Beyond birdies - enhancing biodiversity on urban golf courses

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Abstract: In urban areas where public land for habitat protection is limited, golf courses can play an important role in supporting biodiversity. Out-of-play areas on golf courses present an opportunity for restoring and enhancing biodiversity in ecologically simplified landscapes. We aimed to develop a greater understanding of factors that enable or constrain the adoption of improved biodiversity practices on Sydney's golf courses.

The project consisted of three stages:

1. Mapping the location of golf courses across the greater Sydney region in relation to priority conservation areas;
2. A participatory workshop with golf course superintendents and managers drawn from across the greater Sydney region. The workshop findings informed the development of a survey instrument; and,
3. A survey of golf course staff across the greater Sydney region to determine the heterogeneity of capacity to adopt improved practices for biodiversity.

Critical factors were identified that constrain and support the adoption of practices to improve biodiversity conservation on golf courses. We found that the influence of constraining and enabling factors varied spatially across the region. The reasons for this variation were complex and related to the interaction of local biophysical and social context in which the club operates rather than simply to issues such as land tenure. The findings of this project provide a baseline from which to measure temporal changes in capacity resulting from targeted capacity building initiatives and related improvements in conservation outcomes.

Introduction

In Australia, 40% of nationally listed threatened ecological communities are present in urban areas (Victorian Department of Environment and Primary Industries, 2013). Most of the native vegetation communities of the greater Sydney region are listed as threatened species with considerable potential for further loss of biodiversity due to the rate of urban development particularly in the west of the region (Tozer, 2003). To help prevent further loss of biodiversity, Gordon *et al*. (2009) called for more strategic approaches to conservation planning in urban environments based on a scientific understanding of landscape patterns, species requirements and development pressures, which includes greater attention to conservation in areas where people live and work (Miller & Hobbs 2002).

Golf courses represent significant areas of urban green space that are relatively under utilised in urban conservation strategies. The number of golf courses in New South Wales exceeds 400 with approximately 27% of these located in metropolitan areas and occupying an area of approximately 4,000ha in the greater Sydney region (Australian Golf Industry Council, 2009). Beyond being spaces for sport and recreation, Sydney's existing golf courses have the potential to perform important ecological functions within a highly urbanised landscape. As well as containing large expanses of open playing space, most golf courses also contain vegetated and aquatic out-of-play areas. As golf has been played within Sydney for over a hundred years (Australian Golf Club, 2010), many out-of-play areas contain remnants of endemic woodland, grassland, heath, scrub, and aquatic features such as wetlands, which have declined significantly within the surrounding landscape due to urban

development. As a consequence, these spaces present unique opportunities to restore and enhance biodiversity within an ecologically simplified urban landscape (Colding & Folke, 2009).

A number of international studies have shown the potential for golf courses to play a meaningful role in biodiversity conservation (Cohen *et al*., 1999; Frank & Shrewsbury, 2004; Fordham, 1988; Tanner & Gange, 2005; Terman, 1997; Scott *et al*., 2002). From an action based research perspective, a notable Australian study by Hodgkison (2005) concluded that conservation potential is dependent upon the extent to which ecological thinking is incorporated into golf course management and design. Internationally, Hammond and Hudson (2007) reported that the majority of surveyed course managers in the United Kingdom believed golf courses were important for biodiversity and that wildlife should be promoted on courses. However, they uncovered evidence of constraints to the implementation of formal planning for biodiversity often stemming from conflicts among the competing views of stakeholders in the operation of golf courses.

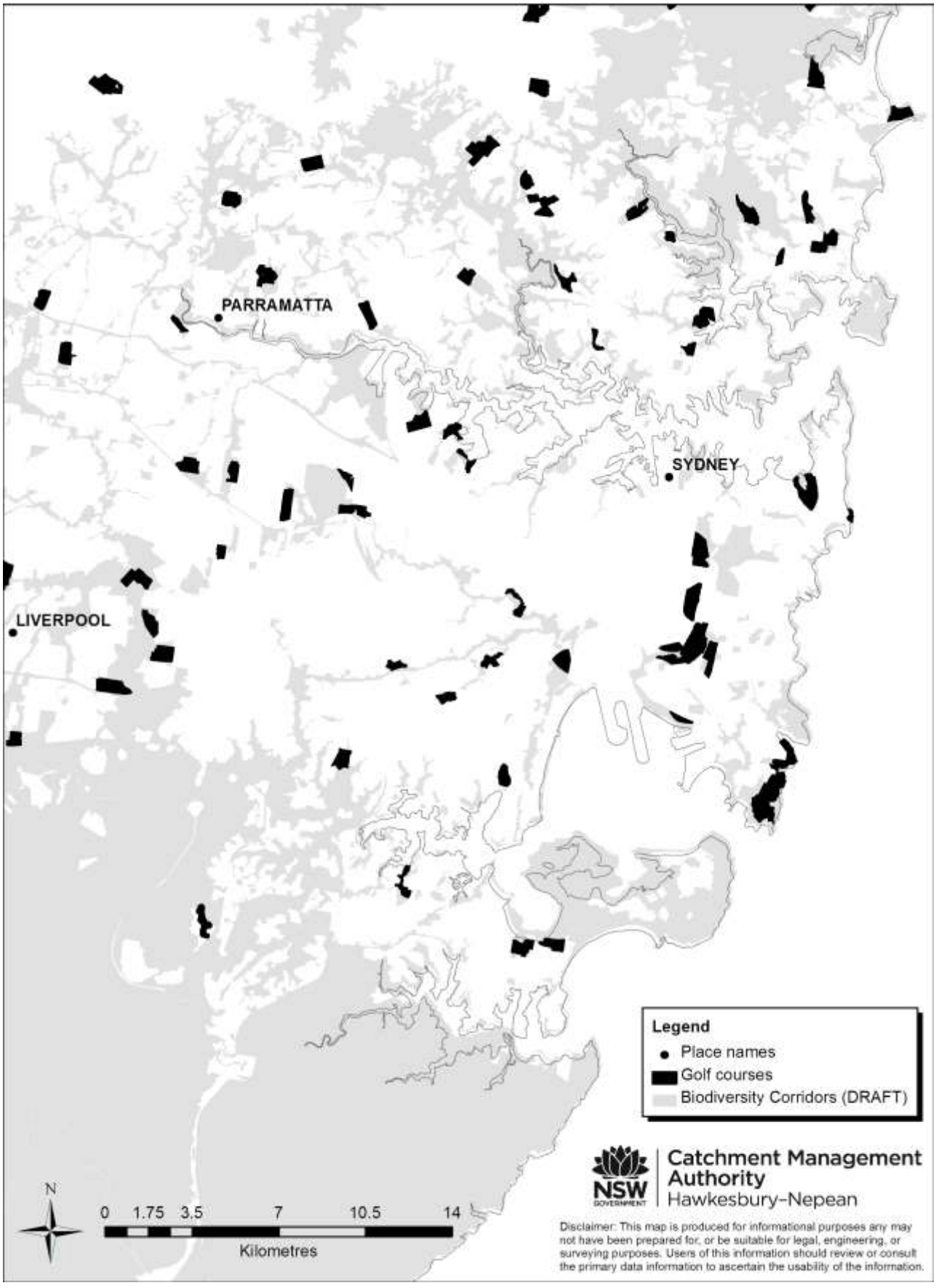
The divergence between the positive views expressed by golf course managers towards biodiversity and their inability to change management practices to promote biodiversity is analogous to constraints on the capacity of agricultural landholders to improve their management of natural resources. Research investigating the capacity of farmers to manage natural resources has shown that in practice, management can be constrained and enabled by multiple, diverse, interconnected and changing factors, which vary substantially across time and space (Brown *et al*., 2012; Leith *et al.* 2012). Similarly we expect capacity to manage biodiversity on Sydney's golf courses will be context dependent. Moreover, understanding that capacity relates not only to the human capital of the workforce but also to dynamic social interactions and broad-scale economic drivers is essential to targeting investments in capacity building by government or industry (Jacobs & Earl, in press).

This research aimed to produce a baseline measure of the capacity of Sydney golf course staff to manage biodiversity, investigating factors that constrain and enable conservation, and prioritising actions to improve management capacity using a tested participatory methodology.

Location of Sydney golf courses in relation to biodiversity corridors

Figure 1 shows the location of golf clubs in the greater Sydney region in relation to priority biodiversity corridors. Many courses are located adjacent to biodiversity corridors, often along the region's waterways. Such co-locations emphasize the potential for golf courses to support biodiversity conservation in the greater Sydney region, by maintaining additional native vegetation and riparian areas that provide connectivity between remnant vegetation patches and aquatic habitats within the wider landscape.

Figure 1: Map of golf courses in relation to biodiversity corridors



Methodology

Mapping

Golf courses in the greater Sydney region were mapped in ArcMap by the Hawkesbury-Nepean Catchment Management Authority using aerial photography and visual recognition of golf courses by their distinctive layout (linear fairways and greens bordered by trees and other vegetation). Where possible, individual golf courses were named and cross referenced with clubs affiliated with Golf NSW, the representative body of golf in NSW and a key project partner.

This golf course layer was then overlayed onto existing native vegetation data (DECC, 2009) and draft biodiversity corridor mapping (Eco Logical Australia, 2010) collated by the former Sydney Metropolitan Catchment Management Authority. This map (Figure 1) provided an overall view of the location of golf courses in relation to key natural assets and conservation areas in the region.

A total of 116 active golf courses, covering more than 4,500ha, were identified in the Hawkesbury-Nepean Catchment Management Authority area of operation (as of July 2013), with the majority located in the greater Sydney region.

Participatory self-assessment workshop

A workshop was held to develop a greater understanding of factors that enable or constrain the adoption of improved biodiversity practices on Sydney's golf courses. The workshop had nine participants representing seven golf courses across the greater Sydney region. The participants were drawn from various positions within each golf club, including superintendents, greens-keeping staff, club managers and other staff.

A transferrable, place-based process was employed in participatory workshops to evaluate the capacity of golf course personnel to manage biodiversity (Brown *et al.,* 2010). The technique uses a Sustainable Livelihoods Approach (Ellis, 2000) to enable land managers to define, describe, and evaluate locally relevant indicators of capacity. This method coupled with a targeted survey of the capacity indicators enabled an assessment of the capacity of golf course managers to improve their management of local remnant vegetation to protect biodiversity.

Workshop participants were asked to identify relevant sets of indicators under a framework of five capitals (or classes of resources) - *human, social, natural, physical* and *financial* (Table 1). Following whole group discussions, participants anonymously rated each indicator on a scale of 0 to 5 using keypads, according to the degree to which the indicator was constraining or supporting the adoption of practices to improve biodiversity at their course. Participants were also asked to provide a trend in the indicator over time, and to identify and discuss actions to overcome the barriers to adoption (in order to develop a targeted capacity building program).

Table 1: Description of the five capitals used in the livelihoods analysis framework.
Ellis (2000).

Capital	Description
Human	Skills, health, knowledge, education, ability to labour, physical capability
Social	Networks, social claims, social relations, affiliations, associations.
Natural	Natural resource stocks and environmental services from which resource flows must be managed
Physical	Capital items that can include infrastructure, equipment and improvements in genetic resources.
Financial	Capital base - cash, credit/debt, savings and other economic assets

Online Survey

A survey was developed to elicit a larger collection of perspectives from golf course staff and conservation volunteers working on courses in the greater Sydney region. The survey design was based on the information generated from the self-assessment workshop. It was intended to ground truth or assess how widely issues raised at the workshop occurred throughout the greater Sydney region. The survey used a mix method approach that combined the collection and analysis of the quantitative and qualitative data. In total 36 people completed the survey, representing 29 spatially dispersed golf courses. Survey respondents again represented a variety of management positions within each club, but also included a number of conservation volunteers who have worked on golf courses of the greater Sydney region.

Results

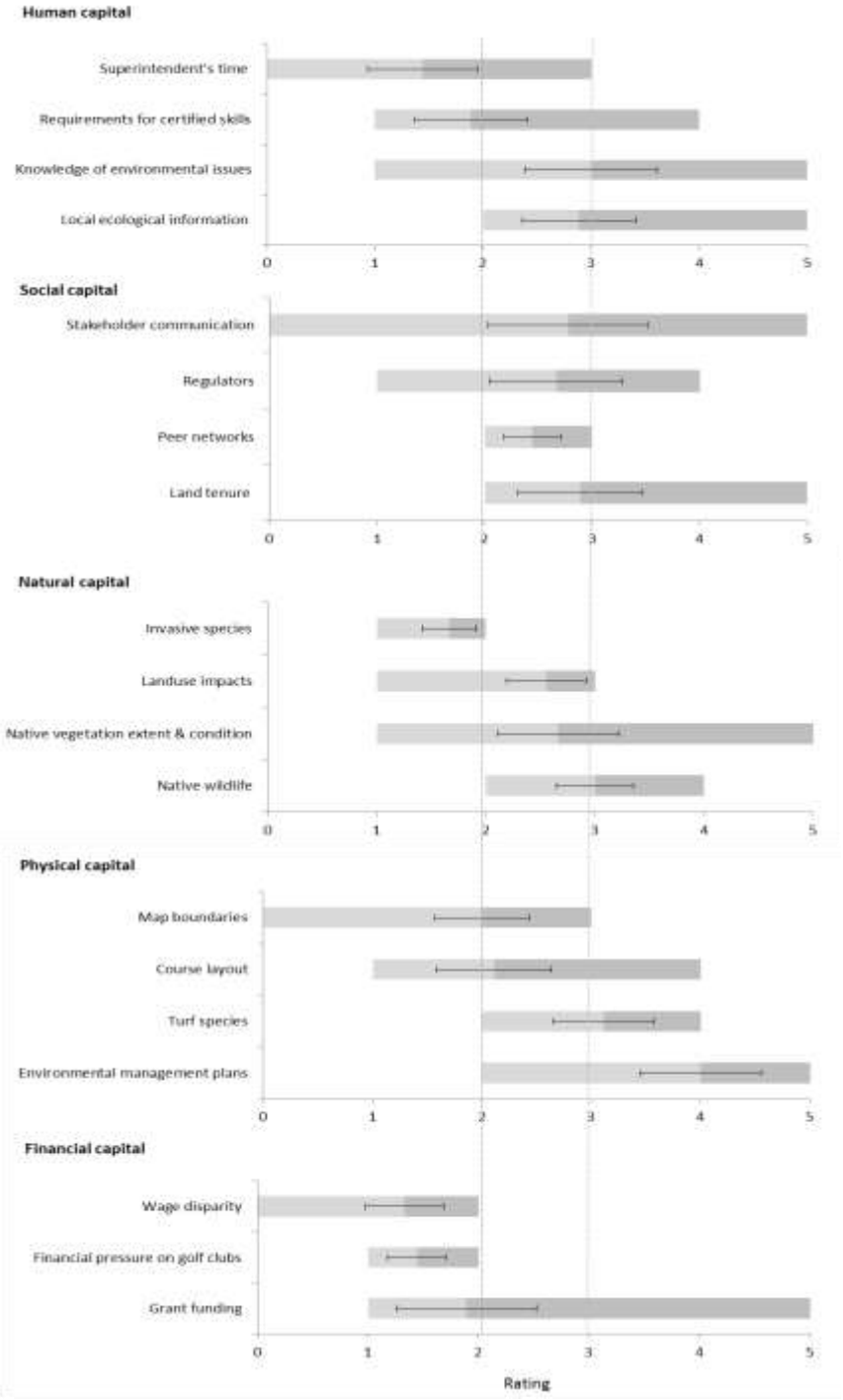
Capacity Assessment Workshop

Workshop participants identified 3 or 4 indicators of capacity for each capital (Figure 2). The mean, standard deviation and range of ratings varied considerably among indicators and capitals. Few indicators were rated as, on average, strongly supporting improved biodiversity. The exception was Environmental Management Plans (EMPs) (physical capital), which emerged as the most supporting indicator for biodiversity conservation. One of the major drivers for EMPs was said to be land owners and local government increasingly requiring golf clubs to have them in place as well as an increasing public awareness about environmental issues.

Among constraining indicators, superintendent's time (human capital), invasive species (natural capital), wage disparity, financial pressure and grant funding (financial capital) were most constraining. In particular, the ranges of ratings for invasive species, wage disparity and financial pressure suggest that these were constraints to biodiversity management experienced by all of the golf clubs represented at the workshop. Participants related constraints on golf course superintendents' time to the lower level of priority assigned to maintaining and improving the biodiversity of the course compared with maintenance of the playing surface. Most clubs reported limited labour for biodiversity management. The disparity in wages with other trades made it difficult for golf courses to find and retain suitable young staff dedicated to environmental management and biodiversity conservation for the salaries on offer. While financial pressure on golf clubs was reported as varying considerably between clubs and seasons, there was a general perception that the industry was experiencing a financial down-turn, with less people playing golf alongside rising management costs. Participants felt that when clubs experience financial pressure, they are more likely to focus their management priorities towards greens, tees, fairways and bunkers before directing their attention to the out-of-play areas for biodiversity.

The wide ranges of ratings for other indicators, suggested they represented local constraining or enabling factors to improved biodiversity management. In particular, the ratings for stakeholder communication (social capital) spanned the full range of the scale and showed the widest range of values of any indicator identified during the workshop. A broad range of stakeholders with influence over the management of biodiversity was identified including: golf course superintendents; course maintenance staff; external contractors; environmental regulators; the land owner; executive management committee; the general manager or club CEO; course architects; club members; visiting players; neighbouring residents; and public users of areas adjoining the course. Each golf course reported a unique mix of stakeholders that exert different levels of influence on course management, which either support or constrain biodiversity conservation at any given point in time.

Figure 2: Pooled analysis of the indicators of each of the five capitals showing the variation in ratings among workshop participants. Values (x axis) are the self-assessment ratings for each indicator and described the degree of support for biodiversity (0 = constraining to 5 = supporting). The total length of the bar (light and dark shaded regions) shows the range of values for each indicator, the junction of the light and dark shaded regions shows the mean value. Error bars represent the mean standard deviations.



With the exception of one club that had developed considerable skill in accessing grant funding, other clubs felt that sourcing, applying and implementing environmental grant funding constrained biodiversity management with participants expressing uncertainty about where to source information about grants and difficulty with the process of writing applications for funding.

Ratings for indicators related to knowledge and information (knowledge of environmental issues and access to local ecological information) also showed considerable variation. Superintendents' reported that an increasing knowledge of environmental issues and access to local ecological information had become an enabling factor for biodiversity conservation at some clubs over the last decade. However, others reported the need for greater access to information to support 'on the ground' decision-making.

Participants identified two indicators of physical capital as emerging issues for biodiversity management. Changes to course layout from technological improvements in golfing equipment (metal driver heads and longer-flight golf balls, see Farrally *et al*. (2003) for a discussion) mean that players are generally able to drive golf balls longer distances putting pressure on superintendents to increase the length of the course. On smaller courses in particular this can place considerable pressure on out-of-play areas to be incorporated in the playing surface. On some courses, changes to layout to improve storm water management have resulted in restoration of creek lines and improved aquatic habitat throughout the course. In addition, selection of turf species can have unintended consequences for biodiversity management. For example changing turf species from kikuyu to couch while accommodating player preference and reducing levels of inputs (water, fertiliser), may result in increased invasion of turf into remnant native vegetation.

Survey Findings

Five themes emerged from the survey analysis, which correlate strongly with the participatory workshop findings. These include:

- Knowledge and information;
- Management and operation of the golf course;
- Endangered Ecological Communities and Endangered Species;
- Actions to improve out-of-play areas for biodiversity.

Information and knowledge

Almost half (44%) of the survey respondents had received training related to environmental management or biodiversity through e-par training (http://www.epar.com.au). A further 33% had attended a workshop or training day run by a local Council or government agency. However, a high number of survey respondents, 38 per cent, had not received training in environmental management.

A moderate proportion of respondents (63%) said their club had received advice or guidance about managing natural areas or biodiversity over the last decade. Information was commonly sourced from government agencies such as the Environmental Protection Authority, National Parks and Wildlife Service and Catchment Management Authorities and Local Council. The Australian Golf Course Superintendents Association (AGCSA) and Golf NSW were also important sources of information. There was a clear link between clubs that had received information and those that agreed that knowledge had been improving, with 83 per cent agreeing that knowledge about managing biodiversity had improved at the club over the past decade. The majority of clubs (87 per cent) had developed an EMP and this was viewed as an important guide for decision-making and action.

Managing and running the golf course

The major barriers to improving and restoring natural areas for biodiversity and ecological function were identified as a lack of resources - time and money. The majority of respondents (86%) agreed that golf courses are becoming increasingly expensive to maintain. Over half of the survey respondents (54%) said that their club does not currently have adequate resources to restore out-of-play areas**.** However, almost 60 per cent agree that improving biodiversity will ultimately reduce some on-going costs to maintain the course (e.g. less area to mow, less pesticides and fertilisers). Almost 90% of respondents felt a lack of time constrained their ability to manage out-of-play areas for biodiversity.

About 70% of respondents believe that protecting and enhancing biodiversity often conflicts with the demands of players. A high proportion (94%) agreed that players get frustrated with loosing golf balls in shrubby or dense vegetation. Furthermore, half of the respondents agree that players increasingly

want to play on longer courses that may mean moving tees to make fairways longer or removing or modifying vegetation.

Actions to enhance and protect natural areas can be undermined by players who fail to take notice of signs and walk through sensitive natural areas of the course. The majority (86%) of respondents agreed that players damage native vegetation if they regularly walk through natural areas and almost 90% agreed that golf carts can damage natural areas by compacting the soil or damaging plants. Over half of the staff surveyed said that mowing and slashing fairways and tees can gradually spread into natural areas.

Managing Endangered Ecological Communities and Endangered Species

The majority (97%) of survey respondents believed that managing biodiversity on the golf courses is important and 91% agreed that biodiversity enhances the experience of playing on a golf course.

Almost 40% of the golf courses surveyed contained Endangered Ecological Communities (EEC) or Threatened Species that could be affected by course management (Table 2). Up to 77 per cent of survey respondents agreed that regulations to protect natural areas sometimes conflict with golf course priorities.

Actions to restore or improve natural areas for biodiversity

Survey respondents reported a broad range of actions had been undertaken on their golf courses to improve biodiversity over the past 10 years. The actions most widely undertaken included planting native vegetation, control of introduced weeds and minimising soil erosion. These actions may be undertaken by course staff or may be out-sourced to contractors or bush care volunteers.

Golf course staff were most often involved in planting locally native trees, shrubs or grasses, removal of dumped rubbish, control of introduced weeds and retention of trees with hollows or fallen logs for wildlife. Actions most often outsourced to contractors included restoring or 'naturalising' creek lines, building dams or ponds to collect water and controlling introduced animals. Volunteers were reported as most often involved in planting native vegetation and control of introduced weeds.

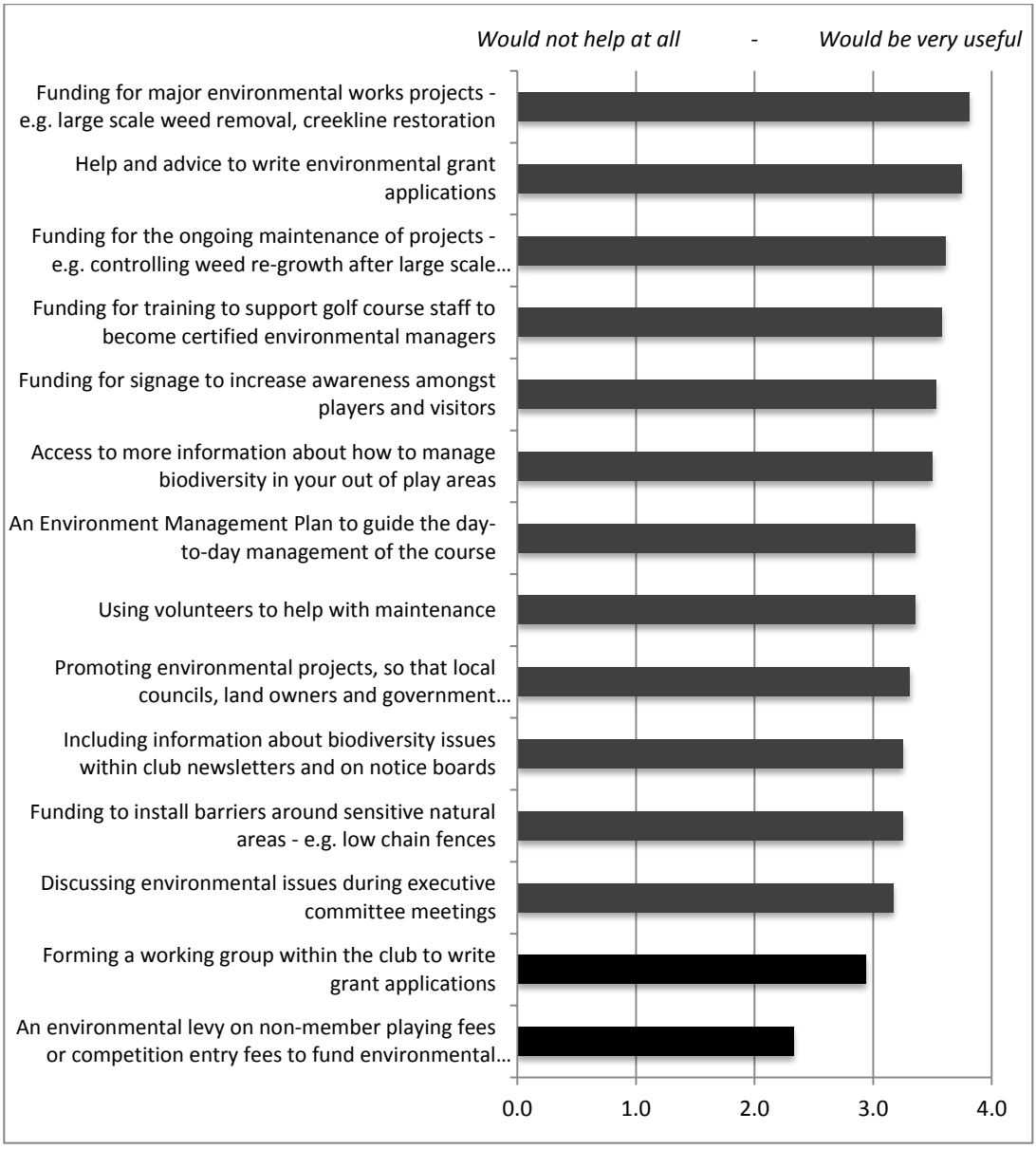
Table 2: Identified Endangered Ecological Communities and Endangered Species

Endangered Ecological Communities	**Endangered flora and fauna**
Eastern Suburbs Banksia Scrub	Eucalyptus Camfieldii (Camfield's Stringybark)
Blue Mountains Hanging Swamp	*Pteropus poliocephalus* (Grey-headed Flying-fox)
Sydney Turpentine-Ironbark Forests	*Callocephalon fimbriatum* (Gang-gang Cockatoo)
Themeda grassland on seacliffs and coastal headlands	*Calyptorhynchus lathami* (Glossy Black-Cockatoo)
Swamp Sclerophyll Forest	*Pandion cristatus* (Eastern Osprey)
Swamp Oak Floodplain Forest	*Litoria aurea* (Green and Golden Bell Frog)
Coastal Saltmarsh	

Survey respondents rated the usefulness of specific actions to improve biodiversity outcomes on the course (Figure 3). The actions rated most useful related primarily to the availability of funding for on-ground works, for staff training and for signage to educate players and visitors. Improvements in the ability of staff to source grant funding were also important.

Accessing grant funding is a major barrier conservation action, a third of the respondents indicated they are unsure of where to access information about environmental grants, and less than 30% regularly apply for grants for environmental projects. In terms of winning grant money, about 40% of clubs have been successful in obtaining grant money and 40% had been unsuccessful. Other actions to increase funding such as forming a committee to write grant applications or applying an environmental levy were considered to be relatively less important.

Figure 3: Actions to manage biodiversity or natural areas on your course

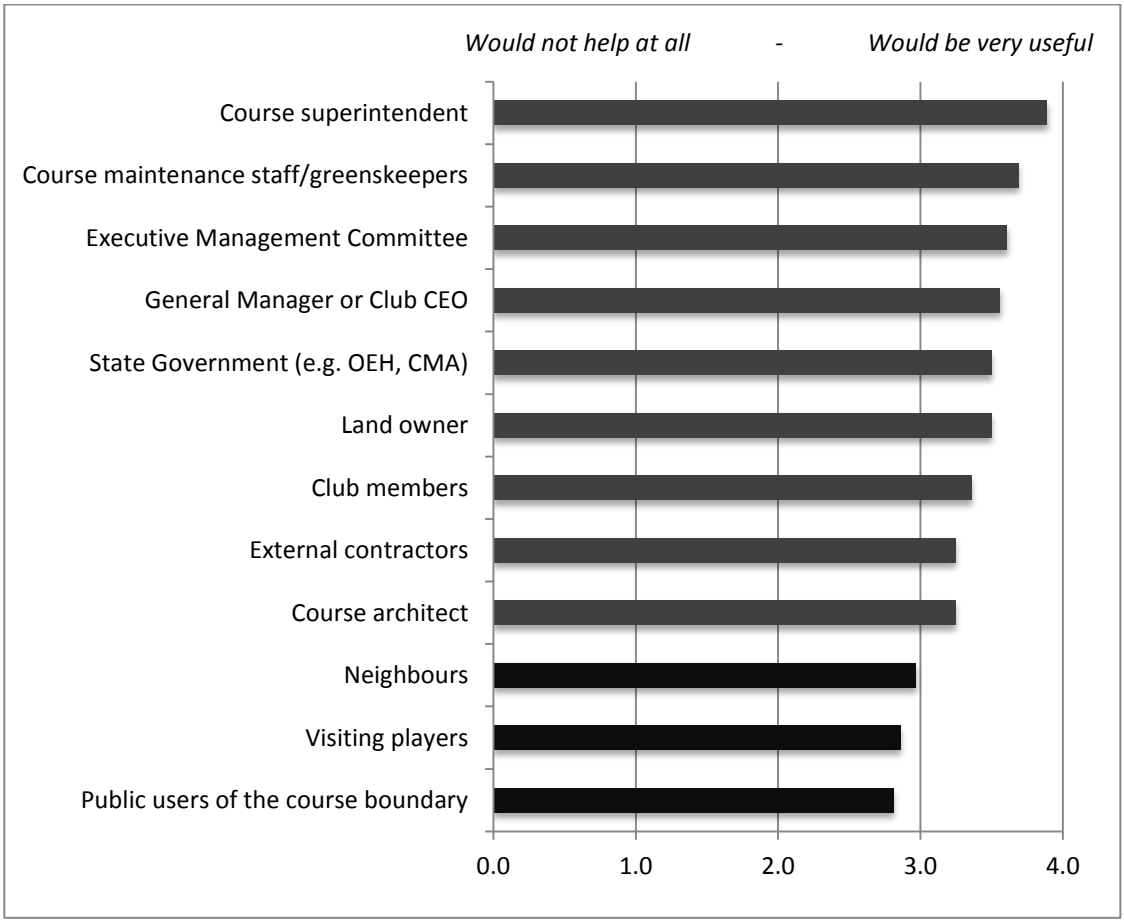


Influential stakeholders

Multiple stakeholders exert varying degrees of influence on biodiversity management on golf courses (Figure 4). Not surprisingly, because of their role in directly managing the golf course, support from the course superintendent and greens-keeping staff was considered most useful in improving biodiversity management. The next most influential group was made up of the institutional hierarchy of the golf club: the executive management committee and CEO/General Manager. This is the stakeholder group with responsibility for setting golf club policy, allocating financial resources and liaison with members. In declining order of relative importance but still considered highly influential were State Government agencies, land owners, club members, external contractors and the course architect. Despite being only indirectly connected to the club and course, support from external stakeholders such as

neighbours and public users of land around the course boundary were also perceived to be influential in managing biodiversity.

Figure 4: How useful would support from the following people be for managing biodiversity or natural areas on your course?



Discussion

This study identified critical factors that constrain and support the adoption of practices to improve biodiversity conservation on golf courses. The study was limited to the greater Sydney region of Australia, an area that is undergoing an increasing level of urbanisation (Zhang *et al*., 2013). The research found that the influence of constraining and enabling factors varied with location. The reasons for this variation were complex and related to the interaction of local biophysical and social circumstances in which the club operates rather than simply to issues such as land tenure. Despite widespread constraints, many results are encouraging. Golf club management and course staff:

- believe that managing biodiversity on the golf courses is important and agree that biodiversity enhances the experience of playing on a golf course;
- are aware of the presence of endangered ecological communities and threatened species within their landscapes that could be affected by course management; and,
- had taken some action towards improving the management of biodiversity on their course themselves or by using contract staff or volunteers.

These results indicate that past programs to raise awareness of the loss of biodiversity and to promote the benefits of biodiversity conservation in urban landscapes have had some success. However, other findings (up to 38 per cent of golf course staff had not undertaken training in biodiversity management) suggest that there is a continuing need for extension of knowledge and practical training in biodiversity management to golf course staff, most recently a role filled in NSW by Catchment Management

Authorities. Golf course staff also indicated a role for peer-to-peer learning through the establishment of networks for sharing among clubs information about biodiversity management (Rodela, 2013).

Despite high levels of awareness of its importance, we found evidence of considerable variation in capacity to manage biodiversity across the greater Sydney region. There was broad agreement that financial capital was the major barrier to improved biodiversity conservation. There was a belief, supported by industry data (AGIC, 2007; Hueber, 2012) that participation in the sport is showing a declining trend (attributed to ageing club members and lack of uptake from younger players) which means that the viability of some clubs may be suffering. Poorer financial viability reduces the likelihood that scarce resources (including superintendent's time) will be directed towards biodiversity conservation on out-of-play areas (Hammond & Hudson, 2007), a finding common to other types of natural resource managers (Leith *et al*., 2012). There are implications for urban biodiversity should a decline in the viability of golf clubs lead to the sale of golf courses and their conversion to other land uses, most likely for further urban development. In the US, declining viability of some golf course developments has resulted in calls for resuscitation of the golf industry by fostering the redevelopment of its built environment into sustainable golf courses (Hueber *et al*., 2010).

Golf course staff at the self-assessment workshop described green-keeping as a 'lifestyle job'. There was general agreement that wage disparity ensured staff with environmental qualifications were both hard to find and difficult to retain. Placing greater emphasis on the environmental aspects of landscape management during apprenticeship training of greens-keepers may overcome this problem. The labour force issues experienced by the golf industry mirror those reported for other industries such as agriculture where high wages on offer in the mining industry draws workers away from the rural workforce (Williams & Measham, 2013) and limits capacity to manage natural resources (Leith *et al*., 2012).

For the majority of clubs, accessing external grant funding to undertake environmental works appeared difficult. Staff reported both a lack of knowledge about funding programs and a reluctance to develop funding applications as the major issues. However, one coastal club in Sydney's north was able to demonstrate considerable success in securing grant funding for biodiversity conservation and would serve as a useful model for other clubs to follow. This club employed a staff member to promote and celebrate among external stakeholders their environmental achievements, in particular, actions the club had taken protect wildlife on the course and retain habitat for vulnerable species. Almost a quarter of staff surveyed considered that establishing a working group or sub-committee within the club to draw on the skills-base and professional experience of club members to apply for external grants would be effective in providing funds for on- ground works.

Constraints related to social capital clearly require greater attention than they may have in the past. In common with other natural resource managers (Jacobs & Brown, 2012; Hudson & Hammond, 2007), golf course superintendents motivated to take action to improve biodiversity have to negotiate a dizzying array of stakeholders with varying degrees of influence on golf course management. These stakeholders are both internal to the running of the golf club (greens-keeping staff, boards of management, club members, and general managers) and external to it (neighbours, visiting players, and users of open space around course boundaries), and often involve considerable power imbalances. Superintendents recognised the value of an Environmental Management Plan as a tool for negotiating resource implications of biodiversity conservation with golf club boards, and also for demonstrating a pro-active environmental stance to the broader community (83 per cent of golf clubs in the survey had developed an EMP). However, the extent of stakeholder involvement in the development of these plans, a factor associated with their success (Margerum, 1999), is uncertain. The variation in ratings assigned to stakeholder communication at the self-assessment workshop indicates that superintendents in some locations will need considerable support and understanding from government environmental regulators and Catchment Management Authorities to develop adaptive co-management frameworks that facilitate collaboration among recreational, conservation and economic interests (Colding & Folke, 2009; Hodgkison, 2005). Examples of these types of collaborative relationships are evident in the workshop narratives that demonstrated close co-

operation between environmental institutions such as Sydney Water and the NSW Office of Environment and Heritage and staff at some golf courses. However, it is difficult to gauge the extent to which such relationship building is institutionally supported (Loevinsohn *et al*., 2002) or results from the enlightened attitude of individual agency staff.

The value of golf courses in managing biodiversity was recognised by the large majority of course managers that were surveyed. Although there is considerable debate about the impact of golf courses on the environment, many studies have demonstrated that if a course is designed and managed appropriately it can have a positive impact on biodiversity through the protection and conservation of natural habitats (e.g. Hodgkison 2005). Almost 40% of the golf courses surveyed in this study contain Endangered Ecological Communities or support regionally Threatened Species. Golf courses can be designed and managed in a way that yields multiple benefits such as increased landscape diversity, ecosystem functions and refugia for wildlife (Colding & Folke, 2009; Higginson & McMaugh, 2007). Hammond and Hudson (2007) found that passive approaches such as maintaining undergrowth can have ecological benefits in terms of nutrient cycling and habitat provision. However, there is a limit to the acceptability of these actions to players and there is scope for further research into the motivations of golfers in playing the sport to discover the value they place on the environment (Correia & Pintassilgo, 2006). Integral to this is the need to educate golfers about environmental issues surrounding the management of their golf course (Dodson, 2000). Improved internal communication about environmental management on notice boards, posters and in newsletters could be a way to better engage members, the executive committees and volunteers (Hammond & Hudson, 2007). Despite the tensions the majority of staff surveyed agreed that retaining native vegetation enhances the experience of playing on a golf course, and saw the financial benefits from lower maintenance costs (Dodson, 2000).

The ability to detect change over time in golf course manager capacity is essential to gauge the effectiveness of capacity building activities. In a recent study, Jacobs and Brown (in press) demonstrated that participatory assessment processes such as the one described in this paper, are able to detect changes in capacity of natural resource managers over a 2-3 year period. These changes were attributable to several factors including environmental effects such as drought, the availability of funding for on-ground remediation works and, importantly, investment in capacity building through skills development.

Although not a specific focus of this study, volunteer Bushcare groups, some drawing on the membership of a golf club, have emerged as an important, but in many places largely untapped, source of support for biodiversity conservation efforts by course staff. Clubs could explore the opportunity of a strategic alliance with NSW Landcare or other appropriate non-government organisation to establish greater involvement of community volunteers in biodiversity conservation on golf courses.

Conclusions

With a growing awareness of the need to retain native habitat, golf courses are under increasing pressure to undertake actions to conserve biodiversity. However, the adoption of improved practices for biodiversity management will likely require that adaptive co-management is firmly established within environmental agencies. As this style of management can foster support, mutual learning and trust between agency staff and external natural resource managers. This approach is particularly useful within multi-stakeholder, multi-use landscapes such as golf courses, where natural resource managers may experience competing priorities and other constraints. Ultimately, key actions such as integrated revegetation, habitat protection and management of invasive species must be supported by both environmental agencies and natural resource managers to effectively build ecological resilience and safe guard Sydney's biodiversity.

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