Submission on

EPBC Act referral 2020/8652: WaterNSW Macquarie River Re-regulating Storage

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1. Executive Summary

The building of a re-regulating storage on the Macquarie River, as a proposed action has been referred to the Australian Government Department of Agriculture, Water and the Environment for assessment against Matters of National Environmental Significance (MNES) (EPBC Act referral 2020/8652).

Matters of National Environmental Significance (MNES)

- First, the referral acknowledges that the proposed action is likely to have a direct or indirect impact on the ecological character of the Ramsar listed Macquarie Marshes, but concludes that this impact is not significant. This is clearly wrong andcontradicts the overwhelming scientific evidence for the management of the health of the Macquarie Marshes and scientific understanding of river flow and inundation regimes, the listed advice on the management of the ecological character of the Marshes as a Ramsar site, as well as the evidence presented in this submission.
- Second, the referral acknowledges that the proposed action is likely to have a direct or indirect impact on nationally listed threatened species or their habitats or any threatened ecological community, concluding that this impact is significant. This submission supports this conclusion, based on the scientific evidence but points out the inadequacy of the proponent's preliminary assessment in relation to the level of impact.
- Third, the referral acknowledges that the proposed action is likely to have a direct or indirect impact on listed migratory species or their habitats but then concludes that this impact is unlikely to be significant. This is clearly wrong and contradicts the overwhelming scientific evidence for the management of the health of the Macquarie Marshes and scientific understanding of river flow and inundation regimes, the listed advice on the management of the ecological character of the Marshes as a Ramsar site, as well as the evidence presented in this submission.

Ecosystem assessment of the proposal

The proposed development, an increase in the regulation of flows in the Macquarie River, is likely to have a significant impact on a considerable range of Matters of National Environmental Significance, particularly the Macquarie Marshes Ramsar site, nationally threatened species, and migratory species, under the EPBC Act 1999. Further, it will significantly degrade these downstream ecosystems, including habitats for nationally threatened and migratory species, already in decline because of the building of dams and diversion of water. The Australian Government notified the Ramsar Secretariat in 2010 of a "likely change in ecological character of the Macquarie Marshes Ramsar site", stating a range of reasons based on scientific evidence, including changes in the flow regime; change in the extent and condition of the wetland vegetation communities in the southern part of the Macquarie Marshes Nature Reserve; change in extent and condition of wetland

vegetation communities in the northern section of the Macquarie Marshes Nature Reserve; changes in the ecological character of the Wilgara wetland and; changes in colonial waterbird breeding (http://www.environment.gov.au/water/topics/wetlands/database/pubs/28-statement-of-reasons-3-2-notification-20100204.pdf). Further details on the extent of these issues are outlined in this submission. There is limited scientific evidence to indicate that these issues have been significantly addressed, even though there is increased environmental flow to the Macquarie Marshes. The proposed re-regulating storage will exacerbate ongoing decline in all of the elements outlined in the Australian Government's 2010 notification.

Proposal specification – size and scale

A critical issue relates to uncertainty about the size of the proposed re-regulating storage. The referral states that the "preferred option for the project is a new 6,000 megalitre (ML) re-regulating storage" (p. 1, EPBC Act referral 2020/8652 – Macquarie River Re-regulating storage). A different project is presented in the scoping document (WaterNSW, 2020), submitted for referral under the EPBC Act 1999, about 37% larger in capacity. The scoping document (p.9) states: "Recent investigations into water security for the Macquarie River included the analysis of a new reregulating storage with a capacity of up to 9,500 megalitres (ML) of water" (WaterNSW, 2020). This submission assumes the lower size of 6,000 ML re-regulating storage but this problem highlights the lack of transparency around this proposal in relation to its size and scale and effect on the hydrology, which are all highly relevant to Matters of National Environmental Significance under the EPBC Act 1999.

Best available scientific evidence

The proponents have inadequately outlined the range of impacts that this proposal will have on the downstream Ramsar site, nationally threatened species or migratory species, all of which are Matters of National Environmental Significance under the EPBC Act 1999. Insufficient scientific evidence has been taken into account in the assessment of the proposal, despite the considerable understanding about the relationship between river flows and flooding regime, and dependent ecosystems, such as Ramsar wetlands, nationally threatened species, and migratory species. This submission provides a brief summary of the scientific evidence in relation to the Macquarie Marshes, supported by peer-reviewed literature.

Further, the scoping document supporting the proposal implies that the establishment of the re-regulation storage in the Macquarie River will be at worst neutral, but may actually improve environmental flow management. This is contrary to current evidence-based, scientific understanding of river management, which is outlined in this submission.

Alternative management options – improved water security

There is no presentation of other potential options for improving water security in the Macquarie River catchment, which may reduce environmental, social, cultural, and economic impacts. In a recent peer-reviewed, scientific paper (Steinfeld et al., 2020), the authors identify that the particular high risk approach to the management of the Macquarie River and water allocations, different to some other rivers in NSW, actually reduces water security during dry periods. Water management in the Macquarie River operates under a 'credit' model where allocations are based on the history of record for run-off into the dams even if there is no water in the dam. In dry periods, this can result in allocations provided before there is sufficient water as in the recent dry period (2018-2019). Water security could be improved by adopting different management practices.

Assessment process

The proponent, WaterNSW, prefers "that the proposed action be assessed using an accredited process" in NSW. This 'preferred' approach should not be followed, given the significance of this development and the likely significant impacts it will have on Matters of National Environmental Significance. This is a national obligation and needs to be an independent process, not one where the NSW Government is assessing its own project – a clear conflict of interest. Further, the NSW assessment process is not equivalent for assessing on Matters of National Environmental Significance, given some limitations of Part 5 of the Environmental Planning and Assessment Act 1979 in NSW, particularly in relation to: rigour, independence, public consultation, enforceability, and ability to adequately assess on Matters of National Environmental Significance.

Recommendation

This proposed development is nationally significant, likely to have significant impacts on a range of Matters of National Environmental Significance, and needs to be assessed by the Australian Government Department of Agriculture, Water and the Environment under the EPBC Act 1999, not through an accredited process in NSW. The *Re-regulating Storage on the Macquarie River proposal 2020/8652* should be designated a controlled action under the EPBC Act 1999 and require assessment by public inquiry.

2. The Macquarie River and the Macquarie Marshes

The Macquarie River runs west from the Great Dividing Range, with flows primarily dependent on rainfall in its upper catchment (Fig. 1) (Kingsford and Thomas, 1995). Flows are heavily regulated in the Macquarie River by Burrendong dam and Windamere Dam (Fig. 1), affecting the river downstream to the Macquarie Marshes until it reaches the Darling River. However, the Bell River, Little Bell River, and Talbragar Rivers (Fig. 1) are all unregulated rivers which join the Macquarie River, downstream of Burrendong Dam. This means their flows are primarily natural. This is critical because they mimic the natural flow

regime on which many ecological processes and the organisms depend. This includes nationally threatened species and migratory species, which rely on triggers and stimuli from these flows for survival and breeding and recruitment. The unregulated flows as well as the dedicated adaptive environmental water are essential for supporting these organisms in the Ramsar-listed Macquarie Marshes (Fig. 1), thereby maintaining its ecological character.

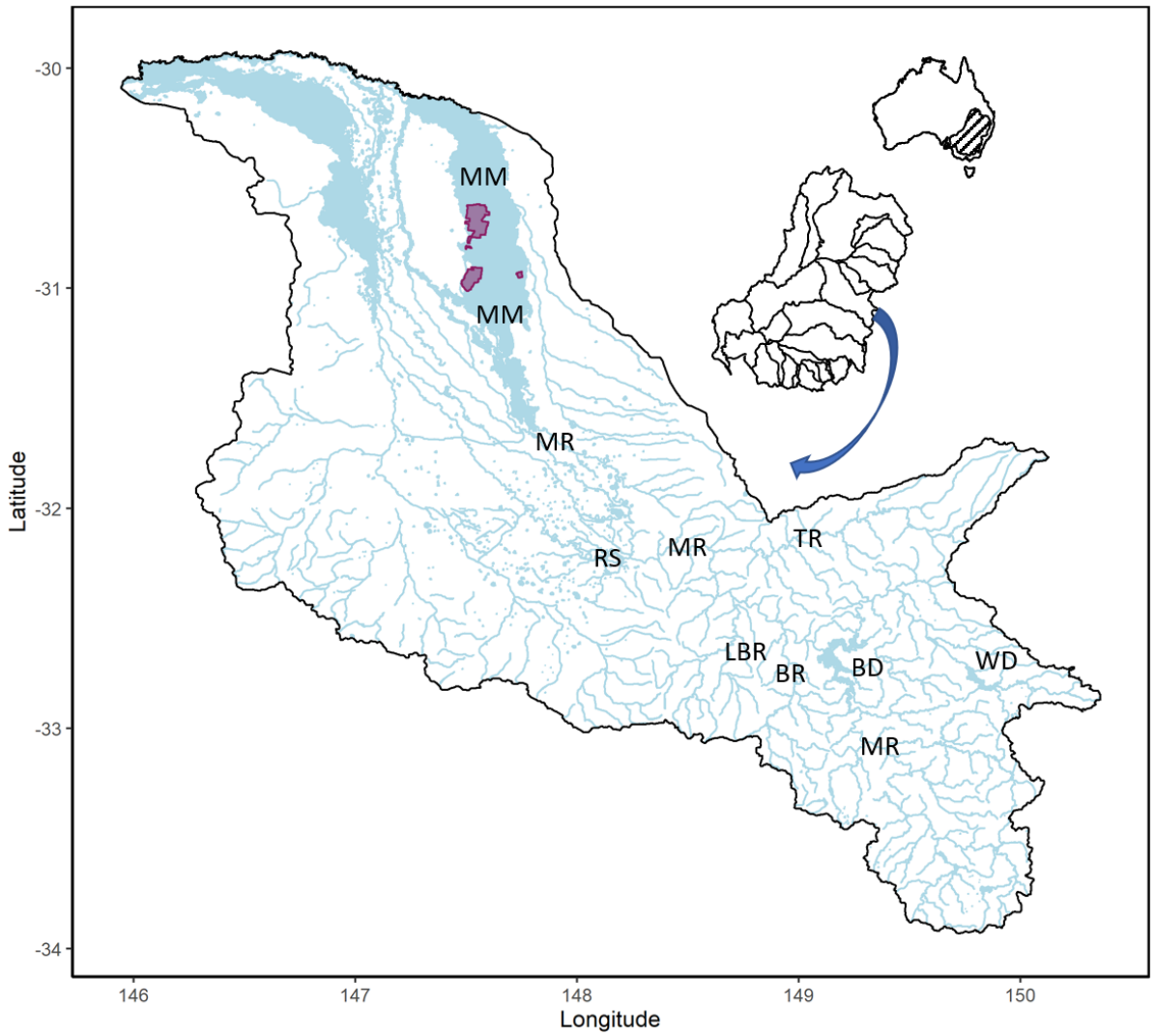


Fig. 1. Macquarie river catchment in the Murray-Darling Basin (insets), showing the location of the Macquarie River (MR), Burrendong Dam (BD) and Windamere Dam (WD), naturally flowing tributary rivers (Bell River (BR), Talbragar (TR) and Little Bell River (LBR), as well as the proposed re-regulation storage (RS), and mapped downstream ecosystems (Kingsford et al., 2004) affected by this proposal, including the Macquarie Marshes (MM), within which are the Ramsar-listed Macquarie Marshes Nature Reserve and Wilgara Wetland (purple).

The wider Macquarie Marshes and Ramsar-listed Macquarie Marshes Nature Reserve and Wilgara Wetland, depend primarily on both natural and managed environmental flows and flooding regimes from the Macquarie River (Kingsford and Thomas, 1995; Kingsford and Auld, 2005; Ralph and Hesse, 2010). It is the natural variability and quantity of water which determines the extent and quality of habitat for the many different species that depend on

this Ramsar-listed site, and adjacent floodplain wetlands, and other wetlands. These flows provide the essential flooding regimes which support some of Australia's most important wetland areas for biodiversity. They also support ecosystem services in the form of floodplain areas for cattle grazing and tourism, as well as many culturally important sites (NSW Office of Environment and Heritage, 2012). The unregulated floods, particularly the significant large floods, are critical for sustaining this ecosystem of national and international importance (Kingsford and Thomas, 1995; Thomas et al., 2011; Bino et al., 2015b; Thomas et al., 2015). It is these large floods that inundate the extensive mosaic of different types or vegetation including river red gum (*Eucalyptus* camaldulensis) forests, reed bed swamps (predominantly *Phragmites australis*), water couch (*Paspalum distichum*) areas, lignum (*Duma florulenta*) areas, and coolabah (*Eucalyptus coolabah*) and black box (*Eucalyptus largiflorens*) floodplains. These support 233 native bird species, including 77 waterbirds many of which occur in extensive and abundant populations in the region (Kingsford and Thomas, 1995), as well as 60 native reptiles, up to 11 species of native fish, 29 small and large native mammals, 15 native frogs, and 324 plant species (NSW Office of Environment and Heritage, 2012). The wetland is so significant, it provides some of the most important breeding areas forwaterbird populations, including straw-necked ibis (*Threskiornis spinicollis*), Australian white ibis (*Threskiornis moluccus*), glossy Ibis (*Plegadis falcinellus*), intermediate egret (*Ardea intermedia*), great egret (*Ardea alba*), nankeen night-heron (*Nycticorax caledonicus*), and different cormorant species (*Phalacrocorax sp.*). There are also a range of other waterbirds including ducks, grebes, wading birds which also occur in the Macquarie Marshes. In particular, the extensive reed bed swamps of the Macquarie Marshes are particularly important for the nationally endangered Australasian bittern (*Botaurus poiciloptilus*) and Australian painted snipe (*Rostratula australis*). The Macquarie Marshes are one of the most important sites for waterbirds in Australia.

3. Proposed Project – Re-regulating Storage on the Macquarie River

The proposed project involves building a weir across the Macquarie River near Narromine (Fig. 1) and creating a weir pool upstream for about 30 kilometres, the re-regulating storage. It is called a ‘re-regulating storage’ because it can capture unregulated flows and store those for later release, primarily for irrigation.

i. Project size and scale

This project has caused considerable concern in the community, reflected in the community comments in the scoping document in the appendices. There has been considerable concern about the likely impacts of the proposal but the proponent WaterNSW has not provided key information relevant for assessing the scale of the downstream impacts on Matters of National Environmental Significance under the EPBC Act 1999. In particular, the size of the development and the amount of water which will be ‘secured’, primarily for irrigation and town water supply remains largely unspecified making even a preliminary assessment of this referral difficult to assess. Despite consultations, there is uncertainty

about the project and scale of this re-regulating storage, even on the dedicated web site information https://www.waternsw.com.au/projects/regional-nsw/macquarie-river-re-regulating-storage.

This is most obviously identified in two differently sized projects, provided in the referral and in the scoping document. The referral states that the "preferred option for the project is a new 6,000 megalitre (ML) re-regulating storage" (p. 1, EPBC Act referral 2020/8652 – Macquarie River Re-regulating storage). A different project is presented in the scoping document (WaterNSW, 2020), submitted for referral under the EPBC Act 1999, about 37% larger in capacity. The scoping document (p.9) states: "Recent investigations into water security for the Macquarie River included the analysis of a new reregulating storage with a capacity of up to 9,500 megalitres (ML) of water" (WaterNSW, 2020). This represents an ongoing concern about transparency about this project and the level of impact on the environment and downstream communities. This submission assumes a 6,000 ML re-regulating storage.

ii. Downstream and onsite hydrological effects

Downstream effects can be primarily identified by examining the project objectives as there is no other information in relation to the size and scale of this project, or for its impact on downstream hydrology. Four objectives are provided in the referral (p. 1, EPBC Act referral 2020/8652 – Macquarie River Re-regulating storage):

- achieve long-term water security strategic objectives in the Macquarie River catchment;
- improve delivery efficiency to water customers downstream of Gin Gin Weir;
- reduce transmission losses when transferring and delivering water through the river system on an annual basis and;
- maximise available water for general security water customers within the sustainable diversion limits set under the Murray-Darling Basin Plan.

The key elements of these objectives are delivery efficiency, reduction in transmission losses, and maximising available water for general security. This identifies that the proposed weir and re-regulating storage structure is aimed to capture unregulated flows in the Macquarie River so that they can be diverted primarily for irrigation. This water is currently not diverted for irrigation. It goes to support the riverine environment, including downstream wetlands such as the Macquarie Marshes and its dependent organisms. The proposed re-regulating storage on the Macquarie River will reduce flows downstream to these important, nationally significant and Ramsar-listed wetlands, and will have socio economic impacts on downstream areas of the Macquarie Marshes. It will be able to redirect planned environmental water and unregulated water from the Little Bell River, the

Bell River and the Talbragar Rivers – all of which are currently unregulated and exhibit flows consistent with natural regimes - for irrigation use downstream. The quantity of flows which will be taken from the environment, as a result of this proposed structure remains unknown.

The proposal also specifies a 30km upstream weir pool. This will kill riparian vegetation such as river red gums because these plants cannot tolerate permanent inundation resulting from this pool. There are also a range of other impacts to biodiversity, changing the river from a flowing ecosystem to a lake type ecosystem (Walker, 1985; Walker et al., 1994; Blanch et al., 2000). In addition, this proposed re-regulating storage will affect the passage of nutrients and organisms that need to migrate up and down the river. This includes a range of native fish species, likely including nationally threatened species such as Murray cod (*Maccullochella peelii*), silver perch (*Bidyanus bidyanus*), and Macquarie perch (*Macquaria australasica*). The provision of a potential fish ladder or fishway does not ameliorate this problem. Fish species and other organisms naturally navigate a river without obstructions better than a river with obstructions. It is for this reason that the New South Wales Fisheries Act 1994 specifies that the erection of instream barriers is a key threatening process for native fish species in New South Wales. The fish communities of the Macquarie River and Macquarie Marshes are in extremely poor condition and are identified already as and endangered ecological community: *The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/endangered-ecological-communities/darling-river-eec#:~:text=The%20Darling%20River%20endangered%20ecological,of%20New%20South%20Wales%2C%20and). Native species are affected by river regulation including the building of dams and weirs (Gehrke et al., 1995; Gehrke and Harris, 2001; Koehn et al., 2014), such as this re-regulating storage, and the diversion of water from the rivers and development on the flood plain. Exacerbating this problem introduced species like European carp (*Cyprinus carpio*) and mosquito fish (*Gambusia affinis*) benefit from the introduction of such regulatory structures in the Macquarie River (Rayner et al., 2009; Rayner et al., 2015; Cruz et al., 2020).

ii. Alternative options for water supply

The purpose of the re-regulating storage on the Macquarie River is to "improve water security, reliability and delivery efficiency in the Macquarie River valley" (WaterNSW, 2020). This was particularly acute during the recent 2018-2019 drought, when some of the towns along the Macquarie River were running short of drinking water and a decision was made to shut off water supply in the Macquarie River from the lower downstream areas. This re-regulating storage on the Macquarie River focuses primarily on water security, including as a supply measure for ensuring that town water supply is more reliable. WaterNSW have not considered other options for managing this issue, including the potential effects of

management rules in the Macquarie River. This is clearly identified in a recent scientific paper which demonstrates the riskiness of current water management in the Macquarie River (Steinfeld et al., 2020).

The Macquarie River is run as a 'credit' model, essentially with predictions about how much more water is projected to fall in the catchment driving the allocation of water (Steinfeld et al., 2020). This is a highly risky approach to water management and when there are dry periods which are not predicted occur, there is an increased risk of running out of water. In 2018-2019, the Macquarie River and the towns it supplied started to run out of water. A lower risk approach to the management of water in the Macquarie River, such as waiting until there is sufficient water in the dams and managing the releases to limit evaporation, would limit vulnerability to water scarcity. It would also make this proposal of building the re-regulating storage on the Macquarie River unnecessary, maintaining the importance of unregulated flows for downstream ecosystems and communities. This is quite apart from the ecological and socio-economic impacts on the river which will be caused by the weir.

There is no compelling case provided for socio-economic benefits of this development. In particular, the community downstream has not been adequately consulted on the long term effects of reducing flows in the River system and ecosystem services to downstream communities.

4. Current condition of the Macquarie River and Macquarie Marshes

The Macquarie Marshes and the Macquarie River are in poor ecological condition reflected in declining ecology and abundance and diversity of dependant aquatic organisms. This has resulted from the development of dams and river regulation structures such as the proposed re-regulating storage on the Macquarie River.

The current condition of The Ramsar-listed wetlands and the adjoining areas of the Macquarie Marshes are in decline, recognised by the extensive peer-reviewed, scientific evidence (Ralph and Hesse, 2010; Ren et al., 2010; Thomas et al., 2010; Ren and Kingsford, 2011; NSW Office of Environment and Heritage, 2012; Steinfeld and Kingsford, 2013; Bino et al., 2014; Bino et al., 2015b; Catelotti et al., 2015; Rayner et al., 2015; Thomas et al., 2015; Kingsford et al., 2017; Cruz et al., 2020). This is reflected in declines in flow and inundation area in terms of frequency and flow volume (Kingsford and Thomas, 1995; Ren et al., 2010; Thomas et al., 2010; Ren and Kingsford, 2011; Thomas et al., 2015). This is causing a decline in areas of flood-dependent vegetation (Thomas et al., 2010; Bino et al., 2015b), including causing the mortality of river red gum forests (Catelotti et al., 2015). Many different frog species are also highly reliant on the now-reduced flooding and flows and this is likely to be causing long-term declines in frog species (Ocock et al., 2016). Native fish populations are declining, and introduced species of fish (e.g., European carp (*Cyprinus carpio*)) are increasing in the Macquarie River and the Macquarie Marshes (Rayner et al., 2009; Rayner et al., 2015; Cruz et al., 2020). Increased regulation of flows is increasingly impacting by

reducing native fish populations and creating conditions which enable introduced species to thrive (Gehrke et al., 1995).

The Macquarie Marshes are among the most important wetlands for waterbird populations in the Murray-Darling Basin and Australia (Kingsford and Thomas, 1995; Bino et al., 2015a; Kingsford et al., 2017; Bino et al., 2020), sustaining significant populations of waterbirds at times, albeit in long term decline (Fig. 3). The Macquarie Marshes also represents one of the more important sites for the breeding of waterbirds in Australia with tens of thousands of waterbirds of up to 10 colonial-nesting species breeding regularly in the Macquarie Marshes (Fig. 4). The regulation of the Macquarie River and impacts on flows and flooding have caused long term declines in the number of breeding of colonial waterbirds and the frequencies of breeding (Kingsford and Johnson, 1998; Kingsford, 2005).

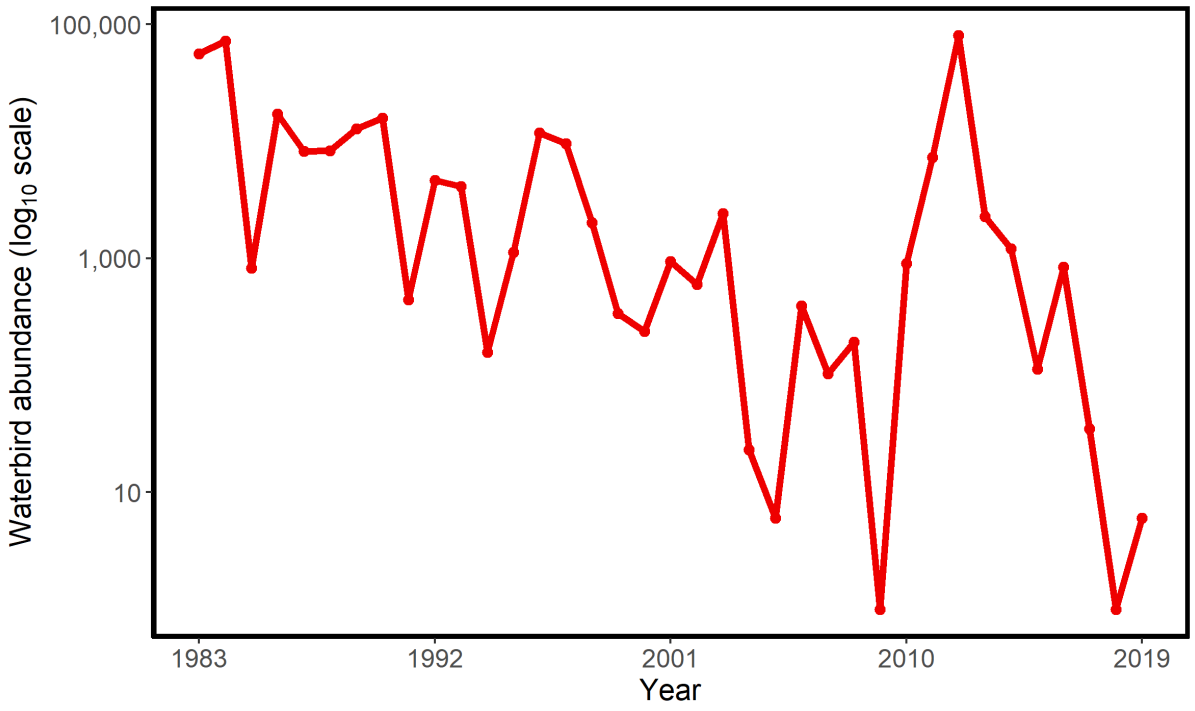
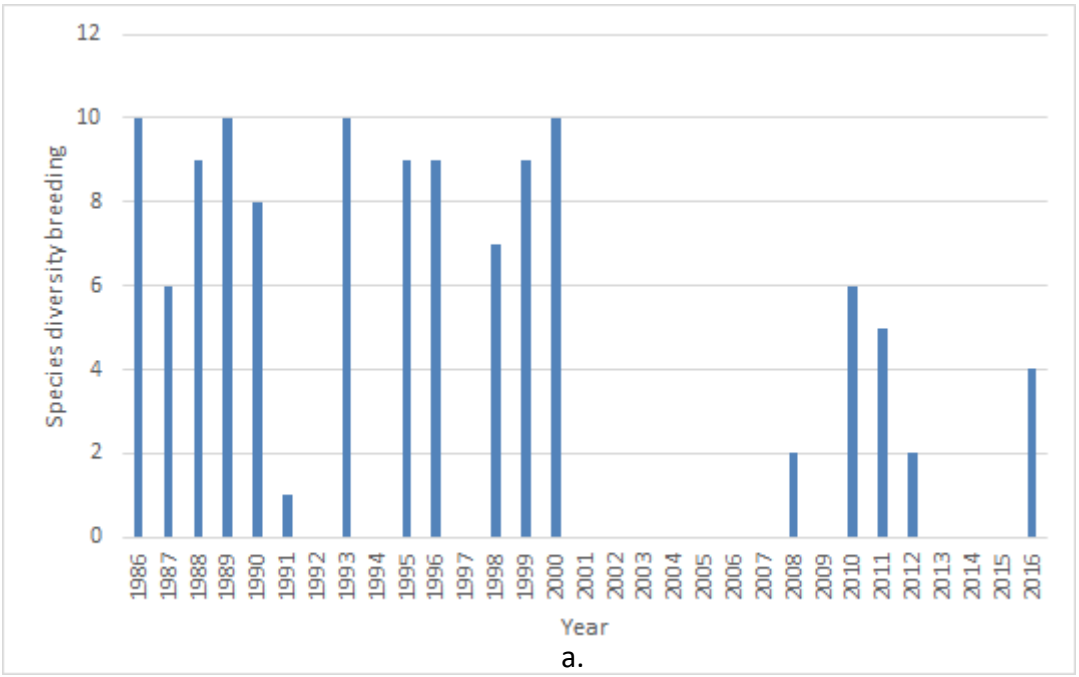


Fig. 3. Aerial surveys of waterbirds in the Macquarie Marshes, where about one third of the Macquarie Marshes are surveyed in October of each year (Kingsford and Thomas, 1995; Kingsford and Porter, 2009; Kingsford et al., 2017), showing considerable variation but a long term decline in abundance (1983-2019).



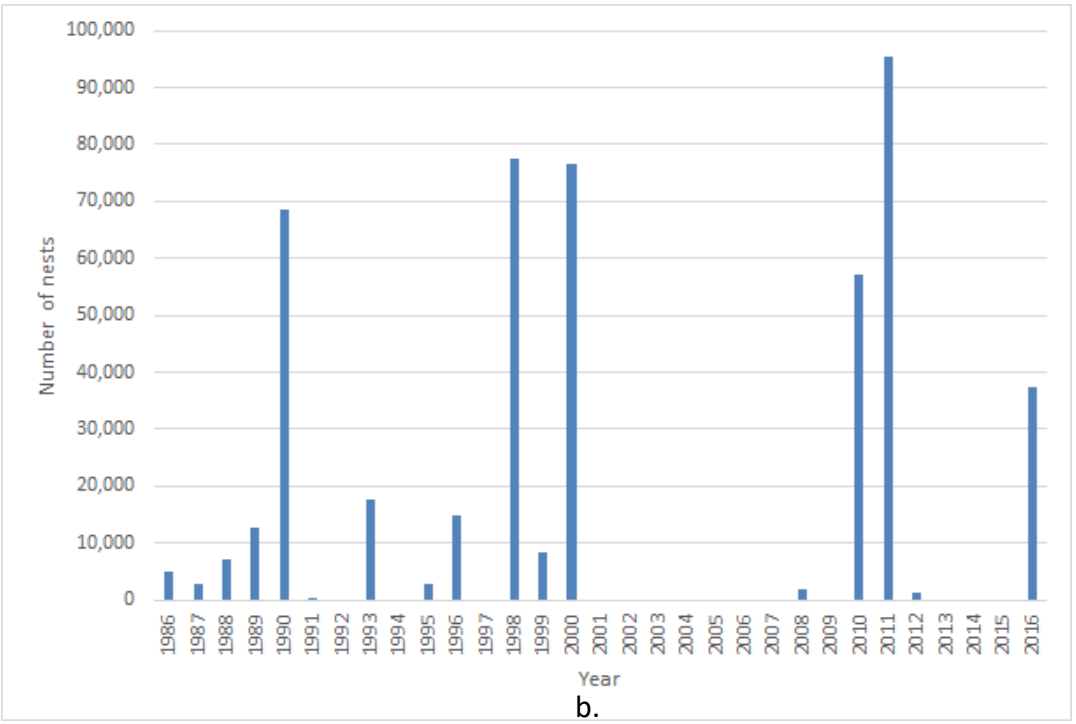


Fig. 4. Breeding of colonial waterbirds in the Macquarie Marshes (1986-2016), showing a. the number of breeding species and b. estimated number of nests (Kingsford and Johnson, 1998; Kingsford, 2005; Bino et al., 2014). No breeding of colonial waterbirds has occurred since 2016.

These scientific studies have all shown the inextricable links between flows in the Macquarie River and the habitats created in the Ramsar-listed Macquarie Marshes and the broad floodplain wetlands. They also clearly identified dependencies of native species, communities, and populations on river flows and subsequent declines in flow and flooding

regimes. These are poorly accounted for in the referral or scoping document (WaterNSW, 2020). In particular, some of the interpretations provided by the proponent are scientifically misleading. In the scoping document (WaterNSW, 2020) (p. 10), there is an acknowledgement that the Macquarie Marshes has some of the largest scale waterbird breeding events ever recorded in Australia and that this is assisted by targeted delivery of water for the environment the creeks rivers and lagoons in the Macquarie system. This rationale ignores the published science. It does not reference any of the original research (Kingsford and Johnson, 1998; Kingsford and Auld, 2005; Bino et al., 2014) or the NSW Government's publications in relation to waterbird breeding (NSW Office of Environment and Heritage, 2012). These publications and the links to river flow regimes clearly demonstrate that it is the unregulated flows, the same flows that are likely to be affected by the proposed re-regulating storage on the Macquarie River, that are most important for the breeding of waterbirds. It is critical to maximise the amount of uncontrolled flows which reach the Macquarie Marshes to ensure that the extent of breeding can occur that marks this area as a wetland of international importance under the Ramsar Convention.

In the scoping document (WaterNSW, 2020) (p. 11), there are a number of comments made about the value of the Macquarie Marshes in relation to water from the Macquarie River. These include supporting riverine and wetland ecosystems including: river red gum forests, reed beds, and water couch meadows; critical water needs of colonies of nesting waterbird species; feeding and breeding habitat for a range of water birds; opportunities for breeding a movement of native fish including Murray cod and golden perch; and a habitat for several species of international migratory shorebirds that visit the catchment. These values and Matters of National Environmental Significance under the EPBC Act 1999, will be affected by the development of a re-regulating storage on the Macquarie River as it will reduce the amount of water making its way to this wetland of international importance, reducing overland flooding, critical to creating habitat for nationally threatened species, migratory species and the ecological character of the Macquarie Marshes Ramsar site.

The referral (2020/8652 – Macquarie River Re-regulating Storage, p. 6) specifies: "*Environmental watering flows to the Macquarie Marshes will be unaffected by the operation of the project*". This represents a misleading and narrow definition of environmental flow management which includes all components of environmental flow water, including adaptive environmental flow and planned environmental flow (so called 'inefficiencies' in river, unregulated flows and 'transmission losses'). Therefore, by definition, the re-regulating storage reduces the amount of flow making its way to the Ramsar-listed Macquarie Marshes. It does this because the so-called inefficiencies and transmission losses will have to be taken up by environmental flow water, as they will be regulated. The re-regulation storage is turning planned environmental water into consumptive water.

In addition the scoping document identifies a range of other impacts which will occur at the

site on the river but also downstream (WaterNSW, 2020). These include: changes of flowing river habitats to pool habitat; impacts on two aquatic habitats and riparian vegetation from regular variability of water levels within the storage; and the associated effects on riverbank stability. Regarding fish, the scoping document argues that there will be improvements to fish passage in the locality, with fish passage provided at the new storage and the removal of the barrier fix of Gin Gin Weir (WaterNSW, 2020). The problem of fish passage at Gin Gin Weir could be improved by just addressing its issue to fish passage, rather than building another structure which will impede the passage of native fish.

5. Matters of National Environmental Significance (MNES)

There are three relevant Matters of National Environmental Significance: Ramsar wetland, nationally threatened species, and migratory species. The Macquarie Marshes includes a Ramsar site, among the broader landscape which includes the Macquarie Marshes floodplain (Fig. 1), including Macquarie Marshes Nature Reserve and a privately owned area, Wilgara wetland. There are also nationally threatened species and migratory species (Fig. 5).

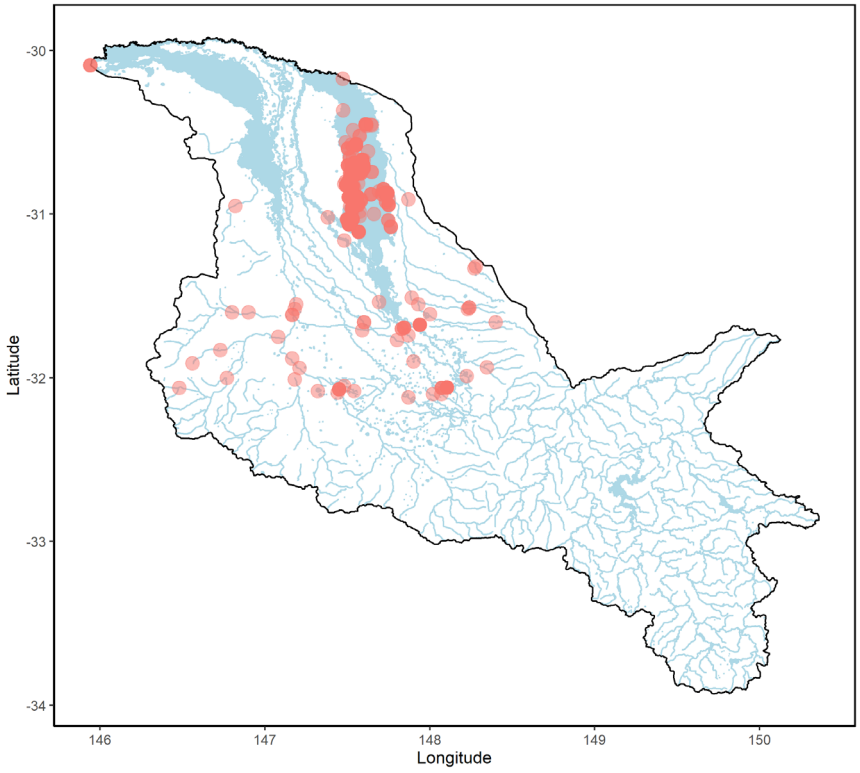


Fig. 5. Distribution of records (n=794) of water-dependent species listed as Matters of National Environmental Significance, under the EPBC Act 1999 likely to be affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed Re-regulating Storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

i. Ramsar-listed Wetland

The scoping document for this development of a re-regulating storage on the Macquarie River states that: "*The greatest threat to the Ramsar site and the greater Macquarie Marshes is identified as the alteration of the natural flow regime through River regulation*" (WaterNSW, 2020) (p. 45). This quite clearly contradicts the conclusion that this proposal is not likely to have a significant impact on the Macquarie Marshes Ramsar site (quoted in EPBC Act referral 2020/8652, p6, by proponent). The re-regulating storage proposed on the Macquarie River is designed to specifically impact the natural flow regime, as a regulatory structure, by storing transmission flows or unregulated flows coming down the Little Bell River, Bell River and Talbragar River.

The condition of the Macquarie Marshes Ramsar site remains poor because of ongoing effects of river regulation. This conclusion is also supported by the Australian Government's formal notification of a likely change an ecological character. The Australian Government notified the Ramsar Secretariat in 2010 of a "likely change in ecological character of the Macquarie Marshes Ramsar site", stating a range of reasons based on scientific evidence, including changes in the flow regime; change in the extent and condition of the wetland vegetation communities in the southern part of the Macquarie Marshes Nature Reserve; change in extent and condition of wetland vegetation communities in the northern section of the Macquarie Marshes Nature Reserve; changes in the ecological character of the Wilgara wetland and; changes in colonial waterbird breeding (http://www.environment.gov.au/water/topics/wetlands/database/pubs/28-statement-of-reasons-3-2-notification-20100204.pdf). There is limited scientific evidence to indicate that these issues have been significantly addressed, even though there is increased environmental flow to the Macquarie Marshes. This proposal will exacerbate ongoing decline in all of the elements outlined in the Australian Government's 2010 notification. This proposal for a re-regulation storage on the Macquarie River is likely to have a significant impact on the ecological character of the Macquarie Marshes Ramsar site, a Matter of National Environmental Significance.

ii. Threatened species

a. Fish

There is little assessment of potential impacts of the re-regulating storage on the Macquarie River on three threatened fish species occurring in the Macquarie catchment, under the EPBC Act 1999, including silver perch *Bidyanus bidyanus* (Critically Endangered, Fig. 6), Macquarie perch *Macquaria australasica* (Endangered, pre 1970 record) and Murray cod *Maccullochella peelii* (Endangered, Fig. 6). In particular the Murray cod population is in low numbers (Rayner et al., 2015). All species are affected by changes to flow and flooding regimes brought about by the building of dams and diversion of water from the river (Koehn et al., 2013; Vilizzi et al., 2013). This proposal is likely to have a significant impact on these nationally threatened fish species, a Matter of National Environmental Significance under the EPBC Act 1999.

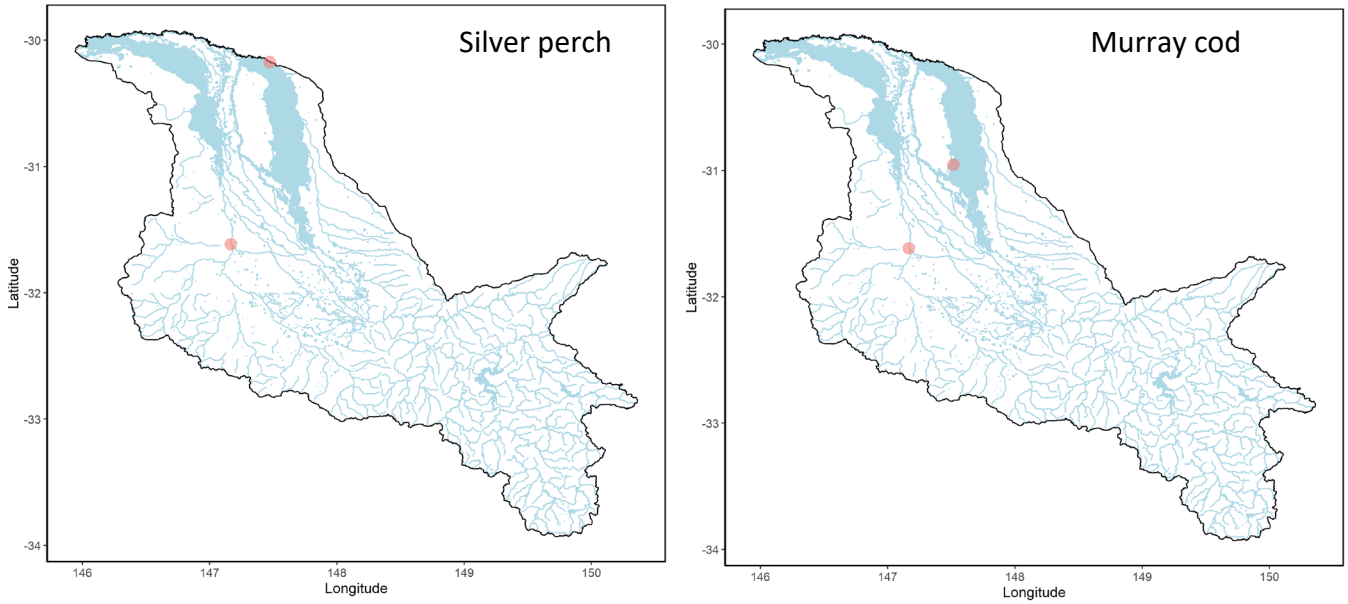


Fig. 6. Distribution of records of two nationally threatened fish species, silver perch and Murray cod, listed as Matters of National Environmental Significance, under the EPBC Act 1999, likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed Re-regulating Storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

b. Birds

Four birds, three waterbird species, the Australasian bittern *Botaurus poiciloptilus* (Endangered), the Australian painted snipe *Rostratula australis* (Endangered) and curlew sandpiper *Calidris ferruginea* (Critically Endangered), and one bush bird the superb parrot *Polytelis swainsonii* (Vulnerable) occur downstream of the proposed re-regulation storage on the Macquarie River (Fig. 7) and are listed under the

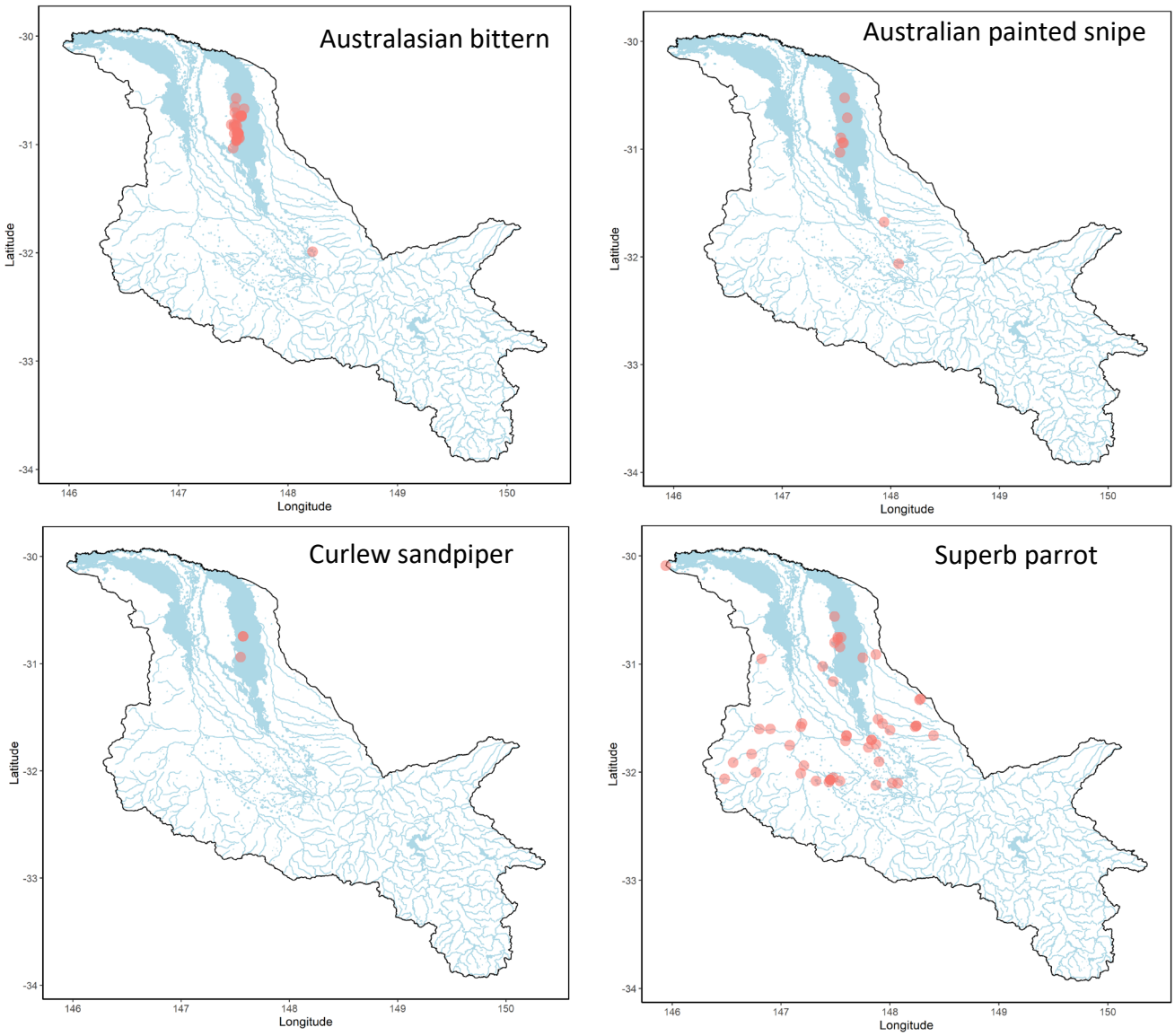


Fig. 7. Distribution of records of four nationally threatened bird species, Australasian bittern, Australian painted snipe, curlew sandpiper and superb parrot, listed as Matters of National Environmental Significance, under the EPBC Act 1999, likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed re-regulating storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

EPBC Act 1999 as nationally threatened species (Fig. 7). They all rely on the habitat created by the Macquarie River and its floodplains, including the Macquarie Marshes. The waterbirds in particular depend on the flows and floods for their feeding and breeding. Australasian bitterns are highly dependent on the extensive reed bed swamps in the Macquarie Marshes. The superb parrots utilise nest hollows in river red gum forests, affected by reductions in flows in the river (Catelotti et al., 2015). The proposal to build a re-regulation storage on the Macquarie River is likely to have a significant impact on these

nationally threatened waterbird species, a Matter of National Environmental Significance under the EPBC Act 1999.

c. Frogs

There is no assessment of potential impacts of re-regulation storage on the Macquarie River on one threatened frog species, under the EPBC Act 1999: the Sloane's froglet *Crinia sloanei* (Endangered) (Fig. 8). In particular, there is growing understanding of the importance of widespread flooding for frog populations in the Macquarie Marshes (Ocock et al., 2014; Ocock et al., 2016). As water dependent species, frogs are highly vulnerable to reductions in flows and flooding regimes to the lower river, resulting from reductions in flow caused by the Re-regulating Storage on the Macquarie River. This proposal is likely to have a significant impact on these nationally threatened frog species, a Matter of National Environmental Significance under the EPBC Act 1999.

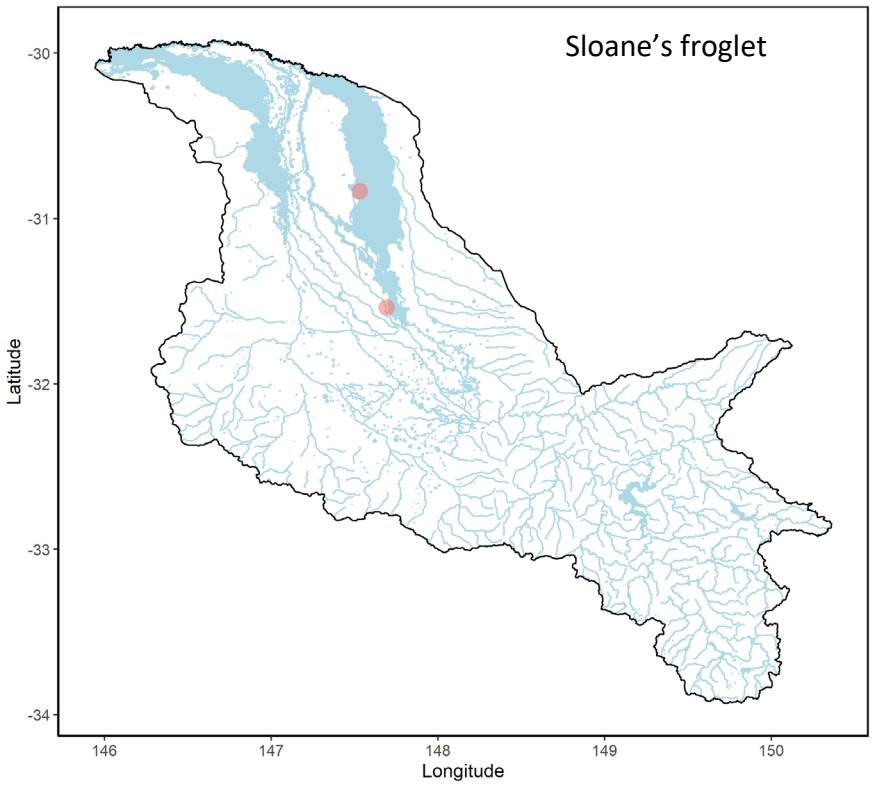


Fig. 8. Distribution of records for Sloanes froglet, listed as a Matters of National Environmental Significance, under the EPBC Act 1999 likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed re-regulating storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

d. Plants

There is no assessment of potential impacts of the enlargement of the dam on two threatened plant species, under the EPBC Act 1999, including chariot wheels *Maireana cheelii* (Vulnerable) and slender darling pea *Swainsona murrayana* (Vulnerable) (Fig. 9). As species typically found in floodplains and depressions, such plant species are likely to be highly vulnerable to reductions in overland flows and flows to the lower river, resulting from reductions in flow caused by structures such as the re-regulating storage on the Macquarie River. This proposal is likely to have a significant impact on these nationally threatened plant species, a Matter of National Environmental Significance under the EPBC Act 1999.

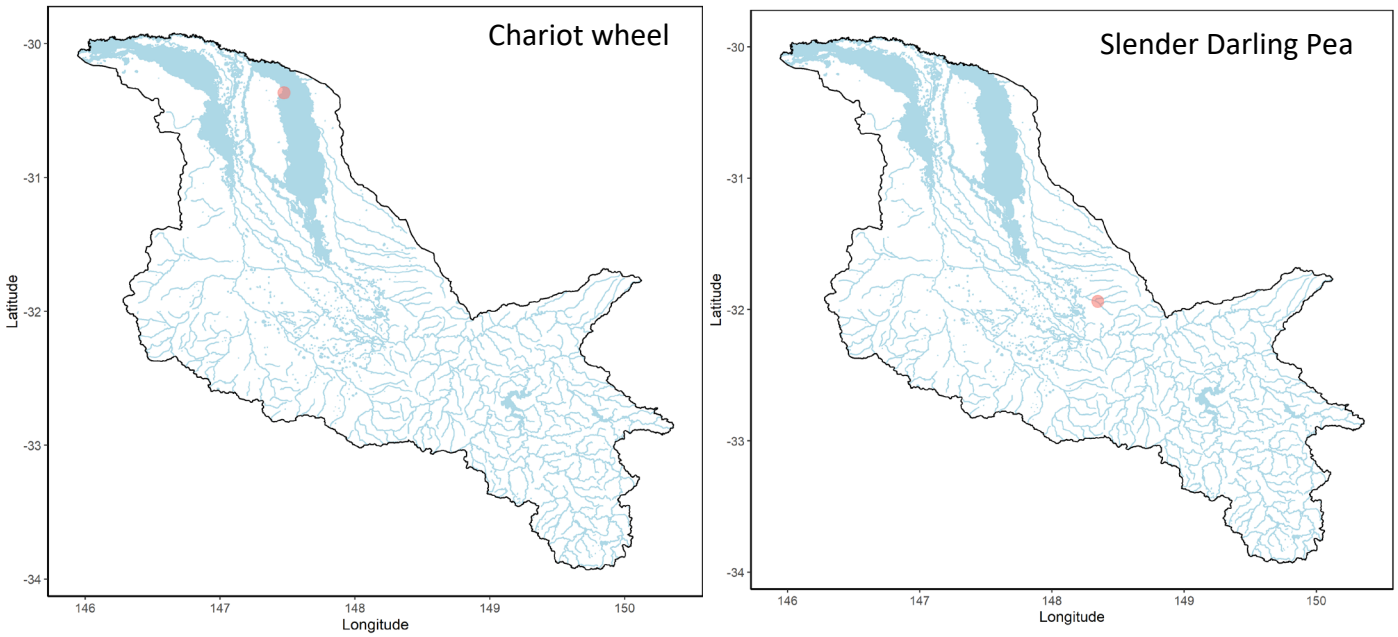


Fig. 9. Distribution of records for nationally threatened plants, chariot wheels and slender darling pea, listed as a Matters of National Environmental Significance, under the EPBC Act 1999 likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed re-regulating storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

iii. Migratory species

Under Section 5 of the referral, there is an assessment by the proponent that it does not consider listed migratory species to be significantly affected. This is clearly wrong. There are at least 13 migratory species of waterbird listed under the EPBC Act 1999, which have occurred downstream of the proposed re-regulating storage on the Macquarie River. There is increased understanding the development of river systems,

migratory shorebirds are affected by the building of dams and diversion of water (Nebel et al., 2008). It is likely these 14 species will be significantly affected by proposed re-regulating storage on the Macquarie River. Species listed as migratory species for consideration as a Matters of National Environmental Significance include: bar-tailed godwit *Limosa lapponica*, black-tailed godwit *L. limosa*, common greenshank *Tringa nebularia*, common sandpiper *Actitis hypoleucos*, Latham's snipe *Gallinago hardwickii*, marsh sandpiper *T. stagnatilis*, red-necked stint *Calidris ruficollis*, sharp-tailed sandpiper *Calidris cuminata*, curlew sandpiper *C. ferruginea*, wood sandpiper *Tringa glareola*, Caspian tern *Hydroprogne caspia*, gull-billed tern *Gelochelidon nilotica* and Eastern osprey *Pandion cristatus* (Figs 7, 9, 10). Further, glossy ibis frequently breed in the Macquarie Marshes in significant numbers (Fig. 11), potentially one of Australia's more important breeding sites for this species (Kingsford and Johnson, 1998). This re-regulating proposal on the Macquarie River is likely to have a significant impact on these nationally threatened migratory species, a Matter of National Environmental Significance under the EPBC Act 1999.

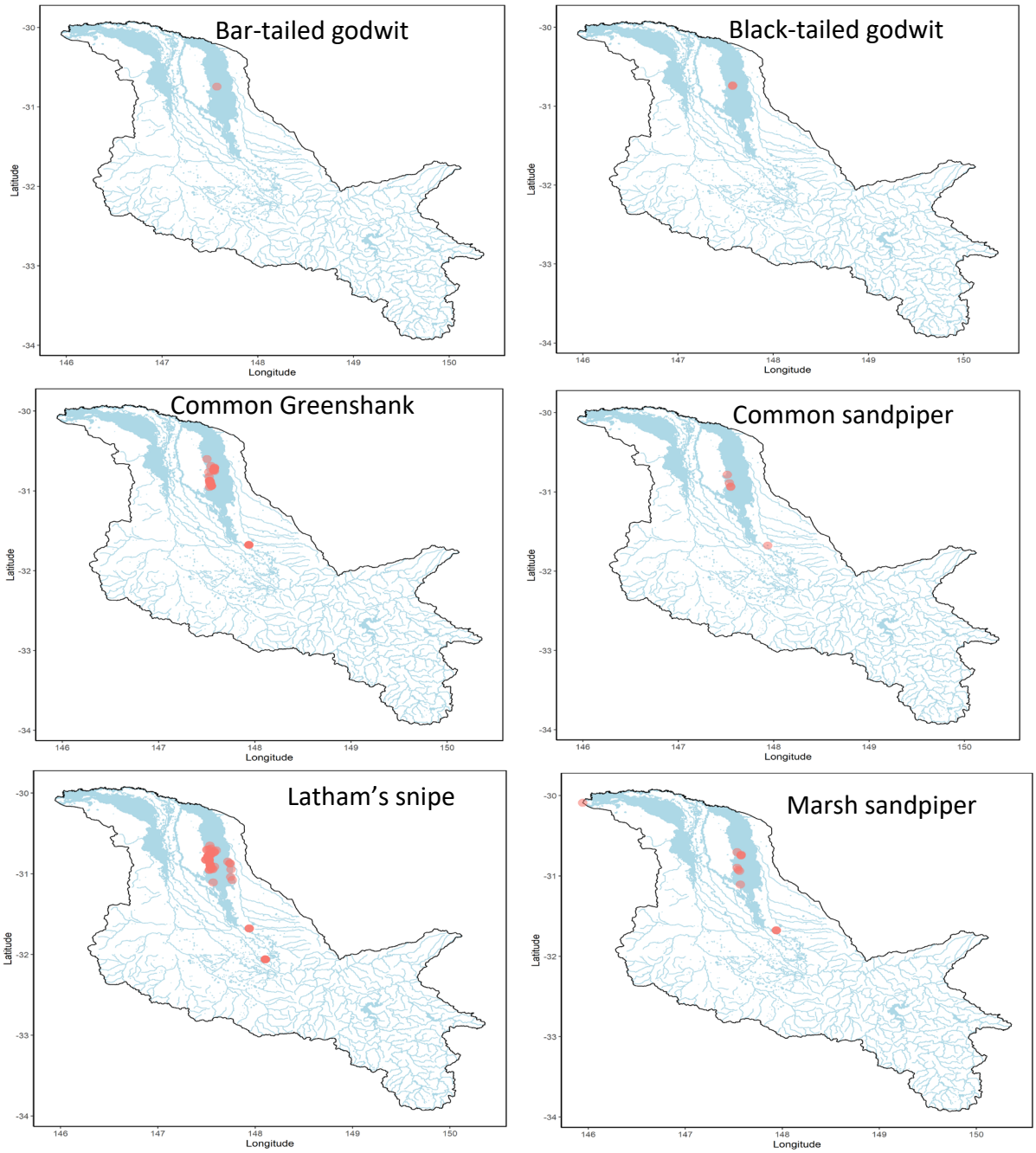


Fig. 9. Distribution of records of six migratory bird species, bar-tailed godwit, black-tailed godwit, common greenshank, common sandpiper, Lathams snipe and marsh sandpiper listed as Matters of National Environmental Significance, under the EPBC Act 1999 likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed Re-regulating Storage on the Macquarie River, including data from NSW environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

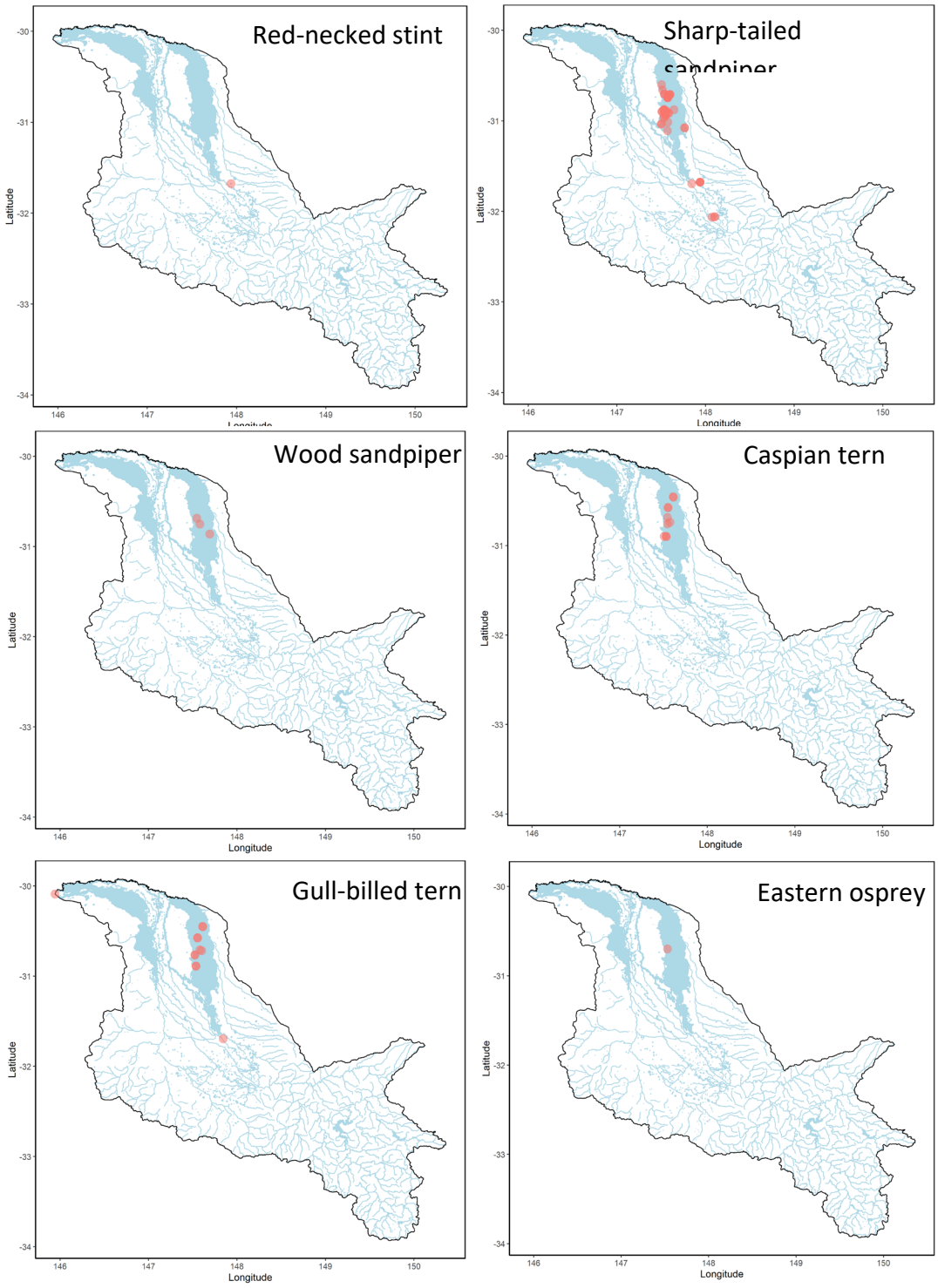


Fig. 10. Distribution of records of six migratory bird species, red-necked stint, sharp-tailed sandpiper, wood sandpiper, Caspian tern, gull-billed tern and Eastern osprey, listed as Matters of National Environmental Significance, under the EPBC Act 1999 likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed Re-regulating Storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km).

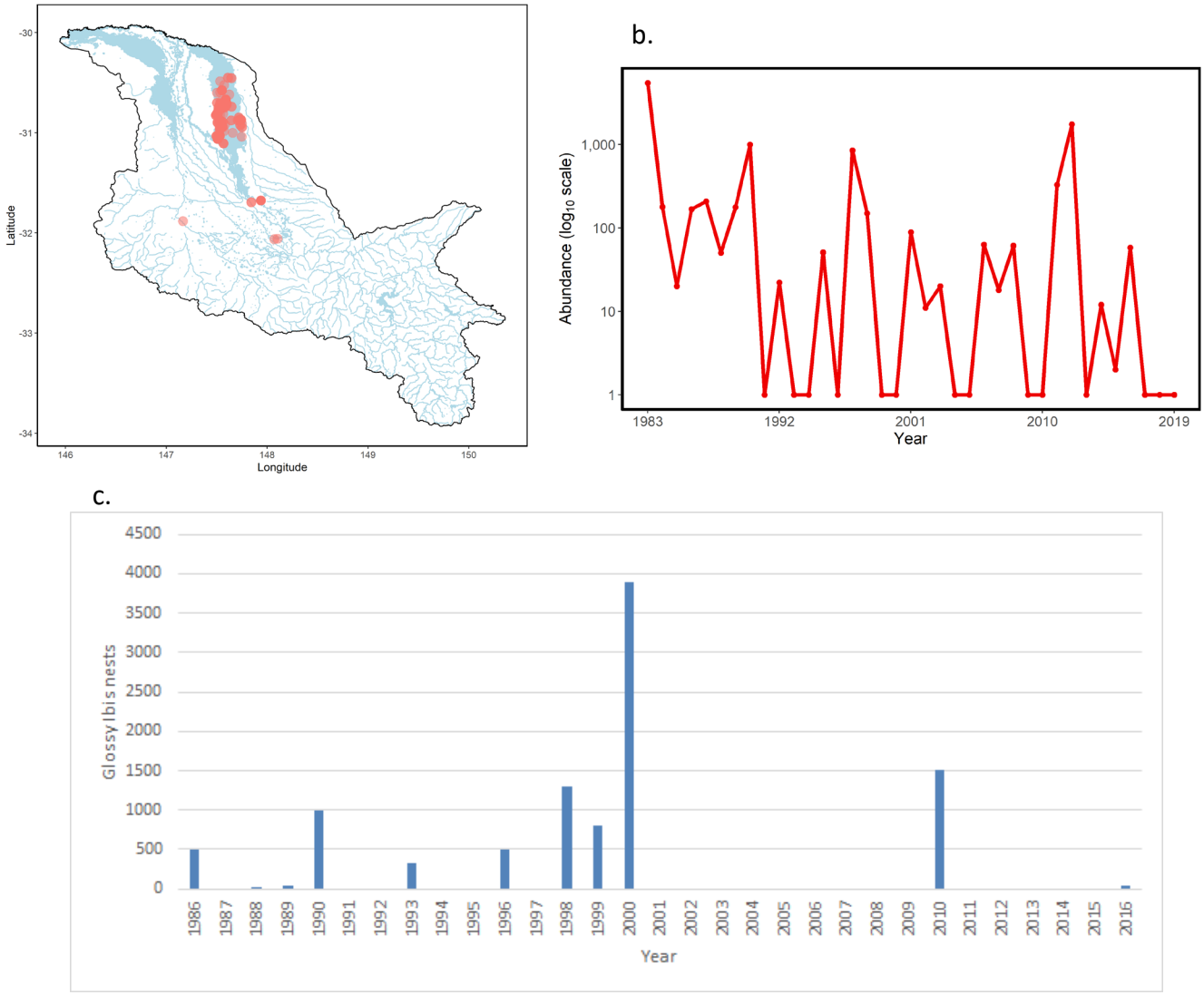


Fig. 11. **a.** Distribution of records of the migratory bird species, glossy ibis, listed as Matters of National Environmental Significance, under the EPBC Act 1999 likely to be significantly affected by the proposed re-regulating storage on the Macquarie River. Data were sourced from the Global Biodiversity Information Facility (https://www.gbif.org/) for the Macquarie Catchment, downstream of the environmental footprint (i.e. 30km upstream) of the proposed re-regulating storage on the Macquarie River, including data from NSW Environment agency surveys, Atlas of Living Australia, museum specimens and citizen-science datasets, including species-level records from 1970-2020 (spatial uncertainty of 0-20 km). **b.** Estimates of glossy ibis in the northern third of the Macquarie Marshes during annual aerial surveys of waterbirds. **c**. Records of breeding glossy ibis in the Macquarie Marshes since 1986 (no breeding has occurred since).

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Appendix 1 – Species and groups of species counted on aerial surveys of waterbirds, their status under the EPBC Act 1999, highest count and the year of the count and the number of years counted

Surveys were in the northern third of the Macquarie Marshes each year (1983-2019)

Common name	Specific name	Nationally Threatened Species (EPBC Act)	Migratory species (EPBC)	Highest Count	Year	Number of years
Australasian shoveler	*Anas rhynchotis*	NA	NA	312	1983	6
Black swan	*Cygnus atratus*	NA	NA	2652	1983	18
Freckled duck	*Stictonetta naevosa*	NA	NA	15	1983	1
Glossy ibis	*Plegadis falcinellus*	NA	Listed	5460	1983	23
Pacific black duck	*Anas superciliosa*	NA	NA	6006	1983	29
Silver gull	*Larus novaehollandiae*	NA	NA	62	1983	1
Australian white ibis	*Threskiornis molucca*	NA	NA	6739	1983	26
Black-winged stilt	*Himantopus himantopus*	NA	NA	2242	1984	17
Great crested grebe	*Podiceps cristatus*	NA	NA	118	1984	2
Grey teal	*Anas gracilis*	NA	NA	48881	1984	27
Hardhead	*Aythya australis*	NA	NA	2065	1984	10
Whiskered tern	*Chlidonias hybridus*	NA	NA	2389	1984	9
Australasian darter	*Anhinga melanogaster*	NA	NA	151	1986	11
Musk duck	*Biziura lobata*	NA	NA	174	1988	2
Blue-billed duck	*Oxyura australis*	NA	NA	18	1989	1
Brolga	*Grus rubicunda*	NA	NA	50	1989	4
Caspian tern	*Hydroprogne caspia*	NA	Listed	25	1989	2
Small grebes	*small grebe sp.*	NA	NA	50	1989	5
Wood duck	*Chenonetta jubata*	NA	NA	1751	1989	21
Dusky moorhen	*Gallinula tenebrosa*	NA	NA	24	1990	2
Masked lapwing	*Vanellus miles*	NA	NA	1145	1990	8
Pied cormorant	*Phalacrocorax varius*	NA	NA	248	1990	5
White-faced heron	*Egretta novaehollandiae*	NA	NA	348	1990	23
Purple swamphen	*Porphyrio porphyrio*	NA	NA	133	1993	7
Royal spoonbill	*Platalea regia*	NA	NA	68	1995	11
Eurasian coot	*Fulica atra*	NA	NA	2532	1996	14
Great egret	*Ardea alba*	NA	NA	278	1996	13
Gull-billed tern	*Gelochelidon nilotica*	NA	NA	50	1996	1
Magpie goose	*Anseranas semipalmata*	NA	NA	25	1996	1
Pacific heron	*Ardea pacifica*	NA	NA	2304	1996	26
Plumed whistling-duck	*Dendrocygna eytoni*	NA	NA	536	1998	4
Australian shelduck	*Tadorna tadornoides*	NA	NA	40	2001	5
Pink-eared duck	*Malacorhynchus membranaceus*	NA	NA	95	2003	3
Wandering whistling-duck	*Dendrocygna arcuata*	NA	NA	12	2007	1
Black-tailed native-hen	*Gallinula ventralis*	NA	NA	500	2011	1
Great cormorant	*Phalacrocorax carbo*	NA	NA	114	2011	9

Nankeen night-heron	*Nycticorax caledonicus*	NA	NA	70	2011	1
Egrets	*Ardea/Egretta sp.*	NA	NA	23700	2012	25
Little black cormorant	*Phalacrocorax sulcirostris*	NA	NA	1297	2012	16
Little pied cormorant	*Phalacrocorax melanoleucos*	NA	NA	1603	2012	10
Australian pelican	*Pelecanus conspicillatus*	NA	NA	3783	2012	23
Straw-necked ibis	*Threskiornis spinicollis*	NA	NA	13817	2012	19
Yellow-billed spoonbill	*Platalea flavipes*	NA	NA	1740	2012	28
Small waders	Small wader sp.	NA	NA	7	2016	3
Tern	Tern sp.	NA	NA	27	2016	1
Little egret	*Egretta garzetta*	NA	NA	2	2017	1