



# Native frogs born in rice bays consume rice pests

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## in a rice hull

- Insectivorous frogs may be important for pest control in agricultural ecosystems
- Nearly five billion frogs may be produced in rice bays in the Riverina each year
- Native frogs born in rice bays consume a wide range of invertebrate pest species

**Frogs play very important roles in the ecosystems in which they live because they are a food source for many other animals including birds and reptiles, and they may be important in regulating populations of their prey species. There is also some evidence that suggests that insectivorous frogs that consume different types of insects may be important for pest control in agricultural ecosystems.**

Frogs are an important source of biological diversity. Biodiversity can be broadly defined as every species of wildlife, the ecosystems in which they live and their various ecological functions. Australia is a hotspot of biodiversity and is home to many species of reptiles and frogs. About 220 species of frogs inhabit this continent, 93% of which occur nowhere else in the world.

Although frogs have existed in Australia for the last 45 million years, their numbers are in drastic decline. The main causes of this decline are considered to be habitat loss, degradation and fragmentation, the introduction of non-native species into their habitats, the use of herbicides and pesticides, and infectious diseases, in particular a little understood fungus called chytrid.

## The importance of frogs in rice agroecosystems

Nearly a dozen species of frogs can be found in the Riverina, including the eastern banjo frog (*Limnodynastes dumerilii*) named for its call that sounds like the plucking of a banjo string, and Sudell's Frog (*Neobatrachus sudelli*), a burrowing species that may only be observed following a warm summer's rain.

Two of the more common species however, are the spotted grass frog (*Limnodynastes tasmaniensis*) and barking marsh frog (*L. fletcheri*). These species live in remnant patches of bushlands beneath logs, bark and in crevices in the ground. They breed in flooded rice bays, irrigation channels and dams between August and May. Males trying to attract females can often be heard calling during this time. While breeding, males hug females in a process called amplexus in order to stimulate them to lay eggs (Figure 1). Females

deposit foamy masses ranging from 80–1500 eggs around young rice plants. Tadpoles hatch after a few days but can take up to five months to develop legs and transform into adults. During this period, young frogs consume invertebrate prey while growing before they leave the rice bays and enter the terrestrial environment.

While there is recognition that frogs may be important in controlling invertebrate populations, little is known of their role as a natural control of pest species in agricultural ecosystems. Our research program, supported by RIRDC, RGA and the University of Canberra, aimed to:

- use pitfall trapping to estimate the number of spotted grass frogs produced in rice bays each year in order to calculate their annual invertebrate consumption
- determine through stomach content analyses the species of rice pests and other invertebrate fauna that frogs consume on rice farms.



**Figure 1: Male and female spotted grass frogs in amplexus (Photo: Lydia Fucsko/frogs.org.au).**



The research took place on four rice farms in the Gogeldrie and Jerilderie Environmental Champions Program (ECP) cluster groups: *Old Coree* (Jerilderie) and three properties owned by the Houghton and Kirkup families (Leeton). These farms were chosen because of their participation in the ECP and because rice was grown here during the study period.

### How many frogs in Riverina rice fields?

To estimate the number of frogs produced in rice bays each year, six experimental rice bays measuring 45 x 15 m were constructed at *Old Coree* (RRAPL). Pitfall traps made of silt fencing with 20 L buckets buried in the ground at 10 m intervals were erected around the bays (Figure 2). Young frogs dispersing out of the bays to terrestrial habitats were captured in the buckets and counted. The total number of frogs produced in the experimental rice bays was used to estimate the number of frogs produced per hectare of rice grown in the Riverina. Two estimates were calculated to determine the range between normal and drought years.

Our data support the estimate calculated in our previous study, which indicates that about 500 million frogs may be produced in rice bays each year in the Riverina. Our current estimates indicate that nearly five billion frogs may be produced in normal years when approximately 150,000 ha of rice are sown. However, this figure falls to about 37 million in drought years when the amount of rice sown is roughly 12,000 ha.

### What are frogs in rice fields eating?

A gentle and basically harmless stomach flushing technique was used to determine the types of invertebrate fauna that frogs consume on rice farms. In this procedure a small, flexible tube that is attached to a water-filled syringe is first inserted into the frog's throat and then into its stomach (Figure 3). The water pumped into the stomach flushes out any prey items present. The prey items obtained in the present study were then identified using a microscope in

the laboratory. Prey items were identified to the order level, except when pest species were detected. In the latter case, items were identified to the species level.

The frogs ingested a wide variety of prey items; however, the most frequently consumed invertebrates were beetles (order: Coleoptera), ants (Hymenoptera), true bugs (Hemiptera) and caterpillars (Lepidoptera).

The frogs also consumed a range of rice pest species including: the stink bug (*Eysarcoris trimaculatus*), water snails (*Glytophysa* sp. and *Isidorella newcombi*), paddy bug (*Leptocoris acuta*), slender rice bug (*L. oratorius*), common armyworm (*Leuciana convecta*), sugarcane looper (*Mocis frugalis*), rice root aphid (*Rhopalosiphum rufiabdominalis*), day-feeding armyworm (*Spodoptera exempta*) and lawn armyworm (*S. mauritia*).

Furthermore, our estimates indicate that spotted grass frogs may consume about eight insects each evening during their nine-month active season (September–May). Therefore, if the 37 million frogs produced in rice bays in the Riverina during our study period consumed an average of eight insects per night for about 300 nights over their active season, then approximately 80 billion insects may be consumed in a given year.

The dietary habits of insectivorous frogs may affect the health of rice plants. Future research may determine if spotted grass frogs affect the health of rice plants by consuming pest species. Pest abundance and plant health may be compared between rice bays with and without frogs present. 🌱

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Figure 2: Experimental rice bay at Old Coree (RRAPL) with pitfall traps and silt fencing used to capture frogs exiting the bays.



Figure 3: The stomach contents of the frogs were flushed out with this gentle technique. Prey items were captured in a sieve and later identified in the laboratory.