Reducing impacts of brood parasitism by Brown-headed Cowbirds on riparian-nesting migratory songbirds

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Abstract.-Riparian habitats throughout the Southwest have been altered directly and indirectly by human activities. Many migrant songbird species specific to riparian communities during the breeding season are experiencing population declines. Conversely, the Brown-headed Cowbird (*Molothrus ater*) benefits from fragmentation of, and livestock grazing in and near riparian habitat. Brood parasitism by cowbirds may accelerate the process of local extirpation of small, remnant populations of migratory songbirds. Cowbird trapping programs have successfully reduced brood parasitism of the Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Empidonax trail/ii extimus)* in riparian habitats of California. This removal technique has not been used commonly in riparian habitats of other states but may be beneficial if a significant problem is identified. Preliminary surveys should be conducted to determine abundance and distribution of cowbirds, and nests of potential hosts should be monitored to assess rate of parasitism. It is not likely that remnant populations of migratory songbirds can sustain parasitism rates greater than 30%. We provide trapping, habitat restoration. and research suggestions to improve management strategies for cowbird hosts nesting in riparian zones.

INTRODUCTION

Changes in riparian habitat

The first naturalists to visit the Rio Grande Valley near Albuquerque in the 1800s found vast flocks of waterfowl and extensive marshes (Funk 1993). These ecosystems co-existed with irrigation systems for farming constructed by Native Americans and improved by Spanish colonists (Scurlock 1988; Funk 1993). These agricultural impacts were smaller spatially and changed the ecosystem more slowly than those imposed by Anglo-American settlers in the mid- to late-1800s (Scurlock 1988).

Since the late 1800s, Arizona and New Mexico lost about 90% (Johnson 1989) and California lost about 95% (Roberts et al. 1980) of their pre-Anglo-American riparian habitat. Remaining cottonwood-willow forests in Arizona and New Mexico are home to more than 100 state and federally listed threatened and endangered species (Johnson 1989).

The floodplain riparian community of New Mexico has changed significantly since settlement by Anglo-Americans (deBuys 1993; Dick-Peddie 1993). The waters of the Rio Grande are used intensively for irrigation of agricultural crops and are controlled by channels and levee systems. More than 2,833 ha (7,000 ac) of wetlands of the Middle Rio Grande ecosystem have been drained (Funk 1993). Remaining cottonwoods date back to

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the flood of 1941 (Funk 1993), and cottonwood (*Populus* spp.) and willow (*Salix* spp.) regeneration is minimal. Exotic woody species such as *Tamarix* spp. (salt cedar), *Elaeagnus angustifolia* (Russian olive), and *Ulmus pumila* (Siberian elm) have become established and are expanding their distributions in the riparian community (Scurlock 1988; Funk 1993; Mount et al. [in press, this volume]). Dumping, arson, and vandalism from adjacent urban dwellers are frequent (deBuys 1993; Dick-Peddie 1993).

Impacts of changes on avian species

In the Southwest, migratory songbirds frequently select riparian habitat for nesting (Carothers et al. 1974; Ohmart 1994). Hubbard (1971) estimated that 25% of breeding avifaunas found in the Gila and San Juan river valleys of New Mexico were restricted to riparian habitat. Greater than 50% (Ohmart 1994) of avian species listed as endangered by the New Mexico Department of Game and Fish, depend on riparian and aquatic habitat for breeding and/or feeding sites. Throughout the Southwest, lowland desert riparian ecosystems support a disproportionate number of rare and endangered bird species (Johnson et al. 1987).

Loss of mature broadleaf trees (e.g., cottonwood spp.) and snags along the Colorado, Gila, Salt, and Santa Cruz Rivers of Arizona coincided with the decline of large raptors and cavity nesters (Hunter et al. 1987). In low elevation river systems, loss of broadleaf tree and shrub mixtures resulted in the decline or absence of nine neotropical migratory songbird species (Hunter et al. 1987).

Cowbird range expansion

Concomitant with loss and degradation of riparian habitat, nesting migratory songbirds have experienced increased rates of parasitism by Brown-headed Cowbirds (*Molothrus ater*). Cowbird abundance and distribution in North America have changed significantly since the arrival of Europeans. Originally, the Brown-headed Cowbird was distributed in the central short- and mixed-grass prairies of North America (Great Plains and Great Basin regions; Mayfield 1965; Rothstein 1994). The cowbird was rare in the unbroken tracts of forest in the eastern United States (Mayfield 1965). Because the Brown-headed Cowbird maintained a symbiotic relationship with large grazing animals of the prairies, especially bison (*Bison bison),* its abundance and distribution were limited by sizes of grazing herds and their migratory patterns. Cowbirds benefit from grazing animals by feeding on flushed insects and seeds exposed on bare, trampled ground (Friedmann 1929; Mavfield 1965). The tallgrass prairies and unbroken forests did not provide adequate foraging habitat for large populations of cowbirds. By the late 1700s, the eastern forests had been opened substantially by loggers and farmers. In addition, herdsmen opened pathways to the West and began to increase the number of cattle, sheep, and swine grazing and trampling the tallgrass prairie (Mayfield 1965). The cowbird expanded its range and increased in abundance in response to Europeans' creation of additional foraging habitat and to tolerant, naive hosts (Mayfield 1965; Brittingham and Temple 1983; Friedmann and Kiff 1985).

In the West around 1900, the "Nevada" or "Sagebrush" Cowbird *(M. a. artemisiae)* was widespread throughout the Great Basin and adjoining parts of Oregon and Washington east of the Cascades (Laymon 1987; Rothstein 1994). The Spaniards brought livestock into the Colorado River valley in the late 1600s and may have enabled the "Dwarf Cowbird" *(M. a. obscurus)* to become common by the early 1900s along the Colorado River, the Tucson, Arizona area, and farther east to Texas (Rothstein 1994). Cowbird abundances increased in response to improved feeding habitats provided by irrigation and agriculture (e.g., waste seed remaining in agricultural fields, increased density of livestock) in the Southwest and forest-clearing in the Sierra Nevada, Cascades, and Pacific Northwest (Rothstein 1994).

Response of host populations

Hosts susceptible to cowbird parasitism tend to exhibit one or more of the following traits: 1) build open cup nests (Friedmann 1929; Laymon 1987); 2) have an incubation period longer than that of cowbirds (Mayfield 1977); 3) are long-distance migrants (e.g., neotropical migrants) and have few opportunities to renest due to their short breeding season (May and Robinson 1985); 4) are smaller

than cowbirds (Mayfield 1965); 5) are "new" hosts that have not developed anti-parasite behavior (Mayfield 1977, May and Robinson 1985); and 6) nest in the interface between open and forested habitats (Brittingham and Temple 1983).

Cowbird parasitism has the potential to reduce recruitment rates of host species. Possible reasons for reduced reproductive success of host species include removal of host's egg(s) from the nest by the cowbird (Friedmann 1963; Weatherhead 1989; Sealy 1992; Robinson et al. 1993), a shorter incubation time for cowbird eggs (11 days) relative to eggs of most hosts (12 to 14 days) giving cowbird chicks a "head start" (Friedmann 1963, Robinson et al. 1993), larger size of cowbird chicks relative to chicks of the host increasing the cowbird chick's successful competition for food (Robinson et al. 1993), and a faster growth rate of cowbird nestlings allowing them to out-compete host nestlings for food and space in the nest (Mayfield 1977).

Hosts nesting in fragmented patches of shrubs, trees, and open prairie are likely targets of cowbirds. Cowbirds divide their activities between shrub and forest breeding habitats, and open foraging habitats such as short grass pastures, paddocks, corrals, lawns, feeders, etc. Distance between habitat types is not likely a limiting factor in site selection by cowbirds. In Rothstein's (1994) studies in California, radio-tagged cowbirds were recorded commuting up to 6.7 km from communal feeding sites to breeding territories. Cowbirds conduct breeding activities (e.g., courtship, egg-laying) in their individual territories in the morning then fly to localized, communal foraging sites in the afternoon (Rothstein et al. 1980, 1984).

Rothstein (1994) noted that brood parasitism by cowbirds is partially or mainly responsible for the decline of at least ten songbird species in California. Many of these host species are obligate riparian breeders in all or much of their range (Rothstein 1994). In the Sacramento Valley of California, Gaines (1974) found that the spread of Brown-headed Cowbirds into riparian forest resulted in the decline or disappearance of 9 species of passerines susceptible to nest parasitism. It is probable that cowbird parasitism, if left unchecked, will cause the extirpation of many remnant populations in narrow fragments of riparian habitat (Rothstein 1994). Especially vulnerable are those species with no reservoir populations that escape cowbird parasitism (Mayfield 1965). Vulnerable species may include small, long distance migrants that normally produce only one brood a year (e.g., warbler, vireos, and flycatchers; Mayfield 1977), and passerines occurring in small disjunct populations limited to patches of suitable habitat (Rothstein et al. 1987; Rothstein and Robinson 1994). Small populations are particularly at risk of extirpation from cowbird parasitism because cowbirds do not reduce parasitism rates as hosts become rare (Post and Wiley 1977; Mayfield 1978; May and Robinson 1985). Rothstein (1994) surmises that most of the cowbird hosts that have declined would have maintained self-sustaining populations if large expanses of riparian habitat had remained. The primary cause of host declines in the West seems to be habitat destruction (Rothstein 1994). If extensive riparian habitats were still widespread, hosts would likely be able to survive in the presence of cowbirds (Rothstein 1994; Rothstein and Robinson 1994). Harris (1991) stated that birds nesting in riparian habitat are especially vulnerable to cowbird parasitism because this habitat is "linear, ecotonal, often patchy, and frequently near pastures, stockyards, or agricultural fields;" the preferred habitat of cowbirds.

Reducing impacts of brood parasitism

Studies on threatened populations of riparian-nesting neotropical migrants in the West have demonstrated that cowbird control programs can successfully increase the reproductive rate of host species. For example, the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) was common in lowland parts of California and sporadic in montane localities (Grinnell and Miller 1944). However, as the range of the Cowbird expanded in the 1920s and 1930s, the abundance of Southwestern Willow Flycatchers declined in central and coastal California (Unitt 1987, Harris 1991). By the mid-1980s, Harris et al. (1987) estimated that the entire California population had less than 150 pairs. Arizona Game and Fish Department reported approximately 200 flycatchers found during 1994 surveys throughout Arizona, with 119 males on territories, at least 77 males paired, and 62 pairs breeding. New Mexico Game and Fish Department (Sartor 0. Williams, III [personal communication] indicated

that about 260 flycatchers detected were during New Mexico surveys in 1994, with 116 males on territories, of which at least 95 were paired. The Southwestern Willow Flycatcher may be extirpated from Nevada and Utah (Unitt 1987). Brown (1988) and Rothstein (1994) implicated both cowbird parasitism and habitat destruction as causes of population declines of the Southwestern Willow Flycatcher.

Brown (1988, 1994) found that Southwestern Willow Flycatchers experienced a high rate of cowbird parasitism (at least 50%) along the Colorado River in Grand Canyon, Arizona and that parasitism was partially responsible for a decline in flycatcher abundance. Harris' (1991) studies along the south fork of the Kern River in Kern County, California found that 68% of nests examined were parasitized. Sedgwick and Knopf (1988) monitored Willow Flycatcher nests in northcentral Colorado (Arapaho National Wildlife Refuge) and found that Brown-headed Cowbirds parasitized 41% of nests examined. Brood parasitism was the leading cause of nest failure during Harris' study, and he suggested that brood parasitism may be the most important limiting factor to Willow Flycatchers nesting in low-elevation riparian habitats (Harris 1991). The best long-term management strategy for Southwestern Willow Flycatchers may be to reduce fragmentation of their nesting habitat and to reduce the quality of cowbird feeding sites (e.g., increase grass height and foliar cover, reduce availability of waste grain, etc.; Harris 1991).

Cowbird control programs may not be cost-effective in areas with low cowbird populations and negligible nest parasitism rates. Cowbird populations in New Mexico are reported to be lower than in Arizona and California according to the Breeding Bird Survey (Finch et al. 1995), although parasitism rates at nests of Southwestern Willow Flycatcher in New Mexico have not been determined. Spot survey and cowbird trapping programs may be needed in specific localities where cowbird and host populations are reported, even though state or regional populations of cowbirds are low. In some areas, immediate action may be required if cowbird parasitism is significantly affecting hosts' annual rate of recruitment. Whitfield (1995) began a cowbird control program along the south fork of the Kern River in Kern County, California in 1992. She found that trapping female cowbirds significantly reduced rates of parasitism and increased fledging rates of flycatchers. Controlling cowbirds by shooting, addling eggs, and removing chicks from nests did not significantly increase nest success of Willow Flycatchers. Whitfield (1995) recommends removing female cowbirds from the nesting habitat of Willow Flycatchers to reduce rates of parasitism.

The decline of the Least Bell's Vireo *(Vim bellii pusillus*) occurred within 20 to 30 years of the population expansion of cowbirds in California (Rothstein 1994). Studies of remnant populations of vireos in the late 1970s found parasitism rates of about 50% (Goldwasser et al. 1980, Franzreb 1989). Modeling by Laymon (1987) estimated that parasitism rates greater than 48% would lead to extinction in a "short time" and parasitism rates greater than 30% would lead to an unstable population that could suffer extinction due to stochastic events. In addition to the impact of parasitism, the Least Bell's Vireo has been affected by habitat loss. The Central Valley of California lost 95% of its riparian vegetation in the 1900s, and habitat loss in southern California has been great also (Rothstein 1994).

A cowbird trapping program began operating in 1983 on Marine Corps Base Pendleton, California to increase the reproductive success rate of Least Bell's Vireos (Griffith and Griffith 1993). This program reduced the parasitism rate from more than 47% in 1981 and 1982 to 17% in 1987. There has been 0% parasitism of vireo nests since 1990. The number of singing males has increased from fewer than 20 in 1980 to 250 in 1993. Populations of the California Gnatcatcher (*Polioptila californica californica*) and Southwestern Willow Flycatcher have also increased since trapping began.

MANAGEMENT RECOMMENDATIONS

Cowbird trapping

Results of these studies on Southwestern Willow Flycatcher and Least Bell's Vireo populations demonstrate that cowbird trapping and removal programs can reduce rates of brood parasitism significantly. Suggestions for initiating a cowbird trapping and removal program to reduce brood parasitism rates on rare, riparian-nesting bird species are provided in Table 1. Data on cowbird abundance, distribution, and rates of parasitism

will indicate the extent to which the reproductive success of rare avian species is affected. The magnitude of the cowbird management program should be based on these results (Robinson et al. 1993). Data from Item 3 in Table 1 can be used to estimate the effect of the program on cowbird and host abundances, and parasitism rates. Rothstein et al. (1987) suggest that removal of females is especially critical to reducing the local breeding population of cowbirds. Although control measures described in Item 4, Table 1 were not effective in Whitfield's (1995) study in Kern County, California, Rothstein et al. (1987) recommend shooting at feeding sites that receive small numbers of cowbirds because shooting individuals is more efficient than operating traps. Layman (1987) suggests that shooting individual cowbirds in narrow, riparian habitats may be more effective than trapping.

Rothstein et al. (1987) provide recommendations for cowbird trapping programs in situations where there are abundant, dispersed feeding sites for cowbirds within a 7-km radius of host breeding sites (Table 2) and these can be used to supplement recommendations given in Table 1. Feeding sites used by cowbirds may include herds of large grazing animals, corrals, pack stations, powerline rights-of-way, lawns, bird feeders, and campgrounds. Traps have also been used successfully in breeding territories of host species (Beezley and Rieger 1987; Robinson et al. 1993; Whitfield 1995). In these situations, Robinson et al. (1993) recommend that traps be placed in open areas, near the perimeter of hosts' nesting territories, and near cowbird perch sites but not placed such that cowbirds in traps can see perch sites through the trap opening. Methods for constructing cowbird traps are given in Table 3.

The distribution and abundance of female cowbirds may be used as indices of spatial distribution and intensity of brood parasitism at the community level (Robinson et al. 1993). Because cowbirds respond and are attracted to a recording of the female chatter call, the call can be used to improve estimates of numbers of females, which tend to be harder to detect than males, and to attract individuals for removal (Rothstein et al. 1987; Robinson et al. 1993). Table 4 describes methods for counting cowbirds.

Habitat restoration

Damage to riparian ecosystems is the ultimate factor affecting the balance between avian hosts and parasites and their abundance and distribution. Long range plans of natural resource managers should strive to enhance riparian ecosystem functions. Lavmon (1987) states that "reforestation is the method that holds the most promise for long-term management of cowbird parasitism." Addressing the ultimate problem of the ecosystem will involve changing land-use practices to reduce the quality and quantity of cowbird feeding areas (Robinson et al. 1993) and to increase the value of the habitat for nesting host species.

Most restoration research projects in southwestern riparian habitats have been conducted in the lower Colorado River Valley of California and

Table 1.—Suggestions for initiating a cowbird trapping and removal program.

1. Identify area(s) for cowbirds and nest surveys and studies based on known presence of individuals/populations of target host species, i.e., species of concern that are susceptible to cowbird populations.
2. Conduct initial cowbird host surveys[1] to identify cowbird feeding sites and to estimate cowbird and host abundance (Verner and Ritter 1983, Beezley and Rieger 1987, Rothstein et al. 1987, Whitfield 1995).
3. Conduct nest surveys of target host species and monitor host nests to estimate rates and reproductive success.
4. Based on survey information, determine if a cowbird trapping and removal program is needed. If so, implement the program following suggestions provided in text and tables.
5. Continue host and cowbird population surveys and nest monitoring through the duration of the cowbird control program to evaluate program success. Success can be measured by increased in host populations, recruitment rates, or nesting success, and reductions in rates of cowbird parasitism or cowbird populations. Continue program based on its effectiveness in recovering host populations. Discontinue program if the host population is recovered and cowbird parasitism is no longer judged to be a problem.
6. In areas where cowbird abundances are low but a trapping program is still necessary to recover host populations, shooting individual cowbirds, addling cowbird eggs by shaking them, and removing cowbird chicks may be effective.

[1] See Table 4 for point count method suggestions.

Table 2.--Recommendations for cowbird trapping programs where there are abundant, dispersed feeding sites for cowbirds within a 7-km radius of host breeding sites (Beezley and Rieger 1987, Rothstein et al. 1987).

1. Place traps at each possible feeding site, especially near concentrations of livestock.
2. Continue trapping program for 3 to 4 months (late March to July).
3. Continue trapping program for several years.

Table 3.—Cowbird trap design, operation, and placement.[1]

Design
1. Size of trap may range from 2 x 2.5 x 1.5 m to 5 x 5 x 2 m.
2. Traps can be constructed into panels for quick assembly and disassembly when moving them from one location to another.
3. A funnel or slit entry is located at the top of the trap. The funnel entry is dropped from the ceiling of the cage such that cowbirds circling around the sides and top of the trap have enough room to circle around the funnel and above its entrance or opening. The funnel should have some wire mesh across it and below its top wide enough for cowbirds to pass through but not presenting an obvious open hole when viewed from the floor of the cage. A slit should be wide enough for birds to enter (drop through with closed wings) but narrow enough that the birds can not exit with open wings (about 1.5" width).
4. Traps should have a small side-box with a removable side opening into it at a top corner wall no more than an arm's length in depth. Cowbirds can be collected in this side-box and easily removed.
5. Materials typically used to construct traps include:
a. 1" x 1" chicken wire or ½" hardware cloth. Wire mesh that is 1" x 1.5" is large enough for some female cowbirds to escape, especially Dwarf Cowbirds.
b. 2" x 2" boards for panels.
c. Bolts and butterfly nuts with which to assemble panels.
d. Traps may be constructed using metal or PVC to make them last longer.
6. Use the following to attract free-ranging cowbirds to the trap:
a. live cowbirds (8 females and 5 males) as decoys,
b. food (wheat, millet, cracked corn, or sunflower seeds), and
c. water.
7. Managers in Texas and California have found that concentrations of cattle or other large ungulates adjacent to traps attract cowbirds to the site.
Operation
1. Place food directly under the funnel or slit entrance. Don't place food in large piles that look abnormal to cowbirds.
2. Place water dishes and perches on the sides of the trap but not where the entrance will be directly visible from them.
3. Keep the trap floor bare; remove herbaceous and woody vegetation.
4. The wings of the decoy birds can be clipped to reduce the probability of the birds' escape; however, don't clip the wings so much that they appear injured.
5. Replace decoy birds with fresh decoys each week.
6. Check traps daily and remove newly captured birds.
Placement
1. Place traps in partly open settings, near observation perches of cowbirds, but don't place traps directly under perch sites.
2. Place traps in foraging habitat especially where high concentrations of cowbirds gather. If cowbirds are widely dispersed in their foraging habitat, place the trap between the nesting habitat of their hosts and the foraging habitat.
3. If cowbirds tend to use a corridor to migrate from breeding habitat to foraging habitat due to the topography of the area (e.g., draws, hollows, saddles), place trap between habitats in the corridor.
4. The number of traps placed and the distance between them will depend on the dispersion of nesting hosts and foraging sites for cowbirds. For example, Rothstein et al. (1984) found that cowbird may travel up to 7 km between nesting and foraging sites. Thus, traps may be placed as far as 7 km apart. In Michigan, however, birds are concentrated in a smaller area and traps have been placed about every 1 km^2.

[1] *See also Robinson et al. 1993.*

Table 4.—Suggested methods for counting cowbirds and their hosts.'

Counting Cowbirds at communal foraging sites
1. Count by sex and age, number of cowbirds from a fixed point at feeding sites. Fixed point should be placed such that entire flock of cowbirds can be seen using binoculars. If birds are too dispersed to count from one point, add point(s) such that all birds are counted. However, fixed points should be placed far enough apart to minimize the probability of double-counting birds.
2. Do not count any birds that are not positively identified as cowbirds.
3. Count at feeding sites during the afternoon (>12-noon).
4. Counts should last from 5 to 10 min.; determine the maximum amount of time needed to count all birds from a fixed point then use that time as your standard througnout all surveys.
5. Counts should begin in May (when birds migrate to their breeding range and begin to establish territories) and continue through July.
Counting Cowbirds at breeding/nesting territories
1. Establish fixed points through nesting habitat of species of concern (e.g., Least Bell's Vireo; Southwestern Willow Flycatcher).
2. Place points far enough apart to avoid double-counting birds (by sight and/or song). Distance between points will differ according to habitat type (e.g., little visual obstruction vs. dense brush and trees).
3. Count for 5 to 10 min. (standardized time used for counting).
4. Conduct counts in the morning (<12-noon).

'*See also Whitfield 1995.*

Arizona. Anderson et al. (1979) began a project there in 1977 in the Valley and found that they could increase horizontal and vertical height diversities of the riparian vegetation by replacing salt cedar monocultures with native cottonwood, willow, honey mesquite (*Prosopis glandulosa*), quail bush (*Atriplex lentiformis*), and annual forbs. Numbers and densities of bird species were enhanced by the restoration experiment. Additional restoration work and monitoring of wildlife population parameters has continued in the lower Colorado River Valley (California and Arizona) and along the Kern River (California) (Anderson and Ohmart 1980, 1984; Anderson 1989; Anderson and Laymon 1989; Anderson et al. 1989; Hunter et al. 1989). In New Mexico, Swenson and Mullins (1985) and Swenson (1988) successfully reestablished native cottonwood and willow in degraded riparian habitat along the middle Rio Grande.

RESEARCH SUGGESTIONS

Most cowbird-host relationship studies, and riparian restoration and subsequent monitoring of responses of flora and fauna in the Southwest have occurred in California and Arizona. There has been little research or management conducted in riparian ecosystems of New Mexico. To determine the effects of habitat restoration efforts and cowbird management programs on sensitive migratory songbirds, surveys that document species abundance and distribution must continue. Nests of endangered and rare species must be monitored to determine rates of brood parasitism by cowbirds. These results will provide essential data for determining species richness, evenness, and diversity relative to habitat conditions, and for calculating reproductive success of hosts relative to habitat and cowbird management. Evaluation of factors such as size of habitat blocks, extent of edge, and habitat isolation on host nest placement and vulnerability to cowbird parasitism are likely to be useful in developing models for managing and restoring riparian landscapes. In addition, these data can be compared to land-use practices such as grazing and agriculture in and near the riparian habitat. These data are necessary to evaluate our ability to reduce the ultimate and proximate factors adversely affecting riparian-nesting migratory songbird populations and to enhance overall condition of riparian ecosystems.

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