1998)	Non-conforming (2006)	Deterioration
11	Pescara(Springs)	Non-conforming (1996-1998)	Cyprinid (2004-2005)	Improvement
12	Sangro (Lake Serranella)	Non-conforming (1996-1998)	Salmonid (2002-2003)	Improvement
13	Tavo River	Non-conforming (1996-1998)	Non-conforming (2007)	Unchanged
14	Orta River	Salmonid (1996-1998)	Salmonid (2004-2005)	Unchanged
15	Nora River	Non-conforming (1996-1998)	Non-conforming (2007)	Unchanged
16	Fiumetto or Chiarino River	Non-conforming (1996-1998)	Non-conforming (2006)	Unchanged
17	Fino River	Cyprinid (1996-1998)	Non-conforming (2007)	Deterioration
18	Lavino River	Non-conforming (1996-1998)	Non-conforming (2004-2005)	Unchanged
19	Vera River(Springs)	Salmonid (1996-1998)	Salmonid (2004-2005)	Unchanged
20	Sinello Brook	Non-conforming (1996-1998)	Non-conforming (2002-2003)	Unchanged
21	Lo Schioppo River	Salmonid (1996-1998)	Salmonid (2007)	Unchanged
22	Tordino River	Non-conforming (1996-1998)	Salmonid (2006)	Improvement
23	Vomano River	Non-conforming (1996-1998)	Cyprinid (2006)	Improvement
25	Aterno (Vittorito) River	Non-conforming (1996-1998)	Non-conforming (2003-2004)	Unchanged
25	Sagittario (Pratola Peligna) River	Non-conforming (1996-1998)	Salmonid (2003-2004)	Improvement
26	Tirino River	Salmonid (1996-1998)	Salmonid (2004-2005)	Unchanged
27	Sagittario (Villalago) River	Non-conforming (1996-1998)	Salmonid (2003-2004)	Improvement
28	Tasso River	Non-conforming (1996-1998)	Salmonid (2003-2004)	Improvement
29	Sangro (Scontrone) River	Non-conforming (1996-1998)	Non-conforming (2003-2004)	Unchanged
30	Sangro (Mozzagrogna) River	Non-conforming (1996-1998)	Cyprinid (2002-2003)	Improvement
31	Rio Verde Rio	Non-conforming (1996-1998)	Salmonid (2003-2004)	Improvement
32	Turcano Brook	Non-conforming (1996-1998)	Non-conforming (2003-2004)	Unchanged
33	Trigno River	Non-conforming (1996-1998)	Non-conforming (2002-2003)	Unchanged
34	Aventino (Lettopalena) River	Non-conforming (1996-1998)	Salmonid (2002-2003)	Improvement
35	Aterno (Molina) River	Non-conforming (1996-1998)	Non-conforming (2003-2004)	Unchanged
36	Vetoio River	Cyprinid (1996-1998)	Non-conforming (2004-2005)	Deterioration

In the second monitoring campaign, eight salmonid stretches were confirmed, while the ninth (Lake Campotosto) was classified as non-conforming.

In addition to these salmonid stretches, another nine were added, which were classified as non-conforming.

The two cyprinid stretches of the first monitoring campaign became non-conforming, whereas five stretches improved from non-conforming to cyprinid.

The location and classification of the stretches covered by the two monitoring campaigns are shown in Figures 1 and 2.

The parameters that generally downgrade fresh waters in the stretches monitored are those associated with the presence of urban

wastewater, such as ammonia nitrogen and BOD<sub>5</sub>.

## Conclusions

The Abruzzo Regional Council has designated and classified 36 stretches of watercourses as waters able to support fish life, giving priority to those that run through parks and sites of environmental interest, as specified in section 84 of Legislative Decree No. 152/2006.

If the results of the water classification over twelve years of monitoring are compared on the basis of quality, 14 stretches have improved, 3 have deteriorated and 19 have remained unchanged. Of the 20 watercourses that have remained unchanged, 11 present non-conforming waters (Fig. 3).

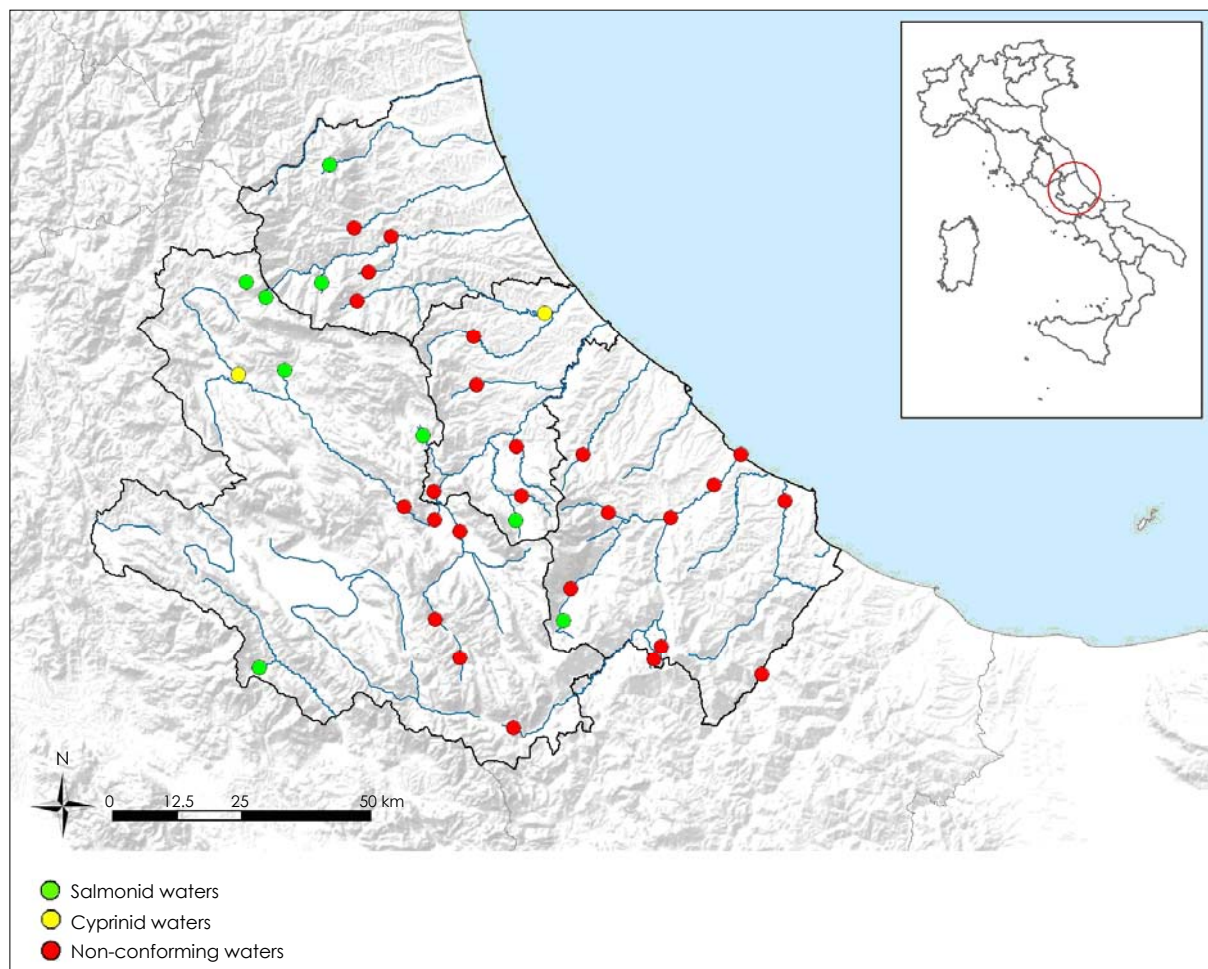


Figure 1  
Classification of salmonid, cyprinid and non-conforming waters in the first monitoring campaign (1996-1998)

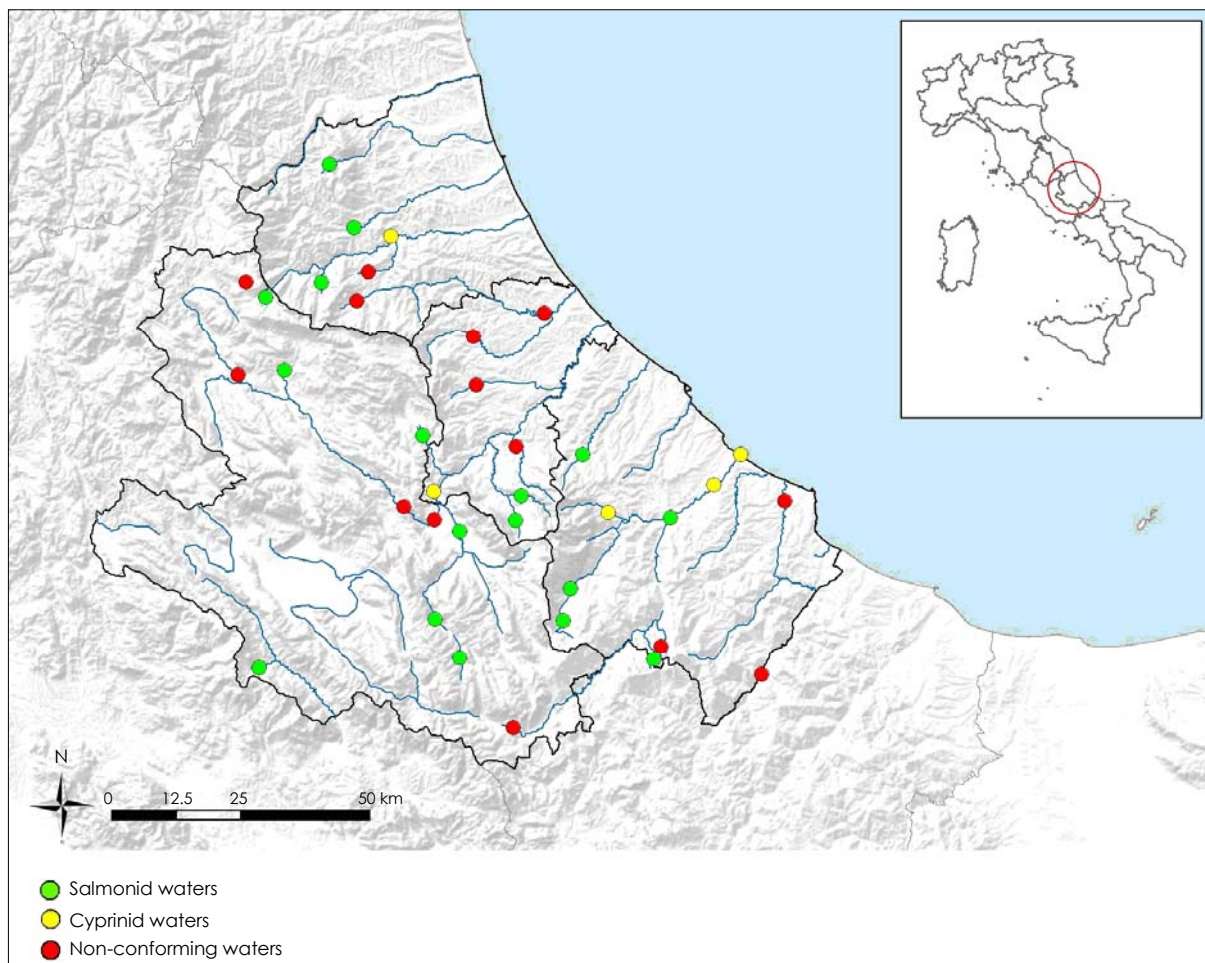


Figure 2  
Classification of salmonid, cyprinid and non-conforming waters in the second monitoring campaign  
(2002-2003, 2004-2005, 2006 and 2007)

As the prevalent contamination demonstrated by the analyses conducted is determined by urban wastewater, the inefficiency of the purification plants present, if any, obviously also affects areas of environmental value.

While the survival of wild fish depends on the speed of the current, the depth, substrate and weirs, water quality must also be viewed as a limiting factor which can cause behavioural disorders and irreversible damage to genetic identity, organs and tissues, leading to death (1, 2, 15, 18, 19, 20, 21, 22, 23).

Section 85 of Decree No. 152/2006 states that if the waters are non-conforming in terms of one or more values, the competent authorities shall ascertain whether the non-conformity is due to natural phenomena, inevitable accident, input of pollutants or excessive drawing of water,

and suggest the appropriate measures to the competent authority (5).

After the comparison between the two monitoring campaigns performed over a period of twelve years, no water quality improvement measures appear to have been taken in the majority of stretches classified as non-conforming.

Moreover, as stated in section 84 (5), the designation and classification of salmonid and cyprinid waters needs to be extended gradually to cover the entire river network, whereas regional instructions focused on reclassifying stretches already monitored.

The measures implemented to improve water quality where necessary and to protect the salmonid stretches need to be assessed to determine whether they have resulted in an

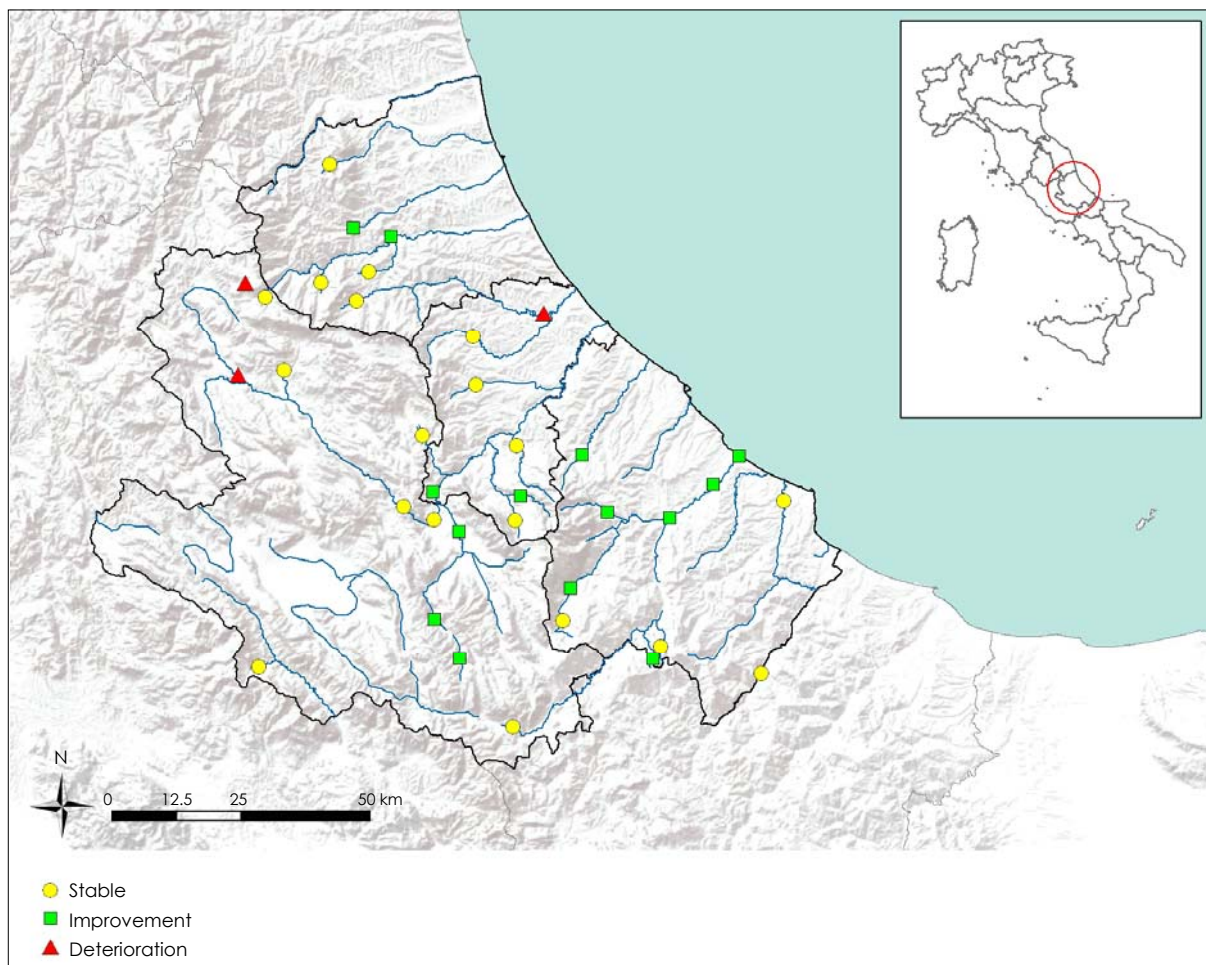


Figure 3  
Classification of waters: differences between monitoring campaigns 1° and 2

improvement as required by the relevant legislation to attain the quality targets stipulated by the European Union.

It would also be appropriate for the classification of the salmonid and cyprinid waters in the Abruzzo region to become the

basis for consultation on the annual preparation of the regional fishing calendar, which establishes the procedures for recreational fishing laid down by Regional Law No. 44/1985 (2).

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