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FINAL DETERMINATION

The seagrass *Posidonia australis* as Endangered Populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a final determination to list the seagrass *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW) as ENDANGERED POPULATIONS in Part 2 Schedule 4 of the Act.

The listing of Endangered Populations is provided for by Part 7A, Division 2 of the Act.

The Fisheries Scientific Committee, with reference to the criteria relevant to this species, prescribed by Part 11B of the *Fisheries Management (General) Regulation 2002* (the Regulation) has found that:

Background

1. The seagrass *Posidonia australis* Hook.*f.* (1858) is a valid, recognised taxon and is a species as defined in the Act.
2. Seagrasses are flowering plants (marine angiosperms) that can complete their life cycle completely submerged in marine waters, but are not related to terrestrial grasses. The seagrass *Posidonia australis* is a member of the family Posidoniaceae. It is very similar in growth habit and form to *Posidonia oceanica,* which occurs in the Mediterranean (Kuo 1978, Kuo & Cambridge 1978). There are a number of additional *Posidonia* species in Western Australia and further work is required on the genetics of both the species and the family (Waycott 1995, Waycott *et al*. 1997).
3. *Posidonia australis* is widely distributed, sub-tidally, in temperate and cool-temperate marine waters of southeast, southern and southwest Australia. The type locality is Georgetown, Tasmania. It occurs in extensive meadows in the Gulfs of South Australia and along the open coastline of southern Western Australia (Larkum & McComb 1989). In NSW, the largest meadows of *Posidonia australis* are found on soft sedimentary environments, within the protected waters of marine embayments and marine dominated coastal lakes. In these environments it is often the dominant plant community (West *et al*. 1985, West *et al*. 1989). Within the state, the species occurs from Wallis Lake in the north to Twofold Bay in the south. In addition, there are a few isolated populations found at sheltered sites along the open coastline and offshore islands of NSW (West *et al*. 1985, West *et al*. 1989).
4. In the Sydney and Central Coast Region of NSW, populations of *Posidonia australis* are found in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters, Lake Macquarie and Port Stephens (West *et al*. 1985).
5. Meadows of *Posidonia australis* are composed of a rhizome mat, usually buried under the sand or mud, with vertical shoots emerging through the sediment. Each shoot carries 2-4 strap-like leaves, which are often heavily covered with epiphytes. Leaves grow quickly and provide a highly productive (Kirkman & Reid 1979, West & Larkum

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1979), sheltered environment for fish (Burchmore *et al*. 1984, Bell et al. 1992, McNeill & Bell 1992, Rotherham & West 2002). The plant spreads across the surface of the seafloor by extending horizontal shoots into bare areas, which consolidate sediment and become buried. As the rhizome mat spreads, it consolidates and produces a complex arrangement of dense vertical shoots. The development of large meadows of *Posidonia australis* is thought to have occurred primarily through rhizomatous growth, that is, through the division and spreading of the horizontal shoots. This process is extremely slow (West 1983, Meehan & West 2000), and it has been calculated that the existing extensive meadows of *Posidonia australis* may have taken centuries to establish. Restoration of meadows of *Posidonia australis* is also a very difficult and slow process, which has proved largely unsuccessful to date (West *et al.* 1990, West 1996, Kirkman 1998, Meehan & West 2002, Ganassin & Gibbs 2008).

6. Sexual reproduction in *Posidonia australis* is by the production of monoecious flowers that are pollinated underwater. There is evidence that cross-pollination is not uniform and can occur across relatively large areas (Waycott & Samspon 1997), although probably not between estuaries. Fruits are produced that float and can be distributed by currents. The fruits split open to reveal the seed. Seedlings are very rarely observed, except in some coastal lakes (e.g., St Georges Basin). It is estimated that seedlings take decades (or longer) to develop into mature plants (Kirkman 1998, Meehan & West 2004), although development of a mature meadow from seedlings has not been observed in any *Posidonia* species.
7. The slow development of individual plants, the likely low level of dispersal of fruit and seeds and the slow expansion rate of meadows mean that existing areas of *Posidonia australis* within the estuaries and embayments of NSW can effectively be considered as isolated populations in respect to their long-term survival.
8. All seagrasses, including *Posidonia australis*, are protected within NSW waters (NSW DPI 2007). In addition, there are a number of aquatic reserves and marine parks which provide some protection for the species at some locations (e.g., Towra Point Aquatic Reserve, Jervis Bay Marine Park. Port Stephens-Great Lakes Marine Park, Batemans Marine Park).
9. Seagrasses in many regions and locations around the world are considered under threat from a range of anthropogenic activities and losses may have severe impacts on biodiversity and productivity in estuaries and near-shore environments (Orth *et al*. 2006).

Criteria – reduction in abundance, geographic distribution or genetic diversity (Regulation clause 340I)

1. Mapping from historical aerial photographs and records from the scientific literature have demonstrated that extensive and continuous meadows of *Posidonia australis* occurred in many areas in the latter part of the 20th century. Many changes in area of *Posidonia australis* have occurred (e.g., Larkum & West 1990), although these changes are often difficult to quantify due to poor historical data and changes in mapping techniques between surveys (e.g. Williams et al 2003, Williams et al 2006).
2. Despite the problems in calculating the historical changes in seagrass areas, a combination of anecdotal and scientific information is available that indicates that significant losses in area have occurred in the populations of the seagrass *Posidonia australis* within a number of estuaries and embayments in the Sydney and Central

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Coast region. For example, documented losses of 18% from Port Hacking since the 1950s (Meehan 2001), losses of 57% from Botany Bay since the 1940s (Larkum & West 1990), and losses of 12% from Pittwater, 32% from Brisbane Waters and 47% from Lake Macquarie since the mid-1980s (NSW DPI, unpublished information).

3. In addition to these documented losses, there is anecdotal information to suggest significant declines in the area of *Posidonia australis* occurred much earlier than the late 20th century and have gone largely undocumented. Many sites in Port Hacking, Botany Bay and Sydney Harbour, originally suitable for *Posidonia australis*, were subject to significant modifications during the late 19th and early 20th century. Major dredging and reclamation operations occurred during this period and only a few records exist of the impacts of these developments (e.g., see Larkum 1976).
4. In light of the above, the Fisheries Scientific Committee has found that populations of the seagrass *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW) have undergone a very large reduction in abundance and a very large reduction in geographic distribution within a time frame appropriate to the life cycle and habitat characteristics of the taxon; this meets the criteria of an Endangered Population.

Criteria – threatening processes (Regulation clause 340J)

1. There are many causes for the declines in extent of *Posidonia australis*. Direct physical damage has occurred from dredging, sand mining, reclamation, boat moorings, boat propellers, bait gathering and from changes to the physical environment (e.g., wave heights). Losses have also occurred at some locations due to anthropogenic changes in water quality, particularly increased nutrients and reductions in water clarity. These latter losses are more difficult to identify and quantify. In addition, the invasive pest alga *Caulerpa taxifolia* has invaded many estuaries in NSW (NSW DPI 2009), and this may have some long-term consequences for *Posidonia australis* within Port Hacking, Botany Bay, Sydney Harbour, Pittwater and Brisbane Waters.
2. In light of the above, the Fisheries Scientific Committee has found that the threatening processes continue to operate in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW).

Conclusion pursuant to section 220FA(1) of the Act

In the opinion of the Fisheries Scientific Committee that:

a. Populations of the seagrass *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW) are facing a very high risk of extinction in the near future, as determined in accordance with the criteria prescribed by the Regulation as discussed above; and

b. The seagrass *Posidonia australis* in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (NSW) are eligible to be listed as ENDANGERED POPULATIONS.

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