Tourism trade-offs: An analytical framework for visitor management in fresh water systems

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Tourism facilities with views of rivers and lakes are extremely popular landscape and cultural tourism destinations. As such, water-rich areas experience high tourist demand which can, and often does, contribute to degradation of water resources. In many cases, it is possible to map the types of ecological disturbances associated with visitation (Hadwen et al., 2008). Disturbance of soils and sediments occurs where people walk, ride, or drive and often results in track widening, deepening, and erosion. Motor vehicles and powerboats can contaminate land and water systems through fuel spills, oil and grease discharges, and engine operation. Fishing can exacerbate decline of freshwater species, and fish stocking of lakes and streams can result in domination of introduced species. Litter and waste pollution are likely to occur with visitation for any purpose.

The framework presented here is based on identifying relationships between ecosystem services (which provide benefits and resources to people), visitation for tourism and recreation, and potential trade-offs that may occur in order to maintain visitor numbers. Understanding these interactions is important as the Millennium Ecosystem Assessment (MA) proposed that action was essential "to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being"(2005, ii). Ecosystem services include *cultural* services such as recreational, aesthetic, and spiritual benefits; *provisioning* services such as food and fresh water; *regulating* services such as climate regulation and water purification; and *supporting* services such as soil formation and nutrient cycling.

Access to freshwater is identified as a key ecosystem service and use of this resource is now considered to be well beyond sustainable levels, currently and into the future. It is imperative that those involved in development of visitor facilities and services consider water quality and quantity in the early stages of planning, implement strategies that address economic, social and ecological sustainability, and design monitoring processes capable of detecting signals from freshwater systems.

Common management strategies include controlling the number of visitors to particular sites; providing designated paths or diverting traffic away from fragile areas; building shoreline facilities such as jetties, lookouts, boardwalks, or other structures; restricting vehicle or boating access; and providing waste cans and toilets. Interventions to mitigate ecosystem degradation may reduce or improve the attractiveness of particular tourism destinations. For some tourists, evidence of ecological damage and human intervention through built environment changes may substantially detract from the experience they seek. For others, installation of visitor services and amenities may well contribute to heightened experience through ease of access or perceptions of lower risk (Pigram, 2006).

However, some associated impacts on ecosystem services are not as easily managed. Increased turbidity, eutrophication, toxic exposures, weed infestation, or presence of exotic species can result from human visitation and disturbance of local ecosystems. This can become particularly problematic when visitors seek to benefit from cultural ecosystem services, but overuse in popular areas results in the loss of supporting, provisioning, or regulating ecosystem services, with consequential reduction in cultural services.

To better manage sites where visitation occurs, some natural resource managers have begun to develop setting classification systems that assess landscape appearance (from undeveloped to developed) and the presence (or lack) of facilities (Seqwater, 2009). The classification system currently in use in southeast Queensland (and a similar system being developed by the Swan River Trust in Western Australia) was adapted from the Recreation Opportunity Spectrum, a conceptual framework designed to help clarify relationships between recreational settings, activities and experiences (Clark and Stankey, 1979). Classification of settings is designed to assess the diversity and range of recreational opportunities, and determine the most appropriate sites for particular activities within a regional area (Parkin et al., 2000). It is recognised that visitors may have different expectations and seek different experiences within specific settings, with different settings attracting different types of visitors.

Our framework provides a vehicle for examining the systemic nature of ecosystem services and trade-offs, enabling consideration of both how and why trade-offs between ecological, social and economic effects might occur. It considers visitation settings, the features of an ecosystem that appeal to visitors in each setting, and the ecosystem services that are subsequently derived in each case.

From the perspective of the tourism sector in its broadest sense, this framework identifies five properties of aquatic ecosystems that have remained relatively unconnected:

1. Appeal for visitors;
2. Ecosystem service(s) that match desirable features;
3. Processes that change the feature;
4. Relationships between visitor experience, behaviours and ecosystem changes; and
5. The trade-offs made when ecosystem services are compromised.

This presentation will discuss the types of trade-offs that commonly occur and the many challenges faced by those working within the freshwater aquatic tourism and recreation industry to convert relatively abstract trade-offs into management responses. The essential value of this analysis framework is centered on developing an understanding of the systemic nature of trade-offs, describing decisions by

Table 1. Relationships between aquatic ecosystem features with appeal for visitors (water, biodiversity and facilities), processes that may change features and visitor experience, and potential trade-offs between ecosystem services

Aquatic ecosystem features with appeal for visitors	Processes that change features (with potential to compromise the ecosystem service)	Relationships between visitor experience and changes in features	Trade-offs made among ecosystem services
Water			
Clarity (clear water) **Quality (absence of odors)** **Quantity (availability of water for consumption)** **Water views**	Eutrophication (nutrient delivery and oversupply) and sediment delivery through erosion from access points and trails Removal of riparian vegetation and shade Discharge can change biogeochemical processes and result in increased toxicants	Changes in water quality from clear to turbid likely to lead to reduced visitation; certainly expect a reduced number of swimmers Removal of riparian vegetation and shade may increase water temperatures and enhance appeal for water-based activities Potential for state of water to change from clear to turbid. If accompanied by nutrients or shoreline decay, site may be less attractive with elevated perceptions of risk to health	Choices made to enhance cultural services where overuse or inappropriate use comes at the expense of supporting and regulating services. This might occur as a redistribution of services: trading access (cultural) for water quality (regulating) Decrease in water quality may undermine cultural services with visitors going elsewhere (trading one destination for another ,where the process might be repeated)
Biodiversity			
Locally characteristic plants and animals **Absence of vector-borne and waterborne pathogens** **Emergent plants in water, overhanging vegetation, riparian shade**	Changes in riparian zone structure and function Changing aquatic habitat to suit particular forms of visitation Disturbances associated with overuse (too many visitors), which can reduce species diversity and adversely influence animal behaviour or result in introduction of weeds or other non-native species Increased fishing opportunities in some areas in response to fish stocking	Bird-watchers and recreational fishers may respond negatively to any loss of aquatic vegetation or loss of associated habitat Visitors are attracted to protected areas to experience native character of an area; human-wildlife interactions can increase wildlife abundance (of some species) but decrease diversity; relationships may be strongly seasonal	Where aquatic habitats and their species are manipulated to enhance cultural services, some regulating services (e.g., flood storage; soil, sediment, and nutrient retention) are enhanced at the expense of others (e.g., water purification/treatment; species trophic interactions) Enhancing cultural services associated with fishing stocking means eroding (trading off) regulating services (particularly species trophic interactions, biological control agents) and perhaps even other cultural services (like educational or nature study)
Visitor facilities			
Accessibility to water bodies (short and safe when desired) **Land-based infrastructure**	Erosion of landform features Access point modifications and changing facilities influencing the use and visitor loads at key sites Access facilitated through infrastructure like jetties, boardwalks, with disturbances changing water-sediment interactions	Too few, just right, or too much: provision of features and facilities, or the presence of other people, will be perceived positively until an individually determined point is reached, after which perceptions will be negative	Increased visitor numbers can lead to a need to change accessibility (spatial and temporal) at key sites; supporting and regulating services are exchanged for cultural services; with trade-offs among access, demand, and increases in visitor numbers occurring at key sites

acknowledging trade-offs made, and developing both non-market and market-based approaches that take them into account.

Selected examples of the types of trade-offs that might occur in response to changes in aquatic ecosystem features are included in Table 1.

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