

Key points:

- Free-roaming populations resort back to original levels within a year of any spay / neuter efforts
- Spay / neuter will not reduce overpopulation but may reduce population turnover if a shelter system or animal control euthanasia policy is present

Imagine a garden plot full of a plant that you want to remove. Starting in year 1, if you applied a certain chemical to handfuls of individual plants, but by year 5 you had also used a shovel to remove 7 plants for every 1 that was there originally, would you still be willing to attribute the lack of this plant to the chemical applied? Was it the weed killer or the fact that you pulled 7X as many plants from the ground directly?

Using the same analogy, imagine this same garden plot, with the same plant that you know can seed twice a year, with each new plant also from 6 months on being able to seed. If you started from bare ground, it would be a short period of time before the empty garden plot was full of this plant. But, considering that there is only so much soil and water available, the plant population will soon stabilize at whatever its maximum capacity might be. Weeds cannot literally grow in the exact same space as another given that their roots occupy a certain amount of space. The population density can be increased through adding water and fertilizers, but otherwise remains the same year after year.

If you then wanted to remove this plant, knowing that it will self-seed every 6 months, would you then start to remove low percentages of the plant and expect it to slowly reduce the total population, or would you expect that for every one you removed, another would soon sprout? If you wanted to clear this plot of land of this plant (so that

you could plant tomatoes instead), but your plot of land was a mile long, you would understand that you have to clear a small part of this land piece by piece, and continue to weed periodically. You would not take 20% of the weeds from the entire property and expect the weeds to be gone in a few years.

Further, even if you were able to finally weed the entire garden, but it shared a common boundary and came into direct contact with the garden next door, owned by your dirtbag neighbor who never weeded his, what then? What if you left home for 2 growing seasons but left the irrigation on? What would you expect to find after allowing seeds from next door to blow in, turn into adult plants, then each adult plant reseeding a second time? Without staying on top of it and continuing to weed (albeit at lower numbers), it would be as if you had never weeded in the first place.

Now imagine a row of houses that were on fire, none burned to the ground but all also on fire nonetheless, with the houses themselves serving as the limited source of food (fuel) for the fires. Knowing that fire quickly spreads, what is the best approach to dealing with the fire? Is the best strategy to work on putting 10% of the fire out of the first house, then move on to the next house, put 10% of the fire out in the second house, and repeat? Or, knowing that the fires continue to burn, would it be best to put the entire fire out at one house? The obvious approach would be to put as much effort into putting all efforts into one focal house since at least one house would be salvageable in the end. Dousing 10% of a house would in the end accomplish nothing as the fire quickly retook lost ground. As with an out of control wildfire in a forest, 10% containment is no containment at all if in a short period of time the gap will be refilled.

The fire and garden analogies apply to free-roaming dogs and cats, effectively species that also depend on limited resources in the form of food, water, and shelter. In our garden plot of the reservation and the Third World at large, resources are already maxed out, although we can literally increase dog and cats numbers by increasing food access via garbage dumps, backyard food dishes for feral cats, or by providing feeding stations. Replacing our garden plant with dogs that

can have multiple litters every year, coming into an area and spaying in less than one heat cycle even 10% of the intact females would not only be a logistical impossibility in a place like Mexico City or the even the Navajo Nation, it would accomplish nothing in the long run. High fives all around, as soon as the spay / neuter team left, the process of reproduction would continue unabated. With fewer nursing moms to compete with, other non spayed females would come into heat more rapidly, and in one or two heat cycles, all of that hard work just went out the window in terms of the total population.

Much like a garden plot or a fire, spaying free-roaming populations will not reduce populations for more than one heat cycle unless a critical number is reached, conservatively 70% but likely much higher. Assuming the lowest percentage reported in peer reviewed journals, the solution is either to focus on small isolated areas in which 70%+ of seeding females can be spayed, or to limit dispersal of new females. This is possible in large sprawling areas with small pockets of humans, such as the Navajo Nation or rural areas of the Mexican desert, but in more contiguous areas is not possible if animals are not left to free roam and compete for food. Culturally, outside of the reservation system, most Americans have stopped allowing free-roaming (dispersal) of their animals, and there are few areas left in the Western world where street dogs roam freely. Outdoor cats are decidedly more common, but becoming less so each year. Urbanization and culturally accepted practices are shifting the landscape.

On reservations or in the world outside the USA, achieving this 70%+ spay rate is an impossibility with current surgical methods, and suggesting that low spay rates will reduce population is no different than suggesting that weeding smaller percentages of your garden plot once a year will reduce the total numbers of weeds. Larger percentages done repeatedly (faster than the reproductive rate) are needed if the long term population is to be reduced. The idea that 2 starting dogs can lead to 64,000 in a few short years is fundamentally true, but we are already at maximum capacity given that they depend on humans for food. As human populations grow in Third World locations, so will dog populations. We are already at the top of the

inverse pyramid, and the exponential growth rate of dogs and cats is exactly why spaying low percentages will not reduce populations. It is why dog populations are not endlessly rampant on the reservations. Dogs have been there for hundreds of years, and yet the streets are not teeming with dogs every 10 feet. Resources are limited, fixing the number of free-roaming animals. Removing a few results in rapid expansion of the existing population to fill the gap, which then resorts back to the same steady state. Adding food resources leads to more street dogs and cats, which leads to higher overall deaths in the long run and is why cat colonies actually increase in size when extra food is supplied (34). It is the same reason National Park officials encourage people not to feed the wildlife. Not only does it make the wildlife dependent on people, it artificially increases the carrying capacity beyond the natural state.

Carrying capacity explains why If in a remote area where people routinely leave unwanted dogs or litters of puppies at the local garbage dump where they will then compete for limited food resources, the long term population will stay the same locally (assuming no animal control methods). Intact females that might be outcompeted will not go into heat or will have smaller litters with less survival of these litters, and the number of successful dogs that make it from birth to adulthood in the feral community will go down to adjust for the increased competition from the arrival of a new dog or new litter (26). Many will die from starvation or disease secondary to starvation, and at no point does the population increase exponentially as claimed by spay / neuter advocates. Spaying within a closed household would have prevented the excess litter, but the absence of the new litter that will not arrive from that household will afford less competition for food, and therefore larger future litters. In the end, given free-roaming status and competition for food, the overall population numbers remain the same.

If the owner of the theoretical unwanted litter instead buys dog food and finds homes for the dogs, they will increase the total population through food supplementation but also use up the very limited resource of homes for street dogs, whose numbers will then stay the same. If the owner had their female dog spayed beforehand, the

available shelter and foster home space will be freed up for street dogs, decreasing competition at the local garbage dump and allowing remaining intact females to come into heat more readily and again with larger litters that survive to adulthood. In the end, there will be a new litter somewhere, either on the street or in the home, unless the free-roaming aspect is curtailed. The total number of spays makes no difference to the population at large given finite resources.

The importance of spaying changes, however, if there is an active shelter system locally or if there is an active animal control agency that is removing feral animals or euthanizing them. Ignoring TNR practices and focusing on owned animals in a closed household (i.e. not free-roaming), if an unspayed female has a litter of puppies that are abandoned after weaning, they then compete with local animals and reduce fecundity in other strays, leaving neither a change to total population nor a change to the total number that live and die. If however, this litter is admitted to a shelter or animal control is actively removing animals from the street and placing them in shelters and/or euthanizing, this changes things.

If a shelter admits a litter of puppies and then euthanizes other "less desirable" animals for space, then the total overall ecological population numbers may stay the same but the total number of animals that live and die may increase, something we want to avoid. In this case, the outlet to a shelter effectively makes spaying within the household important even though the total population number remains unchanged in the long run.

If a shelter is maxed out for space and turns away the litter (as occurs in "no kill shelters"), and the owner finds homes for the weaned litter, this effectively removes homes for other animals, and at some point the animals end up on the street, and thereby compete for resources, reduce fecundity of competing females, and thus negate any effect of spaying. Not only does this have no effect on the total population, a "no kill" policy that closes the doors to new intakes that would be difficult to adopt out also effectively shifts the burden back onto both the feral population and municipal shelters that by default have to either close their doors or decide to euthanize for space. As stated in

an article in the Journal of the American Veterinary Medical Association, "in many parts of the United States, "no kill" shelters are not sustainable"(59).

This is not to say that spay and neuter have no use within individual households in any country if euthanasia is the alternative, only that the long term overpopulation problem will never be repaired using spay / neuter. The decision by animal control agencies and municipalities to euthanize feral dogs and cats is important, since in most cases with large populations it will not change the total population numbers but will simply increase the population turnover. If euthanasia is being done, then spaying within a household may reduce the total number of euthanasia deaths over a time period for the community. This is obviously desirable, even if the total overpopulation issue remains unchecked.

In this sense, spaying as done in conventional private practice in the United States does make sense, since it relieves urban shelters from having to make the decision as to admit animals or euthanize others. For "no kill" shelters, the burden is simply shifted back onto municipal shelters or in the case of reservations, back into the free-roaming populations where animal control, if present, may euthanize. If animal control is euthanizing, spaying will not reduce population but will reduce the total turnover (the total number of deaths over a time period). But for feral populations, or semi free-roaming populations left to their own devices without animal control actively euthanizing, spaying makes no difference.

Despite the complicated issues around shelters, the promotion of shelters and expansion of the pet adoption movement into mainstream American culture over the past 30 years provided a much needed outlet for shelter animals, who are now adopted at much higher rates. Purchase of purebreds has declined significantly, and the end result of this culture shift is less people intentionally breeding animals, effectively shifting resources (homes, food, etc.) to shelter animals. This is a massive fundamental change, coupled with urbanization and a cultural change away from allowing one's family pets to roam is why shelter euthanasia has declined steadily for 30 years, and why in

Europe there is no pet overpopulation issue despite a general lack of spay / neuter. If spay / neuter is to be used, it has to be in combination with major cultural and legislative shifts, neither of which is likely in most of the world.

As an example, Holland effectively eliminated the presence of all stray dogs, but used a multimodal approach in which greater than 75% of all feral dogs were sterilized in a few short months and a massive legal campaign was done to encourage shelter adoption. Further, economic stimulus was provided in the form of elevated taxes on store bought animals (66). If Sweden and its minimal stray population despite extremely low spay levels is any indication, the cultural shift that has occurred in Holland is the more likely explanation for their success at addressing feral populations. However, if the spay campaign is at least partially responsible, this may be due to the Dutch government recognizing that a >75% approach was necessary.

Holland's success is likely unachievable throughout most of the world, however. Holland is one of the richest places on Earth, with significant economic resources and a minimal stray population at the start of its campaign. More importantly, the national culture and the concept of animal welfare is very different in Holland than throughout Latin America, Asia, Africa, and the Middle East, where in many cases mass euthanasia is cheaper, easier, and accepted. Surgical spay / neuter is not the answer in these locations.