A Synthesis: Wetlands as Settings for Human Health

C Max Finlayson, Pierre Horwitz and Philip Weinstein

Abstract The interactions between wetlands and people have been explored in this book through the treatment of ecological and human health and well-being issues for both wetland management and public health practitioners. This recognises that both sectors have reciprocal and important roles to play in ensuring that the benefits provided by wetlands are maintained and even enhanced. Examples are given of the benefits for human health and well-being derived from wetlands, as well as the potential for adverse outcomes if the ecological character of wetlands is not maintained when making decisions about wetlands and human health issues. The examples provide more resolution to what it means for a wetland to be 'healthy' with a proposition that wetland health should be based on social values and indicators that could be agreed through the following steps: establish the best possible reference condition, given acceptable land or water use; make judgements based on uses of human amenity derived from the wetland; acknowledge that restoration may be necessary, especially where wetland uses prove to be non-sustainable; and accept that changes in use/amenity can change the condition and hence perception of the health of the wetland.

The 'settings' approach for wetlands is promoted whereby the wetland is the 'setting' in which people "*take care of each other, our communities and our natural environment*". The setting also includes the institutional and governmental aspects required to deliver health services, to address health inequalities, and to intervene for public health. The key message from this book is that wetlands (as places of water on land, and where water shapes the land), and human health (which in its richest sense addresses the well-being of people, beyond

C. M. Finlayson (✉)
Institute for Land, Water and Society, Charles Sturt University, Albury, Australia
UNESCO-IHE, Institute for Water Education, Delft, The Netherlands
e-mail: mfinlayson@csu.edu.au

P. Horwitz
School of Natural Sciences, Edith Cowan University, Joondalup, WA, Australia
e-mail: p.horwitz@ecu.edu.au

P. Weinstein
School of Biological Sciences, The University of Adelaide, Adelaide 5005, Australia
e-mail: philip.weinstein@adelaide.edu.au

C. M. Finlayson et al. (eds.), *Wetlands and Human Health*, Wetlands: Ecology, Conservation and Management 5, DOI 10.1007/978-94-017-9609-5_12

ill-health or the absence of disease), are interconnected and to a certain extent interdependent. Maintaining or restoring wetlands can promote the ecosystem services that support the many benefits that provide vital support for human health and well-being.

Keywords Wetland settings · Ramsar convention · Wise use · Disease · Public health · Food pollution · Livelihoods · Disasters · Guidance · Intervention · Management

Introduction

The interactions between wetlands and people have been explored in this book through a general treatment of ecological and human health and well-being issues for both wetland management and public health practitioners. This recognises that both sectors, and the disciplines that support them, have reciprocal and important roles to play in ensuring that the benefits provided by wetlands are maintained and even enhanced. At the same time there is substantial evidence to demonstrate where wetlands have been lost and degraded resulting in adverse health and well-being outcomes for local communities (see global assessment presented in MEA 2005).

Another perspective of wetland ecosystems is where there is a complex interplay between the health and well-being of components of wetland ecosystems (including humans), and ecosystem processes and functions. As an example of this shift in emphasis to one of humans being considered as part of ecosystems rather than the singular threat to them, the Ramsar Convention on Wetlands seeks to place more emphasis on understanding how people and wetlands interact, including the interactions that occur between human health and wetlands (Horwitz et al. 2012). This emphasis provides a connection with the wise use of wetlands approach promoted through the Ramsar Convention (Finlayson et al. 2011) which provides a basis for ensuring the maintenance of the ecosystem services that support human health and well-being. These interactions have been loosely encompassed within the metaphor ‘healthy wetlands, healthy people’ that conveys an intimate relationship between wetlands and people (Finlayson and Weinstein 2008; Horwitz et al. 2012) and supports the application of interdisciplinary approaches that have been the hallmark of recent global assessments that have examined human well-being and ecosystem services (Finlayson and Horwitz 2015a).

Information on the interactions between human health and wetlands has been provided in this book through the ‘lens’ of the ecosystem services available in and from wetlands. In doing so it has been implicit that human health should be treated as a component of human well-being that is itself inextricably linked with broader systemic conditions found within wetlands, and that this set of relationships can be referred to as “wetland health”. It follows that wetland management has a mandate to attend to these dimensions.

Locating Human Health in the Context of Wetlands

Where wetlands are involved in the lived experiences of local people, there are outcomes for their health and well-being. Horwitz et al. (2012) emphasised that wetlands could "… *either enhance or diminish human health depending on the ecological functioning of wetlands and their ability to provide ecosystem services.*". At the extremes there are situations where people and wetlands both benefit (the double dividend), and where a detriment might be felt for both (a double negative). But the simple argument that healthy wetlands mean healthy people may not sufficiently recognise the complexity of the linkages that exist between people and wetlands nor the social and environmental changes that influence these linkages (Finlayson and Weinstein 2008). A more realistic interpretation is that wetland health incorporates the health of its components, and humans are one of those components, and that the interactions between people and wetlands are complex and multi-faceted and associated with local circumstances and drivers of change (MEA 2005; Finlayson and Weinstein 2008; Horwitz et al. 2012).

By perceiving people as part of ecosystems rather than outside of them, in this case belonging to wetland ecosystems, the meanings of the double dividend and the double negative outcomes become unmistakeable. But paradoxical outcomes also become clear: in some circumstances well-managed wetlands even those that have been hydrologically unaltered or functionally maintained, can provide poor outcomes for human health; and the converse, that human health can be supported even when wetlands are degraded (though for how long no-one is quite sure; see Raudesepp-Hearne et al. 2010).

With this background, the purpose of this book was to review and map the relationships and issues concerning human health in the context of the wise use of wetland ecosystems, including specific issues associated with the benefits derived from ecosystem services and the paradoxes that also occur.

Linkages Between Human Health and Wetlands

In order to address these issues and consider the trade-offs that may occur between wetland health and the multiple ways in which wetlands are managed (or mismanaged), with subsequent impacts on human health and well-being, the following topics have been covered in individual chapters:

- Public health perspectives (Cook and Speldewinde 2015)
- Basic needs, food security and medicinal properties (Cunningham 2015)
- Sites of exposure to water-borne infectious diseases (Derne et al. 2015)
- Human exposures to pollutants and toxicants in wetlands (Horwitz and Roiko 2015)
- Mosquito borne disease (Carver et al. 2015)
- Livelihoods and human health (McCartney et al. 2015)
- Urban wetlands and community well-being (Carter 2015)

- Natural disasters, health and wetland (Jenkins and Jupiter 2015)
- International guidance for wise use of wetlands (Finlayson and Horwitz 2015b)
- Interventions for enhancing human well-being (Horwitz et al. 2015)

The key issues raised in the individual chapters are presented below.

Public Health Perspectives

Cook and Speldewinde (2015) provide a public health perspective on wetlands with a summary of the relationship between public (community) health and the water cycle and how water systems and their ecology relate to public health, and emphasise the value of systematic approaches for assessing the health risks that can arise from water contaminants. This includes an examination of how two important public health activities—the application of epidemiological methods and the use of systems of surveillance—relate to water sources and supplies and recognises that biological and chemical contamination can originate from or be mitigated by wetlands. Hence, investigations into public health risks need to focus on potential exposure pathways and consider how wetlands or specific features within wetlands are linked to adverse health effects. This further implies that an understanding of the features of wetlands that could affect public health could assist in epidemiological investigations and surveillance programs.

The importance of wetlands for public health are realised when the many potential consequences for public health from exposure to wetlands are considered. These include those that affect hydration and potable water, nutrition, exposure to pollutants or toxicants, or to infectious diseases, and physical hazards, as well as being settings for livelihoods and mental health and psycho-social well-being, and sites from which medicinal and other products can be derived. As many wetlands are under threat from development activities there is increasing recognition that degradation could affect human health and well-being, for example through changes to wetlands that cause an increase in exposure to vector borne diseases or the loss of a protein source for local communities.

Given the extent of wetland degradation, and the relationship between human health and well-being and the condition of wetland ecosystems, public health authorities need to be aware of the potential for the emergence or re-emergence of wetland-linked diseases, and where necessary to act preventatively and proactively when developing responses. As the ecological outcomes from wetland degradation as well as from efforts to restore wetlands are largely uncertain there could be unexpected consequences for human health.

Basic Needs, Food Security and Medicinal Properties

Cunningham (2015) describes the contributions wetlands make to food security for local people, in particular through the provision of high water quality, protein, and

edible or medicinal plants, as well as a means of obtaining income by trading resources, including fish, shell-fish or fibrous plants. There is also a sustained interest in seeking traditional medicines and new natural products from wetland environments such as hot springs, alpine wetlands, particularly in high diversity montane systems, desert salt-pans, soda lakes, highly alkaline or acid streams and high diversity tropical rivers.

The importance of the benefits derived from wetland products can mediate some of the negative aspects associated with wetlands and generate support for policy reform and action for wetland conservation. Understanding the links between ecosystem services and human health, especially for local and indigenous communities with close associations with wetlands, provides a platform for addressing changes in policy and practices to ensure the benefits are maintained or restored. The difficulties of making such changes are recognized, especially when attempted at a catchment scale with attendant complexity and competing needs, necessitating trade-offs, co-management and/or incentive schemes, including payment for ecosystem services to ensure some of the wider benefits can be sustained. Schemes for payment for ecosystem services have been developed, but are still at an early stage. Nevertheless, they are seen as an important option for policy makers and communities alike.

Sites of Exposure to Water-Borne Infectious Diseases

Derne et al. (2015) provide an overview of the diversity of infectious water-borne diseases that humans are exposed to as a result of their association with wetlands, and of the manner in which environmental and human factors interact to determine the overall risk of infection. A proportion of the organisms found in wetlands can cause diseases in humans with an expected increase in the disease burden as pressure builds on wetlands, particularly where sanitation infrastructure is poor. Understanding the interactions between the multiple factors affecting such diseases is difficult and often situation-specific as almost all outbreaks or emergence of disease result from a unique set of circumstances. This necessitates a multidisciplinary approach in order to establish the potential health gain from interventions that are aimed at improving ecosystem and human health concurrently, much like the ‘One Health’ concept where human health is recognised as being intricately linked with that of animals, and with the environment in which they coexist.

Knowledge and methods from multiple disciplines are needed to create integrated management plans for wetlands as settings for wetland conservation and for minimising the disease burden faced by humans. This includes acknowledging the importance of risk mitigation steps that involve the prevention of contamination, providing adequate sanitation and maintaining or restoring healthy wetlands. Future research needs to include investigations of the complexities of wetland ecosystems and the interlinked factors that affect the risk of infection.

Human Exposures to Pollutants and Toxicants in Wetlands

Horwitz and Roiko (2015) consider the exposure of humans to pollutants and toxicants in wetland settings and identify two principal forms of human exposures: (i) where the exposure is determined by the service that is provided (for example the presence of a contaminant in drinking water), and (ii) where the conditions for exposure occur when services are eroded (for example where an oversupply of nutrients overwhelms the water purification capacities of wetlands resulting in an exposure to a microbial toxin). Human activities greatly affect the nature of such exposures, especially where pollution is involved, with complex interactions and difficulties for environmental health practitioners. While steps can be taken to minimise the health risks resulting from such exposures, the risks can increase if the wetlands and their ecosystem services are disrupted. For any resultant interventions to be effective the imbalance in ecosystem services needs to be addressed.

An ecosystem approach provides an alternative to the more traditional risk assessment/risk management approach for addressing health risks from environmental chemicals. This includes determining the upstream socio-cultural and political causes of toxicant accumulation and exposure, and examining the wetland settings and the trade-offs that are made between ecosystem services. Ecosystem restoration, including ecosystem services, could address many of the upstream factors responsible for hazardous environmental exposures to pollutants and other toxicants by humans, but are rarely considered within the scope of public health interventions.

Mosquito Borne Disease

Carver et al. (2015) review and evaluate the links that occur between mosquitoes that breed in wetlands and disease transmission, and the natural mechanisms that regulate these. A particular focus is how wetland health can influence the transmission of disease given the importance of mosquitoes as vectors of pathogens to wildlife, livestock and humans. Despite a paucity of information there is a general belief that healthy wetlands minimise the risk of mosquito-borne disease to surrounding human and animal populations by regulating the production and dominance of mosquito species that carry or host such diseases. Given the importance of these diseases, the lack of data is surprising and suggests that the management of such diseases and their causes is reactive, including a predisposition towards the use of chemicals to control mosquito populations. It may also reflect the absence of any meaningful connection between the public health sector responsible for managing infectious disease transmission and those responsible for managing wetlands. This is an important gap as the interactions between mosquitoes, invertebrates, and vertebrates in wetlands are complex and greatly affected by human activities that can degrade wetlands or disrupt the balances that would have occurred naturally.

In a public health paradigm, the natural ecological interactions that occur in wetlands can be considered a direct ecosystem service, namely the natural mitigation

of vector-borne disease risk. This is an important service given the impact of some diseases such as malaria. The disruption of these interactions and the balances that occur in wetlands due to land-use activities, habitat alteration and biodiversity loss, and climatic changes, could disrupt the ecological processes that regulate mosquito populations and have severe implications for human health. The maintenance of healthy wetlands is likely to have benefits for human health, and provide a more cost effective and sustainable way forward than chemical control of vector species. Future multidisciplinary research that can bring together the processes that regulate the transmission of mosquito-borne diseases is likely to have significant consequences for human health, as well as provide a dividend for biodiversity through the maintenance of healthy wetlands.

Livelihoods and Human Health

McCartney et al. (2015) consider the importance of wetlands for supporting and sustaining the livelihoods and hence the health of the millions of people who depend on subsistence agriculture, at times with limited access to basic human needs such as food and water. Under these conditions, wetlands, through the provision of a range of ecosystem services, are a vital asset because of their contribution to basic human needs. The "natural capital" of wetlands can be transformed, either directly or indirectly, to other forms of capital that can support their livelihoods and well-being.

Throughout much of the developing world wetlands are places where many people live and are vectors for wherefrom they derive much of their livelihoods. The extent to which people depend on wetlands is highly specific and influenced by the diversity of wetlands as well as local social-economic and cultural circumstances.

For many people, wetlands underpin their food and water security as well as other tangible and intangible benefits that affect their health, including their safety. Some of these benefits are derived directly from wetlands, such as food and medicinal plants, but, in common with all forms of natural capital, many others are only realised when the natural capital supplied by wetlands is switched to other forms of livelihood capital, through trade and commerce. However, wetlands can also harbour pests and disease (for example, by providing breeding habitat for mosquitoes that transmit malaria and snails that are vectors for schistosomiasis) that can undermine the health and livelihoods of many people. From a human perspective the benefits and detriments conferred by wetlands vary considerably with vast differences between wetland types, within a wetland type and even, spatially and temporally, within a single wetland. These differences need to be considered when developing strategies to support efforts to reduce the poverty of local communities associated with wetlands, particularly when they depend on the benefits provided by wetlands. Economic development that degrades and undermines the productivity and sustainability of wetlands could just as readily undermine the natural capital on which the poorest and most vulnerable people depend. While support to improve

the livelihoods of local people is not necessarily directly congruent with conservation objectives, there can be significant and adverse livelihood and health outcomes if the balance between conservation and development is not adequately considered.

Urban Wetlands and Community Well-being

Carter (2015) explores the positive health benefits of cultural ecosystem services, including improved physical and psychological health, increased community connection and sense of place, and those derived from community involvement in urban conservation, associated with the use and enhancement of urban wetlands. These benefits are seen as a counterbalance to the detrimental interactions between wetlands and people as a consequence of wetland degradation and exposure to toxicants. The benefits are derived from the role that wetlands play in improving the quality of human surroundings and providing aesthetically pleasing places for recreation, education and spiritual development.

Cultural services, such as those mentioned above, have positive relationships to human health and are at the centre of efforts to prevent further loss and degradation of urban wetlands and where, possible, to restore them. For conservation and restoration to be successful the values of cultural services from urban wetlands need to be clearly articulated and used to guide decisions about urban planning. Thoughtful decisions about the placement of urban wetlands and the benefits available to urban communities could engage and empower people to visit and care for them. The latter activity could be supported through plans to survey and evaluate the services and the level of community benefits that are provided.

Natural Disasters, Health and Wetland

Jenkins and Jupiter (2015) review the direct and indirect health consequences of interruptions to wetland ecosystem services associated with disaster events in the context of small island developing states in the Pacific and emphasize how longer-term health effects of natural disasters can be exacerbated when wetland services are lost. Given their geographic isolation and level of economic development these states are seen as sensitive to natural disasters and may lack the adaptive capacity to effectively respond especially as the threat to public health from natural disasters may be growing. Additionally, the effects of natural disasters will interact with effects of climate variability and rapid environmental change.

Because the extent to which wetlands can mediate the impact of disasters and assist recovery is not well understood, it is recommended that the role of wetlands and disaster-related epidemiology be further investigated. Doing this could strengthen existing models for disaster risk management and wetland conservation, taking into account that wetlands can mitigate or contribute to health outcomes from disasters. In this respect the health risks from disasters that affect people living in the vicinity

of wetlands or are dependent on wetland services cannot be considered in isolation of the wetland setting. The importance of considering the connections between wetland settings and disasters is accompanied by a note of caution about the need for specific information and evaluation to ensure the connections are understood and included, when appropriate, in disaster recovery activities. This could include measures to protect and restore wetlands, such as mangroves and those in riparian zones, that can help mitigate human exposure to water pollution and storm surge associated with disasters. It could also support measures to maintain ecosystem services, such as fisheries, that contribute to livelihoods, and the cultural (including psycho-social) factors that contribute to human well-being.

International Guidance for Wise Use of Wetlands

Finlayson and Horwitz (2015b) review the guidance developed by the Ramsar Convention to support the wise use of wetlands as a basis for promoting the importance of wetlands as settings for human health and well-being. The following topics were identified as needing further attention: linking human health and well-being with wetland conservation; the maintenance of existing ecosystem services; strengthening collaboration and partnerships; development of integrated wetland policies; extending research and information sharing; assessment of the consequences of wetland management; addressing the impacts of climate change; and capacity building.

The reciprocal agenda, where wetland management for ecosystem services becomes a core pursuit of the health sector, is no less extensive and no less difficult to achieve. The challenge remains to bring the interventions from both the health and the wetland sectors together. For the wetland sector this could readily build on the extensive guidance provided by the Ramsar Convention for the wise use of wetlands, and incorporate the importance of wetlands as settings for human health and well-being. Reciprocal guidance for the health sector would strengthen the collaboration and actions needed to ensure that the importance of wetlands for human health and well-being is more widely considered. The reciprocal relationship was partly achieved by the Convention's response to the Millennium Ecosystem Assessment whereby purposeful steps were taken to embed human health in guidance for wetland management. The development of guidance for the health sector on wetlands and human health is seen as an important further step, recognising that the sector is both large and diverse.

The convergence that has emerged through recent efforts to specifically address wetlands and human health is evident through the scope of the current 'wise use' handbooks provided by the Convention. While the wise use handbooks were largely produced to support wetland conservation from a biodiversity viewpoint, they do contain guidance that can be used to support the reciprocal relationship between wetlands and human health. This represents a convergence in the conceptual approaches that have underpinned the wetland and health sectors, recalling that the Convention has from the outset recognised the importance of wetlands for people.

There is an absence of existing guidance on climate change and wetlands, and the impacts of climate change on wetlands and human health. Widely dispersed efforts to develop guidance on ecosystem-based adaptation to climate change are expected to support the case for developing further guidance on human health and wetlands.

Interventions for Enhancing Human Well-Being

Horwitz et al. (2015) recognise that many of the possible response options for addressing change in wetlands and human health and well-being are outside the direct control of the wetland sector, or even the health sector. Instead they are embedded elsewhere, including with authorities responsible for sanitation and water supply, education, agriculture, trade, tourism, transport, development, and housing. As a consequence, inter-sectoral and cross-sectoral integrated options or interventions are needed if the potential impacts of wetland degradation on human health and well-being are to be mitigated or avoided.

Interventions will need to take into account existing social values and cultural norms, existing infrastructure, and the social, economic, demographic, and political driving forces that result in wetland change. Key components of such interventions will include (i) engagement with representatives from previously marginalised stakeholders, (ii) increased transparency and exchange of information between and within sectors, and (iii) recognition of the core pursuits of other sectors. The interventions will vary enormously given local circumstances and range from (i) promoting cross-sectoral governance and institutional structures, (ii) promoting rationalized incentive structures, (iii) social and behavioural responses which include capacity building, communication and empowerment; and (iv) technological solutions to enhance the multi-functionality of ecosystems. As some interventions may involve tradeoffs between the benefits derived from wetlands, and between stakeholders, it is important to understand the consequences of choosing one option in preference to another. While recognising the potential for tradeoffs is an important step it will also be necessary to establish transparent processes by which these can be negotiated especially given the close relationship that exists between food production, water use and water extraction. The closeness of this relationship drives a broad societal objective for those charged with wetland management, an objective that extends far beyond nature conservation and a simplistic approach to natural resource management. Because the pressures that impair the capacity of many communities to prepare for their future are very much the same as those that can impede attempts to make use of wetlands, it is necessary for wetland managers to work with communities if the human health and well-being benefits of healthy wetlands are to be realised. This can include capacity building to develop community resilience in support of wider efforts to help achieve the Millennium Development Goals, and the next generation thereof post 2015.

Healthy Wetlands: On Settings and Services

The above text provides examples of both the benefits for human health and well-being derived from wetlands, as well as the potential for adverse outcomes if the ecological characteristics of wetlands are not considered when making decisions about wetlands and human health issues. This includes the potential for livelihoods to be adversely affected through the loss of access to basic needs such as clean water and food, as well as increased exposure to disease, or to physical hazards such as flooding. The importance of the ecosystem services derived from wetlands has been widely illustrated and documented since the publication of the landmark reports by the Millennium Ecosystem Assessment (MEA 2005) and the Ramsar Convention (Horwitz et al. 2012) on human health, well-being and wetlands.

The perspectives and the examples given in this book provide more resolution to what it means for a wetland to be 'healthy'. Finlayson and Weinstein (2008) proposed that wetland health should be based on social values and indicators and that this would be consistent with ecosystems services as a component of the ecological character of wetlands. They argued that a socially-oriented approach could comprise the following steps:

- establish the best possible reference condition, given acceptable land or water use;
- make judgements based on uses of human amenity derived from the wetland;
- acknowledge that restoration may be necessary, especially where wetland uses prove to be non-sustainable; and
- accept that changes in use/amenity can change the condition and hence perception of the health of the wetland.

Horwitz and Finlayson (2011) argued that "A claim to "healthy ecosystems" comes from the inclusion of the systems thinking required to make judgments on the desirability of an ecological character. It is also explicit about the health of components of the ecosystem (including humans), and whether organizations are adaptive and responsive to ecosystem changes."

Both definitions draw on the ecosystem as a location, providing goods and services, and a context for the way people live their lives and make decisions. This is consistent with the dual concepts of 'settings' and 'ecosystem services'.

The 'settings' approach from health promotion was first enunciated in the Ottawa Charter (WHO 1986) whereby the wetland is the 'setting' in which people "*take care of each other, our communities and our natural environment*". The setting also includes the institutional and governmental aspects required to deliver health services, to address health inequalities, and to intervene for public health. Ecosystem services derives from ecological economics, which starts from the assumptions that main-stream market economics externalises the environment, and that when taken for granted, places our environment and human well-being at peril. The marriage of these concepts is rarely achieved in natural resource management, let alone public health, yet it offers considerable scope to both (Horwitz and Finlayson 2011).

The key message from this book then is that wetlands (as places of water on land, and where water shapes the land), and human health (which in its richest sense addresses the well-being of people, beyond ill-health or the absence of disease), are interconnected and to a certain extent interdependent. For multiple reasons outlined herein, there are benefits to be gained when the public sector in general, and the health sector in particular, might intervene to enhance human well-being by addressing the erosion of ecosystem services in wetlands.

References

Carter M (2015) Wetlands and health: how do urban wetlands contribute to community well-being? In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 149–167

Carver S, Slaney DP, Leisnham PT, Weinstein P (2015) Healthy wetlands, healthy people: mosquito borne disease. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 95–121

Cook A, Speldewinde P (2015) Public health perspectives on water systems and ecology. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 15–30

Cunningham A (2015) Wetlands, well-being, food security and medicinal products. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 31–44

Derne B, Weinstein P, Lau CL (2015) Wetlands as sites of exposure to infectious diseases. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 45–74

Finlayson CM, Horwitz P (2015a) Wetlands as settings for human health—the benefits and the paradox. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 1–14

Finlayson CM, Horwitz P (2015b) Wetland wise use and human health—guidance for wetland managers. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 227–250

Finlayson CM, Weinstein P (2008) Wetlands, health and sustainable development—global challenges and opportunities. In: Ounsted M, Madgwick J (eds) Healthy wetlands, healthy people. Wetlands International, wageningen, The Netherlands, pp 23–40

Horwitz, P, Finlayson CM (2011). Wetlands as settings: ecosystem services and health impact assessment for wetland and water resource management. BioScience 61:678–688

Horwitz P, Roiko A (2015) Wetlands as sites of exposure to pollution and toxicants. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 75–94

Horwitz P, Finlayson M, Weinstein P (2012) Healthy wetlands, healthy people: a review of wetlands and human health interactions. Ramsar Technical Report No. 6. Secretariat of the Ramsar Convention on Wetlands, Gland, Switzerland, & The World Health Organization, Geneva, Switzerland

Horwitz P, Finlayson CM, Kumar R (2015) Interventions required to enhance human well-being by addressing the erosion of ecosystem services in wetlands. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 193–223

Jenkins A, Jupiter S (2015) Wetlands as places that help absorb the damage of natural disasters. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 169–192

McCartney M, Rebelo L-M, Sellamuttu Senaratna S (2015) Wetlands as livelihoods and contributions they make to health and well-being. In: Finlayson CM, Horwitz P, Weinstein P (eds) Wetlands and human health. Springer, Dordrecht, pp 123–148

MEA (Millennium Ecosystem Assessment) (2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC

Raudesepp-Hearne C, Peterson GD, Tengö M, Bennett EM, Holland T, Benessaiah K, MacDonald GK, Pfeifer L (2010) Untangling the environmentalist's paradox: why is human well-being increasing as ecosystem services degrade? BioScience 60:576–589

WHO (World Health Organization) (1986) Ottawa charter for health promotion. World Health Organization, Geneva