Invasion of Egeria into the Hawkesbury-Nepean River, Australia

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INTRODUCTION

Macrophytes are considered important components to the ecology of estuaries and freshwater ecosystems (Westlake 1975). Their role as structural habitats and food sources for invertebrates, fish and birds, effectiveness in reducing stream bank erosion, and removing excessive nutrients (Carpenter and Lodge 1986, Barko et al. 1991, Hart et al. 1993) suggests their importance to environmental managers.

The Hawkesbury-Nepean River in New South Wales (NSW), Australia, is the largest river system in the Sydney metropolitan area, and it drains most of the developing areas to the west. This catchment is under increasing pressure from urban expansion and the river frequently experiences extended periods of low flows due to a combination of extensive river regulation and the Australian temperate climate. Added to this, the river and several of its tributaries receive treated sewage and stormwater from various sources.

Habitats and biota within the Hawkesbury-Nepean River catchment have been altered since European settlement and many introduced species have spread throughout the terrestrial and aquatic environment (Recher et al. 1993). Submersed macrophyte assemblages within the river have undergone significant changes in their distribution and abundance due to eutrophication, habitat alteration and changes to river flows (Recher et al. 1993). Anecdotal evidence and some early unpublished studies3,4 suggest that ege-
ria (Egeria densa Planchon), introduced from South America as an aquarium plant, was present in the Hawkesbury-Nepean River prior to 1980. Sainty (1973) reported a persistent and troublesome infestation over a number of years at Wallacia in the upper Nepean River.

Egeria occurs throughout coastal NSW (Sainty and Jacobs 1981), but to date has not caused the same problems as in the United States, Japan and New Zealand. In New Zealand, it has become widespread and its competitive ability has allowed it to successfully dominate and in some cases displace assemblages of native aquatic plants (Clayton 1996).

Here, as part of a larger study on the ecology of macrophyte and invertebrate assemblages associated with anthropogenic disturbance in the Hawkesbury-Nepean River, we document the rapid spread of egeria since 1994. Significant increases in egeria biomass were also found, and we present preliminary evidence which suggests that the native ribbon weed, vallisneria (Vallisneria americana Michx.), is being displaced.

MATERIALS AND METHODS

In 1994, the submerged macrophytes within the Hawkesbury-Nepean River were mapped between Warragamba Dam and Wisemans Ferry to ascertain their large-scale distribution (Figure 1). Vegetation was mapped using a 4.5m Marlin Broadbird equipped with a Garmin-75 Global Positioning System (GPS) navigator, a Furuno paper sounder and a 3d Hummingbird sounder. These remote techniques were used in conjunction with “ground-truthing” using SCUBA. Macrophyte beds were directly recorded onto copies of 1:8000 scale air photographs using relative distances obtained with the GPS and depth sounders. For each bed, its size, species composition and depth were recorded. During this mapping exercise, we found that egeria had spread into areas where it had not been previously reported (Figure 1). The distribution of egeria was further determined during 1996, and its spread estimated (Figure 1).

RESULTS AND DISCUSSION

During our 1994 mapping study, we estimated that egeria occupied approximately 1.1 km² of river. In 1996, it was estimated that egeria occupied approximately 2.1 km² of river-bed within the 11.7 km² stretch of the Hawkesbury-Nepean River between Warragamba Dam and Wisemans Ferry (Figure 1). The fresh weight of egeria in the river during 1994 was estimated to be 9,500,000 kg, whereas by 1996 the estimated fresh weight was around 19,000,000 kg.

Also, at five randomly selected times (between September 1995 and October 1996) the biomass of both egeria and vallisneria were recorded from four fixed sites within the Hawkesbury-Nepean River. At each site, three macrophyte beds (> 5m²) were randomly selected and SCUBA divers harvested aboveground biomass samples from five randomly placed quadrats (0.04 m²) in each bed. The biomass samples were sorted into species and oven dried to constant weight at 105 °C for 48 hours prior to weighing to the nearest 0.01 g (Mathen 1995).

A mixed-sampling nested analysis of variance was used to test the null hypothesis that there were no spatial or temporal differences in the biomass of egeria or vallisneria. The site factor was considered fixed whilst time was considered random. The random “macrophyte” bed factor was nested within the interaction of the two main effects. The bed (time x site) term is valid because beds were haphazardly selected on each sampling occasion. The assumptions of normality and homogeneity of variances were checked prior to analysis of variance (Underwood 1981).

Analysis of the biomass of egeria and vallisneria at four fixed sites (Site 1—Smith Street; Site 2—Devlin Street; Site 3—North Richmond; Site 4—York Reach) revealed significant differences between sites and times. At the Smith Street site, the abundance of egeria increased significantly between September 1995 and October 1996 (Figure 2a) and was concomitant with a significant
displaced relatively quickly by this exotic species. In New

care for the Hawkesbury-Nepean River. Our data indi-

ted that hydrilla could out-compete vallisneria because its

first 0.3 m in the water column.

increased significantly through time, however a significant decrease in the abun-
dance of vallisneria occurred in the Wallacia area (Sainty 1973)

sent and whole plants of egeria became detached from beds between Penrith and Richmond and were transported
down the river during a high-flow flood event. Since that

time, egeria has increased its range downstream into the

rivers comparable with the Hawkesbury-Nepean and the

presence of this plant should always be treated seriously. 

infestations, thus there is a risk that water managers have

come complacent about its potential threat. However, Graham

(1976) reports that concentrations of dissolved ammonia,
nitrate and phosphorous were not depleted in beds of thick
egeria compared with open water.

Significant flood events over the past year have not

reduced the abundance of egeria but appear to have caused
its spread downstream. For example, in January 1995, frag-
ments and whole plants of egeria became detached from beds between Penrith and Richmond and were transported
down the river during a high-flow flood event. Since that
time, egeria has increased its range downstream into the
Hawkesbury River, as fragments of the plant are capable of
vegetative reproduction (Sainty and Jacobs 1981).

The rapid infestation of egeria into the Hawkesbury-
Nepean has the potential to adversely affect the river by

restricting navigation and boating, clogging irrigation and
water supply systems, and slowing river flow. In addition,
dense beds of egeria alter the distribution and abundance of
native macrophyte and invertebrate assemblages, block the
migration of fish, affect water chemistry, depreciate mone-
ty and aesthetic value of waterfront, and severely limit recre-

ational usage.

In the course of two years, growing restrictions to naviga-
tion and the loss of native macrophyte habitats have become
evident. Egeria has been present in Australia for many years
and has not yet caused any troublesome or prolonged weed
infestations, thus there is a risk that water managers have

come complacent about its potential threat. However, it
has been a major problem in other parts of the world with

it ability to thrive in slow flowing waterbodies containing high nutrients is well-documented (Sainty and Jacobs 1981). The Hawkesbury-Nepean River is considered to be eutrophic because the median total phosphorus (TP: 95 μg L⁻¹) and nitrogen (TN: 1.3 mg L⁻¹) concentrations exceed the Australian water quality guidelines (TP: 50 μg L⁻¹; TN: 1.0 mg L⁻¹) for fresh waters (ANZECC 1992). Over the last few years, low flows have occurred which may also be assisting egeria in establishing itself as the community domi-
nant (Cummins et al. 1997).

Egeria and similar species slow water flow substantially and increase siltation rates (Graham 1976, Carpenter and Lodge 1986). Macrophytes have the ability to remove excess nutrients from waterbodies (Carpenter and Lodge 1986, Rat-
tray et al. 1991). Therefore, one could conclude that a prolif-
eration of nutrient removing plants would be beneficial to a river system that was highly eutrophic. However, Graham
(1976) reports that concentrations of dissolved ammonia, nitrate and phosphorous were not depleted in beds of thick
egeria compared with open water.

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LITERATURE CITED


