Managing Wetlands for Waterbirds

on a

Coastal Floodplain of New South Wales, Australia

Adam Noel Smith

Bachelor of Science, University of New England, 1986

Diploma in Natural Resources, University of New England, 1990

Master of Applied Science, Southern Cross University, 1999

Master of Social Science, RMIT University, 2005

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I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Signed [redacted] 9 June 2010

Adam N. Smith Date

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Name of candidate: Adam N. Smith

Name/title of Principal Supervisor: Dr Karl A. Vernes

[redacted]

9 June 2010

Candidate Date

[redacted]

9 June 2010

Principal Supervisor Date

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	Authors Name	**% contribution**
Candidate	Adam N. Smith	100 (All pages)
Other Authors		

Name of candidate: Adam Smith

Name/title of Principal Supervisor: Dr Karl A. Vernes

[redacted] 9 June 2010

Candidate Date

[redacted] 9 June 2010

Principal Supervisor Date

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Abstract

Key to the conservation of waterbirds on coastal floodplains in Australia is improved management of their wetland habitats. Waterbirds and wetlands of the Clarence River floodplain, in north-east New South Wales, were studied from 2005 to 2007 to gather ecological information about the waterbird species that use the floodplain and the physical properties of the constituent wetlands. The work contained in this PhD consisted of a review of historical accounts, including oral history, appraisals of the wetland types and waterbird species present, monitoring of selected wetlands for waterbirds and water quality, particularly salinity, and bathymetric mapping of selected wetlands. Also, the grazing habits of one species (Black Swan *Cygnus atratus*) were studied, and an assessment of the value of drains as waterbird habitat was undertaken. Finally, wetland management on the floodplain was reviewed to contextualise how this would most favour waterbirds.

At the time of European settlement, the wetlands of the Clarence River floodplain sustained considerably higher numbers of waterbirds than at present. These wetlands were valuable natural resources for the local Aboriginal people with ducks, geese and swans easily hunted using traditional methods. European settlers displaced the local Aboriginal people from the floodplain in the 1800s, although through to the 1960s waterbirds were common food items for local residents with hunting being a popular sporting pursuit. European settlement dramatically altered waterbird habitat through the clearing of native vegetation, the introduction of farming and grazing, and hydrological alteration. The hydrology of the floodplain wetlands was altered initially by manually-constructed shallow drains but later, and more drastically, by a flood mitigation scheme that involved the construction of deep drains and channels affecting not only surface, but also sub-surface, hydrology. The subsequent ecological impacts included a dramatic decline in waterbird numbers and depletion of functional habitat. Only very recently have there been methodical efforts to restore locally important habitat, albeit incidentally to other restoration goals. On-going restoration efforts have focussed on modifying hydrological regimes on agricultural land for the control of acid sulphate discharge and creation of fish passage, although most recently a wetland area was purchased by government for nature conservation purposes.

I undertook waterbird surveys in wetlands across the floodplain from 2005 to 2007. I repeatedly identified and counted waterbirds in 13 of these wetlands during this time, and also measured salinity, pH, depth and temperature, and estimated the area covered by water at each visit. I then related the occurrence and number of each bird species to these environmental conditions. Over 60 species of waterbirds were recorded at the floodplain's wetlands, with 53 of these at the 13 monitored wetlands. One wetland, Little Broadwater, was outstanding relative to the other wetlands, in having consistently high numbers of species and birds. This was attributed to it being a large wetland and having retained consistently high levels of water. Wetlands consisted of two main types: those fed by rainfall and runoff only, and those fed by rainfall, runoff and regulated tidal flows through floodgates from the river or estuary. However, the abundances and number of species of birds were not significantly different between the two types of wetlands. Overall though, the wetlands differed significantly in the abundances and numbers of species, and of different ecological groups of birds. The most abundant species of waterbirds were Grey Teal *Anas gracilis*, Black-winged Stilt *Himantopus himantopus*, Black Swan, Pacific Black Duck *Anas superciliosa* and Eurasian Coot *Fulica atra*.

There were generally more waterbirds in wetlands that had a greater area of shallow water. This trend was shown in all foraging groups except diving omnivores, which was the only group where abundances increased as areas of water depths over 100 cm increased, but whose numbers decreased as areas of shallow depths increased. The abundances of all other groups increased as the areas of shallow depths increased. The results confirm the importance of shallow water depths in wetlands to waterbirds, and the potential importance of the aquatic-terrestrial transition zone. Therefore, incorporating bathymetric surveys with high vertical and horizontal resolution are strongly recommended for predictive management.

Of the 53 species recorded on the monitored wetlands, 13 were observed mostly in water of low salinity (<5 ppt total dissolved salts), with five of these species mostly limited to freshwater (<3 ppt), while 25 species occurred across all salinities (up to ~ 28 ppt). The Comb-crested Jacana *Irediparra gallinacea*, Pink-eared Duck *Malacorhynchus membranaceus* and Plumed Whistling Duck *Dendrocygna eytoni* were observed only in freshwater. Fifteen species were not categorised due to too few observations. The results here indicate that the introduction of more saline water (*e.g.*, by hydrological

manipulation via floodgates) could have an impact upon the preferred habitat of threatened species, such as the Comb-crested Jacana and other species that prefer freshwater, locally at least. Other threatened species, such as the Black-necked Stork *Ephippiorhynchus asiaticus* and Brolga *Grus rubicunda*, which occur in both fresh and saline habitats, are less likely to be adversely affected, and may even benefit.

Black Swans were excluded from part of a wetland to measure the grazing impact of this large, and at times abundant, waterbird. After 135 days, the mean above-ground biomass of the dominant sedge *Eleocharis equisetina* was significantly less in grazed sites (607 ± s.e. 81 $g.m^{-2}$) than in ungrazed sites (1259 ± s.e. 177 $g.m^{-2}$) (a difference of ~6.5 tonnes / hectare). This difference was mostly due to the loss of leaf biomass above the waterline in grazed sites. Black Swans grazed preferentially at water depths of at least 15-20 cm, although they moved into shallower areas after depleting the above-water food source in deeper areas. The result was an altered structural habitat for waterbirds above the ambient water level, yet habitat complexity for aquatic fauna and the potential for rapid regrowth of leaves remained. The grazing had the effect of creating open water resulting in more habitat for other birds such as wading birds (*e.g.*, Royal Spoonbills *Platalea regia*) and dabbling ducks (*e.g.*, Grey Teal). Grazing by Black Swans appeared to be an important natural component of the ecological function of many of the floodplain's these wetlands. Where water levels can be artificially manipulated, local wetland managers could attempt to restore the flood pulse to wetlands that are large enough to sustain Black Swan populations in order to retain a variety of other waterbirds that require open water.

Flood mitigation drains provided habitat for only a few common species of waterbirds, mostly the Pacific Black Duck. Birds that used the drains were from a range of foraging groups but with low numbers and species in each. Changes to water quality in the drains did not appear to significantly improve their habitat value. Limitations of drains as waterbird habitat appear to be due to their inherent shape and size, and because the water levels provide a poor view of their surroundings for birds to feel safe using them. Also, lack of shallows, steep sides, lack of aquatic vegetative habitat, difficult flight access, and disturbance from the surrounding land-use activities probably all contribute to these drains being of less value as waterbird habitat than natural wetlands. Future management options to improve drains as waterbird habitat include widening and shallowing drains to

remove the steep sides, an action consistent with the improved management of acid sulphate soils.

Because of the previous land use practices and ongoing restoration there was much interest from local and state government resource managers in the work I was undertaking, and how acquired knowledge could improve management for waterbirds. There appears to be considerable local support for improving the management of wetlands, which often included the restoration of waterbird habitat. Restoration opportunities, however, were limited by the prevailing uses of the land that prevented establishing hydrological regimes most beneficial to waterbirds. Acquisition of land for conservation purposes offered the best possibility to improve wetland management in this regard.

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Abbreviation		
cm	centimetre(s)	1 cm = 0.01 metres (m)
km	kilometre	1 km = 1,000 m
ha	hectare(s)	1 ha = 100 m x 100 m
pers. obs.	personal observation	by the author
cf	compared with / to	
e.g.	for example	
pers. comm.	personal communication	usually verbal
N$^{o.}$	number	
CVC	Clarence Valley Council	
NSW	New South Wales	
NPWS	National Parks and Wildlife Service	a group within DECCW
DECC	Department of Environment and Climate Change	up to 2009
DECCW	Department of Environment, Climate Change and Water	since 2009

Terminology	**International equivalent(s)**
catchment	watershed
drain	canal, ditch
swamp	any wetland