What is the role of dung beetles versus flies in vectoring disease?

In an opinion piece in the NZ Herald it was stated that dung beetles present more risks to health than benefits for example: “the claim that the risks [of dung beetles spreading disease] will be offset by reduced fly numbers has been quashed because, unlike Australia, we don't have the troublesome flies that breed in dung”. Below we explain why we think this claim is misleading.

While it is true that NZ lacks blood-sucking buffalo flies *Haematobia irritans exigua* that was a major problem in Australia prior to the introduction of dung beetles, there are numerous species of fly that feed and breed in dung in NZ. These may not be troublesome in terms of their impacts on livestock, but some are extremely abundant and are very capable of spreading diseases to humans (unlike dung beetles, which are not attracted to humans or their food). The major species are listed below:

Oxysarcodexia varia

The striped dung fly *(O. varia)*

The most common fly of potential medical importance that breeds in cow dung is the Sarcophagid fly *Oxysarcodexia varia* (synonyms = *Hybopygia varia; Sarcophaga milleri* which is native to South America and has been known in New Zealand for many decades but only recently arrived in Australia (Meiklejohn et al. 2012). *Oxysarcodexia varia* also breeds in sheep dung (Bishop 1998) and is present in large numbers in cow dung (Dymock 1993). *Oxysarcodexia varia* was demonstrated to be capable of vectoring tapeworms *Taenia ovis* and *T. hydatigena*, which infest dogs and sheep (Lawson & Gemmell 1986; Lawson & Gemmell 1995). Work in NZ has shown that it is also a vector of rabbit haemoragic disease virus (Henning et al. 2005). A factor which makes it a good vector is its attraction to mammalian secretions, for example it is attracted to human sweat and was described as “cheeky and persistent” and “a real nuisance outdoors” by Harrison (1974).

The biology and ecology of Neotropical Sarcophagids is still poorly known (Mariluis et al. 2007), especially when compared with the vast literature on synanthropic flies species with more widespread global distributions. Nevertheless, sarcophagid flies are considered to have medical and veterinary importance for their biological association with human settlements (Mariluis et al. 2007; Mulieri et al. 2008). Although there is little information specifically pertaining to *O. varia* (other than it is a common synanthropic fly in Argentina; Marilius et al. 2007; Mulieri et al. 2008), given that *O. varia* appears capable of vectoring

diseases as diverse as tapeworms and viruses and it is undeniably attracted to humans, then this species is likely to be capable of vectoring diseases from livestock dung to humans in NZ.

Muscina stabulans

Another important dung-inhabiting fly in New Zealand is *Muscina stabulans* (Dymock 1993). This species has a global distribution and is consequently well studied. It is associated with a large variety of diseases including *Campylobacter jejuni* and *Campylobacter coli* (Hald et al. 2008); parasitic worms including helminths, Ascarids, Trichocephalus and Ancylostomidae (Nadzhafov 1972; Goddeeris 1980); *Escherichia coli* (Shura-Bur'A 1952). *Muscina stabulans* can also cause human myiasis (Derraik et al. 2010).

***Musca domestica* (common house fly)**

Although this species breeds in a variety of dead and decaying organic material, horse dung is a favoured breeding medium (Harrison 1964). *Musca domestica* is extremely well studied and is known to transmit many diseases (http://en.wikipedia.org/wiki/Housefly):

- *parasitic diseases: cysts of protozoa e.g. Entamoeba histolytica, Giardia lamblia and eggs of helminths, e.g., Ascaris lumbricoides, Trichuros trichura, Haemenolypes nana,Hymenolepis nana, Enterobius vermicularis.*
- *bacterial diseases: typhoid, cholera, dysentery, pyogenic cocci, etc. House flies have been demonstrated to be vectors of Campylobacter and E. coli O157:H7 using PCR*
- *Viruses: enteroviruses: poliomyelitis, viral hepatitis (A & E).*

Several of the dung beetle species proposed for introduction into New Zealand are known to feed on horse dung as well as cow dung.

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