Biological Survey of Canada
Terrestrial Arthropods

Briefs

FRESHWATER SPRINGS: A NATIONAL HERITAGE

A brief prepared by the Biological Survey of Canada
(Terrestrial Arthropods)1990

Abstract

Springs are the points of issue of groundwater, an important storage element little studied in Canada. Many springs are very vulnerable because of their potential for recreational development (spas), water-bottling sites and stock watering holes. Some type localities for organisms have already been destroyed. Existing government policy in Canada provides little protection to groundwater despite its increasing use and contamination from a variety of anthropogenic sources. Biomonitoring of spring-dwelling organisms is suggested as a practical method of assessing groundwater quality and the history of individual aquifers.

The Biological Survey of Canada (Terrestrial Arthropods) urges that guidelines be drawn up for the protection of springs from industrial, urban and agricultural pressures. It recommends that an inventory be made to identify rare and regionally characteristic Canadian spring types and their biota which should then be protected as part of our biological heritage.

LES SOURCES D'EAU DOUCE: NOTRE PATRIMOINE NATIONAL

Resumé

Les sources sont les points de sortie des eaux souterraines, important élément de stockage des eaux peu étudié au Canada. De nombreuses sources sont très vulnérables a cause du potentiel qu'elles offrent du point de vue récréatif (spas), commercial (mise en bouteille) et agricole (abreuvement du bétail). Certains milieux types on ainsi déjà été perdus. En effet, les politiques en vigeur au Canada protègent peu les eaux souterraines malgré leur exploitation accrue et bien qu'elles soient de plus en plus contaminées par diverses sources anthropiques. On suggère ici d'exercer une surveillance biologique des organismes présents dans les sources comme moyen pratique pour évaluer la qualité des eaux souterraines et établir l'historique de chaque aquifères.

La Commission biologique du Canada (Arthropodes terrestres) réclame l'établissement de directives pour protéger les sources soumises aux pressions des secteurs industriels, urbains et agricoles. Elle recommande de dresser un inventaire des sources pour déterminer les types de sources rares et caractéristiques des régions du Canada ainsi que leur biote, et pour les protéger par la suite à titre de patrimoine biologique.

Introduction

In the early days of civilization, springs were regarded as sacred places. While springs in general were hallowed, special sanctity was attached to those which served as the immediate sources of large streams and particularly important rivers (Geikie 1912).

Springs are the points of issue of groundwater, an important storage element, which, as was pointed out in the recent Canadian Federal Water Policy Inquiry Report (Pearse et al. 1985) "is less well explored and documented in Canada than in many countries."

Groundwater use in Canada is increasing. Studies show that 26% of the population of Canada relied on ground water for drinking in 1981 (the most recent survey) compared with 10% in the 1960's (Hess 1986). Many local communities and farms are situated on aquifers (water-retaining geological formations) large enough to supply all of their water needs. On Prince Edward Island, for example, more than 99% of the population uses groundwater and nationwide it provides almost all of the water for livestock (Hess 1986).

Problems exist in pinpointing the exact location of springs in different parts of the country. Resort-associated hot springs in the west and some large mineral springs in Ontario and Quebec are well known (Elworthy 1918, van Everdingen 1970) but most of these have been capped for

controlled, commercially-managed discharge and have no natural stream channel or associated biota. Their unique biological features in the original state, therefore, have been lost to science. No federal agency maintains a national inventory of groundwater data or a record of springs. Estimates of the approximate numbers of springs in different regions of Canada and a consensus on the definition of different kinds of springs do not exist despite their many values: springs are key features in many national and regional developments through their uses as sources of drinking water, for commercial bottled-water operations, for fishing, for the therapeutic properties of their water, and as areas for tourism and appreciation of nature.

This brief points out the biological significance of springs and their use in monitoring groundwater quality, together with the need to preserve these valuable habitats.

Biological Significance

Spring faunas provide unique information on endemism and zoogeography and, specifically for Canada, post-Pleistocene colonization patterns. Springs are habitats where relict species of these former times have endured, protected from large oscillations in climate (Hynes 1970). *Mucronothrus nasalis*, for example, is a small, spring-dwelling, oribatid mite previously unknown in Canada but which has an ancient lineage pre-dating the breakup of the supercontinent Pangea. A relatively unchanging genome, unspecialized feeding habits and long generation time combined with the cold, stable environment of springs may have allowed this species to endure through 200 million years (Norton et al. 1988). An ostracod genus, *Mixtacandona* (Klie 1938), similarly has been recorded for the first time in North America from a Canadian spring (L.C. Taylor pers. comm). Springs hold a position of importance as study areas that is far out of proportion to their size and number. A spring is, as Odum (1971) stated, "the aquatic ecologist's natural constant temperature laboratory because of the relative constancy of the chemical composition, velocity of water and temperature."

Some random collections of specific taxa from springs exist in the general holdings of national or regional museums. However, these collections seldom have sufficient accompanying habitat descriptions to make them useful except in an introductory capacity. Compared with many other aquatic habitats, the biological characteristics of Canadian springs still are relatively unknown.

Organized Research

In 1982, the Scientific Committee of the Biological Survey of Canada (Terrestrial Arthropods) identified cold and warm water springs as containing animal communities worthy of special study. The subsequent "Springs Project" aimed, in the long-term, to further knowledge of the systematics, distribution and general ecology of invertebrates, particularly insects, from these widespread but little known aquatic habitats (Williams 1983). The Springs Project, which is an ongoing activity of the Survey, is particularly interested in intensive study of regionally characteristic spring types which might lead to an understanding of variation in life cycles, community dynamics, trophic bases, dispersal mechanisms, effects of past environmental changes and other primary scientific features unique to the faunas of these habitats. To aid interested researchers, the Survey has recently produced an introductory bibliography on spring habitats and their faunas (Williams and Smith 1990). A preliminary scientific treatment of some features of interest is in preparation, based on a recent symposium held in Canada (Williams and Danks [Eds], in prep.), and an inventory of study sites has been initiated.

Habitat Destruction

Many springs are very vulnerable because of their potential for recreational development (spas), water-bottling sites and stock watering holes. In addition, springs in forests can be seriously damaged by skidders during logging. In some cases, damage is so severe that, in the west, type localities of insects have been destroyed by cattle (D.J. Larson, pers. comm.). However, many of these local impacts can be offset simply by protecting the immediate source area (e.g. by fencing), thus confining disturbances to areas below the source.

Ischnura damula a damselfly mainly of the southwestern U.S., occurs in Canada only in the Liard River hotsprings, B.C. where it is a relict of the warm era 5-6,000 years ago when it was more widespread. This habitat has been significantly modified for bathers and currently the whole area is threatened with flooding from a proposed dam on the Liard River (R.A. Cannings unpub. information). Apart from these forms of destruction, the water itself is altered as groundwaters become contaminated from various anthropogenic sources.

Potential for Monitoring Underground Quality

Groundwater contamination can render water unfit for use and many people in New Brunswick and elsewhere have already suffered from contamination of wells (Pupp 1985, Edgett and Coon 1986). Contaminants may migrate along subsurface paths, many of which emerge at the surface as springs before flowing into streams, lakes or wetlands. Some causes of contamination are localized while

others, such as acid rain, may be widespread (K. Henderson and K.W.F. Howard, The sensitivity of North American groundwaters to the effects of acid deposition. in prep.). Generally, however, the extent of contamination of Canada's groundwater is unknown.

Predictions of future contamination of these resources have not been made on either national or provincial scales. Nevertheless, many causes of groundwater contamination are known from hundreds of site-specific investigations (Cherry 1987). Initial recognition of contamination usually occurs after well-users have been exposed to a potential health risk (Beak Consultants Ltd. 1986). Once the problem has been identified, an aquifer often cannot be cleaned enough to restore normal use. Existing government policy in Canada provides little protection to groundwater (Cherry 1987).

Groundwater contamination problems are increasing primarily because the number of organic compounds used in industry and agriculture is very large and many of them tend to be mobile and persistent in the groundwater zone. Of the large array of such hazardous chemicals found in groundwater, few can be detected solely by taste and odour at the very low concentrations which may pose serious health problems over long periods of exposure. Few laboratories that monitor water quality currently have the capability to analyze important organic contaminants (such as chlorinated phenolic compounds, used in the wood preserving industry, or benzene 2-methylbutane, from the petroleum industry) at low, but potentially dangerous, concentrations (Cherry 1987). To detect such compounds at these levels requires sophisticated sampling and sample processing techniques. Consequently, when a consumer of groundwater requests a laboratory to conduct a routine assessment of water quality, the tests done seldom include any evaluation of industrial and agricultural organic compounds (Cherry 1987). To analyze, individually, for the entire spectrum of both organic and inorganic contaminants that may occur in groundwater would be prohibitively costly. To date, there are no proven strategies for cost-effective monitoring to detect trace contaminants (Cherry 1987). However, a realistic and as yet largely unappreciated alternative would be biomonitoring of the organisms living in natural groundwater outflows. Because the faunas of springs live there permanently, integrating the effects of geology, vegetation and climate in space and time, they can potentially provide an additional and especially accurate index of groundwater quality and the history of individual aquifers. Although distantly related in phylogenetic terms, invertebrates and humans share certain physiological properties common to all life, making study of invertebrates valid for the toxicological assay of groundwater quality. Further, such assessment integrates the effects of contamination and is not limited to one or two specific toxins. In this sense, biological study of springs could provide a very effective tool for the management and quality control of groundwater resources.

Conclusion

Because each spring is a discrete entity which can be relatively easily assayed, springs are amenable to inexpensive inventory. This feature, alone, makes springs and their faunas of considerable value in assessing the condition of groundwater resources. Quite apart from this, the fact that springs are unique habitats makes them valuable resources in themselves. These habitats are worth preserving. It is therefore important that guidelines now be drawn up for their protection from industrial, urban and agricultural pressures and malpractices.

Recommendations

The Survey recommends:

1. That inventories be initiated of springs in Canada, both at the regional and continental level, in order to identify various spring types and their distributions.
2. That a survey of the floras and faunas of springs in Canada be made, including the study of representative spring types and regions.
3. That, alongside the biota, this survey should include detailed description of local geology, hydrology and climate together with comprehensive analysis of water chemistry.
4. That rare and regionally characteristic spring types and their faunas be identified and protected as part of Canada's heritage through:
   (a) a local fencing programme to prevent spring sources from becoming trampled or otherwise altered by cattle;
   (b) establishing and enforcing protective areas of woodland around springs where they are subject to logging or inundation;
   (c) restricting the capping of both hot and cold springs for commercial use; and
   (d) raising public awareness and establishing legislation to protect the quality of groundwater.

Several groups and individuals should take responsibility to implement these recommendations. **Federal and Provincial Governments** should carry out inventories of springs, survey their physical and biological characteristics and implement appropriate legislation. Natural history and other **societies** should raise public awareness about the value of springs, and should identify individual springs at risk and take initiatives to protect them. **Individuals** should express their concerns, provide information about habitats known to them and support governments and societies seeking to preserve sites of interest. **Landowners** should ensure that any endangered sources under their

control are protected.

Recommandations

La Commission recommande:

1. de dresser des inventaires des sources du Canada, tant à l'échelle régionale qu' à l'échelle continentale, afin de determiner les divers types de sources et leur distribution;
2. de faire un relevé de la flore et de la faune des sources du Canada et, notamment, une étude des types de sources et des régions représentatives;
3. de compléter ce relevé du biote par une description détaillée des caractéristiques géologiques, hydrologiques et climatologiques locales, parallèlement à une analyse exhaustive des caractéristiques chimiques de l'eau;
4. de dresser un inventaire des types de sources rares et caractéristiques des régions avec leur faune et de les protéger à titre de patrimoine canadien au moyen des mesures suivantes:
   (a) la tenue d'un programme de pause de clôtures afin de prévenir toute perturbation des sources par le bétail;
   (b) l'etablissement de zones de protection boisées autour des sources dansles regions soumises a l'exploitation forestière ou sujettes aux inondations;
   (c) l'imposition de restrictions sur le captage des sources d'eau chaude et d'eau froide à des fins commerciales; et
   (d) la sensibilisation du public et l'établissement d'une loi pour protéger la qualité des eaux souterraines.

Plusieurs groupes et particuliers devraient prendre sur eux d'appliquer ces recommandations. Les **gouvernements fédéral et provinciaux** devraient dresser des inventaires des sources, faire le relevé de leurs caractéristiques physiques et biologiques et adopter les lois qui s'imposent. Les **sociétés** d'histoire naturelle et autres devraient sensibiliser la population à la valeur des sources; elles devraient également déterminer les sources menacées et prendre des mesures pour les protéger. Les **particuliers** devraient manifester leur inquiétude, donner les informations sur les habitats qu'ils connaissent et appuyer les gouvernements et les sociétés qui cherchent à sauvegarder les sites interessants. Les **propriétaires fonciers** devraient voir à protéger tout source menacée qui se trouve sur leurs terrains.

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