THE EFFECTS OF CATTAIL MANAGEMENT ON THE AQUATIC FOOD WEB OF THE PALO VERDE WETLAND

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Abstract: Palo Verde National Park implemented a management strategy to control cattail populations in the wetlands of Palo Verde National Park, Costa Rica, by crushing cattail stems with a tractor. We compared dissolved oxygen, zooplankton abundance, and fish abundance across three sites with different management histories: never managed, managed twice (2000, 2003) and managed eight times (1998-2005). We reasoned that decomposition of large inputs of organic matter in infrequently managed sites demands more oxygen than respiration of standing cattails. In frequently managed sites, low cattail abundance would reduce respiration of decomposing cattails. Therefore we predicted dissolved oxygen, zooplankton abundance, and fish abundance would increase in the following order: site managed twice, unmanaged site, and most frequently managed site. While fish abundancewas similar at the unmanaged site and the site managed twice, it was much higher at the most frequently managed site. Dissolved oxygen and zooplankton abundance trends were consistent with our predictions. Our findings suggest that repeated cattail management can improve productivity of the aquatic food web; this may, in turn, benefit bird populations.

Key Words: cattails, dissolved oxygen, zooplankton, fish, management

INTRODUCTION

A dramatic increase in cattail abundance in the Ramsar Wetlands in Palo Verde National Park, Costa Rica, led the Organization for Tropical Studies to implement a management strategy that involves the crushing of cattails by tractor. After crushing, the cattails are left at the marsh bottom. Their decomposition may reduce dissolved oxygen (DO) in the water column. Without management, high respiration levels in habitats with high cattail biomass may also lower water column DO. We hypothesized that decomposition of abundant organic matter in managed sites demands more oxygen than respiration of standing cattails. However, with frequent cattail management the standing cattail biomass and annual productivity could decrease--reducing inputs of cattail detritus to the marsh bottom.

Water column DO may directly and positively affect zooplankton, which in turn can increase fish abundance. We chose three sites with different management histories (never managed, managed twice and managed eight times) and compared DO, zooplankton abundance, and fish abundance across sites. We predicted that the most frequently managed site would have the highest DO, zooplankton abundance, and fish abundance, and that the site managed twice would have the lowest DO, zooplankton abundance and fish abundance, due to the larger input of crushed cattails.

METHODS

On 11 January 2006 we selected three sites in the Palo Verde Ramsar Wetland, based on site-specific history of cattail management. Site 1, ca. 600 m west of the airstrip and 100 m south of the marsh shore, has never been managed; site 2, 500 m south west of the end of the airstrip, was managed twice (2000, 2003); and site 3, located 10 m south east of the observation tower directly south of the OTS station, has been managed every year since 1998 (Table 1).

We set four passive fish traps at each site in a rectangular formation in the open water. We sampled three times at each site, from the morning of 12 January to the morning of 13 January. After our first sampling, we used wood props to raise three of four fish traps in site 1 and 2 to ensure that the height of the traps in the water column did not limit DO available to the fish. We sampled DO and temperature at five points (once at each trap and once in the middle of the site), with a DO meter at three depths. We sampled zooplankton twice at the undisturbed midpoint of each site. For each sample, we extracted 980 ml of water into a tube (ca. 60 mm diameter), and then filtered the contents on site with a 35 μm mesh screen. After fixing the zooplankton with alcohol, we counted them under a dissecting microscope. We identified, counted, and released fish in the field.

TABLE 1. GIS coordinates for sample sites in the Ramsar Wetlands in Palo Verde National Park, Costa Rica.

Site Number	Site Description	Longitude	Latitude
1	Unmanaged	11.44000°	68.1175°
2	Managed twice	11.43850°	68.1275°
3	Managed eight times	11.43785°	68.1800°

RESULTS

Zooplankton abundance was highest at the most frequently managed site and lowest at the site managed twice (Table 2). Dissolved oxygen was also highest at the most frequently managed site and lowest at the site managed twice (Table 2). Fish abundance was 10-20 times higher in the most frequently managed site than at the other two sites (Table 2).

TABLE 2. Number of fish captured in traps, mean number zooplankton/ L and mean DO across three sites with difference management histories in the Ramsar Wetlands in Palo Verde National Park, Costa Rica. Total fish is number caught at each site over three sampling occasions.

Site description	Total fish	Zooplankton (#/liter) (Mean ± 1 SE)	DO (mg/liter) (Mean ± 1 SE)
Unmanaged	5	24.29 ± 1.44	1.39 ± 0.11
Managed twice	10	13.26 ± 0.72	1.17 ± 0.20
Managed eight times	119	38.27 ± 5.41	1.73 ± 0.13

DISCUSSION

Our data were consistent with the hypothesis that decomposition of large inputs of organic matter in more frequently managed sites demands more oxygen than respiration of standing cattails. Fish abundance was greatest in the most frequently managed site, suggesting that the cattail crushing treatments can enhance fish abundance in the long term. We recommend that follow-up research include replication within sites, fish sampling by seine nets, and repeated zooplankton samples. Nevertheless, our findings suggest that long term, consistent cattail management can improve productivity of the aquatic food web, which may in turn benefit bird populations.