A model of a predator-system with a prey refuge and a predator reservoir

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In many predator-prey situations, the predator has a preferred prey. However, in many cases this preferred prey has a refuge in which it is safe from predation. If it does not search for alternate prey, the predator may well go extinct. Each time the preferred prey attempts to increase its population beyond the refuge, the predator switches its predation to its preferred prey, driving the population back into small numbers in the refuge. The preferred prey is in what is known as a predator trap. In this present work a Gause type model of a predator-prey system in which the prey population can exist in two habitats, one of which is a prey refuge. In addition to this prey, other alternate food sources are available to the predator, which may prevent extinction of its population. Our model consists of a system of three ordinary differential equations representing the hare and lynx populations in the one habitat and the hares in the refuge. This model simulates the Canada lynx-arctic hare interaction on the island of Newfoundland prior to 1864. We obtain criteria for the existence and extinction of the lynx (predator) population and indicate how the mice and caribou may have prevented the lynx from extinction prior to 1864 and kept the artic hare in a "predator pit".