

Climate-associated tundra thaw pond formation and range expansion of boreal zooplankton predators

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Abstract

© 2015 Nordic Society Oikos. Most of the freshwater component of the Earth's surface is composed of shallow tundra ponds. These high latitude ecosystems have been exposed to a variety of abiotic disturbances associated with recent environmental change. However, the biological significance of these changes remains poorly understood. Here, we characterize the abiotic disturbance to the shallow tundra ponds of northwest Alaska. We used historical aerial imagery to determine that up to 53% of the sampled ponds have formed during the recent warmer decades (since the 1970s). We discovered that two top predator species (phantom midges of the genus *Chaoborus*) of the freshwater zooplankton have recently undergone range expansion, forming widespread (a scale of hundreds of km) stable tundra populations. We assessed the population persistence of these boreal predators by longitudinal sampling over 14 yr. Recent thaw ponds had significantly dissimilar zooplankton communities to communities of ponds that formed before 1950. Both predator and herbivore species differed by age of pond. Younger pond ages and warmer surface temperatures were the significant predictors of the presence of temperate *Chaoborus americanus* in tundra ponds. Ponds containing tundra populations of *C. americanus* and *C. cf. flavicans* were associated with recent formation (83-90%). Recent ponds in river valleys appeared more important than recent ponds near roads as colonization corridors for *C. americanus*. Only 24% of the tundra keystone predator, *Heterocope septentrionalis*, populations were from recent ponds. Our results suggest that climate-associated disturbance can lead to a widespread stable range expansion of boreal species despite the propinquity of older ponds with top-down control exerted by an endemic keystone predator.

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