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Intercalibrating classifications of ecological status: Europe's quest for common management objectives for aquatic ecosystems

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HIGHLIGHTS

- Ecological status of European surface waters is harmonised by intercalibration (IC).
- IC ensures greater parity in the funds invested to achieve good ecological status.
- Less than half of the required IC is currently accomplished.
- IC already yielded a unified vision of what constitutes good ecology across Europe.

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ABSTRACT

Halting and reversing the deterioration of aquatic ecosystems requires concerted action across state boundaries and administrative barriers. However, the achievement of common management objectives is jeopardised by different national quality targets and ambitions. The European Water Framework Directive requires that quality classifications are harmonised via an intercalibration exercise, ensuring a consistent level of ambition in the protection and restoration of surface water bodies across the Member States of the European Union. We outline the key principles of the intercalibration methodology, review the achievements of intercalibration and discuss its benefits and drawbacks. Less than half of the required intercalibration has been completed, mostly due to a lack of national assessment methods. The process has fostered a scientific debate on ecological classification with important implications for environmental management. Despite a significant level of statistical abstraction, intercalibration yielded a fundamental and unified vision of what constitutes good ecology across Europe, in principle ensuring greater parity in the funds invested to achieve good ecological status.

1. Introduction

Anthropogenic activities cause ecosystem deterioration worldwide, resulting in loss of biodiversity and impoverished ecosystem services (Halpern et al., 2008; Lotze, 2010). Aquatic systems are among the most degraded habitats, yet must fulfil societal demands for food, drinking water, transport, power generation and leisure activities (Gleick, 1998; Costanza et al., 1997). Halting and reversing the process of deterioration is a global challenge requiring concerted action (Palmer et al., 2004). The principal tool for the coordinated protection of aquatic ecosystems is river basin management planning that acts across state boundaries and administrative barriers (Griffiths, 2002). To identify management priorities harmonised information about the condition of an ecosystem is essential (DeBarry, 2004). However, the definition of uniform standards and common quality targets between political units is hampered by the multitude of different biological assessment methods applied (Birk et al., 2012a; Cao and Hawkins, 2011).

In the case of the European Water Framework Directive (WFD; European Commission, 2000) biological assessment results have to be expressed as Ecological Quality Ratios (EQR), by comparing monitoring data (e.g. on river fish) with equivalent data from undisturbed or minimally disturbed "reference sites". The EQR is divided into five status classes (high, good, moderate, poor, and bad), depending on the scale of deviation from reference conditions where 0 = maximum deviation (bad) and 1 = no deviation (high). The WFD Annex V specifies the characteristics of status classes in terms of normative definitions (e.g. at good status the biota "show low levels of distortion resulting from

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human activity, but deviate only slightly from … undisturbed conditions."). The most important distinction is that between good and moderate status, because, when the quality status is less than good ('failing' water bodies), countries must take action (referred to as a "programme of measures") to improve a water body until good status is achieved.

As with any common water policy a consistent level of ambition in the protection and restoration of surface water bodies is required across participating countries or states. However, this presents formidable challenges at a continental scale where the diversities of physical and human geography overlap — in this case across the more than 500 million inhabitants of the 27 Member States of the European Union whose environmental, cultural, political and socio-economic identities influence awareness and attitudes to water resources and the willingness or ability to protect or restore them. Such challenges are magnified when catchments straddle the jurisdictions of several environmental institutions, both nationally (Moss, 2012) and internationally in the case of large rivers, such as the Danube (Birk et al., 2012b), or when the need to consider future uncertainties is accommodated into long term planning for protection of water resources (Carter and White, 2012). To achieve this harmony of ambition the WFD stipulates that countries participate in an intercalibration exercise designed to identify and resolve inconsistencies and incomparability between countries in their interpretation of the normative definitions (European Commission, 2011). In simple terms, the intercalibration exercise ensures that, for instance, an Irish water body classified in good status according to the Irish assessment method would also be classified in good status by the Polish or German methods if that water body was located in Poland or Germany, respectively (Birk and Böhmer, 2007).

The intercalibration process is organized hierarchically for each water category: rivers, lakes, and coastal and transitional waters (i.e. estuaries and lagoons). Within each category countries that share a similar biogeographical region belong to a Geographical Intercalibration Group (GIG) (Table 1). The exercise is performed among those countries in a GIG that support similar types of aquatic ecosystems (termed "common intercalibration types") and expert groups composed of national specialists deal with each relevant biological quality element (BQE; i.e. phytoplankton, benthic flora and invertebrates, fish). To date, the exercise has involved about 70 expert groups intercalibrating more than 300 biological assessment methods for over 100 common intercalibration types of 27 European countries. As an example of harmonisation of the results of biological assessment methods the intercalibration exercise of the WFD is therefore unparalleled in breadth and scale.

In this publication we (1) outline the key principles of the intercalibration methodology, (2) summarise the achievements of intercalibration after seven years of endeavour, and (3) discuss benefits and drawbacks of Europe's quest for common management objectives for its aquatic ecosystems. Up to now, the intercalibration exercise is mostly documented in technical reports and other grey literature; this paper specifically targets scientists and water managers involved in the interpretation of its results, especially in international river basin management planning.

2. Intercalibration methodology

Setting a consistent level of ambition among ecological status classifications via intercalibration requires an analytical approach that recognises (i) basic differences between the BQEs, (ii) systematic discrepancies between the national assessment methods, and (iii) biogeographical variation across Europe. These issues were addressed by applying appropriate intercalibration options (see Section 2.1), collating suitable datasets, and standardising the national classifications before testing their comparability (see Section 2.2). The keys to consistency were common criteria of comparability that could be applied to every individual intercalibration exercise, be it phytoplankton in Mediterranean lagoons or invertebrates in Alpine streams (see Section 2.3). We outline the principal elements of the intercalibration methodology in the following sections. Further details on the approach, including a flow chart of the main steps of the intercalibration process, are reported in European Commission (2011).

2.1. Intercalibration options

The intercalibration option determines how national quality classes are compared. It is conditioned by the national assessment methods being intercalibrated that generally consist of three (consecutive) components:

(a) Data acquisition — How is the field sampling and sample processing carried out to yield biological data?
(b) Numerical evaluation — Which biological metrics are derived from the data and how are they combined?
(c) Classification — How are the reference conditions and boundaries between status classes defined?

Choosing the appropriate intercalibration option depended on how similar these components were among the countries participating in an exercise (Table 2). In general, a minimum level of similarity among national methods was necessary at the outset if intercalibration was to be feasible.

Intercalibration would be straightforward if countries used the same assessment method (i.e. acquired data in the same way and applied the same biological metrics). The analysis would then focus only on comparing the national definitions of reference conditions and good ecological status. This option requires large datasets covering various countries, thus allowing for a common definition of ecological

Table 1
Geographical intercalibration groups and participating countries. Note that some exercises (e.g. intercalibration of very large rivers or lake phytobenthos) were carried out across groups.

Water category	Geographical intercalibration group	Countries
Rivers and lakes	Northern	Finland, Ireland, Norway, Sweden, United Kingdom
	Central-Baltic	Austria[a], Belgium, Czech Republic[a], Denmark, Estonia, France, Germany, Ireland, Italy[a], Latvia, Lithuania, Luxemburg[a], Netherlands, Poland, Slovakia, Slovenia[a], Spain[a], Sweden[a], United Kingdom
	Alpine	Austria, France, Germany, Italy, Slovenia
	Eastern Continental	Austria[a], Bulgaria, Croatia[a], Czech Republic[a], Greece[a], Hungary, Romania, Slovakia[a], Slovenia[a]
	Mediterranean	Cyprus, France, Greece, Italy, Malta[a], Portugal, Romania[b], Slovenia[a], Spain
Coastal and transitional waters	Baltic	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden
	North-East Atlantic	Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom
	Mediterranean	Croatia, Cyprus, France, Greece, Italy, Malta, Slovenia, Spain
	Black Sea	Bulgaria, Romania

[a] Only rivers.
[b] Only lakes.