

## **General impacts of the feral pig (*Sus scrofa*)**

Rooting by pigs disturbs the seed bank, reduces surface vegetation and alters the soil by increasing soil temperature, increasing or decreasing the nitrogen content, increasing oxidation and increasing the leaching of Ca, P, Zn, Cu and Mg (Kotanen 1994, Singer Swank and Clebsch 1984, Arrington, Toth and Koebel 1999, in Wolf and Conover 2003). Due to the elevated rates of nitrogen in some pig rooted areas, high abundance of feral pigs near to streams leads to increased levels of nitrogen in stream water, Singer et al. (1984) found nitrate-nitrogen in stream water from a rooted site was double that from the undisturbed site, suggesting an alteration in the nitrogen transformation process. In addition, rooting creates large unattractive open spaces, reduces perennial cover and increases the growth of alien annual grasses (Kotanen 1994, in Wolf and Conover 2003). In its native range in Sweden the pig generally roots extensively in deciduous forests and damp soil, preferring these locations to grassland areas with dry soils; most rooting occurring from autumn to early spring (Welander 2000, in Wolf and Conover 2003).

The feral pig may enhance diversity of wetland plant assemblages (on the Kissimmee River floodplain, for example); or it may destroy coastal marsh habitats, increasing the loss of wetlands (Arrinton, Toth and Koebel 1999, Ford and Grace 1998, in Wolf and Conover 2003). In Australia, Hone (1998) has found that plant species richness in grassland decreases as pig rooting increased. Direct removal of root material and rhizomes by pigs can limit existing plant growth and destroy seedlings. Mitchell et al. (2007) found 31% more living seedlings in areas protected from pigs than in the unprotected controls, and a strong general trend of more seedlings surviving in the absence of pig diggings.

Pigs disrupt the ecosystem on a number of levels. In the Great Smoky Mountains they reduce herbaceous understory cover to 5% of its expected value, they destroy the leaf litter habitat of the red-back vole and the short-tailed shrew, they consume the threatened red-cheeked salamander and Jones middle-toothed snail. They reduce the level of micro invertebrates in the soil by an estimated 80%. Depletion of micro arthropods was clearly related to pig activity by Vtorov (1993) micro arthropods are important components of the soil formation process and therefore a depletion of these invertebrates is detrimental to forest ecosystems through the loss of decomposer species. Their rooting habit also accelerates soil erosion and increases siltation in rivers (Peine and Farmer 1990, in Wolf and Conover 2003). Many weedy species require soil disturbance for establishment and are known to invade disturbed sites (Baker & Stebbins, 1965; Baker, 1974), not only does pig rooting create good seedbed conditions and remove competitors but pigs may also act as seed dispersers (Aplet et al. 1991, Siemann et al. 2009). Siemann et al. (2009) conducted a seven year enclosure study in Texas, they discovered that excluding feral pigs from a site increased the diversity of woody plants, especially those with large seeds. This was likely due to the consumption of larger seeds by feral pigs in the non-excluded sites. They also discovered that the relative abundance of different functional groups of plants changed between excluded

and non-excluded sites. In fenced plots, forbs and woody plants were more abundant, however unfenced plots were dominated by graminoids (Siemann et al., 2009). Siemann et al. (2009) then found that the presence of feral pigs significantly increased the abundance of the exotic woody species, Chinese Tallow tree, with saplings of this species more than twice as abundant in unfenced areas when compared to fenced.

Native tree ferns are the staple diet of the feral pig in Hawaii. Feral pigs directly kill several species of native trees by felling or barking them. This destruction of tree ferns and epiphytes brings substantial cover loss to the koa-ohia forest; feral pigs are also known to actively disperse the seeds of the invasive exotic strawberry guava (Diong 1982). Pigs have an impact on native invertebrates, such as earthworms and snails, which they consume in large amounts (e.g. Meads *et al.* 1984). Aplet et al. (1991) found that some plant species may both encourage pig activity and benefit from it, whilst other plant species appear to neither require nor benefit from pig rooting. In Hawaii, pig rooting facilitated the growth of members of the *Ehrhata* group whilst hampering the growth of *Andropogon* species, therefore playing an important role in the composition of plant assemblages (Aplet et al. 1991).

On Santiago island (Ecuador) feral pigs have reduced giant tortoise and sea turtle numbers by preying on their eggs (MacFarland *et al.* 1974a, Green *et al.*, Coblentz 1987, in Patry 2001). Pigs probably also eat the eggs and young of seabirds such as albatrosses, shags and boobies (Moors and Atkinson 1984). Unlike on Hawaii, on Santiago island the pigs do not have a negative impact on the native vegetation; this is due to the increased resistance of plants to generalised herbivores, in particular, the native giant tortoise (Coblentz Baber 1987, in Wolf and Conover 2003). Another study found that feral pigs were a potential cause of the decline of *Powelliphanta hochstetteri* (an indigenous, giant land snail), due to their consumption of the snail on D'Urville Island (Coleman et al., 2001). Feral pigs have also been implicated in the decline of breeding colonies of the New Zealand white-capped mollymawk (*Diomedea cauta steadi*) on main Auckland Island, with visual accounts of pigs with freshly killed mollymawk chicks in their mouths (Flux, 2002). Challies (1975) also found evidence of both yellow-eyed penguin (*Megadyptes antipodes*) and Auckland Island prion (*Pachyptila desolata*) in pig stomachs and also described evidence of predation of Auckland Island shag (*Leucocarbo colensoi*) by pigs. The need for protein in the feral pig diet, especially for breeding and growth (McIlroy, 1990), may be what drives predation of animals. McIlroy (1989) states that earthworms are one of the most common sources of animal protein in the diet of feral pigs. Pav Ecol (1992) found that feral pigs harvested over 95% of the available worms at sites in lowland ephemeral swamps near Cape Tribulation during April-July 1992.

Pig rooting also damages cultivated crop species. In one study conducted in 40 counties of California an economic loss of approximately US\$ 1 730 000 was recorded due to pigs (Frederick 1998, in Wolf and Conover 2003). In Texas (between 1989 and 1994) crop damage due to feral hogs was reported to be between \$10 000 and \$300 000 (Tolleson

*et al* 1995, in Wolf and Conover 2003). Rooting damages irrigation systems and ponds (Frederick 1998, in Wolf and Conover 2003). Pigs significantly reduce seedling recruitment in longleaf pine plantations (Lipscomb 1989, in Wolf and Conover 2003). Pigs are reputed to increase rates of dieback disease caused by the fungus *Phytophthora cinnamomi* (Auld and Tisdell 1986).

Lynes and Campbell (2000) in Northern Queensland, Australia , confirmed that a weed of national significance (*Prosopis pallida*) can be transported through the gut of the feral pig and produce viable seed with a 70% germination rate. Weeds may also be spread to new areas, particularly freshly dug up or trampled areas, through the attachment of their seeds to pig's coats or in soil clinging to the pig's snout or trotters (Johnson, 2001).

Feral pigs are capable of transmitting brucellosis, pseudorabies, leptospirosis, foot-and-mouth disease, melioidosis (*Pseudomonas pseudomallei*), tuberculosis, sparganosis (*Spirometra erinacei*), porcine parovirus, and Japanese encephalitis (Tolleson *et al* 1995, in Wolf and Conover 2003; Hampton *et al.* 2004, Choquenot *et al.* 1996n). Feral hogs may threaten human health by carrying helminth parasites that are passed to humans through the consumption of improperly cooked meat which causes the disease Trichinosis (Tolleson *et al* 1995, Pavlov 1988, in Wolf and Conover 2003). In Spain wild pigs hunted for food carry *Toxoplasma gondii* (Gauss *et al.* 2005). Pigs are also known to spread swine vesicular disease (Europe and Asia), African swine fever (sub-saharan Africa, Portugal and Spain), Aujeszky's disease (Europe, Asia, America, New Zealand and Samoa) and also swine fever.(also called hog cholera).