NONTARGET BIRD USE OF DRC-1339 BAIT SITES DURING OPERATIONAL BAITING PROGRAMS IN LOUISIANA AND TEXAS

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Abstract: Nontarget bird use of DRC-1339 bait sites was assessed during operational baiting programs from 2000-2002 in Louisiana and from 2001-2002 in Texas. DRC-1339 is an avicide registered with the U.S. Environmental Protection Agency to manage blackbirds causing damage to agriculture. It was used in Louisiana between 15 February to 15 March and in Texas from January through March to protect newly planted rice. In Louisiana, there were 55 bait sites observed during 316 observation periods (158 observation hrs) and 312 flush-counts conducted from 2000-2002. In Texas, there were 26 bait sites observed during 182 observation periods (91 observation hrs) and 174 flush-counts conducted from 2001-2002. The nontarget bird species most commonly observed on DRC-1339 bait sites in Louisiana and Texas was the savannah sparrow (*Passerculus sandwichensis*). Killdeer (*Charadrius vociferus*), mourning doves (*Zenaida macroura*), meadowlarks (*Sturnella* spp.), and American pipits (*Anthus rubescens*) were observed less frequently than savannah sparrows. Of these, mourning doves in Louisiana and meadowlarks in Texas are of greatest concern because of their foraging habits, susceptibility to DRC-1339, and frequency and rate of occurrence at DRC-1339 bait sites.

Key words: 3-chloro-4-methyl benzamine HCl (3-chloro-4-methylaniline hydrochloride), blackbirds, damage, DRC-1339, nontarget bird species, rice.

Blackbird damage to sprouting rice can be locally severe, resulting in significant yield reductions and necessitating replanting of some fields (Wilson et al. 1989). Damage caused by blackbirds to newly seeded rice costs Louisiana and Texas growers an estimated $4 million/year (Wilson et al. 1989) and $4.4 million/year (Decker et al. 1990), respectively. Spring-roosting blackbird populations appear to be responsible for most damage, and the greatest rice losses are associated with proximity to roosts (Wilson 1985). Delayed planting of rice would likely reduce damage (Wilson et al. 1989), but is impractical in areas where multiple crops are planted on the same fields within the same season. The standard technique for damage control has involved using exploders, supplemented with shooting (Glahn and Wilson 1992). However, results are often variable and limited in effectiveness depending on the persistence of the user (Wilson 1985). Repellents such as Mesurol® (Holler et al. 1982) and anthraquinone (Avery et al. 1998, Cummings et al. 2002a, 2002b) have been tested on blackbirds with some success, but no registrations with the U.S. Environmental Protection Agency (USEPA) currently exist for avian control. Staging-area baiting with DRC-1339 baits has shown potential for reducing blackbird and starling populations associated with winter roosts (West 1968, Knittle et al. 1980). Glahn and Wilson (1992) demonstrated that a DRC-1339 baiting program is cost-effective for reducing rice damage by blackbirds in Louisiana. Due to the lack of available alternative control techniques for use on blackbirds, DRC-1339 blackbird baiting programs likely will continue in Louisiana and Texas.

DRC-1339 (3-chloro-4-methylaniline hydrochloride) baiting is conducted in Louisiana under a state-sponsored Emergency Use Permit through the USEPA and in Texas under the Compound DRC-1339 Concentrate - Staging Area label (USEPA Reg. No. 56228-30). DRC-1339 is used to bait sites near roosts, which is more effective and requires less effort and time than baiting several widely scattered areas (Knittle et al. 1980). DRC-1339 baiting programs are timed to impact a maximum number of rice-damaging blackbirds by baiting when

natural foods are scarce but after migrants begin to depart. DRC-1339 was originally selected for baiting programs because it is very highly toxic (LD_{50} <10 mg/kg) to certain problem birds, such as European starlings (*Sturnus vulgaris*), herring gulls (*Larus argentatus*), Icterids, and Corvids. This compound is highly toxic (LD_{50} 10-50 mg/kg) to moderately toxic (LD_{50} 51-500 mg/kg) to American kestrels (*Falco sparverius*), chachalacas (*Ortalis vetula*), budgerigars (*Melopsittacus undulatus*), horned larks (*Eremophila alpestris*), and birds in the families Anatidae, Accipitridae, Fringillidae, and Ploceidae (Eisemann et al. 2003). In addition, Cunningham et al. (1981) reported that DRC-1339 is moderately toxic (LD_{50} 51-500 mg/kg) to only slightly toxic (LD_{50} 501-2000 mg/kg) to most mammals, except cats (*Felis* spp.). This differential toxicity reduces the possibility of accidental nontarget bird species poisoning (DeCino et al. 1966). However, DRC-1339 is very highly toxic (LD_{50} <10 mg/kg) to barn owls (*Tyto alba*), northern cardinals (*Cardinalis cardinalis*), African bulbuls (*Pycnonotus capensis*), American robins (*Turdus migratorius*), and birds in the families Phasianidae, Odontophoridae, Columbidae, and Mimidae. Thus, baiting programs can place some nontarget bird species at risk. Techniques to reduce nontarget bird hazards include limiting bait exposure on bait sites, diluting treated rice with untreated rice, positioning bait lanes away from field edges, and observing prebaited fields to avoid those with nontargets (Glahn and Wilson 1992).

Estimating the risk to nontarget bird species at DRC-1339 bait sites is a function not only of their susceptibility to the chemical, but also of their potential for exposure to the chemical. DRC-1339 is relatively slow-acting. Mortality might not occur for 24 to 72 hours post-ingestion. Consequently, sick and dead target birds typically are not found at bait sites, but rather considerable distances away or at evening roosts (Knittle et al. 1990). Because target birds are difficult to find, it is logical that some nontarget bird carcasses would be even more difficult to locate. Therefore, our objective was to determine nontarget bird use of DRC-1339 bait sites in Louisiana and Texas to evaluate which nontarget bird species might be at greatest risk.

STUDY AREA

We conducted the study in Acadia, Cameron, Jefferson Davis, and Vermilion Parishes in Louisiana and in Wharton, Colorado, Jackson, and Matagorda counties in Texas. DRC-1339 bait sites selected for nontarget bird observations were part of the U.S. Department of Agriculture, Animal and Plant Heath Inspection Service, Wildlife Services (WS) DRC-1339 baiting programs. In Louisiana, DRC-1339 bait sites were typically 0.1 to 1.6 ha and established in fallow, ungrazed fields or in soybean or rice stubble fields that had been ditched to promote draining. In Texas, DRC-1339 bait sites were typically 0.6 to 20 ha and were established in plowed or disked fields or near rice dryers.

METHODS

Baiting Procedure

In Louisiana, DRC-1339 was applied between 15 February and 15 March. In Texas, DRC-1339 was applied from January through March. Baiting procedures in both states followed the Compound DRC-1339 Concentrate – Staging Area Label (USEPA Reg. No. 56228.30).

In Louisiana, WS operations personnel established DRC-1339 bait sites under blackbird flight lines emanating from roosts. A seeder/spreader mounted on an all-terrain vehicle (ATV) was used to broadcast prebait and treated bait consisting of brown rice on flagged bait lanes. Prebait was applied until blackbird numbers peaked at the bait site (about 7 days). This period was also used to determine the extent of nontarget bird use of bait sites. DRC-1339 was not applied at sites with large numbers of nontarget birds. Candidate sites were then baited with DRC-1339-treated brown rice where the amount of treated bait applied varied, but did not exceed 57 kg/ha (50 lbs/ac) of diluted bait (1:35 in 2000 and 1:40 in 2001 and 2002). The number of DRC-1339 treatments at each site was dependent upon blackbird numbers and feeding pressure.

In Texas, DRC-1339 bait sites were selected based upon landowner participation. Participating landowners established a bait site by plowing a portion of one of their fields and prebaiting with brown rice for approximately 7 days using a tractor equipped with a broadcast seeder/spreader. During the prebaiting period, landowners determined the numbers of both target and nontarget birds visiting the bait site. Treated bait (diluted 1:25) was provided by WS personnel for application on about the eighth day and was contingent upon weather, feeding pressure, and additional observations by WS personnel. DRC-1339 was not applied where large numbers of nontarget birds frequented the site. The amount of DRC-1339-treated rice provided to each landowner was about half of the amount of prebait (by weight) consumed. WS personnel and the landowner continued to observe fields on the day of baiting to determine blackbird and nontarget bird abundance. If a sufficient (about 1,500 depending upon the site) number of blackbirds continued to return to the site to feed, additional baitings occurred.

Observations

In 2000, we observed 3 bait sites during two 30-minute periods between 0630-1030 and 1430-1830 hrs every third day for 1 to 8 days. In 2001 and 2002, we observed 3 to 4 bait sites for 30 min each between

0630-1200 and 1300-1830 hrs for 1 to 7 consecutive days. Observation times at each bait site varied so that the site observed first on the first observation day was observed second on the second day and third on the third day, etc. Observations were made from a vehicle positioned to provide the best view of each bait site. At the beginning of each observation period, the numbers of birds by species on the bait site were noted. During each 30-min observation period, the time and number of birds by species entering and leaving the bait site were recorded.

Flush-Counts

Following each observation period, the observer walked the length of the bait site and recorded the number and species of birds flushed. Bait sites were traversed through the center of each lane to ensure adequate coverage and independence among observations.

Statistical Analysis

Observational data were summarized according to nontarget bird species for peak numbers and bird use, by site, state, and year. Flush-count data were used to determine whether all bird species were observed on the bait site and to verify the total number of fields for each species.

Table 1. Numbers of observations and flush counts conducted on bait sites in Louisiana 2000-2002 and Texas 2001-2002.

		Observations		
State	Dates conducted	30-min. periods	Hours	Flush counts
Louisiana	18 Feb.-2 Mar. 2000	116	58	115
	17 - 28 Feb. 2001	98	49	98
	21 - 28 Feb. 2002	102	51	99
Texas	15 - 23 Feb. 2001	41	20	40
	10 Jan. - 20 Feb. 2002	141	70	134

RESULTS

The number of observation periods and flush counts conducted each year in Louisiana and Texas are presented in Table 1. We observed 10 nontarget bird species on bait sites in Louisiana and 19 in Texas (Tables 2 and 3), but only 5 species were common to both states each year. The nontarget bird species observed most frequently on DRC-1339 bait sites in both Louisiana and Texas was the savannah sparrow (*Passerculus sandwichensis*), which occurred on ≥85% of all bait sites. Killdeer (*Charadrius vociferus*), meadowlarks (*Sturnella* spp.), mourning doves (*Zenaida macroura*) and American pipits (*Anthus rubescens*) were observed more frequently in Texas (79%, 91%, 49% and 29%, respectively) than in Louisiana (49%, 27%, 32% and 16%, respectively). Northern cardinals, greater white-fronted geese (*Anser albifrons*), snow geese (*Chen caerulescens*), and horned larks occurred on 0-8% of bait sites in Louisiana and 0-17% of bait sites in Texas. All other species observed occurred only in either Louisiana (0-8% of bait sites) or Texas (0-28% of bait sites).

In both Louisiana and Texas, we consistently observed more savannah sparrows than other nontarget birds (Tables 2 and 3). In Louisiana, mourning doves were the next most abundant but the third most common species, followed by American pipits, killdeer (second most common species) and meadowlarks. In Texas, meadowlarks were the next most abundant in addition to being the second most common species followed by killdeer, mourning doves, and American pipits. Flocking bird numbers were occasionally higher than the 5 most common species at a particular site. Geese occurred on only 0-4% of bait sites in Louisiana and 0-17% of bait sites in Texas. Flocks of sandhill

Table 2. Nontarget bird (nonblackbird) species numbers, use, and frequency of occurrence at DRC-1339 bait sites per observation period in Louisiana during February and early March 2000-2002.

	2000 (n=23 sites)			2001 (n=13 sites)			2002 (n=19 sites)		
Species[a]	Peak no. ($\bar{x}$, range)	Bird use ($\bar{x}$, range)	Frequency (%)	Peak no. ($\bar{x}$, range)	Bird use ($\bar{x}$, range)	Frequency (%)	Peak no. ($\bar{x}$, range)	Bird use ($\bar{x}$, range)	Frequency (%)
SVSP[b]	1.72, 0-20	0.86, 0-20	96	5.97, 0-118	2.36, 0-85	85	6.58, 0-46	3.51, 0-41	89
KILL	0.26, 0-9	0.12, 0-8	43	1.14, 0-25	0.35, 0-8	62	0.25, 0-12	0.08, 0-4	42
MODO	0.16, 0-7	0.06, 0-2	13	1.73, 0-27	1.15, 0-27	46	2.23, 0-34	1.28, 0-25	37
MEAD	0.09, 0-3	0.04, 0-2	22	0.26, 0-7	0.12, 0-4	23	0.25, 0-3	0.13, 0-3	37
AMPI	0.81, 0-50	0.25, 0-27	17	2.26, 0-60	0.88, 0-18	15	0.16, 0-4	0.04, 0-1	16
NOCA	0.03, 0-4	0.002, 0-0.3	4	0	0	0	0.01, 0-1	0.0003, 0-1	5
Geese[c]	3.91, 0-300	3.89, 0-300	4	0	0	0	0	0	0
HOLA	0	0	0	0.24, 0-10	0.04, 0-2	8	0	0	0
HEGU	0	0	0	0.19, 0-19	0.19, 0-19	8	0	0	0

[a] SVSP - Savannah sparrow (*Passerculus sandwichensis*); KILL - Killdeer (*Charadrius vociferus*); MODO - Mourning dove (*Zenaida macroura*); MEAD - Meadowlark (*Sturnella* spp.); AMPI - American pipit (*Anthus rubescens*); NOCA - Northern cardinal (*Cardinalis cardinalis*); HOLA - Horned lark (*Eremophila alpestris*); HEGU - Herring gull (*Larus argentatus*).

[b] Also may include <10% unidentified sparrows.

[c] Geese were a combination of snow (*Chen caerulescens*) and white-fronted geese (*Anser albifrons*).

Table 3. Nontarget bird (nonblackbird) species numbers, use, and frequency of occurrence at DRC-1339 bait sites per observation period in Texas during January and February 2001-2002.

Species[a]	2001 (n=8 sites)			2002 (n=18 sites)		
	Peak no. ($\bar{x}$, range)	Bird use ($\bar{x}$, range)	Frequency (%)	Peak no. ($\bar{x}$, range)	Bird use ($\bar{x}$, range)	Frequency (%)
SVSP[b]	14.64, 0-49	6.19, 0-22	100	23.94, 0-230	15.74, 0-195	94
MEAD	7.45, 0-46	3.16, 0-29	88	12.71, 0-111	6.01, 0-50	94
KILL	0.88, 0-10	0.35, 0-5	75	3.22, 0-99	1.98, 0-46	83
MODO	0.24, 0-3	0.10, 0-1	25	2.42, 0-73	1.45, 0-43	72
AMPI	0.14, 0-5	0.04, 0-1	25	1.55, 0-50	0.78, 0-25	33
RODO	0.14, 0-6	0.09, 0-4	25	0.03, 0-2	<0.01, 0-0.3	11
SACR	0	0	0	2.59, 0-120	1.58, 0-116	28
WFGO	0	0	0	1.33, 0-100	0.83, 0-53	17
SNGO	0	0	0	4.22, 0-370	3.67, 0-326	11
CCLO	0	0	0	1.43, 0-100	0.58, 0-19	11
NOCA	0.02, 0-1	<0.01, 0-0.2	13	0	0	0
LALO	0	0	0	0.48, 0-16	0.34, 0-12	6
CAGO	0	0	0	0.16, 0-23	0.13, 0-18	6
WCSP	0	0	0	0.09, 0-6	0.01, 0-1	6
VESP	0	0	0	0.04, 0-5	0.04, 0-5	6
HOSP	0	0	0	0.06, 0-7	0.01, 0-1	6
NOMO	0	0	0	<0.01, 0-1	<0.01, 0-0.1	6
COSN[c]	0	0	0	0	0	11
HOLA[c]	0	0	0	0	0	6

[a] SVSP - Savannah sparrow ; MEAD - Meadowlark (*Sturnella* spp.); KILL - Killdeer ; MODO - Mourning dove; AMPI - American pipit; RODO - Rock dove (*Columba livia*); SACR - Sandhill crane (*Grus canadensis*); WFGO - Greater white-fronted goose; SNGO - Snow goose; CCLO - Chestnut-collarad longspur (*Calcarius ornatus*); NOCA - Northern cardinal; LALO - Lapland longspur (*Calcarius lapponicus*); CAGO - Canada goose (*Branta canadensis*); WCSP - White-crowned sparrow (*Zonotrichia leucophrys*); VESP - Vesper sparrow (*Pooecetes gramineus*); HOSP - House sparrow (*Passer domesticus*); NOMO - Northern mockingbird (*Mimus polyglottos*); COSN - Common snipe (*Gallinago gallinago*); HOLA - Horned lark.

[b] Also might include <10% unidentified sparrows.

[c] Could not determine bird numbers and use because it was only observed when flushed.

cranes (*Grus canadensis*) and chestnut-collard longspurs (*Calcarius ornatus*) occurred on 0-28% of bait sites in Texas.

Flush-count numbers of the 5 most commonly observed species were closely correlated with peak bird numbers from observations for savannah sparrows in both states, mourning doves in Louisiana and meadowlarks in Texas. However, the trend did not hold for the remaining 3 species.

In Louisiana, combining observations with flush-count data for the 5 most common species at bait sites, consistently gave a greater number of sites in which nontarget bird species were observed than using either method alone by 1 to 4 sites (Table 4). In Texas, observations tended to give the more accurate number of bait sites for each of the 5 species, although using both provided the best results. Other species did not occur frequently enough to make a determination on which method would work best.

Table 4. Site visits by nontarget bird (nonblackbird) species at DRC-1339 bait sites in Louisiana, 2000-2002 and Texas 2001-2002.

Species[a]	Louisiana			Texas	
	2000 (n=23)	2001 (n=13)	2002 (n=19)	2001 (n=8)	2002 (n=18)
SVSP	22	11	17	8	17
KILL	10	8	8	6	15
MEAD	5	3	7	7	17
MODO	3	6	7	2	13
AMPI	4	2	3	2	6

[a] SVSP - Savannah sparrow; KILL - Killdeer; MEAD - Meadowlark ; MODO - Mourning dove; AMPI - American pipit

DISCUSSION

Savannah sparrows had the highest exposure rate to DRC-1339 bait sites of any of the nontarget bird species observed. In migration and on wintering grounds, they feed chiefly on seeds and, when available, fruits and invertebrates (Wheelwright and Rising 1993). To assess the sensitivity of the savannah sparrow and other Emberizids, Cummings et al. (2002c) conducted feeding trials in which wild-caught birds were offered 2% DRC-1339-treated brown rice for either 1 or 12 hrs daily for 5 days. In these tests, none of 35 savannah sparrows, 8 white-crowned sparrows (*Zonotrichia leucophrys*), 3 field sparrows (*Spizella pusilla*), 3 song sparrows (*Melospiza melodia*), or 3 chipping sparrows (*S. passerina*) died. In a more recent feeding test, 1 of 10 treated savannah sparrows died when offered 2% DRC-1339-treated brown rice mixed 1:25 with untreated rice for a 12-hr period each day for 5 days (Cummings et al. 2003). No white uric acid residues in the pericardium were observed upon necropsy and no DRC-1339 residues were detected (MLOD <20 µg/g) upon chemical analysis (Stahl et al. 2002). The time between death and analysis was too long (381 days) for detection of DRC-1339 because of the compounds instability (Randal S. Stahl, National Wildlife Research Center, personal communication). Because of these results, we feel that savannah sparrows are at low risk at DRC-1339 bait sites.

Toxicity data for DRC-1339 do present some familial trends (Eisemann et al. 2003), although sensitivity is not always consistent among species within a family. For example, in the family Emberizidae, dark-eyed juncos (*Junco hyemalis*) and white-crowned sparrows have an LD_{50} higher than 162 mg/kg, whereas American tree sparrows (*Spizella arborea*) have an LD50 of 3.5 mg/kg (Eisemann et al. 2003).

There are no published data on the sensitivity of killdeer and American pipits to DRC-1339. The diet of killdeer typically consists of 98% animal matter and <2% plant matter (Jackson and Jackson 2000). American pipits consume mainly arthropods (predominantly insects) during most of the year but also consume plant seeds in autumn and winter (Verbeek and Hendricks 1994). Because of these dietary habits, killdeer and American pipits are probably not at high risk at DRC-1339 bait sites where brown rice is used as the carrier for DRC-1339.

The estimated LD_{50} for western meadowlarks is 4.01 mg/kg (Eisemann et al. 2003) with the lowest lethal dose at 2.24 mg/kg and no effect level of 1.07 mg/kg. The sensitivity of this species is similar to others in the family Icteridae. Both the eastern and western meadowlark (*S. magna* and *S. neglecta*) diet consists of weed seeds and waste grains (mostly corn) in winter (Lanyon 1994, 1995). In a DRC-1339 dietary feeding test, 8 of 9 meadowlarks died when offered 2% DRC-1339-treated brown-rice diluted 1:25 with untreated brown rice for 5 days (Cummings et al. 2003). During DRC-1339 baiting programs in Louisiana and Texas, meadowlarks that use bait sites are probably impacted because of their foraging habits and susceptibility.

The DRC-1339 LD_{50} for mourning doves was estimated at 5.6-10 mg/kg (DeCino et al. 1966). Mourning dove diets consist of 99% seeds (Mirarchi and Baskett 1994). In a feeding test, 9 of 10 mourning doves died when offered 2% DRC-1339-treated brown rice diluted 1:25 with untreated brown rice for 5 days (Cummings et al. 2003). The frequency and abundance of mourning doves at bait sites in both Louisiana and Texas varies from year to year. Considering their susceptibility to DRC-1339, mourning doves could be at risk.

When offered DRC-1339-treated brown rice diluted 1:25 with untreated rice for 5 days (Cummings et al. 2003), both Canada and snow geese survived. There were no quantifiable levels of DRC-1339 in either species. Snow geese near the gulf coast eat bulrush, salt-marsh and olney rootstock, cattail rootstock, spikerush and square-stem vegetation and seeds, cordgrass rootstock, panicgrass vegetation, and rice during winter (Martin et al. 1951). Greater white-fronted geese feed on both grain seeds and sprouting grains or leafy growth during migration and winter (Ely and Dzubin 1994). Cummings et al. (2003) found that snow geese eat small quantities of rice. Perhaps geese prefer seed rice in the dough rather than hard stage. Geese may be at low risk from baiting programs because most of the bait sites in which we observed geese were fields with young green vegetative growth. The succulent vegetation may be more attractive as forage for geese preparing for migration.

Northern cardinals occurred irregularly at the bait sites and we observed very low numbers. They typically consume a variety of foods during all seasons, including grains, wild fruit, weeds and other seeds, miscellaneous vegetables and insects (Halkin and Linville 1999). The estimated LD50 for northern cardinals is <3.2 mg/kg (Eisemann et al. 2003), indicating that this species might be at risk. Dietary exposure calculations conducted for this assessment showed a cardinal eating 10.1 g (USEPA 1993:3-4) of rice a day would eat a dose of approximately 7.7 mg of DRC-1339. To eliminate the impact of DRC-1339 to this species, bait sites should not be located at sites where cardinals are observed.

Horned larks occurred irregularly at bait sites and in small numbers. Eighty to 100% of their winter diet consists of seeds (Beason 1995). Because the lowest observed effect level (LOEL) for horned larks was estimated at 101.3 mg/kg (LD_{50}=232.0 mg/kg) (Eisemann et al. 2003), a 30-g horned lark would need to eat 7.6 treated rice grains (0.4 mg DRC-1339 per grain) to ingest a dose equivalent to the LOEL. If we assume that horned

larks do not discriminate between treated and untreated grains of brown rice, the same bird would have to consume 197.6 grains of field bait (2% DRC-1339 brown rice diluted 1:25 with untreated rice) to ingest an equivalent dose. In a single feeding bout, a 42-g female red-winged blackbird (Dunning 1993) sampled from DRC-1339 bait sites ate a maximum of 104 whole rice grains (n=400 female red-winged blackbirds, $\bar{x}$ = 30.2, SE = 1.5; John Cummings, National Wildlife Research Center, unpublished data). Therefore, we believe horned larks are only minimally impacted by DRC-1339 baiting programs in Louisiana and Texas.

The hazards of DRC-1339 to nontarget bird species are not straightforward and complicating the hazard is the biology of each species. Some nontarget bird species that are on bait sites are likely to eat bait. Others could be on bait sites foraging, but it is questionable if they are eating the brown rice baits. WS personnel conducting baiting operations have observed that blackbirds, the target species, will at times avoid eating DRC-1339-treated rice baits. This avoidance is most pronounced in smaller flocks and is presumably due to a lack of competition for food. The cause of the rejection of DRC-1339 baits by target blackbirds might be due to either the strong odor of the baits, likely caused by the free amine (CPT), or the red-orange discoloration of bait caused by presumed degradation products (Hurley et al. 1999). It is probable that if blackbirds can detect and avoid treated baits then nontarget birds can also detect and avoid them. However, it is unknown to what extent this would occur in the field. Conditions such as the health of the bird, weather, and inter- and intra-species interactions will all play a role in bait consumption.

Concerns about nontarget bird hazards with DRC-1339 are valid because certain nontarget bird species that visit bait sites are as susceptible to the chemical as blackbirds. However, blackbirds often eat all rice in bait sites within a few hours of application. Where bait is not eaten, DRC-1339 rapidly degrades because of the moist climate of the rice growing regions in Louisiana and Texas. In addition, strict adherence to the Compound DRC-1339 Concentrate-Staging Areas label (USEPA Reg. No. 56228-30) instructions will minimize nontarget bird deaths from baiting operations. The label requires a prebaiting period of 1-2 weeks or until prebait is well accepted. During this time, if bait is not well accepted the location should be moved until good acceptance is achieved. The label specifically states that toxic bait should not be applied to sites where prebait has not been accepted well or where nontarget bird species have been eating prebait.

Conclusions

Of all the nontarget bird species observed at DRC-1339 bait sites, we think that mourning doves in Louisiana and meadowlarks in Texas would be the most impacted bird species by DRC-1339 baiting. Savannah sparrow risk is much lower than mourning doves and meadowlarks and a worst case scenario for mortality would be about 2% of the savannah sparrows observed (based on 0 of 35 mortalities (Cummings et al. 2002c) and 1 of 10 mortalities (Cummings et al. 2003). Because DRC-1339 baiting to protect rice is confined to areas where rice is planted, only small groups of mourning doves, meadowlarks, and savannah sparrows would be affected. Based on species where information on their susceptibility to DRC-1339 is available, all other species observed in Louisiana and Texas at DRC-1339 bait sites are minimally impacted.

Future Research

Species that need to be tested in the lab include; killdeer, American pipits, and possibly sandhill cranes. The sensitivity of killdeer should be evaluated because of their numbers and frequency of site visits which increases their chance of accidental consumption of rice even though they don't specifically forage for it. Information regarding the sensitivity of American pipits to DRC-1339 is needed because of their numbers and frequency of site visits and the fact that they do eat some seeds. Data regarding sandhill crane sensitivity are needed because when they are in bait sites, they tend to be in flocks and probably eat rice. In addition, there are no data on susceptibility of these species or of any their close relatives to DRC-1339. Nontarget stomach content and residue analysis of birds collected at DRC-1339 bait sites, movements, and site fidelity would also be important aspects in evaluating their risk.

ACKNOWLEDGMENTS

D. LeBlanc (USDA/APHIS/WS, Port Allen, LA) and G. Nunley (USDA/PHIS/WS, San Antonio, TX) generously provided management information system (MIS) data on their DRC-1339 baiting programs for this project. We thank A. Wilson, T. Muir, C. Branton, C. Cruse, J. Falke, G. McEwen, C. Alberg, and J. Suckow (USDA/APHIS/WS) and J. Davis, E. Tillman, J. Bourassa, S. Gaddis, and P. Groninger (USDA/APHIS/WS/NWRC) for technical support. A. Wilson, D. LeBlanc, M. Tobin, D. Goldade, S. Werner, and 2 anonymous reviewers critically reviewed earlier drafts of this manuscript. We thank the Louisiana Rice Research Board, Louisiana Rice Growers Association, Louisiana State University Rice Research Station, and USA Rice Foundation for support.

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